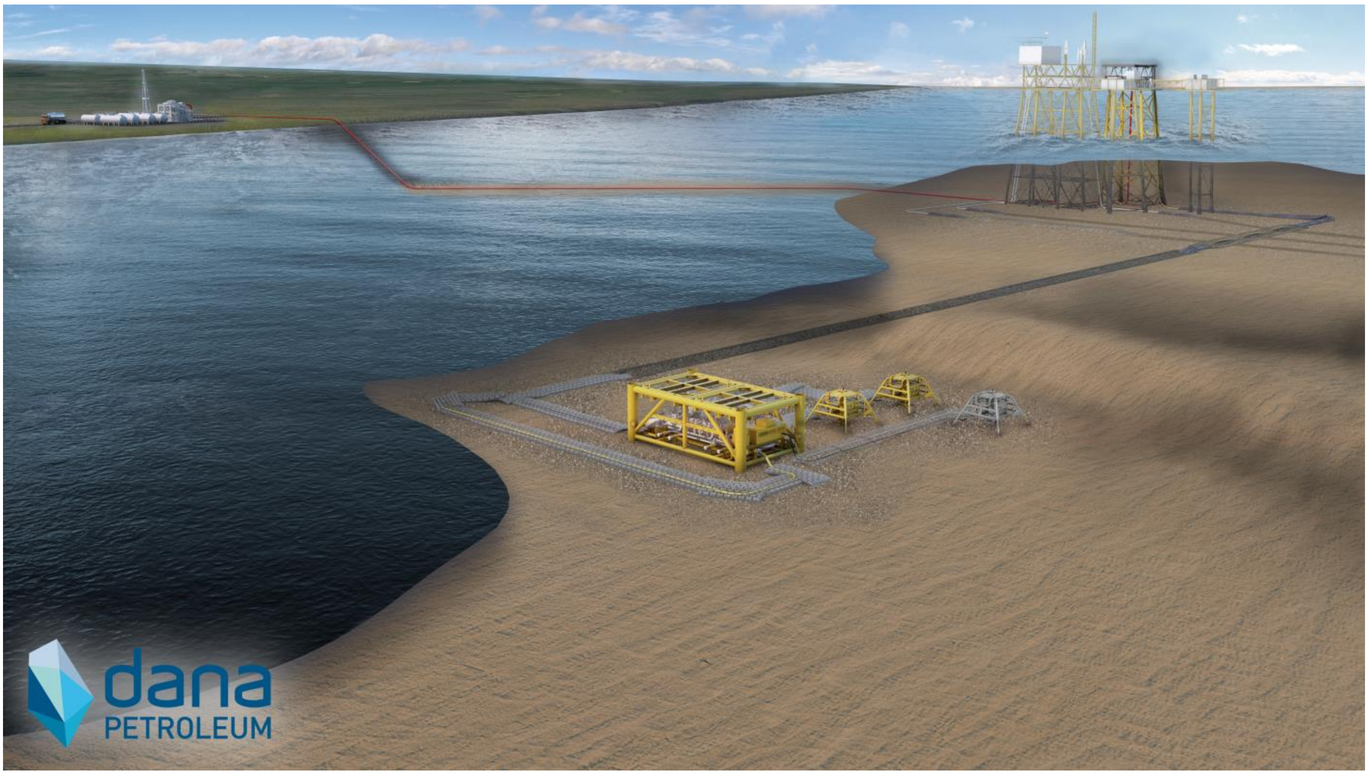
Platypus Development Environmental Statement (D/4229/2018)



Environmental Statement Details

A1 – Project Reference Number

Please confirm the unique ES identification number for the project.

Number: D/4229/2018

A2 - Applicant Contact Details

Company name: Dana Petroleum (E&P) Limited

Contact name: Niall Bell

Contact title: Environmental Team Lead

A3 - ES Contact Details (if different from above)

Company name:

Contact name:

Contact title:

A4 - ES Preparation

Please confirm the key expert staff involved in the preparation of the ES:

Name	Company	Title	Relevant Qualifications/Experience
Niall Bell	Dana Petroleum (E&P) Limited	Environmental Team Lead	25 years of experience in environmental management in oil and gas and other marine sectors. PhD Environmental Impacts of Drill Cuttings Piles BSc (Hons) Marine Biology
Gareth Jones	Xodus Group	EIA Project Manager	Institute of Environmental Management & Assessment (IEMA) Practitioner 15 years of experience as an Environmental Advisor/ Consultant with specialisms in commercial fisheries and marine fish ecology. BSc Zoology, (Hons in Marine Biology)
Iain Dixon	Xodus Group	Environmental Specialist	IEMA Associate 41 years working as a marine environmental consultant. PhD Benthic Ecology MSc Oceanography BSc (Hons) Biology
Nichola Lacey	Xodus Group	Lead Environmental Consultant	4 years working as a marine environmental consultant / marine environmental scientist. PhD Marine Ecology MSc Applied Marine Science BSc (Hons) Marine Biology
David Renner	Xodus Group	Senior Environmental Consultant	11 years working as a marine environmental consultant / marine environmental scientist. BSc (Hons) Marine Biology

A5 - Licence Details

a) Please confirm licence(s) covering proposed activity or activities

Licence number(s): P1242

b) Please confirm licensees and current equity

Licensee	Percentage Equity
Dana Petroleum (E&P) Limited	59% (Operator)
CalEnergy Gas Limited	15%
Parkmead (E&P) Limited	15%
Zennor North Sea Limited	11%

Section B: Project Information

B1 - Nature of Project

a) Please specify the name of the project.

Name: Platypus Development

b) Please specify the name of the ES (if different from the project name).

Name: Platypus Development Environmental Statement

c) Please provide a brief description of the project.

The Platypus Development comprises development of the Platypus field (Licence P.1242) in United Kingdom Continental Shelf (UKCS) Block 48/1a in the southern North Sea. Dana Petroleum (E&P) Limited (Dana) is proposing to develop Platypus via a subsea tie-back to the Cleeton Wellhead (CW) Platform located approximately 23 km to the northwest in Block 42/29. Exported fluids (gas, condensate and water) will be comingled with fluids from other fields on the Cleeton Platform and exported to shore for separation and processing at the Dimlington terminal.

B2 - Project Location

a) Please indicate the offshore location(s) of the main project elements (for pipeline projects please provide information for both the start and end locations).

Quadrant number(s): 42, 47 and 48.

Block number(s): 48/1a, 47/5, 42/30 and 42/29.

Platypus - Latitude: 53° 54' 24.837" N Longitude: 1° 00' 42.429" E

Cleeton - Latitude: 54° 2' 1.637" N Longitude: 0° 43' 40.701" E

Distance to nearest United Kingdom (UK) coastline (from Platypus installation): 65 km, English coast line (Easington area).

Distance to nearest international median line: 121 km to UK/ Netherlands median line.

B3 - Previous Applications

If the project, or an element of the project, was the subject of a previous consent application supported by an ES, please provide details of the original project.

Name of project: N/A.

Date of submission of ES: N/A.

Identification number of ES: N/A.

EIA Quality Mark

This Environmental Statement (ES), and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development, was undertaken in line with the EIA Quality Mark Commitments.

The EIA Quality Mark is a voluntary scheme, operated by the Institute of Environmental Management and Assessment (IEMA), through which EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in the following areas:

- EIA Management;
- EIA Team Capabilities;
- EIA Regulatory Compliance;
- EIA Context & Influence;
- EIA Content;
- EIA Presentation; and
- Improving EIA Practice.

To find out more about the EIA Quality Mark please visit www.iema.net/qmark.

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Acronyms and Terms

ACA	Action Co-ordinating Authority
API	American Petroleum Institute
BAT	Best Available Technique
Bbl	Barrel
BAC	Background Assessment Concentration
BC	Background Concentration
BEIS	(Department for) Business, Energy and Industrial Strategy
BEP	Best Environmental Practice
BOP	Blowout Preventer
BS&W	Basic Sediment and Water
CAPEX	Capital Expenditure
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Co-ordinated Environmental Monitoring Programme
CH_4	Methane
CI	Corrosion Inhibitor
CNS	Central North Sea
CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide Equivalent
CP	Cleeton Production Platform
CW	Cleeton Wellhead
dB	Decibel
Dana	Dana Petroleum (E&P) Limited
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DMA	Dead Man Anchor
DP	Dynamically Positioned / Dynamic Positioning
DREAM	Dose Related and Effect Assessment Model
DSV	Dive Support Vessel
DTI	Department of Trade and Industry
E	East
EBS	Environmental Baseline Survey
EC	European Commission
EEC	European Economic Community
EIA	Environmental Impact Assessment
EIF	Environmental Impact Factor

EMS	Environmental Management System
ENE	East-northeast
ENVID	Environmental Issues Identification
EPS	European Protected Species
ERL	Effects Range Low
ERRV	Emergency Response and Rescue Vessel
ES	Environmental Statement
ESE	East-southeast
EU	European Union
EUNIS	European Nature Information System
FEED	Front end engineering design
Ft	Foot
GHG	Greenhouse gas
H_2S	Hydrogen sulphide
HF	High-frequency Hearing Weighting (Cetacean)
HGS	Humber Gathering System
HIPPS	High-Integrity Pressure Protection System
HMCS	Harmonised Mandatory Control System
HOW04	Hornsea Project 4
HRA	Habitat Regulations Assessment
HSSE	Health, Safety, Security and Environment
Hz	Hertz
ICES	International Council for the Exploration of the Sea
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IMO	International Maritime Organisation
IROPI	Imperative Reason of Overriding Public Interest
IOGP	International Association of Oil and Gas Producers
IPCC	Intergovernmental Panel on Climate Change
JNCC	Joint Nature Conservation Committee
Kg	Kilogram
kg/m^3	Kilogram per cubic metre
KHz	Kilohertz
Km	Kilometre
km^2	Square Kilometres
LAT	Lowest astronomical tide
LF	Low-frequency Hearing Weighting (Cetacean)
LSE	Likely Significant Effect

LTOBM	Low Toxicity Oil-based Mud
M	Metre
m^2	Square Metre
m^3	Cubic Metre
MA	Major Accident
MarLIN	Marine Life Information Network
MBES	Multi-beam Echo Sounder
MCZ	Marine Conservation Zone
MEG	Monoethylene Glycol
MEI	Major Environmental Incident
MER	Maximising Economic Recovery
MF	Mid-frequency Hearing Weighting (Cetacean)
mg/l	Milligrams per Litre
mm	Millimetre
MMO	Marine Management Organisation or Marine Mammal Observer
mmscfd	Million Standard Cubic Feet per Day
MoD	Ministry of Defence
ms^{-1}	Metres per Second
MT	Million Tonnes
MU	Management Unit
N	North
N/A	Not Applicable
N_2O	Nitrous Oxide
NaCl	Sodium Chloride
NCP	National Contingency Plan
NE	Northeast
NFFO	National Federation of Fishermen's Organisations
NM	Nautical Mile
NMFS	National Marine Fisheries Service
NMPi	National Marine Plan Interactive
NNE	North-northeast
NNS	Northern North Sea
NNW	North-northwest
NO_2	Nitrogen Dioxide
Nox	Nitrogen Oxides
NW	Northwest
OBM	Oil-based Mud
°C	Degrees Celsius

OCNS	Offshore Chemical Notification Scheme
OESEA	UK Offshore Energy Strategic Environmental Assessment
OGA	Oil and Gas Authority
OGUK	Oil and Gas United Kingdom
OMA	Oil Mineral Aggregate
OPEP	Oil Pollution Emergency Plan
OPEX	Operational Expenditure
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response
OSPAR	Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic
PAM	Passive Acoustic Monitoring
PEC	Predicted Environmental Concentration
PEXA	Practice and Exercise Area
pk-pk	Peak to Peak
PLONOR	Poses Little Or No Risk To The Environment
PNEC	Predicted No Effect Concentration
ppm	Parts per Million
PTS	Permanent Threshold Shift
Rms	Root Mean Square
ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds
s	Second
SAC	Special Area of Conservation
SBES	Single Beam Echo-sounder
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCI	Site of Community Importance
SCOS	Special Committee On Seals
SE	Southeast
SECE	Safety and Environmentally Critical Element
SEL	Sound Exposure Level
SIMOPs	Simultaneous Operations
SINTEF	Stiftelsen for industriell og teknisk forskning
Sm^3	Standard Cubic Metre
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SNS	Southern North Sea

SNSPS	Southern North Sea Pipeline System
SO_2	Sulphur Dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SO_x	Sulphur Oxides
SPA	Special Protection Area
SPL	Sound Pressure Level
SSE	South-southeast
SSS	Side Scan Sonar
SST	Sea Surface Temperature
SSW	South-southwest
SSWBM	Saturated (sodium chloride) Water-based Mud
SW	Southwest
Te	Metric Tonne
Te/d	Metric Tonne per Day
T90	Period that contains 90% of the total cumulative sound energy
THC	Total Hydrocarbons
TSHD	Trailing suction hopper dredger
TTS	Temporary Threshold Shift
UK	United Kingdom
UKBAP	United Kingdom Biodiversity Action Plan
UKCS	UK Continental Shelf
UKOOA	UK Offshore Operators' Association
US	United States
US CEQ	United States Council on Environmental Quality
VOC(s)	Volatile Organic Compound(s)
WBM	Water-based Mud
WNW	West-northwest
WSW	West-southwest
µg/g	Micrograms per Gram
µm	Micrometre
µPa	Micro Pascal
μPa^2s	Micro Pascal Squared per Second

Non-Technical Summary

Introduction

This Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) conducted by Dana Petroleum (E&P) Limited (Dana) for the development of the Platypus gas field located in United Kingdom Continental Shelf (UKCS) Block 48/1a in the southern North Sea (Figure NTS-1). The field will be developed by drilling two subsea wells into the Platypus gas reservoir. An additional well may be drilled in the future and that would be subject to a separate ES at that time. Both wells will be tied back to a new subsea manifold in Block 48/1a. Production will be routed via a new 12" x 23 km production export pipeline passing through Blocks 47/5 and 42/30 to the existing Cleeton Wellhead (CW) platform in Block 42/29. Chemical, electrical, control and communications services will be supplied to the Platypus manifold via a new 150 mm x 23 km umbilical routed from the CW platform and laid in the same backfilled trench as the new export pipeline. The Platypus manifold will be located approximately 65 km northeast of Easington, East Riding of Yorkshire, and approximately 121 km West of the UK / Netherlands median line. Detailed design is due to commence in Q2 2020, with earliest first gas in Q4 2021.

Consideration of alternatives

The development option selected for the Platypus Development was reached following a concept selection process which considered technical feasibility, project execution schedule, commercial viability, and environmental, health and safety, issues and risks.

Well engineering studies demonstrated that one drill centre is optimal for the development. The subsurface assessment programme demonstrated that all the wells can be drilled from the same location.

Several existing offshore facilities were considered as hosts to which the Platypus installation could be tied back (connected using a pipeline) in order to export production onwards to shore. The Babbage, York and West Sole platforms and the Humber Gathering System (HGS) were discounted as potential offtake routes for various commercial and technical reasons. The Cleeton wellhead platform and onward to the Dimlington onshore terminal provided the optimal combination of technical, commercial and environmental options and was therefore selected as the development option.

The Platypus export pipeline will be constructed from carbon steel, which was selected for its technical properties, availability and economics. The selected “as surveyed” pipeline corridor follows the shortest available route between the Platypus manifold and the CW platform. This minimises the overall pipeline length and environmental impact to the seabed. The final “as laid” pipeline route within the “as surveyed” corridor will be decided following detailed analysis of seabed condition data obtained from survey work.

Due to the fishing activity in the area and general seabed and hydrodynamic conditions in the southern North Sea, it was decided that the safest option to ensure pipeline stability and minimise potential snagging risks is to trench and backfill the pipeline as it is laid. Visual and measured confirmation of burial status will be obtained during pipelay, and where any potential snagging risks are identified (e.g. mounds or berms of stiff clay raised by pipelay activities) these would be remediated as appropriate to leave a safe seabed.

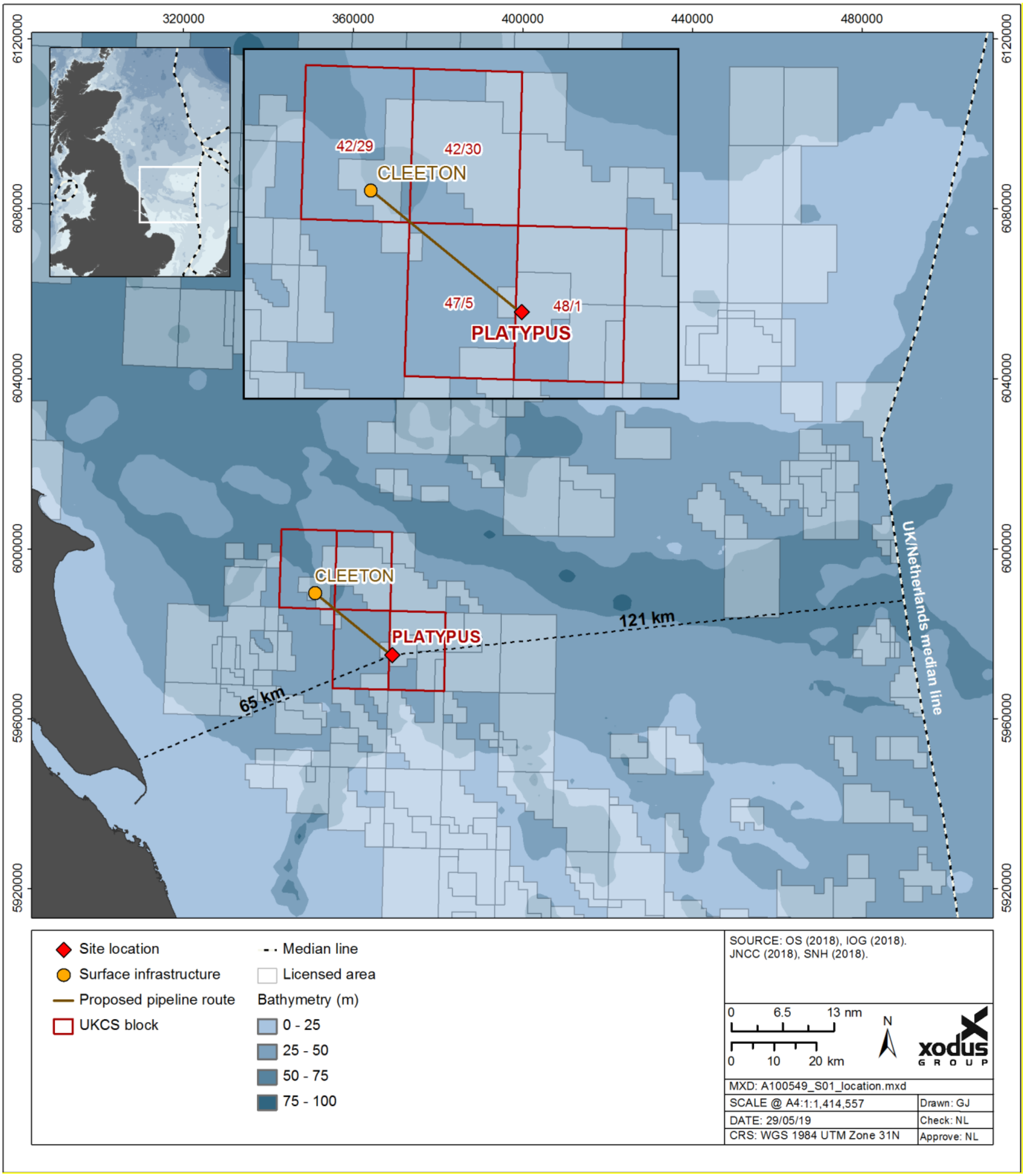

Figure NTS-1: Location of the Platypus Development in the context of the UKCS

Drilling operations

Platypus will be developed by drilling two wells into the Platypus reservoir using a jack-up drilling rig. The wells will be drilled from a single rig location, with the drilling derrick cantilevering as required to access each of the desired top hole targets. Up to 2,500 Te of rock may be placed on the seabed around the jack-up rig feet (known as spud cans) to prevent excessive sediment scour from undermining the spud cans and making the rig unstable. Drilling of the Platypus wells is expected to commence in Q2 2021 and be completed by Q2 2022; first gas will be achieved from the first completed well at the earliest in Q4 2021, while drilling of the other well is ongoing.

The Platypus reservoir is expected to be uniform in nature and the two wells will therefore be of a similar design. Each well will be drilled to approximately 3,109 m (10,200 feet) in five sections of successively smaller diameters (36", 17½", 12¼", 8½" and 6").

Drilling mud will be used to lubricate and cool the drill bit and circulate cuttings out of the wellbore. The top two sections will be drilled without a marine riser in place, meaning the wellbore will be open to the seabed; for these sections the drilling mud will consist of seawater and regular bentonite (clay) sweeps to remove cuttings. Cuttings from these sections will be discharged directly from the wellbore at the seabed. The 12¼", 8½" and 6" sections will be drilled with a marine riser installed, which will connect the wellbore to the jack-up rig drilling derrick and seal the wellbore off from the surrounding seabed and water column. For the 12¼" and 6" sections, low toxicity oil-based drilling mud will be used with cuttings contained and shipped to shore for treatment and disposal. The 8½" section will be drilled using a salt-saturated water-based mud. Cuttings from this section will be cleaned on the drilling rig and discharged overboard.

Steel casings will be inserted into the wells to isolate the drilled formations from the wellbore and provide a controlled environment inside the well. Each steel casing will be cemented into place to provide a structural bond and an effective seal between the casing and the exposed rock formation of the wellbore. The reservoir sections will be completed with a slotted liner and not cemented. Excess cement will be discharged on the sea bed; it is anticipated that up to 10 m^3 per well could be discharged during cementing operations, primarily when cementing the conductor pipe in the 36” section.

Prior to the start of production, each well will be cleaned up to remove waste and debris remaining in the well and each well will be tested for a limited duration. This will result in the production of limited quantities of reservoir fluids which, due to the lack of export facilities at this stage, will be disposed of through flaring.

Subsea operations

An indicative illustration of the proposed subsea layout is presented in Figure NTS-2. Installation of the pipeline and umbilical is expected to be conducted in Q3 2021.

Geophysical and geotechnical surveys have been conducted along the pipeline route, and an additional survey will be conducted prior to pipeline installation. If the seabed is uneven, flattening by dredging or mass flow excavation may be required, and obstructions such as boulders may be removed from the route corridor.

The production pipeline will be 23 km long and 12" diameter and the umbilical will be 23 km with an outer diameter of 150 mm. These will be laid in the trench and backfilled.

The pipeline route crosses three existing cables/pipelines within the Cleeton 500 m zone. The pipeline and umbilical will cross the existing pipelines on top of concrete mattresses placed to ensure appropriate separation. The exposed sections of the pipeline and umbilical at either end of the trench (and including crossings) will be covered with concrete mattresses and rock to protect these from future impacts and produce a low profile that will reduce the possibility of snagging fishing gear. Additional rock placement will be used if required along the trenched section of the route wherever burial has been insufficient in order to prevent upheaval buckling[1]. In total, it is anticipated that up to 155 concrete mattresses and 27,750 Te of rock will be required for pipeline and umbilical installation.

In addition to the pipeline and umbilical installation, each well will be topped by a wellhead and subsea tree. Each of the trees and associated protection structures will measure approximately 9.5 m x 9 m at the seabed and have a height above the seabed of approximately 5.5 m. A manifold structure will also be installed at the Platypus drill centre to act as a comingling point for production from the individual trees; this will be secured to the seabed by four piles that will require hammer-piling into position. The manifold will measure approximately 10 m x 7 m with a height above the seabed of 4 m (Figure NTS-2).

[1] Upheaval buckling is where a pipeline expands due to high pressures or temperatures during use; in buried pipelines this deformation may be sufficient for it to overcome the soil overburden and to become exposed at the seabed.

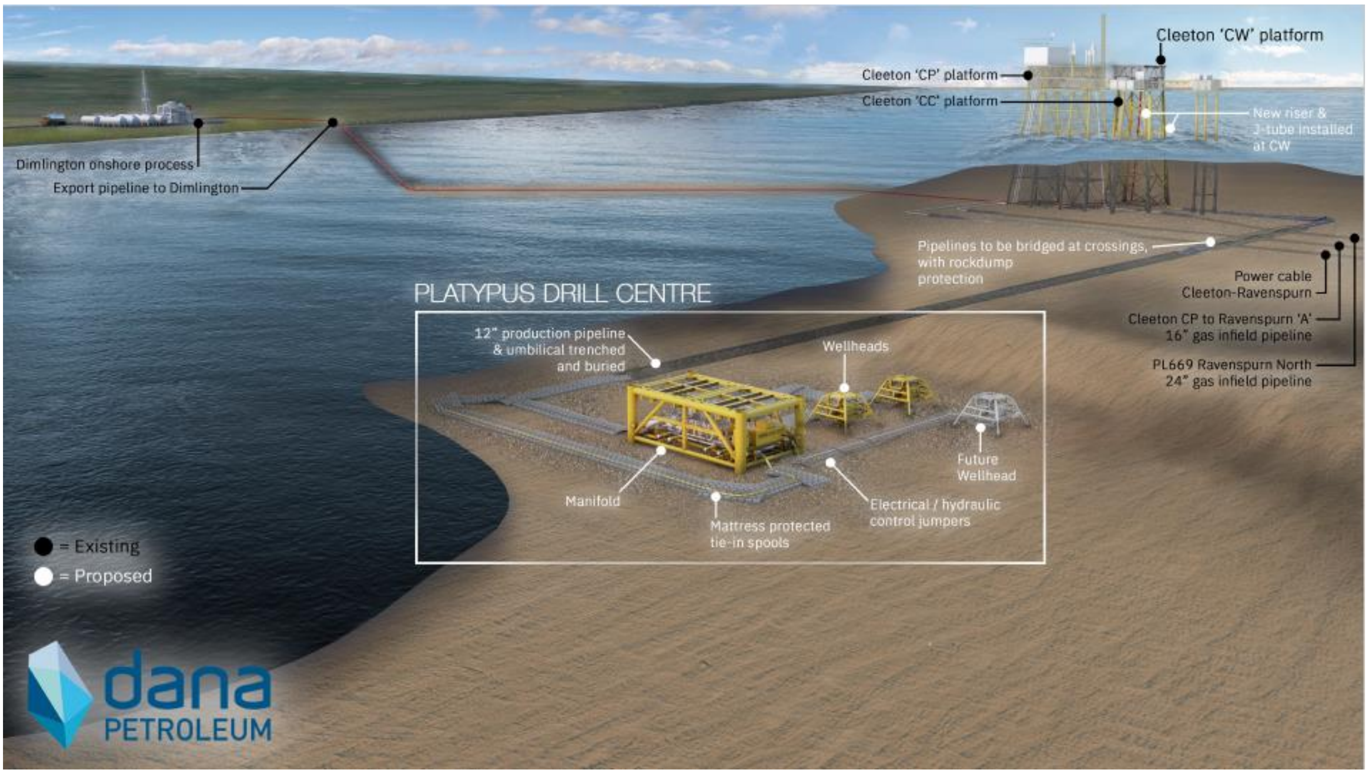

Figure NTS-2: Indicative subsea layout for the Platypus Development

Environment

Information about the environment in the Development area and its surroundings was collated to allow an assessment of those features that might be affected by the proposed Project activities, or which may influence the impact of the operations. The key sensitivities of the areas are summarised in Table NTS-1.

Table NTS-1: Environmental sensitivities in the vicinity of the proposed development

Feature/ Component	Sensitivity
Seabed and associated species	The water depth at the proposed Platypus site range from 39 to 43 m, and water depth along the pipeline route range from 41 to approximately 48 m, with depth generally increasing towards the northwest. Seabed sediments predominantly comprised rippled sand with shell fragments. The broad scale habitat across the survey area is categorised as circalittoral fine sand. The invertebrate community living in the sediment at the Platypus location and along the pipeline route is characterised by small bivalve molluscs and amphipod crustaceans, together with polychaete worms. The sediment surface is sparsely inhabited; animals observed from video footage included swimming crabs, common starfish, brittlestars, hydroids and bryozoans. Hard substrata are colonised by anemones and swimming crabs. The seabed sediments correspond with the UK Biodiversity Action Plan priority habitat 'subtidal sands and gravels'. This habitat in the development area is of low conservation significance as it is widely distributed in UK waters, and examples of this habitat type are protected through the Marine Protected Area network, including the nearby Holderness Offshore Marine Conservation Zone. No other protected habitats (Annex I habitats, OSPAR threatened and / or declining habitats or UKBAP habitats or species) were identified at the Platypus location or on the proposed pipeline route.
Fish	The Platypus field and pipeline route locations are within spawning grounds for cod, herring, lemon sole, plaice, sandeels, sprat and whiting, and nursery grounds for anglerfish, blue whiting, cod, herring, lemon sole, mackerel, plaice, sandeels, sprat, spurdog and whiting. Other species observed during survey efforts include dab, solenette, striped red mullet, gobies and pogge. Block 48/1 (where the proposed Platypus manifold would be located) as well as Block 47/5 on the pipeline route are within potential herring spawning areas. A herring spawning assessment conducted as part of the Platypus site and pipeline route survey confirmed that no sediment suitable for herring spawning occurred within the development area.

Feature/ Component	Sensitivity
Seabirds	Seabird sensitivity to oil pollution across the Development area is generally very high between February and April, high to extremely high in June, low in May, high in July and August, high to extremely high in September and October and low to extremely high between November and January. Sensitivity is generally higher at the Platypus end of the pipeline in Blocks 48/1 and 47/5, where sensitivity is extremely high for five months of the year. In Blocks 42/30 and 42/29 at the Cleeton end of the route, sensitivity is extremely high in one and three months of the year respectively.
Marine mammals	Harbour porpoise and white-beaked dolphin occur regularly in the southern North Sea. Minke whale are seasonal visitors and bottlenose dolphin and Atlantic white-sided dolphin are infrequent visitors. Surveys confirm that harbour porpoise, minke whale and white-beaked dolphin are likely to occur in the vicinity of the Development, with harbour porpoise sighted much more frequently than either of the other two species. White-sided dolphin and bottlenose dolphin are rare sightings in the Development area. Grey and harbour (common) seals have haul-out sites on the coast in the vicinity of the Development area. Grey seals are concentrated south of the Humber Estuary, which is located approximately 65 km to the west-southwest, and harbour seals are concentrated around The Wash, located approximately 95 km to the south-southwest. Grey seals regularly forage up to 100 km from haul out sites and are therefore reasonably likely to occur in the Development area, while harbour seals generally forage within 50-60 km of haul out sites and are therefore less likely to be present.
Conservation	The Development area is within the boundaries of the Southern North Sea Special Area of Conservation (SAC), which has been proposed for the protection of harbour porpoise. The site is large, covering 36,951 km^2 with the Development area constituting a negligible fraction. Other offshore sites close to the proposed Development include Holderness Offshore Marine Conservation Zone (MCZ) 12 km to the west-southwest, and North Norfolk Sandbanks and Saturn Reef SAC 43 km to the east-southeast. Both sites are designated to protect seabed features. There are also several coastal sites located at a greater distance from the Development area that have been designated to protect subtidal, intertidal and terrestrial features and various bird species. The closest of these sites are the Holderness Inshore MCZ (60 km) and the Greater Wash Special Protection Area (SPA, 50 km). The only protected species likely to occur in the Development area are harbour porpoise, minke whale and grey seal, which are all protected under Annex II of the Habitats Directive.
Other sea users	The Platypus Development is located in ICES statistical rectangles 36F0, 36F1 and 37F0. Fishing effort and value varies across the Development area. High value shellfish are the most important catch, and therefore landings live-weight is low compared to value, which itself is high relative to the average across the UKCS. Rectangle 36F0 supports the greatest fishing effort, most of which is concentrated to the south-southwest of the Development area. Shipping density is high in the Development area. The majority of vessels are cargo carriers travelling to and from Hull and Grimsby. There are several active oil and gas fields within 40 km of the Development area. The closest are the Hyde (11 km) and Ravenspurn (14 km) facilities. Block 48/1 (where the Platypus infrastructure would be located), and Block 47/5 (crossed by the pipeline route) lie within Ministry of Defence training ranges and would therefore be subject to special licensing conditions requiring the Ministry to be notified of plans to install infrastructure.

Environmental impact assessment methodology

Offshore activities can involve a number of environmental interactions and impacts as a result of installation and production operations. The objective of the EIA process is to incorporate environmental considerations into project planning, to ensure that best environmental practice is followed and, ultimately, to achieve a high standard of environmental performance and protection. The process also allows for potential concerns identified by stakeholders to be addressed appropriately. In addition, it ensures that the planned activities are compliant with legislative requirements and with Dana's Health, Safety, Security and Environment policy.

The main processes used to identify potential impacts for the EIA were environmental issues identification (ENVID), followed by scoping and consultation with the offshore regulator and its advisors. This process led to the identification of the following key issues for assessment:

- Discharges to sea, such as cuttings and chemicals;
- Seabed disturbance, such as through rig spud can placement, pipelay and rock placement;
- Interactions with other sea users;
- Underwater noise, and potential effects on marine mammals;
- Atmospheric emissions; and

- Accidental events.

To help inform these assessments, the following supporting studies were also conducted:

- Site-specific seabed surveys to assess the possible presence of habitats and species of conservation importance;
- Drill cuttings dispersion modelling, to assist in assessing the fate and impacts of cuttings discharged to the seabed from the drilling process;
- Underwater noise modelling, to assess the impacts of loud underwater noise on marine mammals resulting from hammer piling and vessel use during the Project; and
- Accidental hydrocarbon release modelling, to facilitate assessment of the impacts from worst case scenarios regarding accidental spills of condensate.

Discharges to sea

Discharges to sea from drilling include mud, cuttings, cement and clean-up and well test chemicals. Chemicals will be discharged during the installation and commissioning of the pipelines and spool pieces. These discharges may lead to potential impacts to the seabed or water column through the following mechanisms:

- Increased suspended solids in the water column;
- Settlement of cuttings and muds on the seabed that may:
  - Alter the seabed topography and the physical and chemical nature of the habitat due to the introduction of foreign material with different grain sizes, which can affect oxygen movement within the sediment;
  - Smother benthic organisms where deposition and settlement are high; and/or
  - Impair the feeding and respiratory systems of benthic organisms due to deposition of fine particles and increased concentrations of suspended particles near the seabed.
- Potential toxic impacts from additive within the muds.

Modelling of drill cuttings discharges indicated that whilst there would be some risk to benthic and water column receptors during drill cuttings discharge, the risk to the water column would return to zero within three days after completion of operations, and the risk to the seabed is predicted to be zero throughout the activities.

Discharge of chemically treated seawater during pipeline installation and commissioning will be of limited volume and will occur on a single occasion. Discharged treated seawater will be rapidly diluted and dispersed by currents and tides and no significant impact to the water column fauna is expected.

There will be no discharge of produced water during the life of the field as this will be transported via the export pipeline to shore for treatment.

The Platypus Development is located within the Southern North Sea SAC, a site that is designated for the protection of harbour porpoise. This species is highly mobile and free ranging within the southern North Sea and is expected to be able to detect and actively avoid water column pollution. Given the short-term and one-off nature of the discharges, no significant impacts on harbour porpoise are expected. Other nearby protected sites with potentially vulnerable receptors, such as the Holderness Offshore MCZ, are expected to be outside the range of water-column impacts. As such, there is considered to be no Likely Significant Effect on any SACs, SPAs, or MCZs.

Discharges to sea from drilling and installation / commissioning activities are expected to have minor consequences for benthic receptors, translating to negligible residual risk due to the one-off nature of the impacts and good scope for recovery. Impacts are therefore considered not significant. Consequences from operational discharges are expected to be non-existent, as no operational discharges are planned.

Seabed disturbance

Direct seabed disturbance in the Development area will be caused by installation of the Platypus manifold and well trees, siting of the jack-up rig, pipeline installation operations and rock and mattress placement, all of which will either abrade, overturn or cover the natural seabed. Whilst direct impacts will affect approximately 0.606 km^2 of seabed only approximately 0.07 km^2 of disturbance will persist in the long-term, which given the small area will not result in community-level changes to the benthos.

Indirect impacts will be caused by re-settlement of sediment suspended during installation operations. The area temporarily affected by indirect impacts is expected to be approximately 1.214 km^2 and will be transient in nature because this is an area of naturally turbid and high turbulence water.

Whilst these limited and transient seabed impacts will occur within the Southern North Sea SAC, this site is not designated for benthic features and so there will be no impact to features of conservation importance. There are no protected sites designated for benthic features close enough to the proposed Development area to be impacted at the seabed. Consequently, there is unlikely to be any impact on the conservation objectives or site integrity of any such protected area The impact to the seabed overall is likely to be minor, and apart from the area of long-term impact, impact is not considered to be significant.

Other sea users

The proposed Development may impact other sea users through increased risk of vessel collision, the exclusion of other sea users from the Development area and the possibility of snagging of fishing gear on Development infrastructure.

Although there will be an increase in the number of vessels in the area during the period of drilling and installation & commissioning, this will be of a limited duration. Standard communication and notification procedures will be in place to ensure that all vessels operating in the area are aware of the activities, including the presence of the drilling rig, in order to minimise vessel collision risk.

Other sea users will be excluded from a 500 m radius around the Platypus manifold and drill centre during drilling and for the life of the Development until approximately 2040. For safety, the area in the vicinity of the pipeline route will also be subject to exclusion on a transient basis through minimising the risk of collision.

The risk of fishing vessels snagging gear is also negligible. Drill rig spud can depressions will occur exclusively within the Platypus installation 500 m exclusion zone although no fishing vessel will encounter these or other seabed infrastructure. The pipeline route, which will be exposed to fishing activity once the pipeline becomes operational, will be surveyed following pipeline installation to ensure no residual snagging hazard.

The presence of Project vessels and the pipeline trenching equipment have the potential to result in transient avoidance from the area by harbour porpoise which are resident in the Southern North Sea SAC. Harbour porpoise are not expected to be particularly sensitive to the presence of Project vessels and the Development area is already heavily trafficked and this will not be significantly enhanced by installation operations. No receptors from other sites are expected to be affected by Project-related exclusion. As such, there is expected to be no Likely Significant Effect on SACs, SPAs or MCZs.

The residual consequence of the Development on other sea users is ranked as negligible. The exclusion zone and the negligible snag risk will be present for the entire Development life and, for this reason, the impact frequency has been ranked as continuous. As a result, the residual risk to other sea users from the Platypus Development will be minor and not significant.

Underwater noise

Many species found in the marine environment use sound to understand their surroundings, track prey and for communication. Noise sources associated with the Platypus Development that could cause injury or disturbance to marine mammals are limited to continuous noise from Project vessels and impulsive noise from piling of the Platypus installation.

The most sensitive marine mammals would need to be within 9 metres (m) of piling activity (reduced to 3 m when a soft start is used) and less than 1 m away from vessel noise sources to suffer injury from noise from this project. Consequently no injuries are expected to occur. Nevertheless, to mitigate the potential for disturbance during piling a soft start procedure will be used as will visual monitoring of a 500 m mitigation zone around the piling operations that will have to be confirmed as clear of visible marine mammals before piling commences.

The mitigation measures are also designed to reduce the likelihood of disturbance (as opposed to injury) occurring. Noise modelling predicted that a strong disturbance reaction could be expected at 176 m from piling noise and 635 m from vessel noise. The area within which disturbance could occur is very small compared to the available habitat in the surrounding area, and as such, disturbance is unlikely and the impact is not expected to be significant.

Based on density estimates of harbour porpoise in the Development area and estimates of the population within the Southern North Sea SAC, it was calculated that only one individual, equating to 0.006% of the SAC population would be likely to be within the disturbance zone at any one time. This is not expected to constitute a significant impact on the conservation objectives of the site.

Due to the small area of disturbance associated with Project operations, and the low density of European Protected Species (grey and harbour seals) expected in the Development area, significant impacts on seals are not expected.

Overall, the residual consequence of underwater noise emissions is ranked as negligible. Although most vessel noise will occur during the drilling and installation periods, there is also likely to be a limited requirement for vessel use during the operational phase and thus the residual impact will occur intermittently over the life of the Platypus Development. As such, the residual risk is expected to be negligible and not significant.

Atmospheric emissions

Atmospheric emissions can result in local, regional and transboundary issues through the generation of acid rain from NO_X & SO_X from combustion, and the human health impacts from NO_2 and SO_2 , also from combustion. Ozone (O_3) is generated by sunlight acting on NO_X and volatile organic compounds (VOCs). On a global scale, concern with regard to atmospheric emissions is focused on climate change.

Atmospheric emissions from the Platypus Development will be caused by fuel consumption by the drill rig, installation vessels and helicopters and to limited flaring activities during any well testing, with minor additional emissions from Cleeton through generation of a small increase in electricity required for Platypus.

Emissions from drilling, installation and commissioning vessels will be temporary and one-off and given the distance of Platypus from shore, it is unlikely that atmospheric emissions will negatively impact air quality at sensitive receptors. As such, impacts on protected sites are also expected to be not significant.

The Platypus Development is ≥11 km from other industrial activities (including other offshore oil and gas activity). The low levels of emissions expected, and the dispersion of emissions over the Development area suggest there will be no significant cumulative effects in terms of local air quality. The drilling activities associated with the Platypus Development will be, at their closest, approximately 121 km from the UK/ Netherlands median line and as such there will be no significant transboundary impacts.

Average annual emissions during installation at the Platypus Development will account for approximately 0.14% of the annual emissions on the UKCS from shipping and oil and gas activities, and will contribute a maximum of 0.0028% of the UK's annual carbon budget. This maximum contribution will occur during the 2018 to 2022 carbon accounting period. Following installation, the average annual emissions at the Platypus Development will contribute a maximum of 0.0007% of the annual emissions on the UKCS and will contribute a maximum of 0.00005% of the UK's annual carbon budget during the 2028 to 2032 carbon accounting period. As such, the Development is not expected to have a significant cumulative impact on global climate change.

Considering the above, including that there will be no impact on protected sites or on species from protected sites, the residual consequence of atmospheric emissions is ranked as negligible. As the majority of emissions will occur during the drilling and installation phases and the only operational emissions will be occasional cold venting and fuel combustion from maintenance activities, the operational emissions are defined as infrequent. As a result, the residual risk of atmospheric emissions from the Platypus Development is considered negligible and not significant.

Accidental events

The risk of an oil spill is one of the main environmental concerns associated with offshore oil and gas development. Platypus will produce gas (a release of which is unlikely to have significant environmental impacts) and a small amount of gas condensate and there exists the risk of a diesel spill from the drill rig. The worse-case spills were modelled on the basis of the following scenarios:

- Instantaneous loss of drill rig fuel inventory releasing 2,400 m^3 of marine diesel at the Platypus location; and
- A full-bore well blowout taking 90 days to bring under control (by drilling a relief well) and releasing 3,006 m^3 of gas-condensate at the seabed at a constant rate of 33.4 m^3/day.

At the point of contamination there will be a 100% probability of surface contamination. Modelling of the fuel inventory release suggests a small area of sea surface would be further exposed to a 20% to 30% probability of contamination, with a larger area exposed to between 10% and 20% probability of contamination. Sea surface contamination would be expected to be limited to a transient and very thin layer of diesel.

The maximum probability of shoreline contamination was predicted to be 17% on the Yorkshire and Lincolnshire coasts, and the minimum time between the release and contamination of the shoreline was two days, with a maximum of 874.3 tonnes (Te) of diesel reaching the shore (most model runs predicted a much smaller mass of diesel beaching). There was a very low probability of diesel crossing the UK/Netherlands transboundary line, and the minimum crossing time was two days and four hours.

Modelling of the well blowout scenario suggests a greater probability of sea surface oiling across a larger area, with 90% to 100% probability of surface contamination predicted out to a 40 km to 50 km radius from the release point. The majority of this surface contamination would be expected to comprise a very thin layer of condensate that would be dispersed by currents, only covering a small area of sea surface at any one time. There was predicted to be a maximum 50.9% probability of shoreline contamination, affecting the Yorkshire coast. The minimum arrival time of condensate to shore was 3 days and 23 hours, with a maximum of 4.4 Te predicted to beach. There was a maximum 16.4% probability of condensate crossing the UK/Netherlands median line, with a minimum crossing time of two days and seven hours.

While there is a small probability of environmentally significant quantities of hydrocarbons reaching the coast and impacting coastal waters and protected sites in the event of a worst-case release, the likelihood of such a release occurring in the first place is considered remote to very remote.

Smaller spills associated with hose failures during transfer of drilling mud, diesel and chemicals are more likely to occur, based on historical incident frequencies, but are unlikely to be of sufficient severity to result in significant environmental impacts.

Comprehensive written procedures will be prepared and followed for all relevant activities to reduce the risk of accidental releases. Regular equipment inspections will be conducted, and spill kits will be provided to prevent smaller spills from reaching the sea. Even with comprehensive prevention measures in place, a residual risk remains. To mitigate this risk, detailed and fully tested contingency response plans will be formulated for Project activities. All activities will be covered by appropriate Oil Pollution Emergency Plans (OPEPs) and Shipboard Oil Pollution Emergency Plans (SOPEPs). These plans set out the responses required and the available resources for dealing with all spill sizes. The management processes put in place by Dana will ensure that all prevention and mitigation commitments are implemented and monitored.

Given the potential for significant impacts to coastal receptors and protected sites from a worst-case release, the consequence of a worst-case release is ranked as major. The likelihood of occurrence is considered remote and as such, the residual risk is considered minor and not significant.

Environmental management

The management of environmental risks associated with Dana's activities is integral with the business decision-making process. Environmental hazards are identified at all stages in the hydrocarbon lifecycle and risks are assessed and managed via a structured Environmental Management System (EMS).

The Dana EMS is the mechanism that communicates the Company standards and means by which they are maintained. The Dana EMS will be the mechanism by which the commitments specified in this ES are tracked. This structured management approach will be used to encourage the ongoing process of identification, assessment and control of environmental risks, which will continue throughout planning and operations. The EMS has been developed and maintained to meet the principal requirements of the ISO 14001:2015 Environmental Standard and was independently verified by an approved certification body most recently in March 2019. During all audits the system was found to be in compliance with OSPAR Recommendation 2003/5 and OPRED required industry standards.

A Health, Safety, Security and Environmental (HSSE) plan has been developed for the Platypus Development to summarise how HSSE issues will be managed for the Development and how effective implementation of the Dana EMS will be achieved.

Conclusions

The Platypus Development EIA has considered the objectives and marine planning policies of the East Inshore and Offshore Marine Plans. The aim of the Marine Plans are to help ensure sustainable development of the marine area through informing and guiding regulation, management, use and protection of the area. Across the range of policy topics including natural heritage, air quality, cumulative impacts and oil and gas, Dana considers that the Platypus Development is in broad alignment with such objectives and policies.

The Dana HSE MS will ensure that measures described in this ES to minimise and mitigate against environmental impact will be delivered through the establishment of an Environmental Management Plan for the installation, commissioning and production operations associated with the Platypus Development.

Overall it is concluded that the proposed Platypus Development will not result in significant environmental impacts.

1 Introduction

1.1 The Platypus Field

Platypus is a gas field located approximately 65 kilometres (km) northeast of Easington in Block 48/1a of the southern North Sea (SNS) and 121 km from the UK/Netherlands median line (Figure 1.1). Platypus was discovered in 2010 (48/1a-5 discovery well). A further appraisal well was drilled in 2012 (48/1a-6).

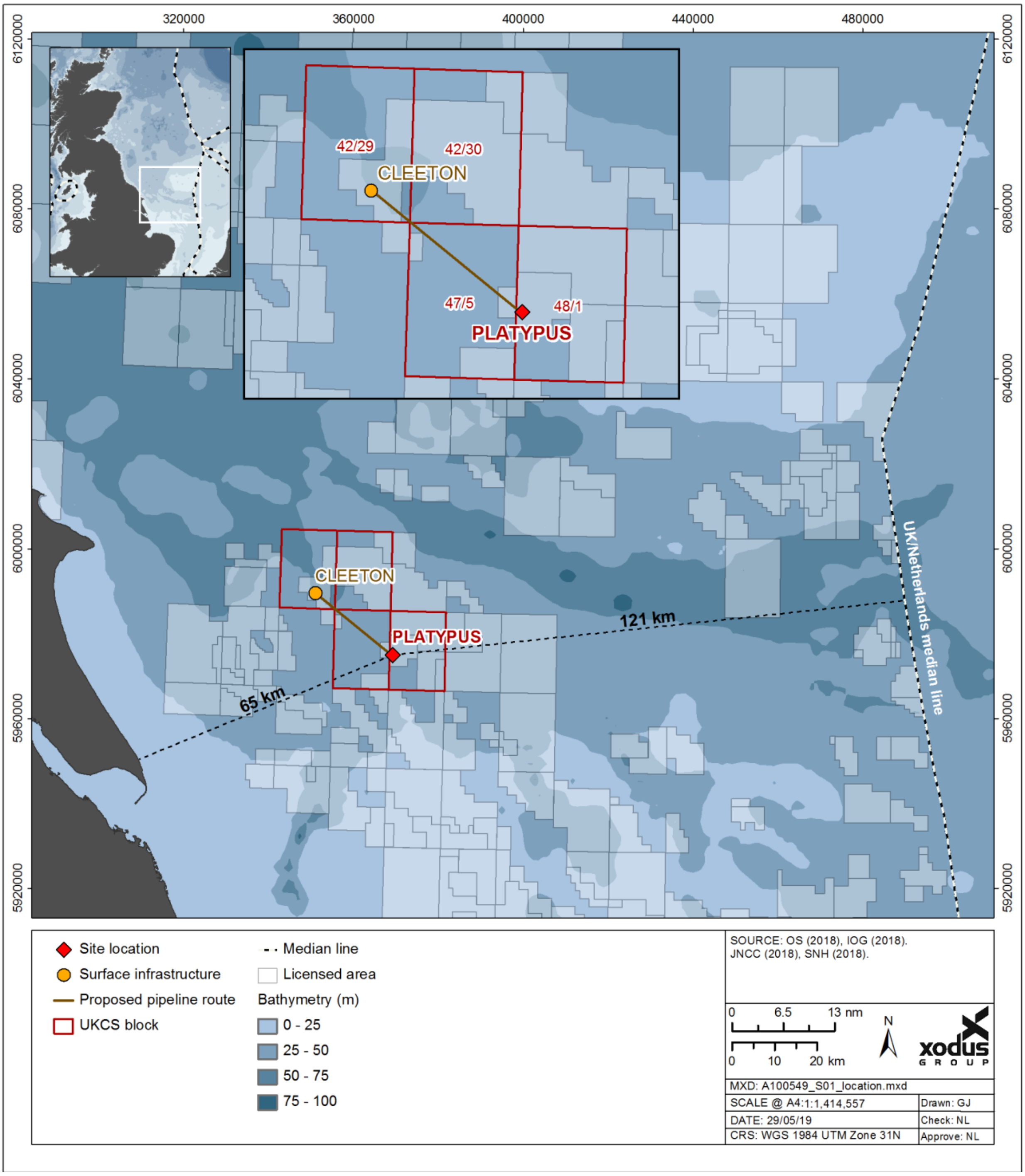

Figure 1.1: Location of the Platypus Development in the context of the UKCS

1.2 Project Background and Purpose

Dana Petroleum (E&P) Limited (Dana) engages in various exploration, production and development activities throughout the northern, central and southern North Sea. Dana's stated strategy is to continue to invest in its UK exploration portfolio and convert exploration prospects into reserves and production. As part of this strategy, Dana proposes to develop the Platypus field by drilling two subsea production wells (plus one contingent on the Platypus well performance) tied back to a new Platypus subsea manifold. Produced fluid consisting mostly of gas but also including condensate and produced water will be exported un-separated via a new 12″ x 23 km pipeline to the Cleeton Wellhead (CW) platform (in Block 42/29) for co-mingling with gas from the other fields that tie in to Cleeton and on to the onshore Dimlington terminal for processing via Cleeton's existing export pipeline. A new 150 mm x 24 km umbilical will be laid to deliver chemical, electrical, control and communications services from the CW platform to the Platypus field. Since the export pipeline and the umbilical will be laid in the same trench for the majority of the route, they are referred to collectively as "the pipeline" throughout this document unless otherwise specified.

The Platypus manifold and associated wells, together with the new pipeline are termed "the Development" in this Environmental Statement (ES). The operations that will be undertaken to install, commission and operate the Development are termed "the Project".

Dana is the appointed Operator of the Platypus field as part of a co-venture between CalEnergy, Parkmead Group and Zennor Petroleum. As Operator, Dana will carry out the Project operations on behalf of the owners of the field. The equity breakdown is as follows:

- Dana: 59%;
- CalEnergy: 15%;
- Parkmead Group: 15%; and
- Zennor Petroleum: 11%.

The Platypus Development has a number of potential economic benefits for the UK:

- Generation of additional revenue to the UK Government from increased oil and gas production;
- Contribution to the security of the UK's energy supply;
- On a local and national scale, the Project may secure or add to the offshore and onshore employment in the area, in particular during the drilling and installation phases; and
- Provision of additional pipeline infrastructure which may facilitate future developments in the area.

The preliminary schedule for the Platypus Development is illustrated in Figure 1.2. Define stage engineering for the Project is scheduled to be completed in Q4 2019. Tendering will be conducted in Q3 and Q4, 2019. Modifications to the Cleeton CW platform will begin in Q3 2020. Construction, installation and commissioning of the Platypus installation and subsea infrastructure be undertaken in Q2 2021 to Q1 2022. Drilling is currently scheduled to commence in Q2 2021 and to be completed by Q2 2022. First gas is expected to be produced in Q4 2021.

	2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
FEED engineering			■	■												
Drilling & production consent					■											
Detailed design						■	■	■	■							
Cleeton modifications							■	■	■	■	■	■				
Onshore terminal modifications								■	■	■	■	■				
Pipeline and umbilical lay											■					
Subsea construction											■					
Subsea well tie-in campaign												■	■			
Drilling and well completion										■	■	■	■			
First gas												■				

Figure 1.2: Indicative schedule for the Platypus Development

1.3 Scope of Environmental Impact Assessment

The overall aim of the Environmental Impact Assessment (EIA) is to assess the potential environmental impacts that may arise from the Platypus Development and to identify the measures that will be put in place to reduce these potential impacts.

The EIA process is integral to the Project, assessing potential impacts and alternatives, and identifying design and operational elements to help reduce the potential impacts of the Project as far as reasonably practicable. The process provides for stakeholder involvement so that issues can be identified and addressed as appropriate at an early stage, and also helps the planned activities comply with environmental legislative requirements and with Dana's environmental policy.

The EIA scope includes installation, commissioning, operational and decommissioning activities of the Development over which Dana has operational control and includes:

- Installation, commissioning, operation and maintenance of infrastructure, including the subsea wellheads and manifold and the pipeline;
- Development well drilling;
- Modifications to host facilities;
- Operational shipping and loading activities occurring within the Platypus Development area[2], and
- Decommissioning of the Platypus Development.

The EIA considers both routine activities and accidental events where there are potential environmental impacts.

The following Platypus Development components are outside the scope of this EIA:

- Transport and processing of production fluids following co-mingling at the CP platform;
- Pre-construction, maintenance and transport of infrastructure outside the Development area (e.g., at ports); and,

[2] Development area is defined as the Platypus field, and the pipeline route between Platypus and the CW platform.

- Further activities that might be undertaken at potential future prospects for which the Platypus Development could act in any supporting manner. Such developments, should they occur, would be the subject of any necessary additional environmental assessment and approval from the UK Regulatory Authorities.

This ES reports the EIA process and the results of the assessment. The scope of the EIA was developed during scoping and wider consultation (refer to Chapter 4). Full details of the methods applied during the EIA process are described in Chapter 4.

Key elements of this ES include the following:

- Description of the background to the Project, and role of the EIA and legislative context (this chapter);
- Description of the Project and alternatives considered (Chapter 2);
- Description of the environment and identification of the key environmental sensitivities which may be impacted by the Project (Chapter 3);
- Description of the methods used to identify and evaluate the potential environmental impacts, including consultation undertaken during the EIA (Chapter 4);
- Detailed assessment of key potential impacts, including assessment of potential cumulative and transboundary impacts (Chapter 5);
- Description of the environmental management measures (Chapter 6);
- Conclusions (Chapter 7); and
- Appendices containing information to support the impact assessment.

The ES is submitted to the UK oil and gas regulator, OPRED (Offshore Petroleum Regulator for Environment and Decommissioning), to inform the decision on whether or not the Project may proceed, based on the residual levels of potential impact. The ES is also subject to formal public consultation.

1.4 Legislation and Policy

The EIA reported in this ES has been carried out in accordance with the requirements of the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999, as amended. These Regulations require the undertaking of an EIA and the production of an ES for certain types of offshore oil and gas developments likely to have a significant impact on the environment.

An EIA is mandatory for any offshore oil and gas development that is expected to produce more than 500 tonnes (Te) of oil per day or more than 500,000 cubic metres (m^3) of gas per day. An EIA is also required for pipelines greater than 40 km in length or with an overall diameter of more than 800 mm. The Platypus Development triggers a mandatory EIA on the grounds of gas production rate.

There are a number of other key regulatory drivers applicable to the Project, with the key UK legislation being:

- The Petroleum Act 1998;
- The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008;
- Energy Act 2008, as amended;
- The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001, as amended;
- The Conservation of Offshore Marine Habitats and Species Regulations 2017;
- The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005, as amended;
- The Offshore Chemical Regulations 2002, as amended;
- The Merchant Shipping (Prevention of Pollution by Garbage) Regulations 1998;
- The Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998;
- The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (as amended);

- Oil Pollution Preparedness, Response and Co-operation Convention Regulations 1998 as amended;
- The Offshore Installations (Emergency Pollution Control) Regulations 2002;
- The Marine and Coastal Access Act 2009;
- The Marine Strategy Regulations 2010 (which implement the European Marine Strategy Framework Directive); and
- Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015.

The EIA Regulations require that the EIA should consider the potential for significant impacts of a project on the environment. The scope of the EIA is informed by a number of different processes, including scoping with the Regulator and stakeholders, as well as an environmental issues identification (ENVID) workshop. Following this, the decision process related to defining whether or not a project may potentially significantly impact on the environment is the core principle of the EIA process. The EIA Regulations themselves do not provide a specific definition of significance, but they indicate that the methods used for identifying and assessing potential impacts should be transparent and verifiable. Despite this being inherently a subjective process, a defined methodology has been developed to make the assessment as objective as possible.

In addition, European Union Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (the Habitats Directive), which provides protection to European sites known as Special Areas of Conservation (SACs), and Directive 2009/147/EC (the Birds Directive), which protects sites important for wild bird populations known as Special Protection Areas (SPAs), collectively referred to as Natura 2000 or European sites, are applicable to the Project. Under Article 6(3) of the Habitats Directive, "Any plan or project which is not directly connected with or necessary to the management of a European site but would be likely to have a significant impact on such a site, either individually or in-combination with other plans and projects, shall be subject to an appropriate assessment of its implications for the European site in view of the site's conservation objectives."

The Habitats Directive applies the precautionary principle to these sites and projects can only be permitted when it is ascertained that there will be no adverse impact on the integrity of any European-designated site(s). Where adverse impacts are identified a project may only be permitted in the absence of alternative solutions if there is an Imperative Reason of Overriding Public Interest (IROPI) for the project to go head. Where this is the case, Member States are required to take all compensatory measures necessary to ensure that the overall coherence of the Natura 2000 network is protected.

For offshore oil and gas, the requirements of the Habitats Directive are transposed through the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001. In accordance with these Regulations, the impacts of a project on the integrity of a European site are assessed and evaluated as part of the Habitat Regulations Assessment (HRA) process. Relevant information required by OPRED as part of the HRA process is provided in Chapter 5. In a similar type of process, the Marine and Coastal Access Act 2009 requires the potential for significant risk to the conservation objectives of Marine Protected Areas (MPAs) and Marine Conservation Zones (MCZs) to be assessed. As for the HRA process, the relevant information is presented in Chapter 5.

The East Inshore and Offshore Marine Plans came into force in April 2014. The aim of the Marine Plans are to help ensure sustainable development of the marine area through informing and guiding regulation, management, use and protection of the area. The key principles of the Marine Plan policies considered relevant to the Platypus Development are summarised below:

- Co-existence: Opportunities for co-existence, for all users, should be maximised wherever possible;
- Biodiversity: Appropriate consideration should be attached to biodiversity, reflecting the need to protect biodiversity as a whole, taking account of the best available evidence including on habitats and species that are protected or of conservation concern in the East Marine Plans and adjacent areas (marine and terrestrial);
- Air quality: Proposals for development should minimise emissions of greenhouse gases as far as is appropriate;
- Fishing: Proposals should seek to minimise impacts on the fishing industry as much as possible;

- Heritage assets[3]: Proposals that may affect heritage assets should seek to minimise compromising or harming elements which contribute to the significance of the heritage asset as far as possible;
- Navigational safety: Proposals that require static sea surface infrastructure or that significantly reduce under keel clearance should not be authorised in International Maritime Organization (IMO) designated routes;
- Socio-economic: Proposals for development should demonstrate that during construction and operation, adverse impacts on tourism and recreation activities should be minimised as far as possible; and
- Cumulative impacts: Cumulative impacts affecting the ecosystem of the East Inshore and Offshore Marine Plans and adjacent areas (marine and terrestrial) should be addressed in decision-making and plan implementation.

Sectoral policies are also outlined in the Plans where a particular industry brings with it issues beyond those set out in the general policies. Specifically for the Platypus Development, oil and gas objectives and policies are of relevance; these are detailed in Chapter 7, along with comment on the degree to which the Project is aligned with such objectives and policies.

1.5 Environmental Management

Dana is committed to managing all environmental impacts associated with its activities wherever it operates. Continuous improvement in environmental performance is sought through effective project planning and implementation, emissions reduction, waste minimisation, waste management (including for naturally occurring radioactive material), and energy conservation. Dana's Health, Safety, Security and Environment (HSSE) policy is presented in Figure 1.3.

[3] "A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest. Heritage asset includes designated heritage assets and assets identified by the local planning authority (including local listing)." Annex 2: Glossary, National Planning Policy Framework, Department for Communities and Local Government, 2012

Health, Safety, Security & Environment (HSSE) Policy

Our policy

The safety of our people and assets, and respect for the environment are two of our core values and are an integral part of how we do business. We believe strong Health, Safety, Security and Environmental (HSSE) performance creates strong commercial performance.

Accountability

The Chief Executive Officer (CEO) has overall accountability to the Dana Board of Directors for the management of HSSE.

Scope

Our policy applies to all employees (staff, contract and temporary), officers and directors of Dana Petroleum Limited (collectively referred to as 'employees') in each of our operating units worldwide and anywhere that we conduct business or visit in the course of our business. It also extends to all our joint ventures business, in all countries in which we or our subsidiaries and associates operate. Where we have a minority interest we will encourage the application of this policy amongst our business partners including contractors, suppliers and joint venture partners.

Policy in practice

Dana strives to continually improve its HSSE performance by setting and monitoring clear objectives, supported by its HSSE Standards. This requires the commitment of everyone at Dana and a culture where people are encouraged and feel able to intervene and report on HSSE issues of concern. It is expected that each individual will recognise their responsibility to put our policy into practice.

We will:

- Provide a safe working environment that protects against injury and minimises work-related ill health
- Provide appropriate security protection for employees and assets
- Commit to protect the environment, and so minimise the impact of Dana's operations
- Ensure compliance with applicable legislation and apply Dana's standards and oil industry best practice in locations where local laws do not exist
- Identify and manage HSSE risks in a systematic way as part of Dana's risk management framework
- Create clear accountabilities and expectations for HSSE at every level of the organisation
- Provide resources to successfully manage HSSE risk
- Identify and manage any form of change in our organisation
- Ensure that our employees and contractors are competent and able to perform the work we are asking them to undertake
- Ensure that our employees and contractors understand their HSSE accountabilities and are aware of the behaviours expected by Dana
- Identify and manage operational interfaces internally and with third parties
- Communicate standards based on oil industry best practice which are consistent with legal and regulatory requirements in all operating areas
- Communicate and report openly on HSSE objectives and performance
- Actively engage with relevant stakeholders to understand and take account of their concerns
- Make sure that appropriate emergency response, crisis management and business continuity plans are in place and are regularly tested
- Investigate HSSE incidents, identify root causes, take effective action to prevent recurrence and identify opportunities for organisational learning
- Strive for continuous improvement of Dana's HSSE performance

Yongwoo Kang
Chief Executive Officer

2019

DP-DP-HS-HSG-POL-0001, Rev 06

Figure 1.3: Dana HSSE policy

2 Project Description

This section of the ES describes the proposed Platypus Development, the Project activities that will be required and the and the alternatives considered.

2.1 Consideration of Alternatives

Selection of the Development option for Platypus involved examining alternative concepts and approaches for the various development components including drilling design, processing, routes and installation methods for the pipeline and umbilical, production and decommissioning.

2.1.1 Option selection process

The development option selected for the Platypus Development was determined following a documented process of technical and commercial concept and host[4] selection. The selection process took cognisance of all issues around risks relating to environment, health and safety, technical feasibility, project execution and commercial considerations. The process also involved extensive discussion with key external stakeholders, including the Oil & Gas Authority (OGA). At a number of points within the option selection process, Dana engaged with the OGA to consider how the Platypus Development might facilitate other developments in the region, with consequent reductions in development cost and, importantly, reduced likelihood of cumulative environmental impact. At the time of writing, there were no known third parties considering use of the Platypus infrastructure, although a tie-in point for this purpose will be included in the design in order to meet OGA Maximising Economic Recovery (MER) requirements.

2.1.2 Selection of well strategy

Well engineering studies demonstrated that one drill centre is optimal for the Project. The subsurface assessment programme demonstrated that all the wells can be drilled from the same general location which will provide the optimum recovery of hydrocarbon reserves. The selected location has been chosen taking in to account seabed and shallow gas information.

2.1.3 Selection of processing facilities

A number of development options were considered for the Platypus discovery with the aim of optimising the value of the field whilst considering the OGA's MER strategy. Objectives in support of this aim are: reducing the risk profile, reducing capital expenditure (CAPEX) exposure, and ensuring commercial viability and positive economic results.

Since the drilling of the Platypus discovery and appraisal wells in 2010 and 2012, respectively, a number of host options have been studied and reviewed. The appraisal and selection of the preferred development options for further study in the Select stage were agreed at the UKCS Field Developments Assessment Phase at the end of 2013.

In April 2019, it was agreed that the Platypus development would transport gas via the Perenco owned Cleeton Platform to the Dimlington Terminal on the Yorkshire coast. This was agreed following screening of available hosts that were capable of receiving the projected production rates, hydrocarbon characteristics, methanol handling and access to a terminal sales facility.

A range of existing offshore platforms was reviewed as a potential offtake route for the development, with all being discounted for various technical and commercial reasons and Cleeton accepted in agreement with partners and the OGA.

[4] A host installation is one that provides services, typically processing facilities, to other separate fields in the vicinity.

Studies assessed various options for accessing the Cleeton complex, including using existing risers, installing new risers or the installation of a riser mono-tower. The option selected is to install a new riser on the CW platform. Existing risers on the CT tower were discounted on safety and environmental grounds because of the low pressure rating of the existing riser which would require a very high integrity subsea high-integrity pressure protection system (HIPPS). The mono-tower option at Cleeton was discounted because of potential load issues on existing infrastructure. By using the existing Cleeton jackets only, this further reduced the requirement for additional footprint and energy and emissions from manufacturing.

2.1.4 Selection of pipeline specifications and route

The production pipeline will be fabricated from conventional carbon steel with a specified corrosion allowance and a two layer polypropylene corrosion coating.

The pipeline corridor selected is the shortest route between the Platypus infrastructure and the host. This minimises the overall pipeline length and environmental impact to the seabed. The final “as laid” pipeline route within the corridor will be decided following detailed analysis of seabed condition data obtained from survey work and specific routing studies. Seabed conditioning/ pre-sweeping using suitable dredging equipment may be required in certain locations to allow pipelay through sand waves that exist within the route corridor.

Based on fishing activity within the area and general seabed and hydrodynamic conditions in the SNS, it was decided that the safest option to ensure pipeline stability and minimise potential snagging risks would be to trench and backfill the pipeline as it is laid. Where the new pipeline crosses existing infrastructure (pipelines/ umbilicals/ cables) the pipeline will be laid on the surface of the seabed and protected by concrete mattresses and rock armour designed to be overtrawlable as detailed in Section 2.4. Visual and measured confirmation of burial status will be obtained during pipelay, and where any potential snagging risks are identified (e.g., clay berms) these would be remediated as appropriate to leave a safe seabed.

2.1.5 Decommissioning

The future decommissioning activities that will be required for Platypus will depend on the regulatory regime in place at the time of decommissioning. It has been Dana’s approach to the option selection process that no design decisions would knowingly prohibit Dana from meeting its decommissioning obligations under current regulatory requirements.

2.2 Drilling Description

Drilling is determined based on the target geologic formation and development of a suitable drill strategy.

2.2.1 Nature of the reservoir

The Platypus target reservoir is the Permian Rotliegend Group Leman Sandstone Formation with the hydrocarbon-bearing reservoir located approximately 10,000 feet (approximately 3,100 m) below sea surface. The Platypus reservoir will be developed with long sub-horizontal wells (between 80° and 90° relative to the vertical) and will be produced under natural depletion (i.e., there will be no injection of gas or water into the reservoir to maintain production). The Platypus reservoir contains gas at reservoir pressure and temperature conditions that are higher than atmospheric conditions at the surface. At surface conditions, the reduction in pressure relative to reservoir conditions will result in some liquid hydrocarbons dropping out of the gas solution. The initial liquid yield is expected to be approximately three barrels per million standard cubic feet per day (bbl/mmscfd). The hydrogen sulphide (H_2S) and carbon dioxide (CO_2) levels are estimated to be low at a maximum of 0.2 parts per million (ppm) and 1.26 mol% respectively.

2.2.2 Drilling strategy

Platypus will be developed by drilling two wells into the Platypus reservoir with an optional future decision on a single well into the Platypus East reservoir (the decision on which will be made depending on performance of the two initial wells. The two wells will be drilled from one drill rig location through two subsea wellhead installations. Drilling of the Platypus wells is expected to commence in Q2 2021 and be completed by Q2 2022.

2.2.3 Drill rig

No drill rig has yet been contracted; however, given the water depth at Platypus a jack-up drill rig will be used. The jack-up would use spud cans to support the rig on the seabed alongside the platform. A site specific survey of the seabed morphology and shallow sediment geology present at the drilling site will be undertaken to confirm the seabed is suitable to support the jack-up. Rock placement may be required around the spud cans to avoid excessive scouring undermining the seabed under the spud cans. As a worst case it is expected that up to 2,500 Te of rock armour will be required for this purpose. The drill rig mobilised for the Project will be fitted with a blowout preventer (BOP). The function of the BOP is to prevent uncontrolled flow from the well by closing in the well at surface if required. The BOP is made up of a series of hydraulically operated rams that can be closed in an emergency from the drill floor and from a safe location elsewhere on the drill rig.

2.2.4 Well design

The Platypus reservoir is expected to be uniform in nature and the both wells will therefore be of a similar design. Each well will be drilled to approximately 3,109 m vertical depth (10,200 feet), and will be deviated to allow drilling through the reservoir at an inclination of 80 – 90 degrees. The total measured depth of the wells will be up to 16,000 ft. The wells will each be drilled in five sections of successively smaller diameters (i.e., 36", 17½", 12¼", 8½" and 6"). Figure 2.1 shows a typical well design of the type that will be used at Platypus, whilst Table 2-1 provides the section diameters, indicative section lengths and drilling rates.

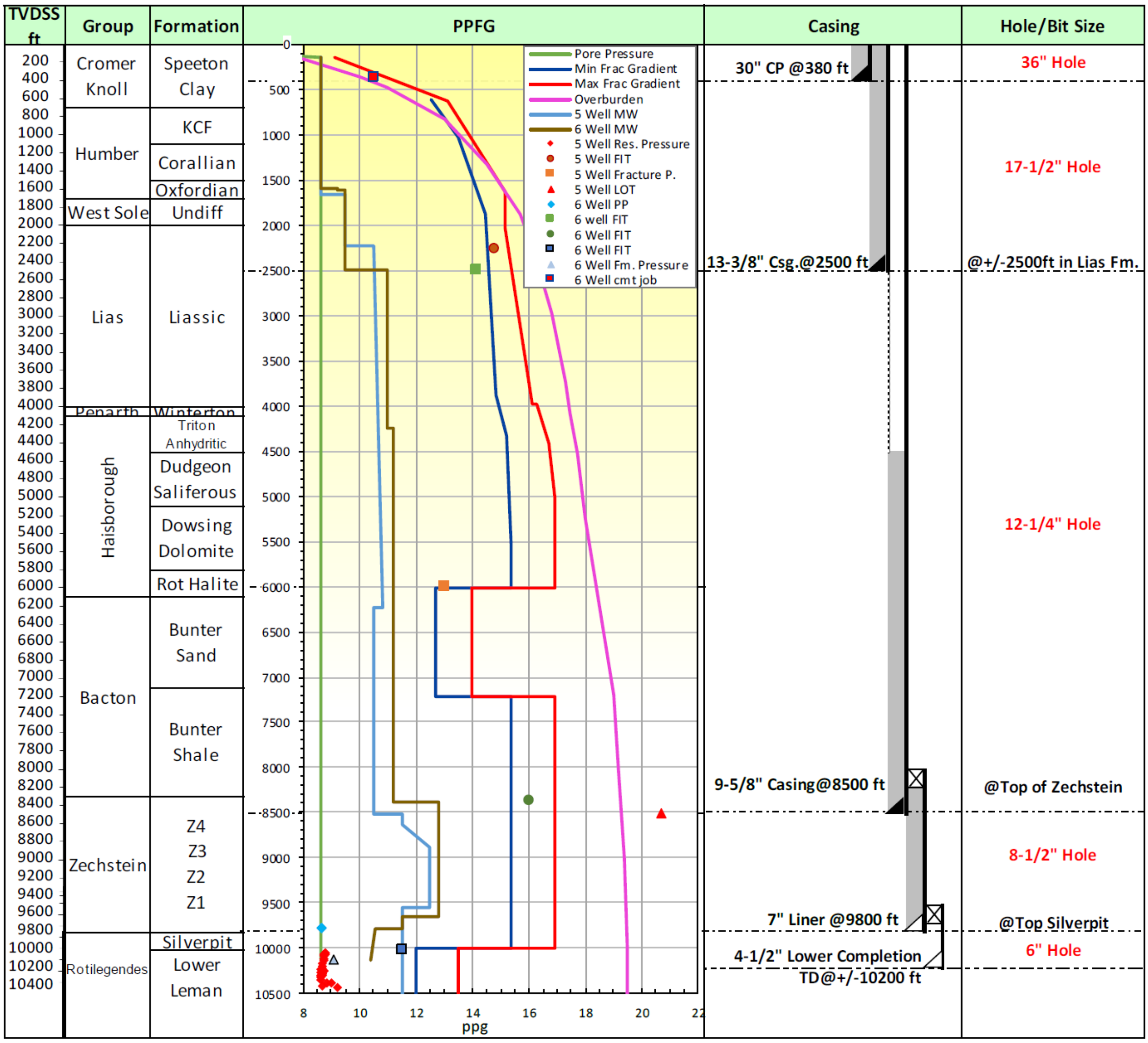

Figure 2.1: Expected well design

Table 2-1: Expected parameters for the Platypus wells

Drilling parameter	Well section				
	1	2	3	4	5
Diameter (inches)	36	17½	12¼	8½	6
Length (m)	116	646	1,829	396	122
Drilling rate (m per hour)	15	12	14	9	9

2.2.5 Mud system and cuttings

The drilling fluids or muds used to drill the various hole sections of a well have a number of functions, including:

- Maintenance of downhole pressure to avoid formation fluids flowing into the wellbore (also called “a kick”);

- Removal of drill cuttings from the drill bit to permit further drilling and transporting cuttings to the surface cuttings handling equipment;
- Lubrication and cooling of the drill bit, bottom hole assembly and drilling string; and
- Deposition of an impermeable mudcake on the walls of the well bore, which seals and stabilises the open hole formations.

Drilling fluids can consist of various materials including weighting agents and other chemicals to achieve the required weight, viscosity, gel strength, fluid loss control and other characteristics to meet the technical requirements of drilling and completing the well. Generally, drilling fluids can be divided into two categories based on their base fluid types:

- Water-based mud (WBM), where the base fluid is water; and
- Oil-based mud (OBM), where the base fluid is a low-toxicity oil.

Various chemicals may also be added to either type of drilling fluid to achieve specific functions, which are mainly driven by formation pore pressures and fracture gradients, downhole temperatures, geological characteristics etc. Different types of mud are planned to be used for the different well sections. For the top two sections (36" and 17½"), seawater and regular bentonite sweeps will be pumped downhole to remove cuttings and keep the hole clean. Cuttings from these top hole sections will be discharged directly from the wellbore at the seabed.

For the deeper sections, a marine riser will be in place between the well and the drilling deck so that cuttings and drilling fluid are circulated back up to the rig for treatment. An oil-based mud with low toxicity (called low-toxicity oil-based mud, or LTOBM) will be used to drill the 12¼" and perhaps also the 6" sections (the selection of the 6" mud system will depend on formation compatibility testing). The mixture of cuttings and used LTOBM circulated back up to the rig will be separated over shale shakers, contained, and the cuttings shipped to shore for further treatment and disposal. The recovered LTOBM will be treated and recycled back into the LTOBM system. The 8½" hole section will be drilled through the salt prone Zechstein Group with a salt-saturated (sodium chloride) water-based mud (SSWBM), to minimise wellbore enlargement from dissolved salt. The cleaned cuttings recovered from the SSWBM drilling returns will be discharged overboard via a caisson opening near the sea surface. Table 2-2 details the proposed drilling mud requirements for one well. The volumes are approximate estimates that will vary depending on final drilling fluids design and well trajectories, but that are representative for the planned wells.

Table 2-2: Tonnage of drilling mud components per well and their fates

Component	Modelled discharges per section (Te)				
	36”	17½”	12¼”	8½”	6”
Mud/fluid (name)	Seawater with sweeps		LTOBM	SSWBM	WBM or LTOBM
Bentonite	15	15	0	0	0
Barite	55	18	82	90	0
Total mud (for one well)	275	1,050	1,315	1,018	220
Fate of cuttings	Discharged at seabed from wellbore	Discharged at seabed from wellbore	Shipped to shore	Overboard discharge via caisson	Shipped to shore

2.2.6 Cementing and other chemicals

Steel casings will be installed in the wells to provide structural strength to support the wellheads and xmas trees, isolate unstable formations and separate formations which have different pressures and fluids. Each steel casing will be cemented into place to provide a structural bond and an effective seal between the casing and formation. During cementing, excess cement may be produced. If so, cement will be treated in the same way as WBM and discharged to sea. To limit discharge of cement, it is anticipated that all cement will be mixed as required, but as a worst-case for this assessment it has been assumed that up to a total of 534 m^3 of cement may be used across bothwells and that up to approximately 10 m^3 per well could be discharged to sea.

All chemicals to be used within the cement will be selected based on their technical specifications and environmental performance. Chemicals with sub warnings will be avoided where technically possible. The cementing chemicals to be used have not yet been determined but will be selected following Dana's chemical management and selection policy.

Chemicals to be used during well completion (the point at which the downhole equipment is assembled to enable production from the well) will be limited to a maximum of 80 m^3 of sodium chloride (NaCl) brine. It is expected that up to 8 m^3 of solids-free LTOBM will be recovered to the drill rig during completion activities and subsequently shipped to shore.

2.2.7 Well testing and clean-up

Prior to production, each well will be cleaned up to remove any waste and debris remaining, to prevent damage to the pipeline and topsides production facilities. A well test may then be conducted at the drill rig to obtain reservoir information and fluid samples. The likely sequence of events for well testing and clean-up will be as follows:

- Open well and flow;
- Initially the well will produce only sodium chloride brine which will be discharged to sea via the drilling rig;
- The water / hydrocarbon interface fluids will be captured and tested:
  - If oil in water concentration is equal to or below 30 milligrams per litre (mg/l) then the fluids will be discharged overboard in accordance with permits; or
  - If the oil in water concentration is above 30 mg/l the water will be treated until it is below 30 mg/l for overboard discharge;
- Produced hydrocarbons will be flared;
- Clean-up will be monitored to capture data regarding the amount of water and suspended solids in the produced fluids (called the basic sediment and water (BS&W) specification);
- After the well has been cleaned up, the well may be flowed for a test period of approximately 24 hours, during which time approximately 1,350 Te of gas and approximately 209 m^3 of condensate may be flared. No extended well test will be conducted; and
- Close well in, ready for production.

2.2.8 Well workovers and interventions

The Platypus wells have been designed with a philosophy of minimum planned intervention. The potential for undertaking scale squeeze and /or water wash treatments for each well will be included within the design.

2.3 Subsea

The subsea layout considered positioning, wellheads and subsea trees, and manifold structure.

2.3.1 Overview

An overview of the proposed subsea layout is shown in Figure 2.2. Further detail on each of the components is given in the subsequent sections of this chapter. Installation of the pipeline is expected to occur in Q3 2021.

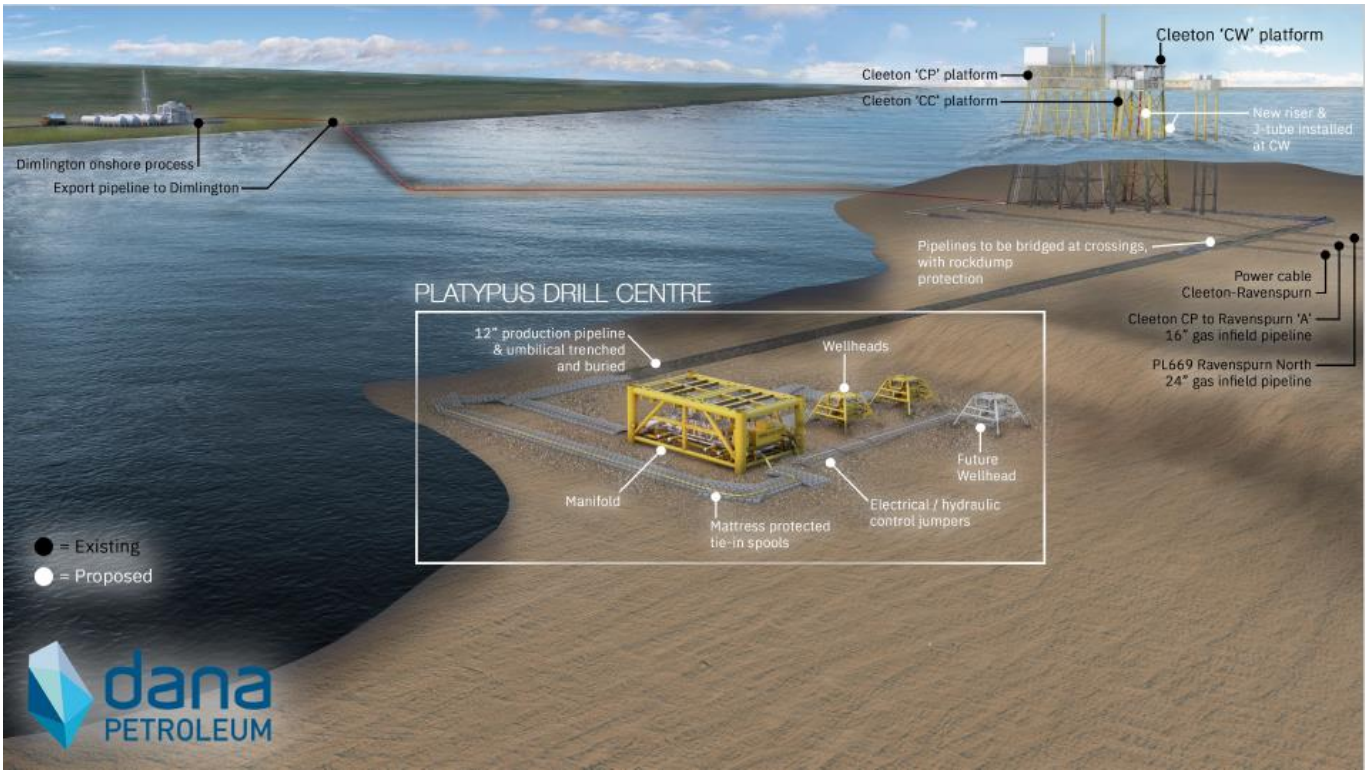

Figure 2.2: Indicative subsea layout for the Platypus Development

2.3.2 Subsea positioning

The placement of the subsea components requires a high degree of accuracy. To facilitate positioning of subsea structures transponders will be installed prior to load out and subsequent installation. The position of the structure during deployment will be determined by the vessel's acoustic positioning system and positioning transponders mounted on the structure. Heading and attitude of the structures will be determined using a high accuracy subsea gyro which may be mounted on the structure, or on a remotely operated vehicle (ROV) which rigidly docks onto the structure. The use of a dead man anchor (DMA) deployed on the seabed and orientation rigging may be required to achieve heading positional accuracy. To verify the seabed condition and ensure no obstacles are present which may prevent successful installation, a visual ROV survey will be carried out before commencement of installation activities.

To facilitate positioning of the pipeline and umbilical, surveys will be carried out prior to installation that will verify the seabed condition and ensure no obstacles are present which would alter the intended route. Positioning of the pipeline and umbilical during installation will be determined by the pipelay and umbilical lay vessels' acoustic positioning systems.

2.3.3 Wellheads and subsea trees

Subsea trees will be installed on top of the wellheads by the drill rig to control flow. The subsea tree is the main barrier between the reservoir and the primary well control element, and also provides a mechanism for flow control and well entry. All wells will have a safety valve installed which is an isolation device that is hydraulically operated and fail-safe closed. During drilling, the subsea trees will be controlled from the drill rig but during production will be remotely controlled from Cleeton via a control umbilical that connects between each of the tie-in structures. The valves will be controlled using a subsea control module, which will be mounted on the subsea tree. As the system will be open loop (i.e., fluids are discharged on each actuation), hydraulic fluid will be selected with due consideration to potential environmental impact.

The trees used will be fishing friendly and incorporate protection structures to provide the snag load resistance required. Each of the trees and associated protection structures will measure approximately 9.5 m x 9 m at the seabed and have a height above the seabed of approximately 5.5 m.

2.3.4 Manifold Structure

A manifold structure will be installed at the Platypus drill centre to act as a comingling point for production from the individual trees. The manifold structure will be a suitably trawlable "fishing friendly" designed with snag free details to limit potential for fishing gear snagging and allow gear to be recovered in the event that interaction with fishing gear occurs. The structure and foundations will be designed for potential fishing gear snag loads and will therefore incorporate piled foundations to resist these potential loads. Roof panels will be provided to avoid ingress of fishing gear into the structures and provide protection from dropped objects. The manifold structure will be approximately 10 m x 7 m and reach approximately 4 m above the seabed. The manifold will be connected to each well by a 6" spool piece of approximately 50 m in length and to the export pipeline by a 12" production tie-in spool of approximately 60 m in length.

Four piles will be required for each structure, with each pile measuring a maximum of approximately 0.6 m in diameter and approximately 20 m in length. Structure installation will be from a construction vessel, with a ROV used during piling.

2.4 Pipeline and Umbilical

Installation of pipeline and umbilical requires survey of the seabed to confirm the appropriate parameters for the installation.

2.4.1 Pipeline requirements

A 12″ production pipeline 23 km in length will be required to transport produced fluids from the Platypus manifold to the CW platform. As described in Section 2.1.4, the pipeline will be constructed from carbon steel.

2.4.2 Umbilical requirements

A single umbilical of approximately 24 km length and 150 mm outside diameter will be required to connect the Platypus infrastructure and the CW platform. The umbilical will be used to deliver the chemical, electrical, control and communications services from Cleeton to the Platypus field for the subsea wells and manifold structure. The umbilical will be slightly longer than the pipeline because, unlike the pipeline, it will not terminate at a spool piece on the seabed at Cleeton, but will be routed up a riser and connected directly on the Cleeton topsides. In addition, the umbilical cannot be cut or added to once it is manufactured, so it must incorporate some extra length as contingency.

2.4.3 Seabed preparation

Geophysical surveys have been carried out along the pipeline and umbilical routes to identify seabed features such as sand waves and / or mega ripples. If the seabed is uneven due to such features, then seabed rectification via dredging or mass flow excavation may be required prior to pipelay activities.

A pre-lay survey will also be carried out prior to pipeline and umbilical installation to determine whether the seabed profile remains suitable for pipelay or if any new obstructions to the route have appeared since the original route survey. Any unacceptable features or obstructions, such as boulders, found prior to pipelay will require rectification or removal from the final selected route corridor.

2.4.4 Pipeline and umbilical installation

It is proposed that the pipeline and umbilical will be laid in a single trench. The pipeline may be laid by S-lay or reel-lay methods. S-lay and reel-lay installations would involve use of dynamically positioned (DP) vessels. Figure 2.3 shows an S-lay operation and Figure 2.4 shows a reel-lay operation, the latter being the more likely installation technique. Pipelay between Platypus and Cleeton could be in either direction depending on access considerations.

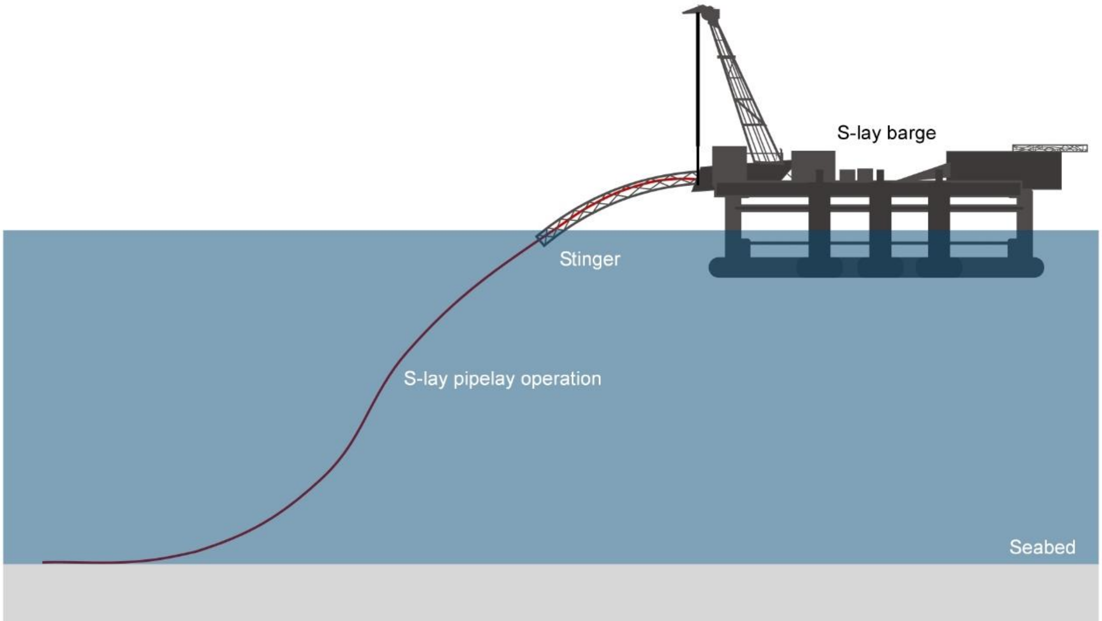

Figure 2.3: Typical S-lay pipelay operation

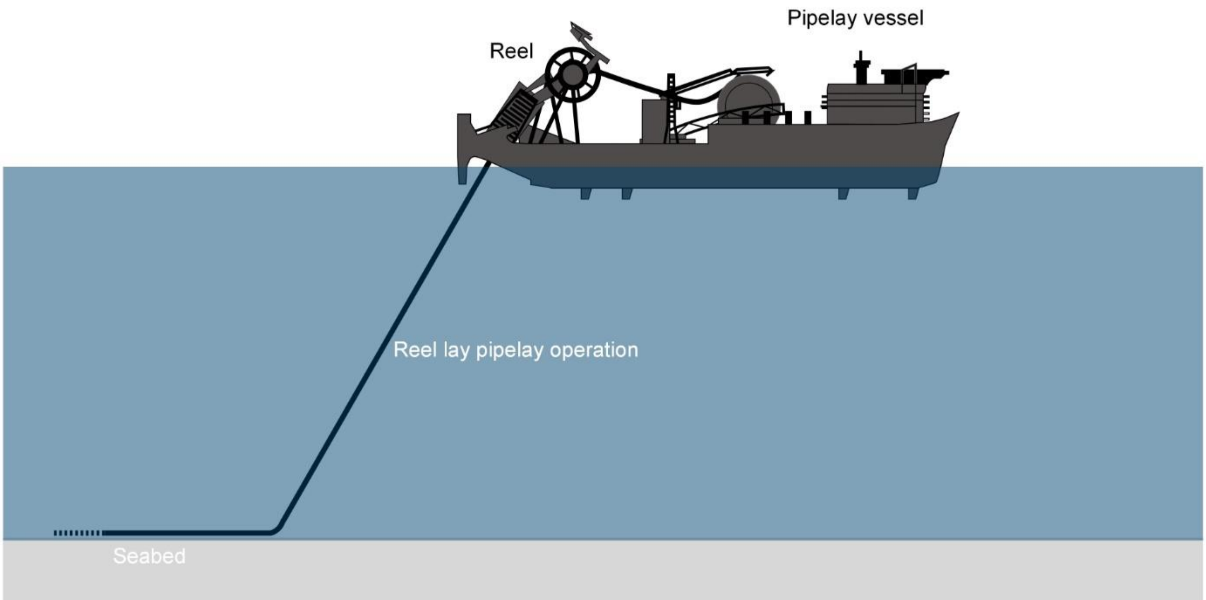

Figure 2.4: Typical reel-lay pipelay operation

After the pipeline is laid on the seabed it will be trenched using a pipeline plough, which will be towed along the route, picking up the pipeline in a cradle while ploughing out a trench underneath, then allowing the pipeline to fall back into the open trench. Following this process, the umbilical will be laid directly into the open trench using a specialised umbilical laying vessel. Finally the trench will be backfilled. Backfilling protects the pipeline and umbilical from other seabed users and will help to prevent upheaval buckling (see Section 2.4.5) and pipeline movement due to external hydrodynamic forces. The target trench depth and cover requirements will be determined during define stage engineering.

2.4.5 Pipeline protection and upheaval buckling mitigation

As noted above, the pipeline will be backfilled (buried) for protection and to mitigate against upheaval buckling. A minimum depth of cover of 0.6 m is specified to provide sufficient protection for fishing gear interaction.

Upheaval buckling may occur in a pipeline where thermal expansion forces cause the pipeline to move as shown in Figure 2.5. Burial, when of sufficient depth, provides download to prevent upwards movement of the pipeline by resisting the expansion forces.

The potential for upheaval bucking is related to the temperature and pressure in the pipeline and the as-trenched shape of the pipeline where deviations in height away from a perfectly straight pipe are susceptible to upheaval buckling. The pipeline burial depth is designed to be sufficient to prevent upheaval buckling for the majority of deviations in height. For larger imperfections, the backfill cover height provided by the backfilled sediment may not, on its own, be sufficient to resist upheaval buckling and at these locations additional placement of rock may be required. In addition, further rock placement may be required at locations where backfill cover is sufficient to mitigate upheaval buckling but insufficient to ensure adequate protection, i.e., less than 0.6 m of cover. Placement of rock is considered the most appropriate mitigation measure for prevention of upheaval buckling or providing additional cover where the backfill depth on its own is insufficient. Whilst trenching to a greater depth could reduce the requirement for rock, there are practical limitations on achievable depth, and experience from the wider area within which Platypus is located suggests that burial to a greater depth is not likely to be guaranteed, and rock placement would likely still be required.

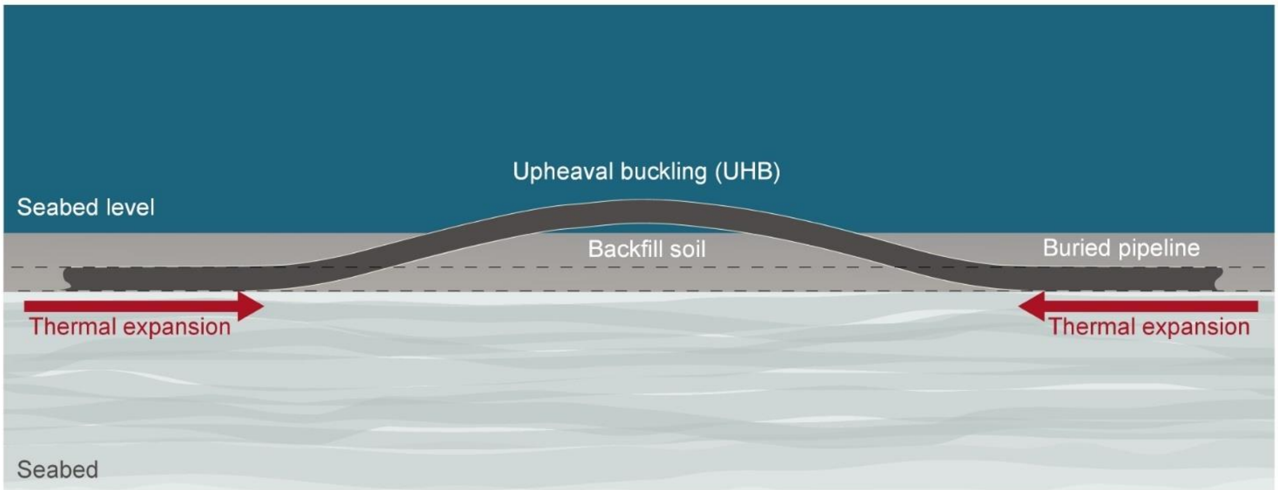

Figure 2.5: Pipeline upheaval buckling

The requirement and volume of rock placement is dependent upon the number of points along the pipeline where backfill alone cannot mitigate upheaval buckling or does not provide sufficient cover for protection purposes. This can only finally be determined following pipeline installation. Empirical upheaval buckling study work is planned during define stage engineering. This work will estimate indicative rock requirements for upheaval buckling prevention of the Platypus pipeline system based on the expected soil conditions along the pipeline route.

Where the pipeline and umbilical exit the trench within the CW platform 500 m safety zone, a combination of rock placement and concrete protection mattresses (Figure 2.6) will be required to protect the on-seabed sections between the trenched pipeline and the riser tie-in at the CW platform. It has been estimated that 45 mattresses (each approximately 6 m x 3 m) will be required in total for the un-trenched sections of pipeline, umbilical and subsea tie-in spools at Cleeton. In addition, it is anticipated that up to 70 mattresses (each approximately 6 m x 3 m) will be required at the Platypus drill centre to provide protection for un-trenched sections of the pipeline and umbilical, manifold to pipeline tie-in spools, well tie-in spools and associated tree tie-in control jumpers.

Figure 2.6: Example of a typical concrete mattress used in offshore developments (3 m x 6 m x 0.5 m)

Indicative worst-case potential rock placement volumes (tonnage) for upheaval buckling mitigation and pipeline / umbilical protection has been estimated based on similar analogous projects with similar soil types to those expected along the Platypus pipeline route. It is estimated as a worst case that up to 22,000 Te of rock placement could be required over the full length of the Platypus pipeline. The locations where rock placement may be required for mitigation of upheaval buckling or provision of additional protection are as yet unknown and potentially could be at any point along the route.

2.4.6 Spool protection and pipeline crossings

The ends of the Platypus pipeline will be connected to the Platypus manifold and the Cleeton riser using tie-in spools which will be laid on the surface of the seabed. Spools will not be required for the umbilical, which will tie in directly to the Platypus manifold and the Cleeton platform topsides, which it will be routed to via a J Tube.

There are no pipeline crossings along the main pipeline route between Platypus and Cleeton. There are, however, existing pipelines and cables within the vicinity of the CW platform that will need to be crossed. Two pipeline crossings and a power cable crossing occur between 250 m and 350 m of the CW platform and are located where the pipeline exits the trench. An additional pipeline crossing is required within 75 m of the CW platform, and will be crossed by the Cleeton tie-in spool and the umbilical.

At each crossing a minimum separation of 300 mm between the Platypus pipeline / umbilical and crossed infrastructure will be required. It is proposed that separation will be achieved using concrete mattresses suitably positioned over the existing infrastructure prior to the Platypus pipelay operation. Once the Platypus pipeline / umbilical have been laid across the mattresses, the crossings will be protected with rock armour to a minimum cover height of 0.6 m above the top of the pipeline / umbilical. The crossing adjacent to the CW platform will be protected using concrete mattresses rather than rock dump.

The flanks of all rock berms will be profiled to a 1:3 gradient or shallower, ensuring that the rock placement does not pose a risk to fishing gear.

It is expected that up to 13,500 Te of rock dump and 110 concrete mattresses will be required for infield pipeline and spool protection and crossings.

2.4.7 Cleeton cuttings disturbance

Pipeline installation activities within the Cleeton 500 m zone will result in the disturbance of an historical drill cuttings accumulation at the base of the platform. Discharge calculations and subsea inspections have concluded that the cuttings are well dispersed with a maximum thickness of 100 mm. Resuspension of historic cuttings is discussed in Section 5.3.6.1.1.

2.4.8 Pipeline pre-commissioning

In advance of the pipeline being readied to carry the produced fluids, a series of pre-commissioning activities will be undertaken. Some of these will be undertaken onshore (such as filling of manifold and well tie-in spools with monoethylene glycol (MEG) based gel with the following required once in the field:

- Flooding, cleaning and gauging of the new Platypus to Cleeton pipeline;
- Hydrostatic strength testing of the new Platypus to Cleeton pipeline;
- Tie-in of pipeline to the manifold and riser and tie-in of the manifold to the wells;
- Hydrostatic leak testing of the completed pipeline system end to end; and
- De-watering the Platypus pipeline system of up to 1,600 m^3 of water via the CW platform using a pig train comprising liquid/gel MEG slugs between pigs driven by nitrogen from a dive support vessel (DSV) at the Platypus manifold. The pipeline may then be further pressurised with nitrogen if required to facilitate start-up operations.

Estimates of the chemical use and discharge for pipeline pre-commissioning are shown in Table 2-3.

Table 2-3: Chemical use and discharge for pre-commissioning of the Platypus to Cleeton pipeline

Activity	Chemical use	Chemical discharge to sea
Flood, clean, gauge and hydrotest the new pipeline.	• Hydrotest inhibitor • Tracer dye • MEG based gel	Discharged to sea at the CW platform during initial or subsequent operations.
Install spools and tie-in structures.	• MEG-based gel • Dye sticks	Discharged to sea at the seabed at Platypus.
Barrier test Platypus tie-in structures and wells and leak test complete pipeline system.	• MEG / water • Tracer dye	Discharged to sea at the seabed at Platypus.
De-water complete pipeline system.	• Hydrotest inhibitor • Tracer dye • MEG / water	Discharged to sea at the CW platform.

2.4.9 Umbilical pre-commissioning

In advance of the umbilical being readied to carry the necessary fluids, a series of pre-commissioning activities will be undertaken. Estimates of the types of chemicals that will be used and discharged are shown in Table 2-4.

Table 2-4: Chemical use and discharge for pre-commissioning of the Platypus to Cleeton umbilical

Activity	Chemical use	Chemical discharge to sea
Installation and post-installation testing.	• Water based hydraulic control fluid • MEG / water	The hydraulic control fluid remains in the umbilical cores during operation of the field, with small intermittent discharges occurring during opening and closing of the hydraulic valves (i.e., this is an open loop system). Most of the MEG / water will be moved into the export pipeline during chemical (methanol) core displacement (see below) and onto the Cleeton process system for discharge during production. The remaining MEG / water will stay in the umbilical spare chemical cores for the life of field unless the spare umbilical cores are used.
Chemical core displacement.	• Methanol	Chemicals will remain in the umbilical cores until operation commences, at which point they will be used to treat the produced fluids and enter the Cleeton process system for discharge over field life.

2.4.10 Operation and maintenance

During its operational lifetime, the pipeline will be subject to a number of inspections to examine its integrity. External inspection would typically be done using a combination of ROV or autonomous underwater vehicle and towed sonar. The frequency of such maintenance will be determined by ongoing risk assessment. It is currently expected that inspections will primarily consist of:

- Vessel-based side scan sonar (SSS) to investigate upheaval buckling or other significant pipeline movement associated with interaction from other users of the sea; and
- Ship-based ROV to investigate specific areas of interest such as local areas of damage, coating condition and cathodic protection integrity.

Whilst, the production pipeline will be designed to enable inspection pigging, it is expected that a suitable integrity management scheme will be sufficiently robust to preclude the requirements for an inspection campaign during the production life of Platypus.

2.5 Cleeton Modifications

Cleeton is a Perenco-operated complex of platforms that are bridge linked. Platypus will be tied back to the CW platform, which is normally unmanned. No processing of Platypus fluids will be carried out at Cleeton. The intent is to minimise brownfield scope. As such tie-in of Platypus well fluids to Cleeton, and through to the SNSPS export pipeline to Dimlington onshore terminal, currently require the following limited modifications:

- Installation of a new production hydrocarbon riser (rated 255 barg) through an existing well slot on the CW platform;
- Installation of riser shutdown valves;
- Installation of temporary pig receiver facilities on the CW platform to allow the Platypus pipeline to be dewatered and pre-commissioned;
- Installation of 12″ production line from the production riser on the CW platform across the existing bridge to the Cleeton production (CP) platform;
- Tie-in of the 12″ Platypus production line to the existing Cleeton 30″ export line on the CP platform, via a shutdown valve and a pressure control valve;

- Installation via a new J Tube and hook-up of electro / hydraulic control and chemical injection umbilical for delivery of methanol and corrosion inhibitor with the potential for additional delivery of scale inhibitor treatments through life, if required;
- Communication and data transfer from the Platypus umbilical though the Cleeton and Dimlington communications network;
- Daily operational services;
- Installation of corrosion inhibitor pump and storage tank package on the CW platform;
- Installation of methanol booster pump;
- Metering/control system updates; and
- Modifications and additions to the existing control systems to service the Platypus subsea tie-back.

To support the CW platform modifications it is expected that a walk to work vessel will be used. This will be on station at Cleeton for between 70 to 90 days. The proposed walk to work vessel will be either a jack-up barge or a floating DP vessel. As such, no anchors will be required, but if the jack-up option is used, spud can stabilisation may be required. Rock dump will be required for rig stabilisation - Section 2.2.3.

2.6 Production

In assessing production options, production profiles along with associated produced water, power generation needs, flaring and venting were examined.

2.6.1 Production profiles

Total gas production from the Platypus wells will reach the highest production rate in the first full year of production (2022) at approximately 2.1 million standard m^3 (Sm^3) per day annual average before steadily declining over field life (Table 2-5, Figure 2.7). Total condensate production from the Platypus wells will also peak in the first full year of production at approximately 28.1 Te/d annual average before steadily declining over field life (Table 2-5, Figure 2.8). Produced water from the Platypus wells is expected to increase over the first 5 years, remaining steady at approximately 14.1 to 14.2 m^3/d for the remaining duration of the field life (Table 2-5, Figure 2.9). Note: the production profiles presented are the highest predictions (called "P10"). The figures shown for 2021 represent the average daily production during the month of December only (i.e., for 31 days of the year).

Table 2-5: Platypus field production figures (P10, annual average)[5]

Year	Gas rate (Sm^3/d)	Condensate rate		Water rate (m^3/d)
		Te/d	m^3/d	
2021	1,543,946	20.3	26.9	0.0
2022	2,132,807	28.1	37.1	1.0
2023	1,559,581	20.5	27.1	2.3
2024	1,279,711	16.8	22.3	6.8
2025	1,027,051	13.5	17.9	10.0
2026	840,576	11.1	14.6	14.1
2027	684,478	9.0	11.9	14.1

[5] A density of 756 kg/m^3 has been assumed for the condensate.

2028	570,641	7.5	9.9	14.1
2029	485,153	6.4	8.4	14.1
2030	413,968	5.4	7.2	14.1
2031	353,480	4.6	6.1	14.2
2032	292,200	3.8	5.1	14.1
2033	247,916	3.3	4.3	14.1
2034	216,990	2.9	3.8	14.1
2035	192,916	2.5	3.4	14.2
2036	173,223	2.3	3.0	14.1
2037	156,656	2.1	2.7	14.1
2038	142,327	1.9	2.5	14.1
2039	129,706	1.7	2.3	14.2
2040	118,560	1.6	2.1	14.1

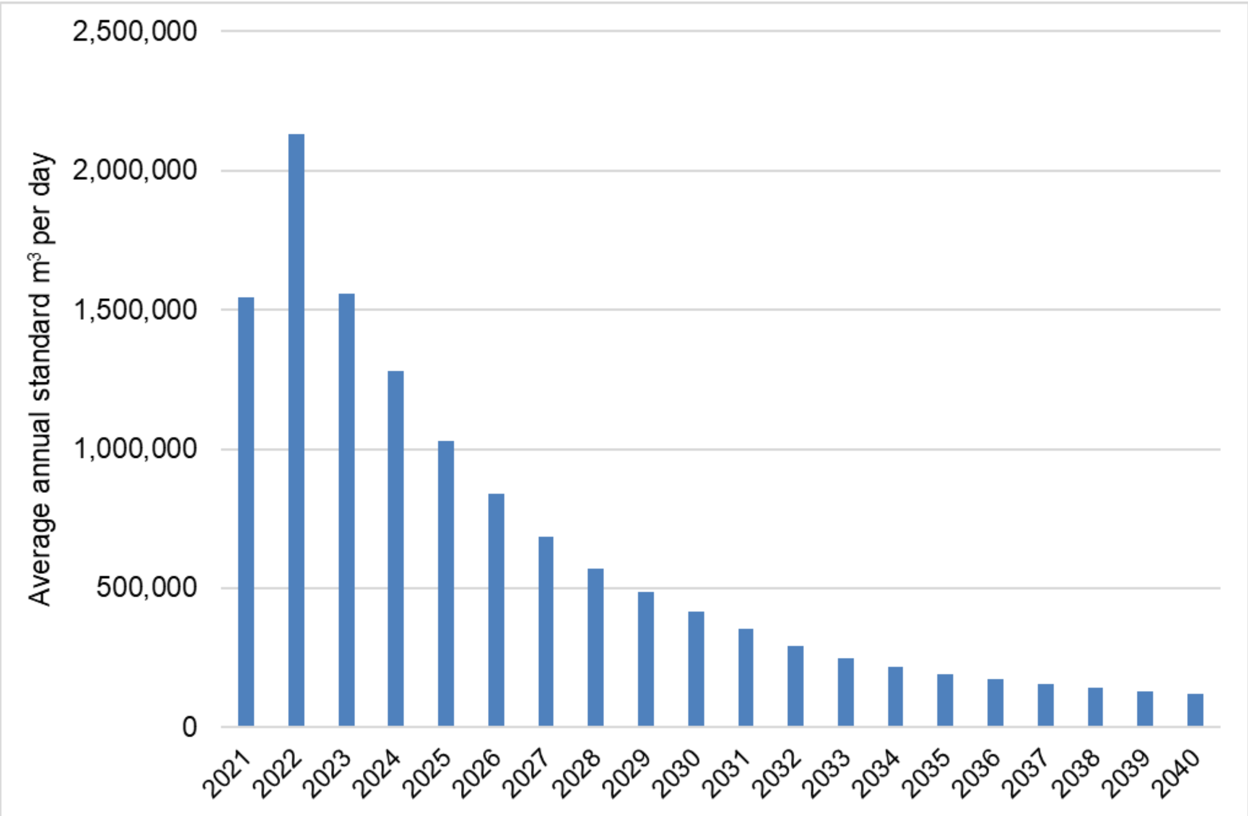

Figure 2.7: Platypus gas P10 production profile

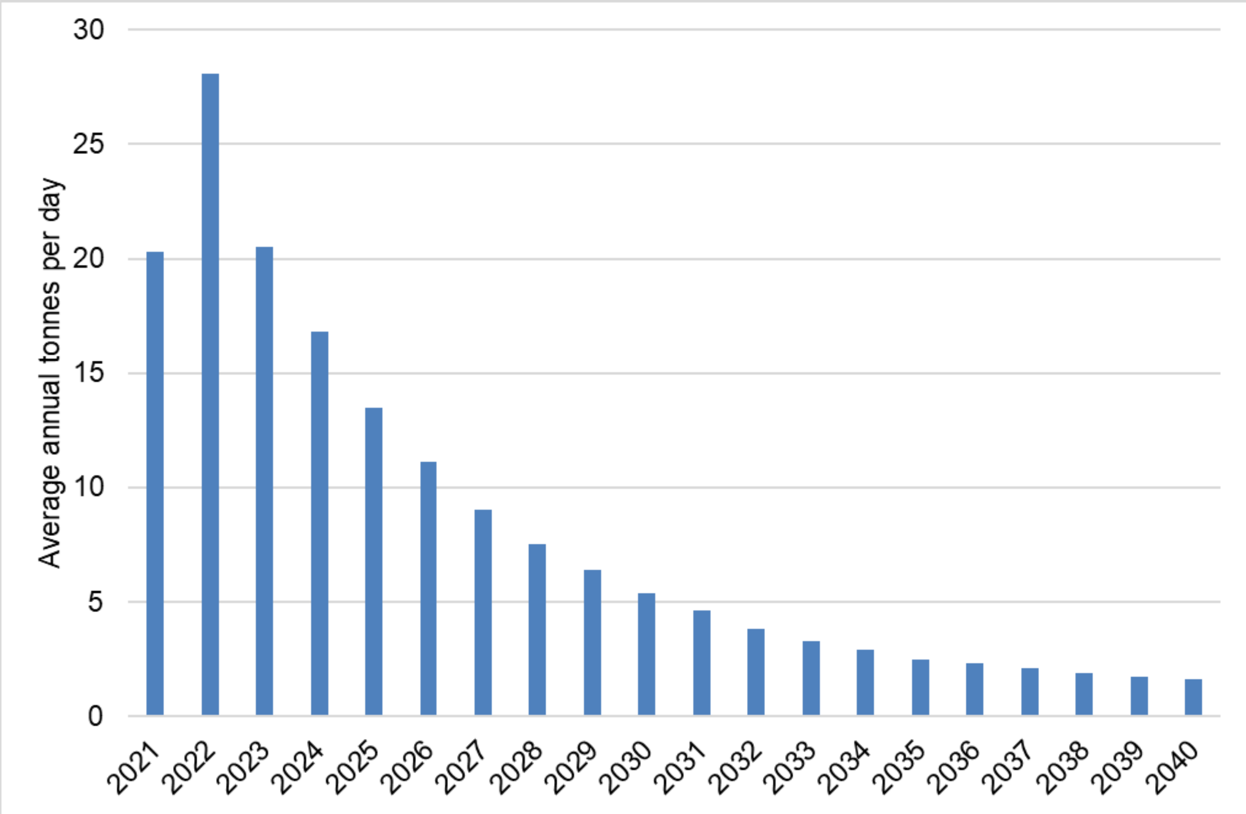

Figure 2.8: Platypus condensate P10 production profile

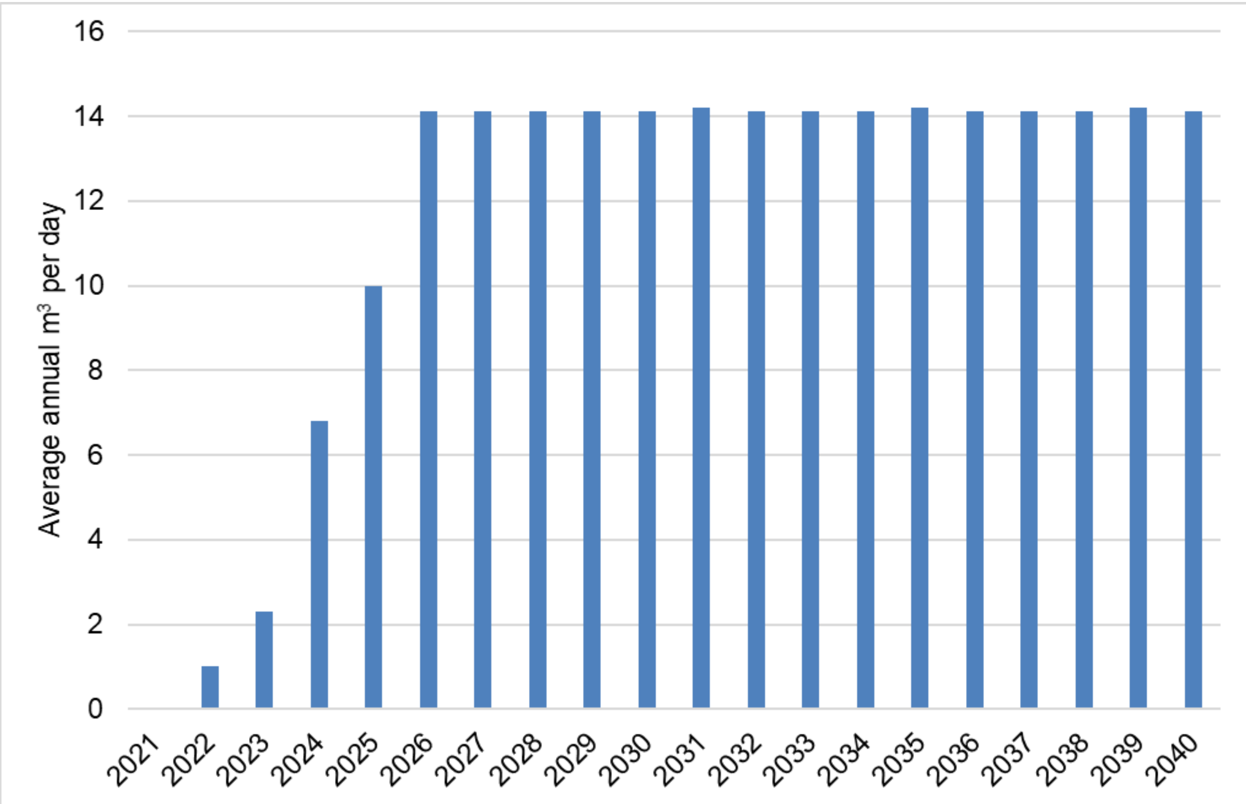

Figure 2.9: Platypus produced water P10 production profile

2.6.2 Produced water

There will be no change to the chemicals currently used at Cleeton as a result of bringing Platypus online as it is planned to use the same methanol and corrosion inhibitor (subject to successful compatibility testing with Platypus fluids). Once the initial pipeline dewatering and pre commissioning have been completed, there will be no offshore discharge of water or production chemicals.

Produced water from Platypus will be transported to the onshore Dimlington terminal via the Cleeton SNSPS export pipeline, where it will be separated from the gas and condensate. The water will be removed from the site to an approved treatment facility using road tankers. The frequency of road tanker traffic movements will not exceed five per seven-day period. This represents the existing maximum tanker rate for the terminal, and is not assessed further in this ES.

2.6.3 Power generation needs, flaring and venting

Electrical power for Platypus will be provided by the existing power generation equipment on Cleeton. Currently, this equipment consists of two Ruston TB5000 gas turbines and two diesel engines for emergency power. Platypus subsea development will require only a minor incremental power demand above that required for Cleeton and consequently there is no requirement for additional power generation facilities.

Cleeton has an existing cold vent, which is used for safe dispersion of gas from the topsides pipework and equipment before maintenance and in an emergency blowdown. The additional pipework volumes for the Platypus field will not change the planned operating philosophy at Cleeton with respect to blowdown or venting. There will be no flaring as a result of the Platypus development.

2.6.4 Flow assurance

Methanol will be injected continuously to inhibit hydrate formation only when the Platypus gas conditions falls within the hydrate formation envelope. These conditions are expected to occur in the first few years of operation. Methanol is returned to Dimlington terminal in the produced fluids.

The Platypus export pipeline will be constructed from carbon steel and corrosion inhibitor will be continuously injected to provide adequate protection of the pipeline over the anticipated design life. The corrosion inhibitor will be provided from Cleeton via the umbilical. It is intended to use the same corrosion inhibitor used at Cleeton, although this will be subject to successful compatibility testing with Platypus fluids.

2.7 Decommissioning

Decommissioning of oil and gas facilities in the UK is regulated under the Petroleum Act 1998, as amended by the Energy Act 1998. The UK's international obligations on decommissioning are governed principally by the Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention). OPRED's "Guidance on the Content of Offshore Oil and Gas Field Development Plans" states "…in accordance with the UK's international obligations, all installations emplaced after 9 February 1999 must be completely removed to shore for reuse, recycling or final disposal on land". OPRED provides specific guidance (DECC, 2011) on decommissioning activities and Dana will adopt the approach outlined in this guidance or any equivalent future guidance that is in place at the time. The current guidance is summarised in Figure 2.10 and shows the process leading to approval of a decommissioning programme.

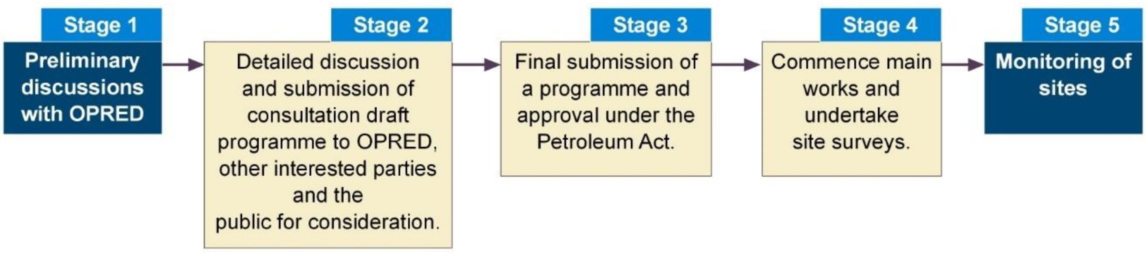

Figure 2.10: Current decommissioning approach

The production wells will be plugged and abandoned at the end of field life in accordance with legislation and guidelines applicable at the time, and with the conductor casing cut below the seabed.

Dana will recover the manifold spools and any supporting structures (e.g., mattresses) at the end of field life.

The OSPAR provisions do not apply to pipelines, however, OPRED guidance (DECC, 2011) sets out UK policy on pipeline decommissioning.

The decommissioning strategy for the pipeline will depend on a number of factors including, the availability of suitable technology and the potential environmental, safety and cost implications of decommissioning methods at the end of field life. The ultimate intention is to leave the seabed of the development area in such a condition that it will pose no risk to the marine environment or to other sea users.

Dana will use recognised industry standard environmental practice during all decommissioning operations in line with the legislation and guidance in place at the time of decommissioning. Discussions on what may be required will be held with the Regulator as early as possible before decommissioning commences.

Prior to the decommissioning process, re-use and recycling alternatives will be considered where feasible to reduce the potential for materials having to go to landfill. In advance of the decommissioning process an inventory of Project equipment will be made and the potential for further reuse will be investigated. As an integral component of the decommissioning process, Dana will undertake a study to comparatively assess the technical, financial, health, safety and environmental aspects of decommissioning options, for which a further EIA may be required at that time.

2.8 Seabed deposits summary

The expected tonnage of rock placement and quantity of concrete mattresses required for subsea operations and rig stabilisation is summarised in Table 2-6.

Table 2-6: Tonnage of rock placement and number of mattresses required for pipeline installation

Location	Deposits required	
	Rock placement (Te)	Number of Mattresses
Spud can stabilisation for Platypus drill rig.	2,500	-
Spud can stabilisation for Platypus accommodation vessel at Cleeton.	1,200	-
Infield pipeline and spool protection including third party pipeline crossings.	13,500	110
Upheaval buckling prevention.	22,000	-
Totals	**37,900**	**110**

2.9 Vessel Requirement

The vessel types expected to be involved in the installation, commissioning and operation of the Platypus field are listed in Table 2-7. The durations given do not include mobilisation, demobilisation or transit times, and also do not include allowance for weather, tide and current delays. Helicopters will also be required for transportation of personnel during installation and commissioning.

Table 2-7: Estimated vessel types and number of days required for the Platypus field development

Operation	Vessel type	Number of days		
		2021	2022	2023 onwards
Drilling				
Drilling	Drill rig	165	55	-
Emergency response and rescue (ERRV)	Safety vessel	165	55	-
Supply vessel	Supply vessel	165	6	-
Pipeline installation				
Pipeline surveys	Survey vessel	7	-	-
Pre-sweep dredging	Trailing Suction Hopper Dredger (or equivalent)	16	-	-
Pipelay	Pipelay vessel	4	-	-
Umbilical lay	Umbilical lay vessel	5	-	-
Trenching and backfilling	Trenching support vessel	14	-	-
Rock placement	Rock placement vessel	8	-	-
Guard vessel	Fishing guard boat	40	-	-
Platypus installation				
Subsea facilities installation and tie-in	DSV or multi-purpose support vessel	29	15	-
Cleeton topsides modifications				
Additional accommodation during modifications – Option 1	Walk to work vessel	90	-	-
Additional accommodation during modifications – Option 2	Walk to work vessel	60	-	-
	Jack-up rig	20	-	-
Operation				
Inspection and maintenance of subsea structures	Survey vessel	-	-	5 surveys taking 4 days each (total 25 days) over the life of Platypus

3 Environment Description

This section provides information on the receiving environment so that physical, biological and socio economic sensitivities are identified and assessed, and appropriate mitigation measures can be developed and proposed.

3.1 Introduction

It is important in any EIA process that the main physical, biological and socio economic sensitivities of the receiving environment are well understood. As such, this section describes the main characteristics and key sensitivities of the environment in and around the Platypus field, the proposed pipeline route and the CW platform location.

This description draws on a number of data sources including site surveys (listed and described in Section 3.2.2), published articles and regional baseline assessments (e.g., the Offshore Energy Strategic Environmental Assessment (OESEA)3 programme).

This environmental description covers the Platypus Development area, including:

- The Platypus field in Block 48/1; and
- The Platypus to Cleeton pipeline, which crosses Blocks 48/1, 47/5, 42/30 and 42/29.

3.2 Physical Environment

The physical environment includes the sea and sea bed and how it is affected by weather and sea conditions.

3.2.1 Weather and sea conditions

The SNS is a dynamic water body, characterised by shallow, well-mixed waters which undergo large seasonal temperature variations.

Meteorological Office wind data for the northern, central and SNS (for 1854 to 1994) show that winds emanate from all directions, but those in the S and SSW directions are dominant. Predominant wind speeds throughout the year represent moderate to strong breezes (6 to 13 m/s), with the highest frequency of gales (>17.5m/s) during winter months (November to March). The major contrast between the northern North Sea (NNS) and the SNS where the Platypus field is located is the relative frequency of strong winds and gales. Percentage frequency of winds of Beaufort force 7 and above in January is approximately >10% less to the south of 55ºN (DTI, 2001). Wind strengths in winter are typically in the range of 6 to 11 ms^{-1} with higher winds (17 to 32 ms^{-1}) being much less frequent (DECC, 2016).

Currents in the North Sea circulate in an anti-clockwise direction, driven by inflows from the Atlantic via the NNS down the UK east coast and from the English Channel, and outflows northwards along the Norwegian coast (Figure 3.1). Against this background of tidal flow, the direction of residual water movement in the SNS is generally to the east (DTI, 2001; DECC, 2016).

There are significant local variations in patterns of semi-diurnal tidal and residual circulation which occur near sandbanks, and the shallow parts of the SNS remain well mixed throughout the year due to tidal action (DTI, 2001; DECC, 2016). The SNS receives significant freshwater input from the rivers along its eastern boundary which, together with input from rivers along the UK coast, makes it less saline than other parts of the North Sea (DECC, 2016).

In general, maximum velocities in the SNS are below 1.0 m/s in the nearshore region, except near major headlands (Flamborough Head, Spurn Point and South Foreland) where peak velocities may reach 2.0 m/s. Peak mean residual currents in the offshore SNS area are approximately 0.2 m/s (Wolf *et al.,* 2016).

Wave heights in UKCS Block 48/1, where the Platypus Development is situated, range from 1.51 to 1.80 m over the course of the year (National Marine Plan interactive (NMPi), 2019; OGA, 2018). Wave energy at the seabed is considered to be moderate (0.21 to 1.2 N/m^2) in the Platypus Development area (McBreen *et al.*, 2011). The annual wave power in the SNS ranges from 12.1 to 18.0 kW/m offshore, reducing to 0.1 to 6.0 kW/m nearshore, with a mean annual wave power of approximately 9.93 kW/m in OGA Block 48/1 (NMPi, 2019).

The annual mean near-seabed temperature across the Development area is moderate for the UKCS and ranges between 9.5 and 9.8 degrees Celsius (ºC), with a mean of approximately 9.8ºC in UKCS Block 48/1 (NMPi, 2019). Temperatures are lowest in February (mean 5.9ºC) and highest in August (mean 14.4ºC). The annual mean sea surface temperature (SST) is slightly higher for the Development area, ranging between 9.8 and 10.1ºC, with a mean of approximately 10.1ºC in OGA Block 48/1. Temperatures are lowest in February (mean 5.7ºC) and highest in August (mean 15.4ºC) (NMPi, 2019).

3.2.2 Bathymetry and seabed conditions

The SNS is shallow (generally <50 m) with a predominantly sandy seabed (DECC, 2016). The seabed is primarily composed of sand and muddy sand with significant areas of coarse sediment, particularly in the nearshore environment (McBreen *et al.*, 2011).

The UKSeaMap online resource provides a broad-scale habitat classification of the seabed in UK waters which uses the European Union Nature Information System (EUNIS) classification system (JNCC, 2018). The seabed type within the Platypus Development area is classified under the habitat complex “deep circalittoral sand”, EUNIS habitat code A5.27 (Figure 3.2).

Figure 3.3 depicts the main seabed features surrounding the Development area. To the north and to the south-east are extensive sandbank features. These large scale features are generally present at depths less than 25 m, and are protected under Annex I the European Union (EU) Habitats Directive (92/43/EEC); see Section 3.4 for information on these designated areas. The closest sandbank feature to the Platypus Development is located 27.1 km to the south-east (Figure 3.3). There are records of potential bedrock reef more than 10 km to the southwest and northwest of the CW platform, and one record of potential cobble (stony reef) more than 5 km to the southwest (Figure 3.3). From these data, the type of Annex I habitat most likely to be found around the Platypus development appears to be stony reef, formed from concentrations of cobbles or small boulders.

The benthic environment around the Platypus Development has been investigated in the following surveys:

- A geophysical and environmental survey at the proposed Platypus installation and the proposed pipeline route (Fugro, 2019a and 2019b);
- An Environmental Baseline Survey (EBS) centred around a previously proposed SL5 well location in UKCS Block 48/1a (Gardline, 2011a, 2011b); and
- An environment survey centred around a proposed rig location in Block 48/1 (Gardline, 2009).

The locations of the sampling stations from the above surveys are shown in Figure 3.4.

Dana conducted a shallow geophysical, high resolution multichannel seismic and environmental survey incorporating ground truth sampling of the seabed using video and stills photography and sediment sampling by grab around the proposed Platypus installation and along the pipeline route (Fugro, 2019a and 2019b). The outputs from this work included:

- A assessment of the habitats present including any features of conservation importance, based on mapping of seabed types derived from the widescale acoustic data gathering combined with the photographic evidence of seabed type and visible signs of animals (e.g., tubes / burrows) (Fugro, 2019a);
- Analysis of sediment particle size, sediment hydrocarbon and metals content, and of the infaunal community (invertebrates) living within the sediments; (Fugro, 2019b); and
- An assessment of the potential for the benthic environment to support herring spawning, based on sediment mapping, photography and sediment particle size analysis (Fugro, 2019a).

Dana also conducted a rig-site survey at the Platypus location in 2011 (Gardline, 2011a and 2011b) using similar equipment and methods to those used in 2019. This included a habitat assessment covering an area of 1 km by 1.25 km, assessing the presence of potentially sensitive Annex I habitats such as biogenic reefs, OSPAR (2008) threatened and / or declining species or habitats, and those listed as priority species and habitats in the UK Biodiversity Action Plan (Maddock, 2008).

In addition, Dana conducted a rig-site survey at Platypus in in 2009 (Gardline, 2009). The survey covered an area of 2 km by 2 km, and included a habitat assessment based on interpretation of acoustic data and ground-truthed using seabed images and sediment grab samples.

The description of the physicochemical and biological nature of the seabed in the sections below is based primarily on the results reported by Fugro (2019b), supplemented where appropriate by information from the other surveys conducted at the Platypus area.

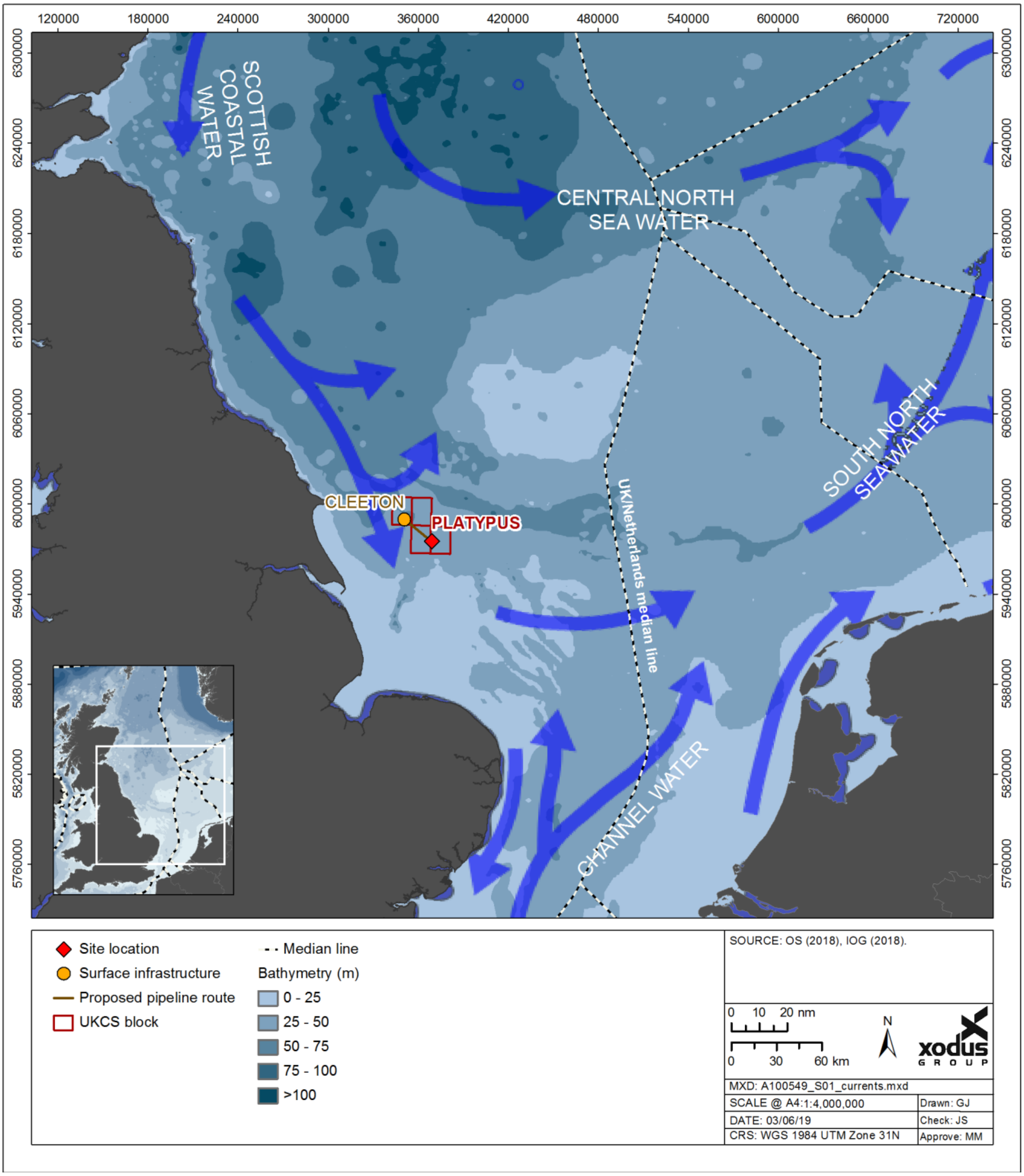

Figure 3.1: North Sea currents

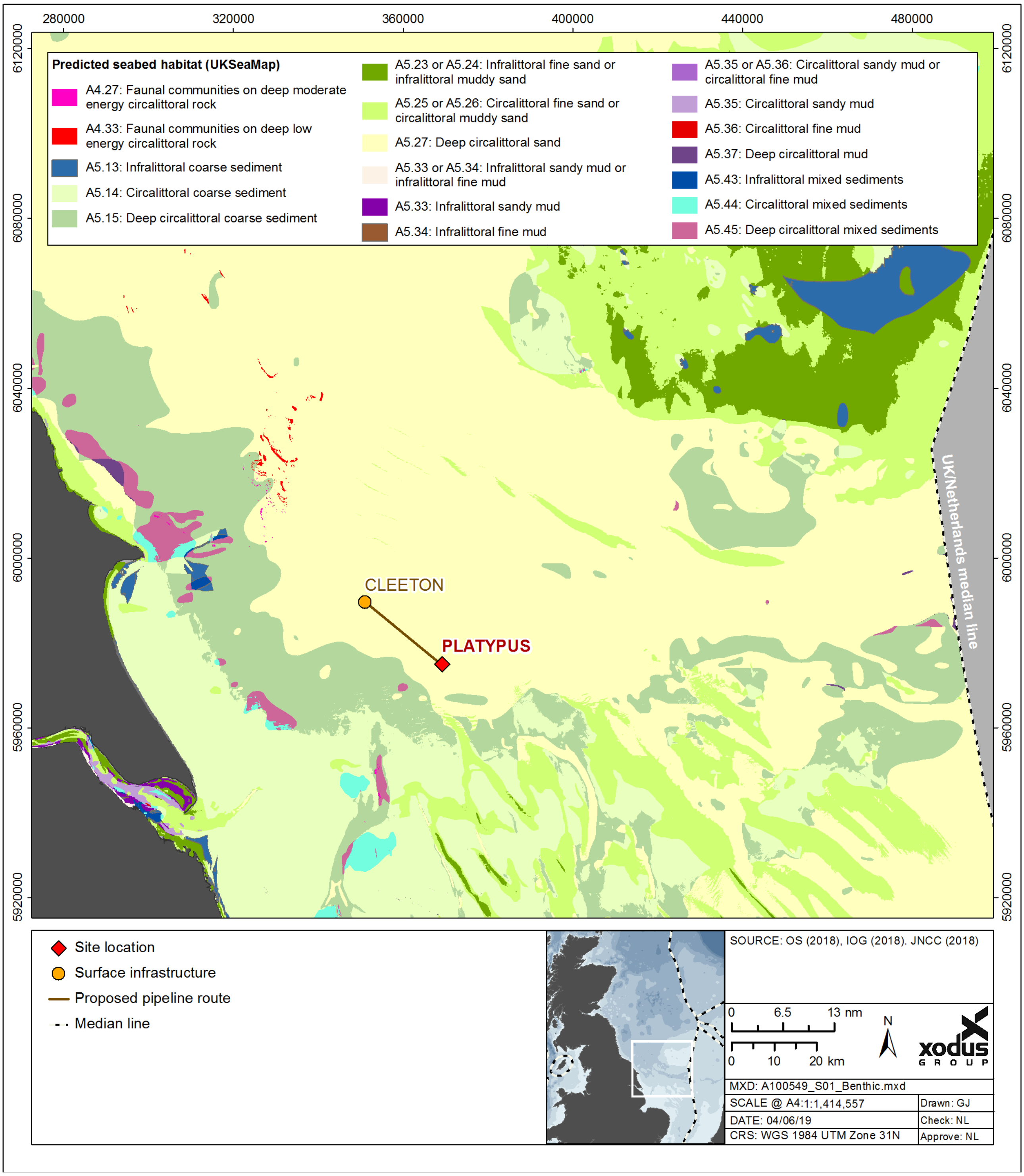

Figure 3.2: Broad-scale seabed habitat classification around the Platypus Development (JNCC, 2018)

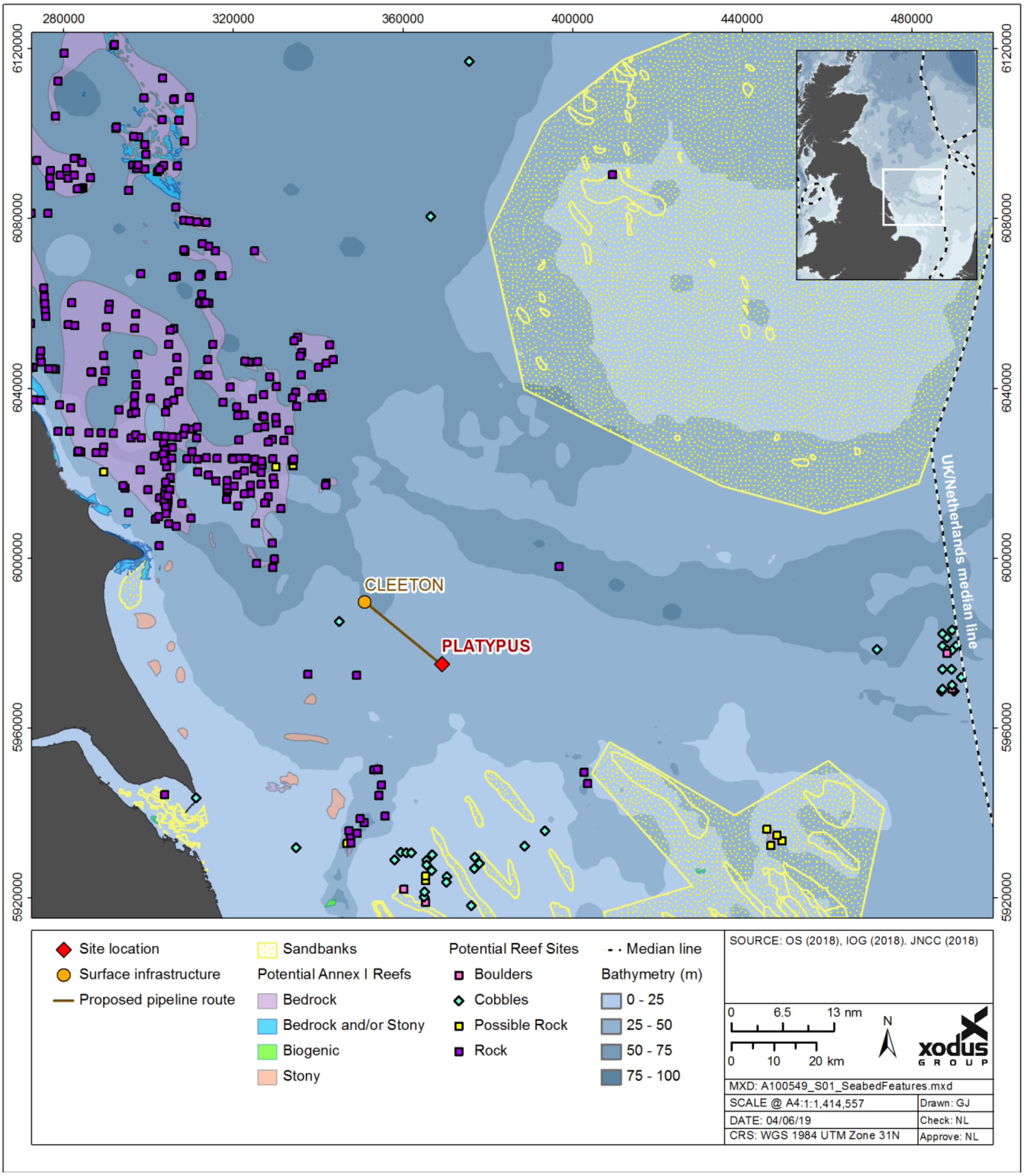

Figure 3.3: Annex I seabed features in the SNS around the Platypus Development

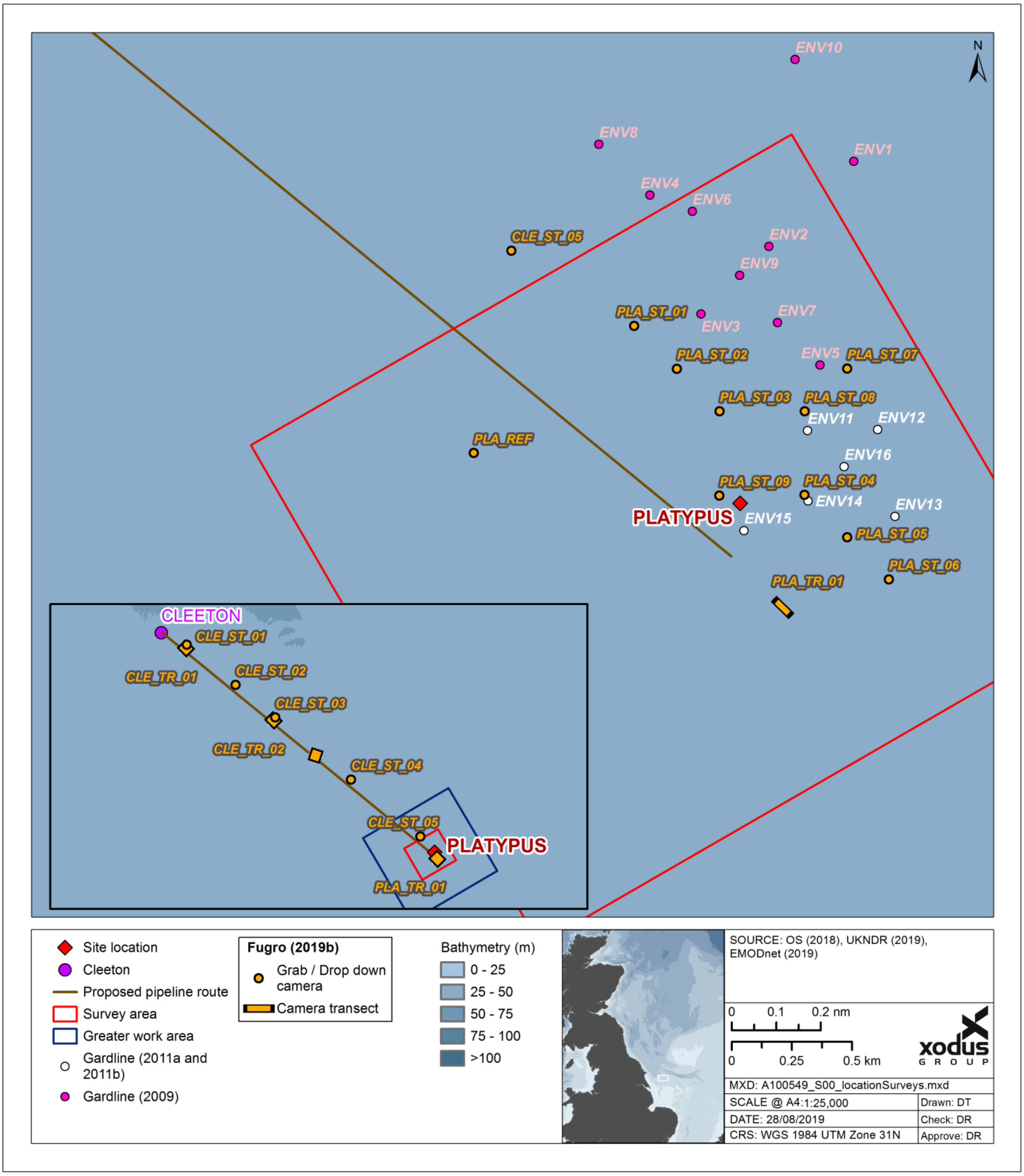

Figure 3.4: Location of sampling stations from all survey work around the proposed Platypus Development (Fugro, 2019b and Gardline, 2009; 2011a; 2011b)

3.2.2.1 Platypus field

Water depth across the Platypus field ranges between 39 and 43 m below lowest astronomical tide (LAT) (Figure 3.5), and the main sediment type observed over the whole area was rippled sand with shell fragments. Sediments were classified as “moderately” or “moderately well” sorted fine sand with a fines (mud, or silt/clay) content of 0 – 6.94% (Fugro, 2019b). This corresponds closely with the data from the earlier surveys in this area

(Gardline, 2009; 2011a, b). The EUNIS habitat classification for the Platypus site in Fugro (2019a) was A5.25 “circalittoral fine sand”, which appears to be more representative of the site that the broad scale habitat A5.27, “deep circalittoral sand” which is applied to this region in UKSeaMap 2018 (JNCC, 2018; Figure 3.2). The previous version of UKSeaMap (McBreen *et al*., 2011) identified the Platypus site as A5.25 “circalittoral fine sand”, in line with Fugro (2019a). Example seabed sediment photographs representative of the rippled fine sand typical of the Platypus survey area are shown in Figure 3.6.

No features of conservation importance, such as sandbanks, rocky, stony or biogenic reefs under Annex I of the EU Habitats Directive, or habitats/species thought to be threatened and/or declining (OSPAR, 2008) were observed in acoustic datasets or seabed imagery in the Platypus installation survey area (Fugro, 2019a). The seabed sediments correspond with the UK Biodiversity Action Plan priority habitat ‘subtidal sands and gravels’. This habitat is expected to be of low conservation significance in the development area as it is widely distributed in UK waters, and examples of this habitat type are protected through the Marine Protected Area network.

Total hydrocarbon concentration (THC) in sediment samples across the Platypus development area were low, ranging between 2.6 µg/g and 4.7 µg/g (Fugro, 2019). These are at or below the background level of 4.34 µg/g reported by UKOOA (2001) for this part of the SNS, and show no gradients or evidence of point sources of contamination in the area.

At all sample stations, sediment metals concentrations were all below UKOOA (2001) mean background concentrations for the SNS, and below Co-ordinated Environmental Monitoring Programme (CEMP) Effects Range Low (ERL) concentrations (OSPAR, 2014) where these were available. When normalised to 5% aluminium in order to account for differences in sediment particle size, OSPAR (2014) background concentrations (BCs, for “pristine” or “remote” sites) for lead and arsenic were exceeded across all sample stations, including the reference station, and the BC for chromium was exceeded at one station. In addition, OSPAR (2005 and 2009) background assessment concentrations (BACs, values for testing whether the concentrations at a location are at or close to background) for arsenic were exceeded at seven stations, including the reference station.

The similar concentrations across the site, and the fact that lead and chromium concentrations were below UKOOA (2001) background concentrations (there is no background concentration available for arsenic) indicates that the normalised concentrations are in line with background concentrations across the SNS, and do not indicate a point source of contamination. However, both lead and arsenic were above BC across all stations, suggesting a wider area of contamination. Metal input can be assigned to a number of natural, agricultural and industrial processes in the coastal region, reaching sediments in the project area via long-range transportation by air, riverine input or run-off from land (Cefas, 1998) as well as offshore activities such as pollution by ships and oil, gas and mineral exploration and exploitation.

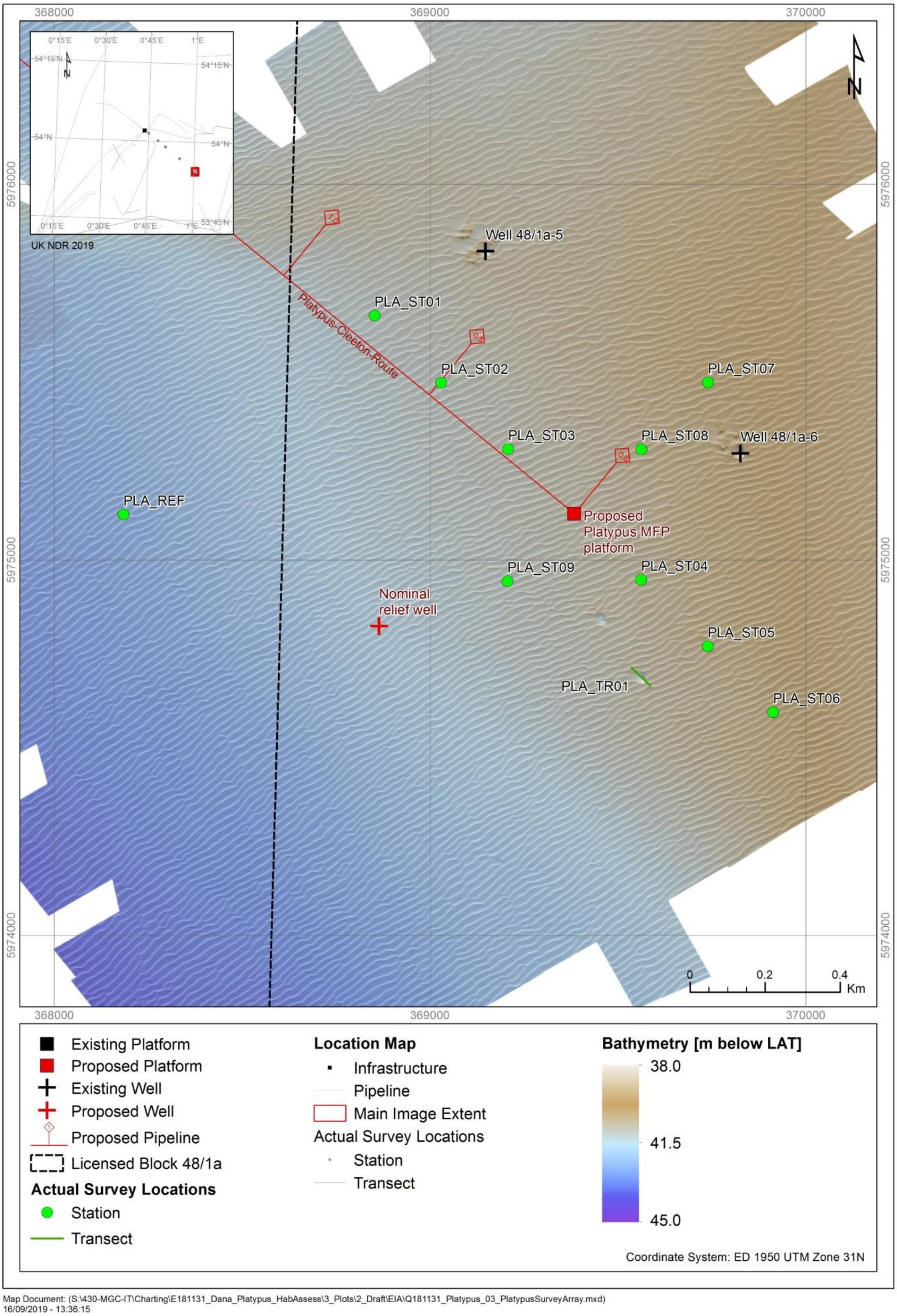

Figure 3.5: Shaded relief bathymetry across the Platypus field (Fugro, 2019b)

	
A. Station PLA_ST_02: Rippled sand with shell fragments, with a flatfish and a brittle star.	B. Station PLA_ST_05: Rippled sand, with brittle star.
	
C. Station PLA_ST_05: Rippled sand with common starfish (*Asterias rubens*) and hydroids.	D. Station PLA_ST_08: Rippled sand with shell fragments.

Figure 3.6: Example seabed images taken in the Platypus field survey area (Fugro, 2019a)

3.2.2.2 Platypus to Cleeton pipeline

Water depth along the pipeline route was approximately 40.7 m below LAT at the Platypus end of the route and 47.4 m below LAT at the Cleeton end, with a maximum depth of approximately 48.4 m below LAT recorded at Station CLE_ST_02 (Figure 3.7). The sediment appeared, from seabed photographs, to be mainly of rippled sand with shell fragments (Figure 3.8). Particle size analysis classified sediments as moderately sorted medium sand at Station CLE_ST_01 and “moderately” to “moderately well” sorted fine sand at all other stations (Fugro, 2019b). Fines (silt and clay) content ranged from 0 to 6.26%. This corresponds closely with the sediment at the Platypus site. The EUNIS habitat classification for the Cleeton route in Fugro (2019a) was A5.25 “circalittoral fine sand”, which appears to be more representative than the A5.27 “deep circalittoral sand” habitat code applied to this region in UKSeaMap 2018 (JNCC, 2018; Figure 3.2). The previous version of UKSeaMap (McBreen *et al*., 2011) identified the Project area as A5.25 “circalittoral fine sand”, in line with Fugro (2019a). Example seabed sediment photographs representative of the rippled fine sand typical of the pipeline route are shown in Figure 3.8.

No features of conservation importance, such as sandbanks with crests at less than 20 m below LAT, rocky, stony or biogenic reefs under Annex I of the EU Habitats Directive, or habitats/species thought to be threatened and / or declining (OSPAR, 2008) were observed in acoustic datasets or seabed imagery in the pipeline route survey area (Fugro, 2019a). The seabed sediments correspond with the UK Biodiversity Action Plan priority habitat ‘subtidal sands and gravels'. This habitat is expected to be of low conservation significance as it is widely distributed in UK waters, and examples of this habitat type are protected through the Marine Protected Area network.

THC ranged from 1.5 µg/g to 3.6 µg/g, below the background level of 4.34 µg/g reported by UKOOA (2001) for this part of the SNS, and show no gradients or evidence of point sources of contamination in the area.

Sediment metal concentrations were mostly below UKOOA (2001) mean background concentrations for the SNS. Mean background concentrations of lead, vanadium and zinc were higher at three of the same stations but 95th percentile concentrations were not exceeded, indicating metal concentrations are within the range of background levels expected for the SNS.

Concentrations at all stations were below CEMP ERL concentrations (OSPAR, 2014) where these were available. When normalised to account for differences in sediment particle size, OSPAR (2014) BCs for lead and arsenic were exceeded across all stations and the BC for zinc was exceeded at one station. In addition, OSPAR (2005 and 2009) BACs for arsenic lead were exceeded at two and three stations respectively.

The similar concentrations along the pipeline route, and the fact that lead and zinc concentrations were generally below UKOOA (2001) background concentrations (there is no background concentration available for arsenic) indicates that metal concentrations are in line with background concentrations across the SNS, and do not indicate a point source of contamination. The slightly elevated concentrations of lead, vanadium and zinc at one station were correlated with a slightly different sediment sediment particle size distribution.

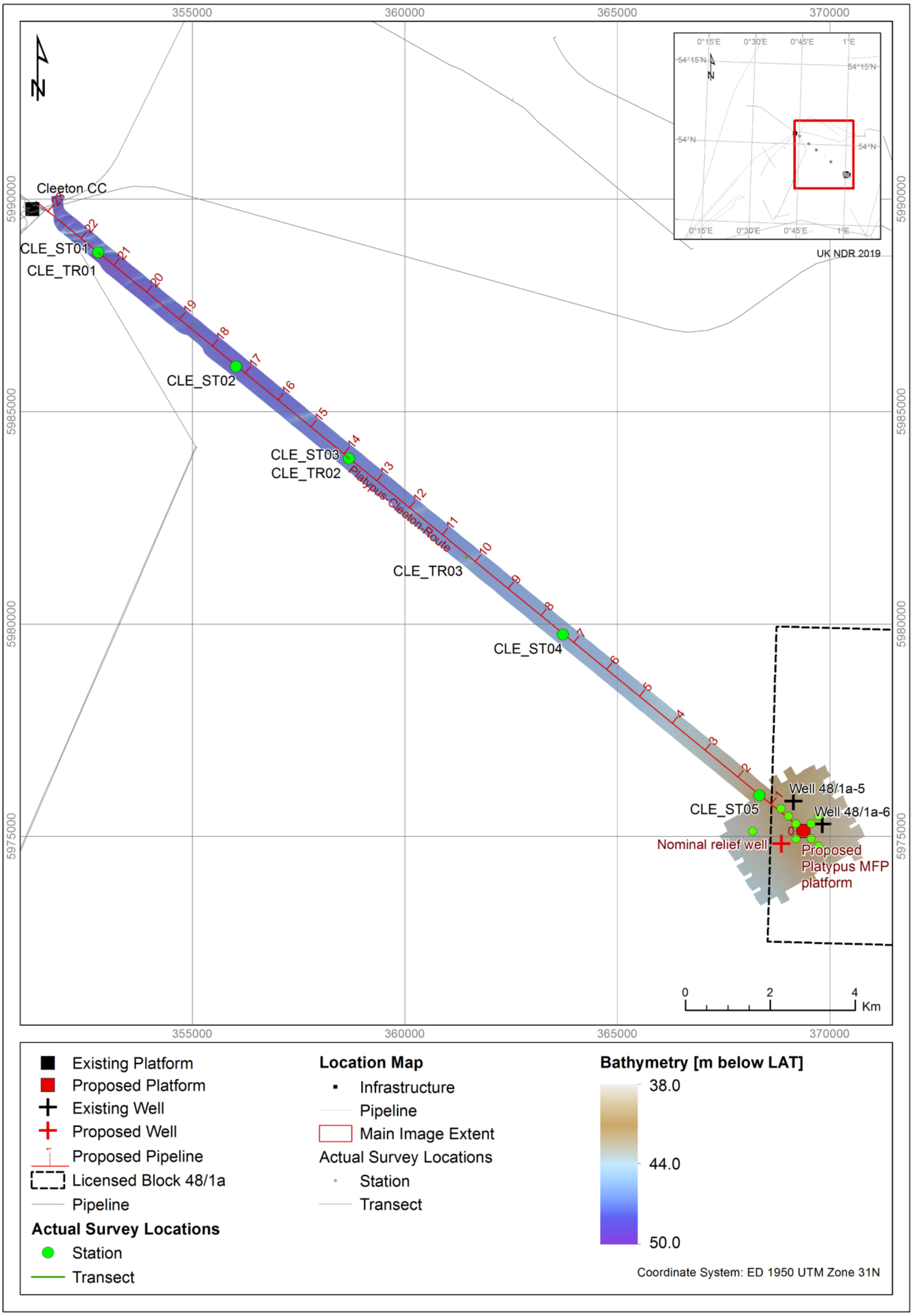

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Figure 3.7: Shaded relief bathymetry for the Platypus to Cleeton pipeline route (Fugro, 2019b)

A. Station CLE_ST_04: Sand ripples with shell fragments and Hydrozoa.

B. Station CLE_ST_02: Sand with shell fragments, flatfish (Pleuronectiformes) and brittle star (Ophiuroidea).

C. Station CLE_ST_04: Rippled sand with shell fragments and hermit crab (Paguridae).

D. Station CLE_TR_03: Rippled sand with shell fragments and starfish (*Asterias rubens*).

Figure 3.8: Example seabed photographs taken on the Platypus to Cleeton route (Fugro, 2019a)

3.3 Biological Environment

The biological environment encompasses the seabed, open water and water surface and includes a full range of species from benthos to cetaceans and seabirds. The habitats and associated species are described below.

3.3.1 Benthos

The biota living near, on or in the seabed is collectively termed benthos. The species present, their diversity and biomass are dependent on several factors including substratum type (e.g., sediment, rock), water depth, salinity, local hydrodynamics and the degree of organic enrichment. The species composition and diversity of the macro-infauna (living within the sediment) is commonly used as a biological indicator of sediment disturbance or contamination.

3.3.1.1 Platypus field

Observed epifauna (living on the sediment) included starfish (*Asterias rubens*), brittlestars (Ophiuridae including *Ophiura albida* and *Ophiura ophiura*), crabs (*Liocarcinus* sp. and *Necora puber*), and faunal turf (Hydrozoa/Bryozoa). Fish on or near the seabed included flatfish (Pleuronectiformes, including dab (*Limanda limanda*)), gobies (Gobiidae), gadoid (cod like) fish (Gadidae) and dragonets (*Callionymus* sp.). Small faunal burrows and possible polychaete worm tubes were also observed across the survey area. Hard substrate, possibly anthropogenic, was observed at one station and supported fauna including anemones (*Metridium dianthus*), crabs (*N. puber*) and pouting (*Trisopterus luscus*). Representative seabed photographs are presented in Figure 3.6 (Fugro, 2019a).

These observations are similar to those from previous habitat assessments of the Platypus field (Gardline, 2009, 2011a and 2011b) in which visible fauna included *O. ophiura;* the burrowing sea urchin *Echinocardium cordatum*; *A. rubens;* hydroids and annelid worms, together with various tracks and burrows. There was no evidence from any of the surveys of the presence of Annex I habitats or species within the survey area, or of the threatened and / or declining species and discrete habitats listed under OSPAR (2008).

The Platypus site macrofauna grab samples from 10 sample stations contained 1,880 individuals spread across 60 taxa. Annelids (worms) contributed the greatest number of taxa (22 taxa comprising 36.7% of the total), but molluscs were the most abundant, contributing 1,080 individuals (57.4% of the total). The most commonly found molluscs were the bivalves *Abra alba* and *Fabulina fabula*. These two species have very similar feeding behaviour and preferred habitat, and are often found associated with each other (WoRMS Editorial Board, 2019). The amphipod *Bathyporeia tenuipes* was also abundant at every station.

Whilst there was some variation, the most abundant taxa were reasonably uniform across the survey area. Those species included the bivalves *A. alba*; *F. fabula*; *Abra prismatica*; the amphipods *B. tenuipes B. guilliamsoniana and B. elegans;* the polychaete worms *Chaetozone christiei*; *Magelona johnstoni; Scoloplos armiger* and the cumacean *Diastylis bradyi* .

Of the top ten most abundant species recorded across the survey area, seven were among the most abundant in previous surveys (Gardline,(2010 & 2012). The macrofaunal species detected represent an undisturbed and broadly stable seabed community typical of such sediment types at this latitude in the North Sea.

3.3.1.2 Platypus to Cleeton

Visible epifauna along the Platypus to Cleeton pipeline route was similar to that at the Platypus site and included starfish (*A. rubens* and *Astropecten irregularis*), brittlestars (Ophiuridae including *Ophiura* sp.), crabs (*Liocarcinus* sp.), cuttlefish (*Sepiola atlantica*), faunal turf (Hydrozoa/Bryozoa) and bryozoans (*Flustra foliacea*). Fish observed on or near the seabed included flatfish (Pleuronectiformes), gobies and gadoids. Faunal tracks were observed across the site (Fugro, 2019a; Figure 3.8).

The macrofaunal community sampled at the five grab stations was generally consistent with that found at the Platypus site. There were 828 individuals identified, spread over 63 taxa. This is approximately half the number of individuals identified at the Platypus site, consistent with five stations being sampled rather than ten, but the number of taxa is very similar.

Annelid worms contributed the greatest number of taxa (27 taxa comprising 42.8% of the total), and molluscs were again the most abundant, contributing 327 individuals (39.5% of the total). The contribution of molluscs to the total abundance was, however, substantially less than at the Platypus site (where it was 57.4%; section 3.3.1.1). The molluscs *F. fabula* and *A. alba* were the most abundant species close to the Platypus site but the abundance of *A. alba* reduced with increasing distance from Platypus.

The top ten most abundant species were the same for the pipeline route as for the Platypus site (Section 3.3.1.1), but were ranked in a slightly different order with fewer *F. fabula* and *A. alba.* The pipeline route faunal community as a whole was slightly more diverse and evenly distributed than at the Platypus site, possibly indicating a less polluted or stressed environment along the pipeline route (Clarke and Warwick, 2001).

Comparison with historic studies allows assessment of the stability of a community assemblages over time. Two studies were conducted in the Cleeton area in 1986 and 1988 (OGUK, 2017). The most abundant taxa in the 1988 Cleeton survey were polychaete worms and hydrozoans, represented respectively by *Spiophanes bombyx* and *Corymorpha nutans* (OGUK, 2017), neither of which appeared in the top ten species in Fugro (2019b). The next most abundant taxa were the amphipod *Bathyporeia* sp. and the mollusc *F. fabula*. It is possible that *Bathyporeia* sp. was one of the three *Bathyporeia* species identified in the top ten taxa in 2019 (Fugro, 2019b). The 1986 survey found that brittle stars (*Ophiura* spp.), *Bathyporeia* sp., *S. bombyx* and the worm *Ophelia limacina* were the most abundant. These results indicate that the infaunal community has stayed relatively stable over time, with differences in the most abundant species likely due to natural, small scale spatial and seasonal variation.

3.3.2 Fish and shellfish

The proposed Platypus Development, including the proposed pipeline route, traverses ICES statistical rectangles 36F0, 36F1 and 37F0. Within these rectangles are spawning and nursery grounds for several commercially important species, including high intensity spawning grounds for plaice (*Pleuronectes platessa*), and high intensity nursery grounds for cod (*Gadus morhua*; MIS, 2018). Information on spawning and nursery periods for these species, including peak spawning times (where applicable), are detailed in the following sub-sections.

Figure 3.9 to Figure 3.11 illustrate areas of potential spawning and nursery grounds in relation to the Platypus Development area. The periods of spawning and nursing occurring in ICES Rectangles 36F0, 36F1 and 37F0 for each relevant species is presented in below in Table 3-1.

Table 3-1: Fisheries sensitivity periods within ICES Rectangles 36F0, 36F1 and 37F0 (Coull *et al.*, 1998; Ellis *et al.*, 2012)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cod	SN	SN	SN	SN	N	N	N	N	N	N	N	N
Plaice	S	S	S	ND	ND	ND	ND	ND	ND	ND	ND	S
Sprat	N	N	N	N	SN	SN	SN	SN	N	N	N	N
Herring	N	N	N	N	N	N	N	SN	SN	SN	N	N
Lemon sole	N	N	N	SN	SN	SN	SN	SN	SN	N	N	N
Sandeel	SN	SN	N	N	N	N	N	N	N	N	SN	SN
Whiting	N	SN	SN	SN	SN	SN	N	N	N	N	N	N
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
Mackerel	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N

S – Spawning | Peak Spawning | N – Nursery | SN – Spawning and Nursery

Species = High spawning intensity as per Ellis *et al*, 2012.

Species = High nursery density as per Ellis *et al*, 2012.

ND = No data available

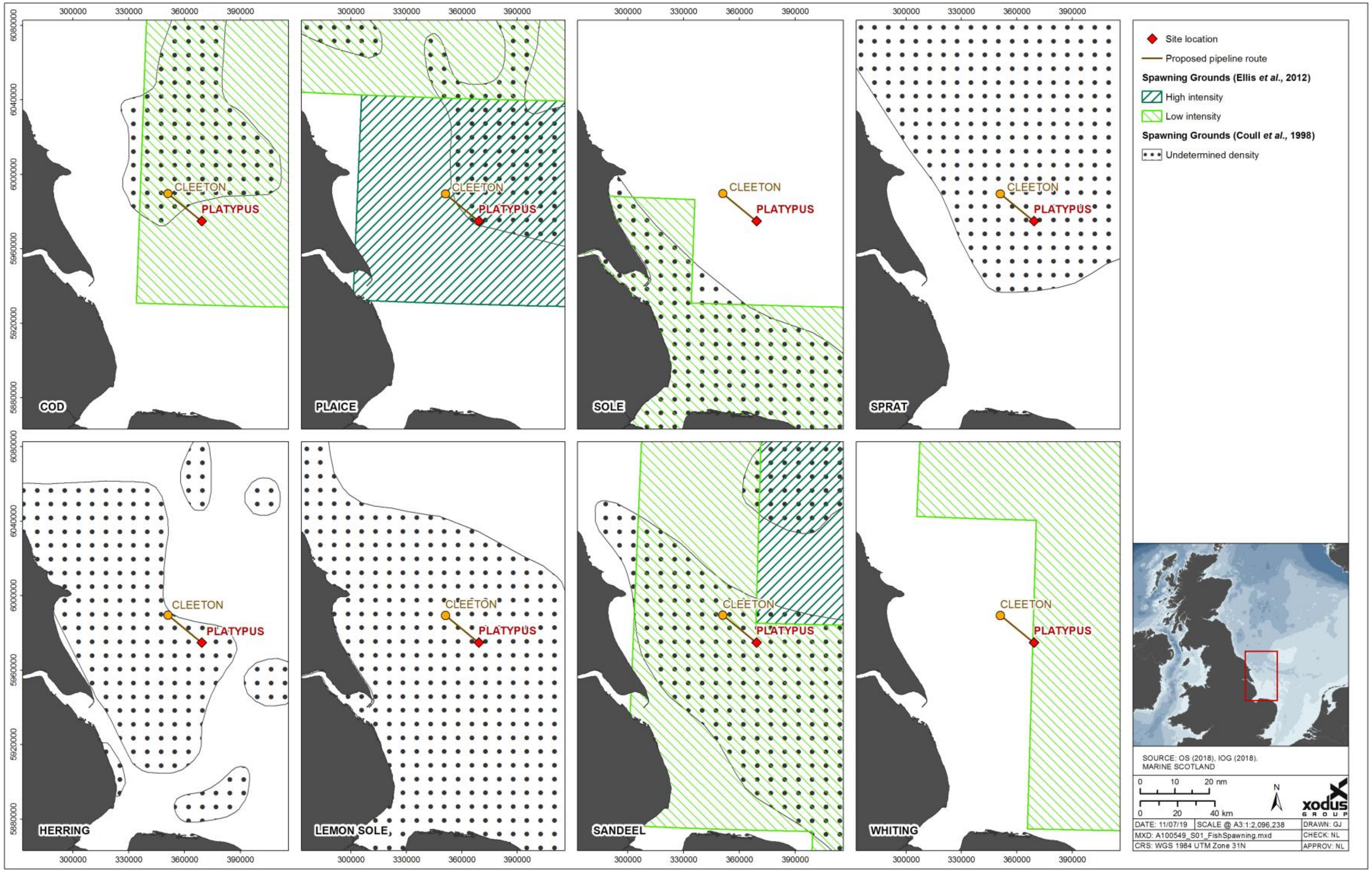

Figure 3.9: Areas of potential fish spawning around the Development area (Coull *et al.*, 1998; Ellis *et al.*, 2012)

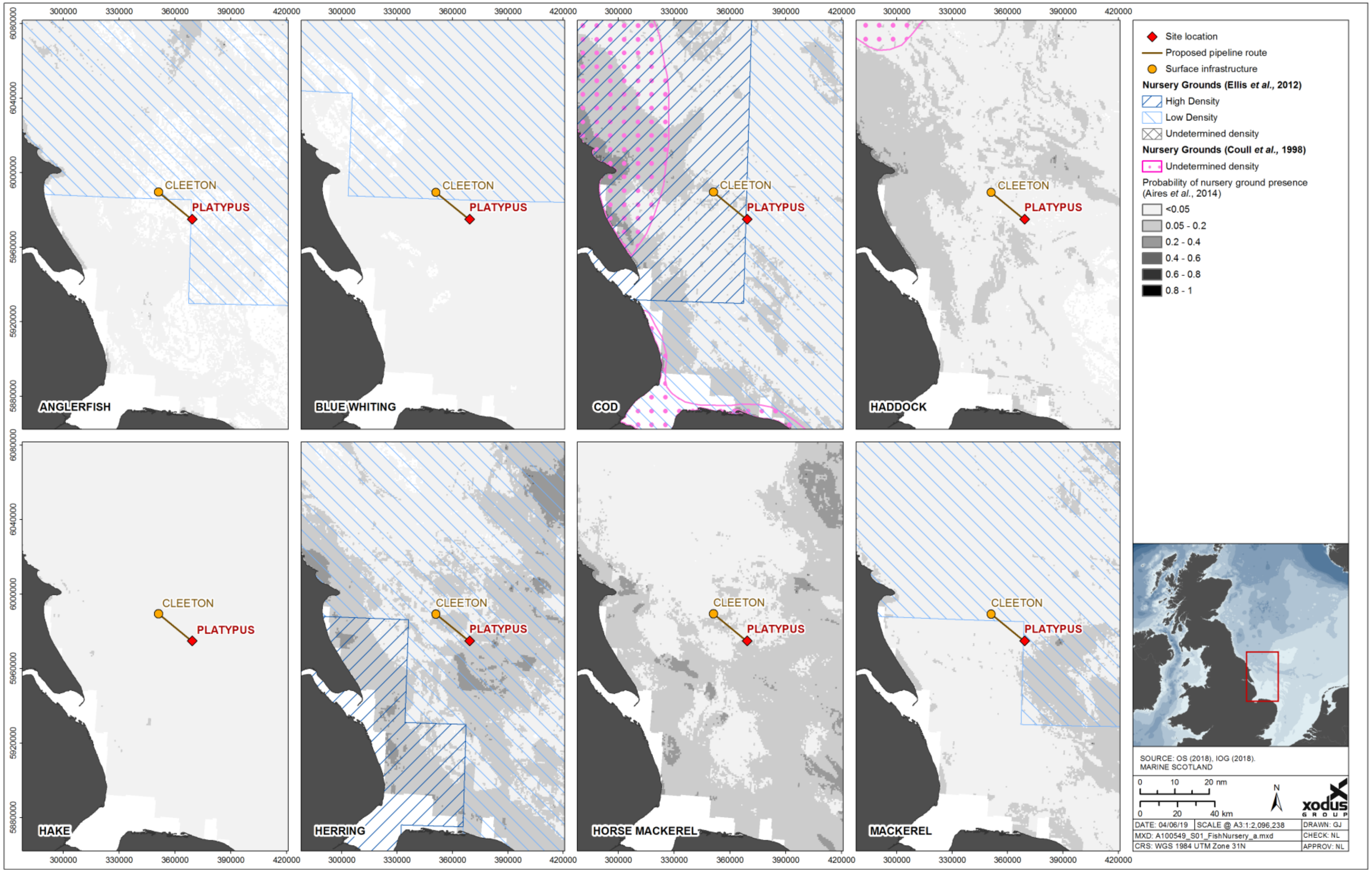

Figure 3.10: Potential fish nursery grounds around the Development area (Coull *et al.*, 1998; Ellis *et al.*, 2012; and Aires *et al.* 2014)

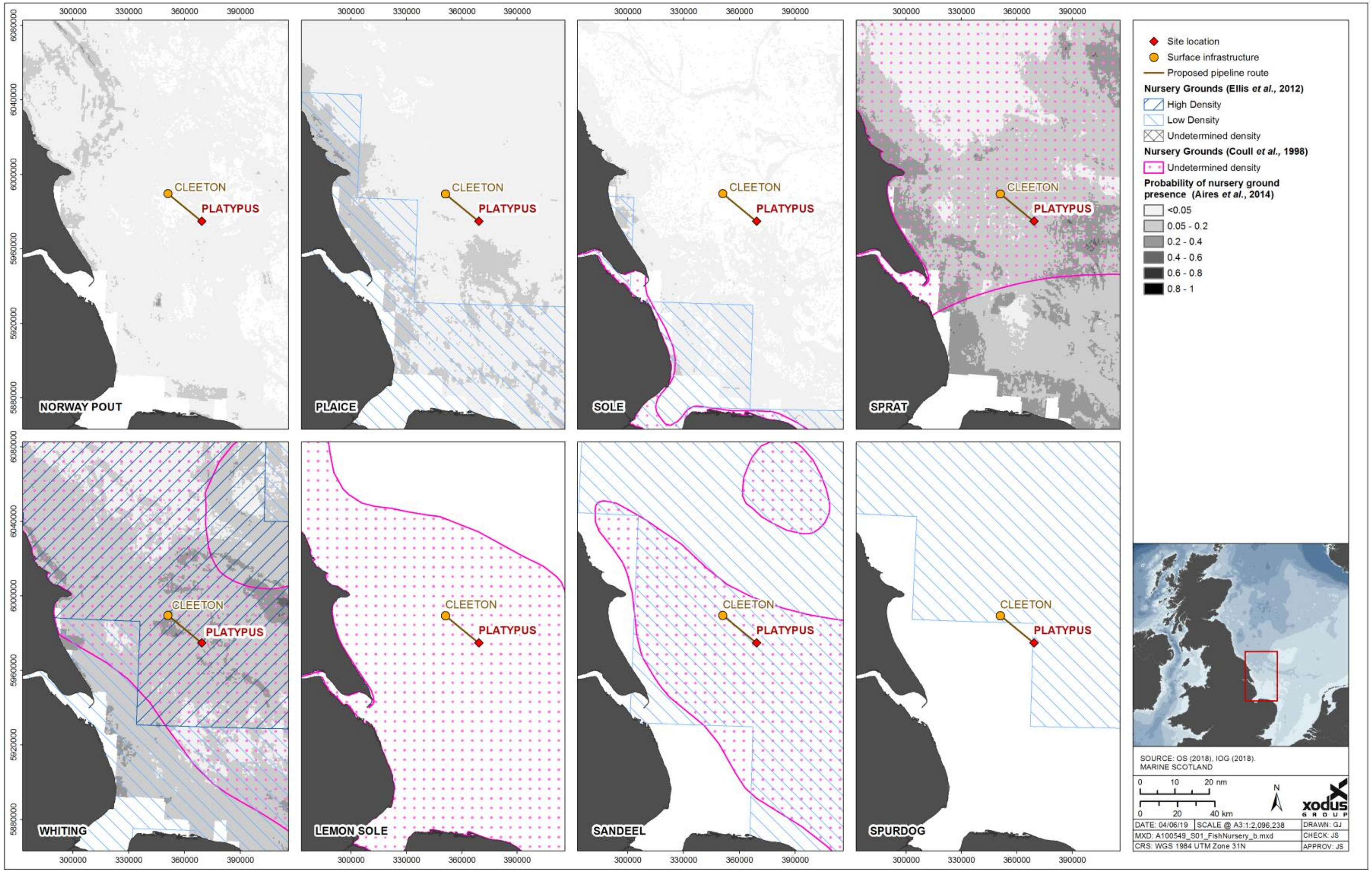

Figure 3.11: Potential fish nursery grounds around the Development area (Coull *et al.*, 1998; Ellis *et al.*, 2012; and Aires *et al.* 2014)

3.3.2.1 Platypus field

The Platypus field is located within an area of spawning for cod, plaice (high intensity), sprat (*Sprattus sprattus*), herring (*Clupea harengus*), lemon sole (*Microstomus kitt*), sandeel (*Ammodytes* spp.) and whiting (*Merlangius merlangus*). It also provides nursery areas for anglerfish (*Lophius piscatorius*), cod (high density), herring, mackerel (*Scomber scombrus*), sprat, whiting (high density), lemon sole, sandeel and spurdog (*Squalus acanthias*; Coull *et al.*, 1998; Ellis *et al*., 2012). The spawning and nursery periods for these species are presented in Table 3-1.

Fisheries sensitivity maps (Aires *et al.,* 2014) describe the likelihood of aggregations of fish species in the first year of their life (i.e., 0 group or juvenile fish) occurring around the UKCS. These maps show low probability for the presence of aggregations of 0 group anglerfish, blue whiting (*Micromesistius poutassou*), cod, haddock (*Melanogrammus aeglefinus*), European hake (*Merluccius merluccius*), herring, horse mackerel (*Trachurus trachurus*), mackerel, Norway pout (*Trisopterus esmarki*), plaice, sole, sprat and whiting (Figure 3.10 and Figure 3.11).

Although there is fish spawning and nursery activity in the vicinity of the proposed activities at certain times of the year, spawning and nursery areas tend to be transient and are part of larger offshore areas (Coull *et al*., 1998, Ellis *et al*., 2012). Spawning areas for most species are not rigidly fixed and fish may spawn either earlier or later from year to year. In addition, the mapped spawning areas represent the widest known distribution given current knowledge and should not be seen as rigid, unchanging descriptions of presence or absence (Coull *et al.*, 1998). While most species spawn into the water column of moving water masses over extensive areas, benthic spawners (e.g., sandeel and herring) have very specific habitat requirements, and consequently, their spawning grounds are relatively limited and potentially vulnerable to seabed disturbance and change.

Other fish species observed during the recent Platypus survey (Fugro, 2019a) included flatfish (such as dab, *Limanda limanda*, and the solenette *Buglossidium luteum*), striped red mullet (*Mullus surmuletus*), gobies and the pogge (*Agonus cataphractus*).

3.3.2.2 Platypus to Cleeton pipeline route

The Platypus to Cleeton pipeline route traverses UKCS Blocks 48/1, 47/5, 42/29 and 42/30. Block 48/1 is located within the ICES Rectangle 36F1, the fish and shellfish baseline environment in this rectangle is covered in Section 3.3.2.1. The other Blocks covered by the pipeline are located within the ICES Rectangles 36F0 and 36F1.

The fish and shellfish species known to spawn in the area along the Platypus to Cleeton pipeline option are cod, plaice (high intensity), sprat, herring, lemon sole and sandeel. This route also falls within nursery grounds for anglerfish, blue whiting, cod (high density), herring, mackerel, sprat, whiting (high density), lemon sole, sandeel and spurdog (Coull *et al*., 1998; Ellis *et al*., 2012). The spawning and nursery periods for these species are described in Table 3-1. The fisheries sensitivity maps produced by Aires *et al*. (2014) show that the probability of 0 group fish species occurring within the survey area is low for all species (Figure 3.10 and Figure 3.11).

3.3.2.3 Regulatory issues

Periods of Concern have been reported for Blocks 48/1, 47/5, 42/29, and 42/30 about possible environmental effects of seismic surveys or drilling operations on fish spawning and seabird sensitivity. The periods of concern extend from January to May and from August to October for all blocks (OGA, 2018). JNCC and OPRED are currently in the process of revising the periods of concern for drilling activities, based on the Seabird Oil Sensitivity Index (SOSI). The 'period of concern' does not prevent any drilling activities during these months; however, the potential implications of drilling operations and/ or an accidental release on seabirds require consideration. As such the months of June and from September to December within Block 48/1, during which the SOSI is recorded as extremely high, is considered in detail in Section 5.7.

Additionally, Blocks 48/1 and 47/5 are within potential herring spawning grounds, therefore the OGA warns that seabed surveys may be required before any drilling activity to confirm whether there are any herring spawning sites within a three-nautical mile radius of the proposed drilling location (OGA, 2018). A herring spawning assessment for the proposed development was undertaken (Section 3.3.2.4). Specific periods of concern for each block are presented in Table 3-2 below.

Table 3-2: Regulatory issues in OGA Licensing Blocks 48/1, 47/5, 42/29 and 42/30 (OGA, 2018)

UKCS Block	Period of concern for seismic surveys	Period of concern for drilling	Herring spawning ground
48/1	January to May (Defra) August to October (Defra) January-March (CEFAS)	August to October (Defra) August to February [JNCC] August to October (CEFAS)	F4[6]
47/5	January to May (Defra) August to October (Defra) January-March (CEFAS)	August to October (Defra) August to February [JNCC] August to October (CEFAS)	F4
42/29	January to May (Defra) January to March (CEFAS)	August to February [JNCC] August to October (CEFAS)	No concern
42/30	January to May (Defra) January to March (CEFAS)	August to February [JNCC] August to October (CEFAS)	No concern

3.3.2.4 Presence of herring spawning grounds

As described above, UKCS Blocks 48/1 and 47/5 are listed as potential herring spawning grounds. A herring spawning assessment was conducted for the Platypus site and pipeline route (Fugro, 2019a). None of the 15 stations sampled across the development area were found to be suitable for herring spawning on account of sediment composition.

3.3.2.5 Presence of sandeel spawning and nursery grounds

As noted in Table 3-1, the Development area is a spawning and nursery area for sandeel. Sandeels are important prey for many other species including harbour porpoise (*Phocoena phocoena*). The Development area is outside of high intensity spawning grounds located to the northeast. Holland *et al*. (2005) indicates that sandeels (*Ammodytes marinus*) prefer sediments with <4% silt and a high proportion of coarse sand. The sediments across the Platypus site and along the pipeline route are predominantly fine sand, usually with >4% silt content (Fugro, 2019b). Only one station showed sediment characteristic which would be in line with preferences for sandeels (Station CLE_ST_01, coarse sand fraction approaching 30% and a silt content of 0.47%); as a result this area is not believed to constitute prime sandeel habitat.

3.3.3 Marine reptiles

The only marine reptiles that have been recorded around the UK are occasional sightings of turtles. Five species of marine turtle have been recorded in UK waters: the leatherback turtle (*Dermochelys coriacea*), Kemp's Ridley turtle (*Lepidochelys kempii*), green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), and hawksbill turtle (*Eretmochelys imbricata*). Of these species only the leatherback turtle is recorded as a very occasional visitor in

[6] For blocks or sub-blocks marked F4, scientific fisheries advice has indicated that seabed surveys may be required before any drilling activity to confirm whether there are any herring spawning sites within a three nautical mile radius of the proposed drilling location. A herring spawning assessment was conducted for the Platypus site and pipeline route (Section 3.3.2.4).

the SNS whereas the other species usually only occur as stray juveniles. Whilst data related to the occurrence of marine turtles in the UK is sparse, most occurrences are of leatherbacks on the west coast, and so it's considered unlikely that the Platypus development will adversely affect turtles.

3.3.4 Seabirds

Much of the North Sea and its surrounding coastline serves as internationally important foraging and breeding habitat for seabirds. The western flank of the Dogger Bank supports high densities of seabirds, with notable colonies on the east coast located at Flamborough Head and Bempton Cliffs, including black-legged kittiwake (*Rissa tridactyla*), northern gannet (*Morus bassanus*), common guillemot (*Uria aalge*), razorbill (*Alca torda*) and northern fulmar (*Fulmarus glacialis*) (DECC, 2016). Seabirds are not normally affected by routine offshore oil and gas operations. However, in the event of an oil spill, birds are vulnerable from oil floating on the sea surface. This can result in direct toxicity through ingestion and indirect impacts, such as hypothermia resulting from the inability to waterproof their feathers.

Seabirds are most vulnerable to spilled oil during the moulting season, when they become flightless and spend a significant proportion of time on the sea surface. For the majority of seabird species, the moulting season occurs directly after the breeding season. After their breeding season ends in June, large numbers of moulting auks (common guillemot and razorbill) disperse from their coastal colonies to offshore waters. In addition to auks, great black-backed gull and northern fulmar are present at sea in sizable numbers during this time (DECC, 2016).

Between 1998 to 2015, the populations of fulmars and kittiwakes have decreased by 31% and 44%, respectively, whilst guillemot numbers increased by 5% (JNCC, 2016a). Breeding seabird numbers of some species have shown a long-term decline, most probably as a result of a shortage of key prey species such as sandeels associated with changes in oceanographic conditions (Baxter *et al*., 2011: DECC, 2016).

According to the seabird density maps provided in Kober *et al*. (2010), the following species have been found near the Development area at relatively high densities: pomarine skua (*Stercorarius pomarinus*) (March to August); Arctic skua (*Stercorarius parasiticus*) (breeding: May to August; moulting: September to November); great skua (*Stercorarius skua*) (wintering: September to April); black-legged kittiwake (*Rissa tridactyla*) (wintering: October to April); little gull (*Hydrocoloeus minutus*) (August to November); great black-backed gull (*Larus marinus*) (wintering: September to March); herring gull (*Larus argentatus*) (wintering: September to March); common guillemot (*Uria aalge*) (August to September; wintering: October to April); razorbill (*Alca torda*) (breeding: May to June; wintering: October to April); and Atlantic puffin (*Fratercula arctica*) (wintering: August to March).

Table 3-3 shows representative breeding season foraging ranges have been identified for several species which may breed in the vicinity of the Development area (Thaxter *et al.*, 2012). Consideration is given to distances from conservation sites with breeding seabird features, as the foraging ranges of those species may overlap with project activities, even when the conservation site does not (Section 3.4).

The Seabird Oil Sensitivity Index (SOSI) (Webb *et al*., 2016) identifies regions where seabirds are likely to be most sensitive to oil pollution. It is an updated version of the Oil Vulnerability Index (JNCC, 1999) 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 (Webb *et al*., 2016).

SOSI data for the Platypus installation location and the proposed pipeline route is presented in Table 3-4 below. As recommended in the guidance (Webb *et al*., 2016), the median sensitivity layer has been used, and months for which no data are available have been populated using data from adjacent months in the first instance, or failing this, adjacent blocks.

Seabird sensitivity to oil pollution in the region of the proposed Platypus Development is generally very high between February and April, high to extremely high in June, low in May, high in July and August, high to extremely high in September and October and low to extremely high between November and January (Table 3-4). Sensitivity is generally higher at the Platypus end of the pipeline in Blocks 48/1 and 47/5, which each display five months of extremely high sensitivity. Blocks 42/30 and 42/29 at the Cleeton end of the route display one and three months of extremely high sensitivity respectively (Webb *et al*., 2016) (Table 3-4; Figure 3.12 and Figure 3.13).

Table 3-3: Representative breeding season foraging ranges for seabird species occurring in the vicinity of the Platypus Development (Thaxter *et al.*, 2012)

Species	Maximum foraging range (km)	Confidence of assessment
Arctic skua	75	Uncertain
Atlantic puffin	30	Low
Black-legged kittiwake	200	Highest
Common guillemot	40	Highest
Great skua	13 and 120	Moderate and Low
Herring gull	50	Moderate
Little tern	11	Low
Razorbill	30	Moderate

Table 3-4: Seabird oil sensitivity in the Development area (Blocks 42/29, 42/30, 47/5 and 48/1) and surrounding OGA Blocks (Webb *et al.*, 2016)

Block	J	F	M	A	M	J	J	A	S	O	N	D
42/23	5	1	2	2*	3	2	3	3	3	3*	4	5
42/24	5*	2*	2	2*	4	1	3	3	3	3*	5*	5
42/25	5*	1*	1	1*	5	1	3	3	1	1*	5*	5
43/21	1*	2	1*	5*	5	1	2	4	1	1*	1*	1
42/28	5	2	2	2*	3	2	3	3	3	3*	3	4
42/29	5	2	1	1*	4	1	3	3	3	3*	5	4
42/30	2*	2	2	2*	5	1	3	3	2	2*	3*	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
47/3	4	2	2	5	4	2	3	3	3	3*	3	4
47/4	5	1	2	2*	5	2	4	3	3	3*	4	4
47/5	1*	1	2	2*	5	2	3	2	3	1*	1	1
48/1	2*	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
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
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

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.

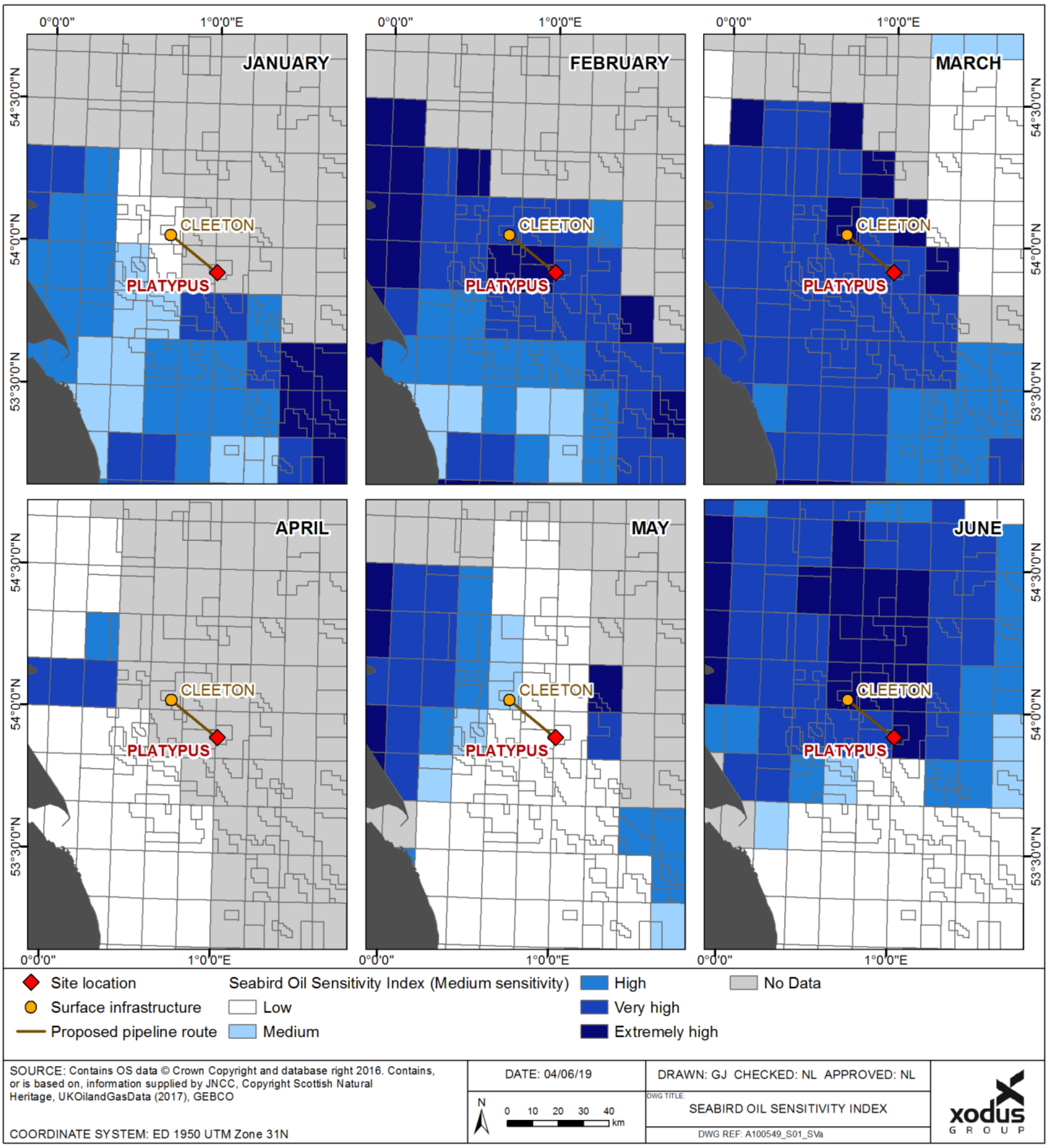

Figure 3.12: Seabird sensitivity to oil pollution within the vicinity of the Development area (January – June) (Webb *et al.*, 2016)

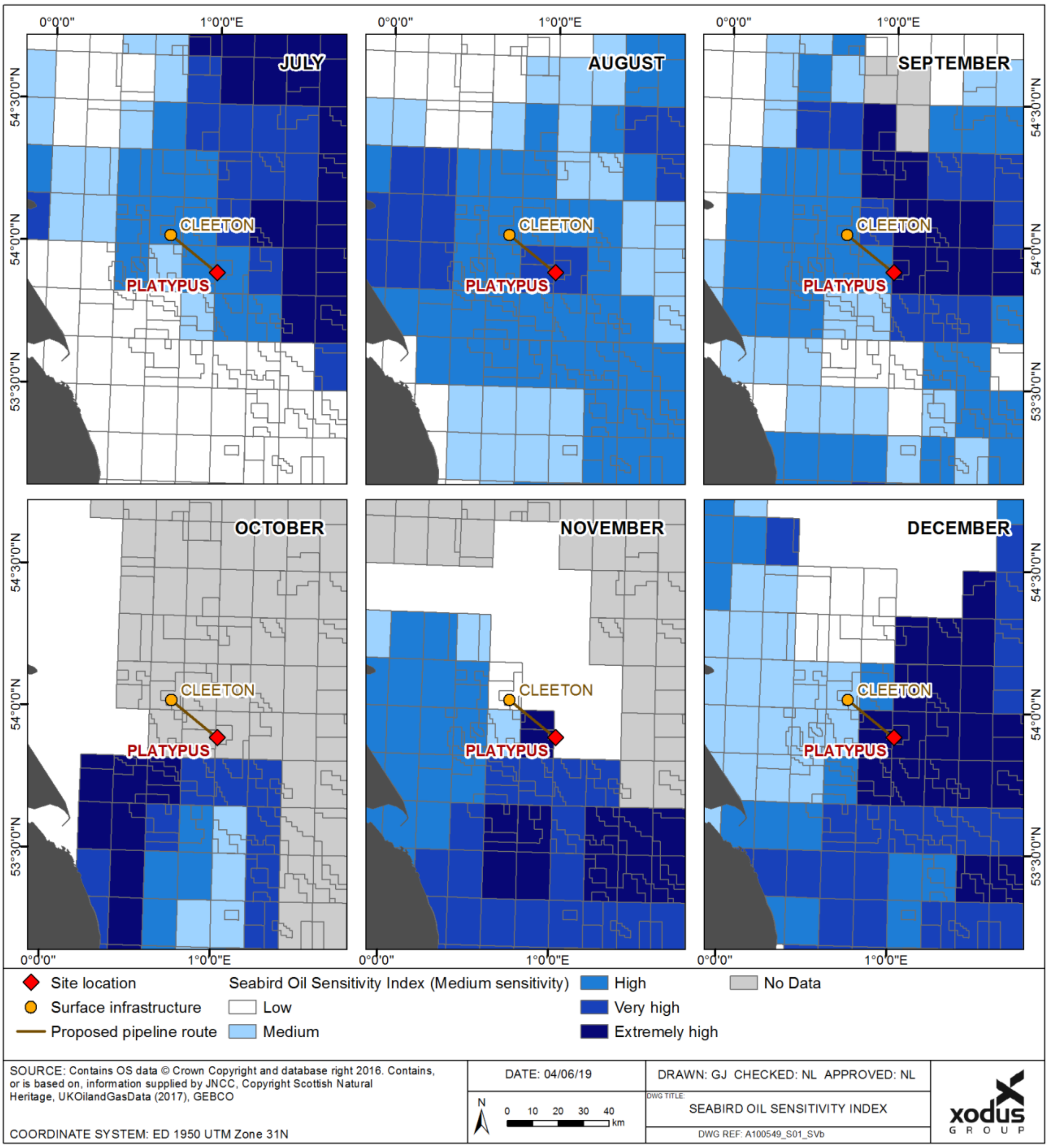

Figure 3.13: Seabird sensitivity to oil pollution within the vicinity of the Development area (July – December) (Webb *et al*., 2016)

3.3.5 Cetaceans

The SNS has a lower density of cetaceans than the Northern and Central North Sea . Although various cetacean species have been sighted within the SNS, only harbour porpoise and white-beaked dolphins (*Lagenorhynchus albirostris)* are considered as regularly occurring species (Reid *et al.*, 2003). The minke whale (*Balaenoptera acutorostrata*) is considered a seasonal visitor, while bottlenose (*Tursiops truncatus*) and Atlantic white-sided (*Lagenorhynchus acutus*) dolphins are considered infrequent visitors (DECC, 2016).

Surveys undertaken for the "Small Cetaceans in the European Atlantic and North Sea (SCANS-III)" project identified harbour porpoise as the most abundant cetacean species in the Development area (approximately

53,500 individuals), followed by minke whale (approximately 600 individuals) and white-beaked dolphin (approximately 150 individuals) (Hammond *et al*., 2017). White-sided and bottlenose dolphins were not observed within the region surrounding the Platypus development during these surveys, though individuals were observed in the CNS (Hammond *et al*., 2017). Their abundance estimates therein were low (approximately 650 white-sided and 2,000 bottlenose dolphins) compared to other regions of the North Sea and Northeast Atlantic (Hammond *et al*., 2017). Relative sightings data from Reid *et al.* (2003) supports these observations, with only 0.01 to 1 white-sided dolphin and 0.01 to 10 bottlenose dolphins recorded per hour of survey effort in the areas around the Platypus development.

Harbour porpoise and bottlenose dolphin are listed for protection under Annex II of the Habitats Directive which enables the designation of SACs for these species. The Platypus development is located within the SNS SAC, designated for the protection of harbour porpoise (Section 3.4). Table 3-5 below describes the cetacean species most likely to be observed near the Platypus development.

Table 3-5: Cetacean occurrence in the Development area (Reid *et al*., 2003; Hammond *et al*., 2017)

Species	Description of occurrence
Harbour porpoise	Harbour porpoise are seen throughout the UKCS, though the greatest numbers are found in the SNS. They usually occur in shallow waters (less than 50 m) in groups of up to three individuals, although they have been sighted in larger groups and in deeper waters (up to 200 m). Harbour porpoise movements are variable, and they do not undertake seasonal migrations.
Minke whale	Minke whales usually occur on the continental shelf in water depths up to 200 m. They are mostly seasonal visitors in the North Sea, and sightings generally do not occur South of the Dogger Bank. They are usually sighted alone or in pairs; however, groups of up to 15 individuals may aggregate during feeding events. Data suggest that animals return to the same seasonal feeding grounds each year.
White-beaked dolphin	White-beaked dolphins can be found hugging the 50 to 100 m depth contour of the continental shelf year-round, though sightings peak in June and early autumn. This species is usually observed in small groups of less than 10 individuals, occasionally in association with white-sided, bottlenose, common and Risso's dolphins.
White-sided dolphin	White-sided dolphins are often confused with white-beaked dolphins, as the two species look similar at sea. They are often seen in large groups, from tens to hundreds of individuals, with breakaway subgroups of between 2 and 15 animals. White-sided dolphins predominantly live in cold, deep (100 to 500 m) waters off the UKCS in the Northern North Sea where they can target gadoid prey. However, they occasionally come into shelf waters in small numbers.
Bottlenose dolphin	Bottlenose dolphins occupy both shallow coastal waters and the deep waters of the open ocean. Individuals found along the continental shelf form smaller groups (2 to 25 animals), while those offshore form groups of upwards of a few hundred animals. Bottlenose dolphins often socialise with other cetacean species, particularly long-finned pilot whales and white-sided dolphins.

3.3.6 Seals

Grey (*Halichoerus grypus)* and harbour seals (*Phoca vitulina)* are found throughout the North Sea, with greater numbers occurring in the northern regions. Both species are protected under Annex II of the Habitats Directive.

Grey and harbour seals feed in both inshore and offshore waters, depending on the seasonal and interannual distribution of their prey. As central place foragers with a terrestrial base, seal density is greatest close to shore, particularly during their respective pupping and moulting seasons. Seal tracking studies from the Moray Firth have indicated that the foraging movements of harbour seals are generally restricted to within a 40 – 50 km range of their haul-out sites (SCOS, 2018). The movements of grey seals often occur on greater scales than those of the harbour seal, and trips of several hundred kilometres from one haul-out to another have been recorded (SMRU, 2011).

Both species occupy haul outs along the Norfolk coast > ca.70 km distant from the development area, with grey seal distribution centred on the Humber Estuary and harbour seals centred on The Wash (Russell *et al*., 2017). Given their greater foraging range, grey seals are likely to more commonly occur in the development area. This is confirmed by the latest grey and harbour seal density maps (Russell *et al*., 2017) which show an estimated mean density of up to 50 grey seals and up to one harbour seal per 25 km^2 at the proposed Platypus installation location and along the pipeline route (Figure 3.14).

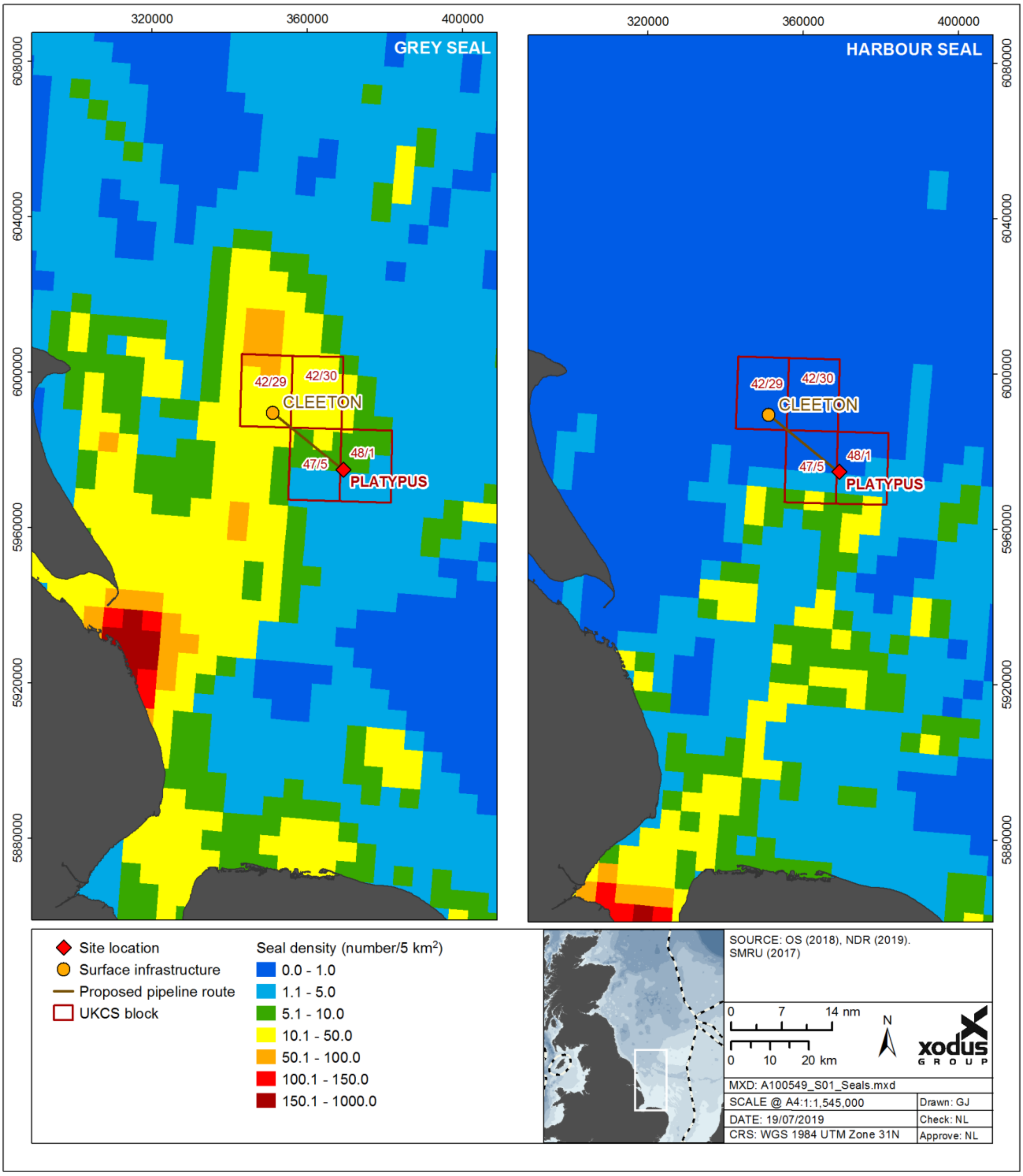

Figure 3.14: Mean estimated usage of Development area by grey seals (left) and harbour seals (right)

3.4 Conservation

There are various offshore and coastal conservation sites designated for the protection of sensitive habitats and species in the vicinity of the Platypus Development. Additionally, there are several protected marine species which may be found in the waters where Project activities are due to the take place. Figure 3.15 shows protected sites occurring in the vicinity of the proposed Development. The subsections below outline the sites and species designated for conservation protection within 100 km of the Development area.

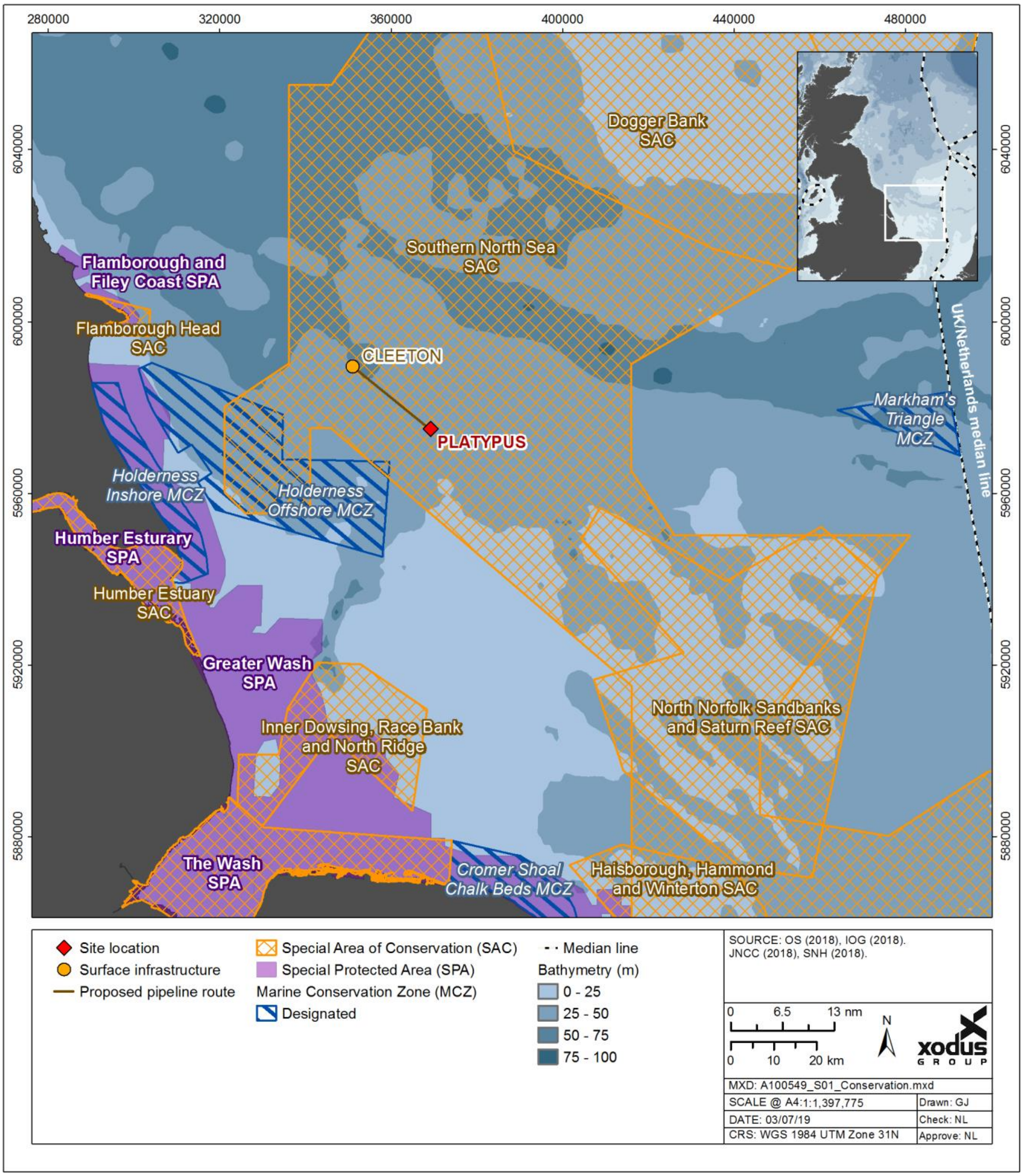

Figure 3.15: Conservation sites around the Platypus Development

3.4.1 Offshore conservation

The proposed Platypus Development is located within the SNS SAC which has been designated for the protection of harbour porpoise (Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6). The SAC is extremely large, covering an area of 36,951 km^2, stretching from the north of Dogger Bank to the Straits of Dover. The site supports an estimated 17.5% of the UK North Sea Management Unit harbour porpoise population. The northern two thirds of the site is more important during the summer season, whilst the southern third supports higher densities during winter. The conservation objective for the site is to ensure that the integrity of the site is maintained and that it makes an appropriate contribution to maintaining favourable conservation status for harbour porpoise in UK waters (JNCC, 2017). This will be achieved by ensuring that:

1. Harbour porpoise is a viable component of the site;
2. There is no significant disturbance of the species; and
3. The condition of supporting habitats and processes, and the availability of prey are maintained.

Other SACs in the vicinity of the Platypus Development include the North Norfolk Sandbanks and Saturn Reef SAC, Inner Dowsing, Race Bank and North Ridge SAC, and Dogger Bank SAC, all of which are designated for the protection of the Annex I habitats “Sandbanks which are slightly covered by sea water all the time” and “Reefs” (Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6). The reefs are biogenic, formed by the Ross worm (*Sabellaria spinulosa*). The tubes of Ross worms can become aggregated to form solid structures that rise above the surrounding seabed and persist for many years, providing a habitat for other epibenthic species that would not be otherwise found in the area (Maddock, 2008).

The Holderness Offshore MCZ is located 12.2 km WSW of the proposed Platypus installation location. The MCZ has been designated in order to protect several subtidal habitats as listed in Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6. The varied nature of the seabed means it supports a wide range of animals, both on and in the sediment, such as worms, bivalves, starfish and crustaceans. The site is also a spawning and nursery ground for several fish species including lemon sole, plaice and sprat.

There are several other MCZs in the vicinity of the proposed Development (Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features as described in Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6. With the exception of harbour porpoise, no Annex I habitats or Annex II species protected by the sites listed in Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6 have been identified by survey or are expected to occur in the immediate vicinity of the Project. There is no evidence of the presence of OSPAR (2008) threatened and/or declining habitats or species (including ocean quahog) or UK Biodiversity Action Plan (BAP) habitats in the survey results (Fugro, 2019b; Gardline 2009, 2011a, 2011b). The predominant sediment type identified across the proposed development area (EUNIS habitat A5.27 “deep circalittoral sand”) is consistent with the broad scale habitat “subtidal sand” which is a feature at several of the MCZs (Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6), but this habitat is not protected outside of designated sites.

3.4.2 Coastal conservation

Coastal protected sites in the vicinity of the proposed development are presented in Table 3-7. The Humber Estuary SAC is the nearest coastal SAC to the Development area. It has been designated for the conservation of several intertidal and subtidal Annex I habitats. It has also supports terrestrial Annex I habitats including grey and white dunes and a variety of coastal and marine Annex II species, including sea and river lampreys and grey seals (Table 3-7).

The coastal sites of Flamborough Head SAC, Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC, and The Wash and North Norfolk Coast SAC are all located nearly 70 km or more from the Platypus Development. These sites are designated for the protection of coastal features which include dunes, sea caves, sandbanks, reefs, bays and lagoons, and the flora and fauna which these habitats support. In particular, The Wash and North Norfolk Coast SAC protects Eurasian otters and harbour seals which occupy the sandbanks and lagoons within the site.

Additionally, there are several SPAs situated along the coast. These sites are designated for the protection of bird species under Annex IV of the Birds Directive and are listed in Table 3-7.

The Greater Wash SPA is the closest SPA to the Development area. It is an extremely valuable site which supports several species including the largest breeding population of little terns (*Sterna albifrons*) within the UK SPA network, as well as the second largest non-breeding aggregations of red-throated diver (*Gavia stellata*) and little gull. The offshore site boundary was placed at the maximum foraging extent of red-throated diver and sandwich tern (*Sterna sandvicensis*) associated with the site.

Other SPAs in the region include: the Humber Estuary SPA, Flamborough Head and Bempton Cliffs SPA, Hornsea Mere SPA, and Gibraltar Point SPA. These sites collectively protect several species of wading birds and seabirds as illustrated in Table 3-7.

There are two coastal MCZs in the vicinity of the proposed Development area (Table 3-7). These sites have been designated to protect a range of subtidal and intertidal habitats, species and geological features.

Table 3-6: Offshore conservation sites within 100 km of the proposed location for the Platypus installation

Site Name	Distance and bearing from Platypus installation	Qualifying Features
Special Areas of Conservation		
SNS SAC (note this site also has a coastal component but it is remote from the Development area).	0 km (is within site boundary)	Harbour porpoise (*Phocoena phocoena*)*.
North Norfolk Sandbanks and Saturn Reef SAC.	43.3 km ESE	Sandbanks which are slightly covered by sea water all the time*. Reefs*.
Inner Dowsing, Race Bank and North Ridge SACs	57.1 km SSW	Sandbanks which are slightly covered by sea water all the time*. Reefs*.
Dogger Bank SAC.	66.9 km NNE	Sandbanks which are slightly covered by sea water all the time*.
Marine Conservation Zones		
Holderness Offshore MCZ.	12.2 km WSW	Maintain in favourable condition: North Sea Glacial Tunnel valleys. Recover to favourable condition: Subtidal coarse sediment, Subtidal sand, Subtidal mixed sediments, Ocean Quahog (*Arctica islandica*).
Markham's Triangle MCZ.	95.2 km WNW	Recover to favourable condition: Subtidal coarse sediment, Subtidal sand, Subtidal mud, Subtidal mixed sediments.

* = Primary reason for site designation.

Table 3-7: Coastal conservation sites within 100 km of the proposed location of the Platypus installation

Site Name	Distance and bearing to Platypus installation	Qualifying Features
Special Areas of Conservation (SAC)		
Humber Estuary SAC.	67 km WSW	Estuaries*. Mudflats and sandflats not covered by seawater at low tide*. Sandbanks which are slightly covered by sea water all the time. Coastal lagoons (Priority feature). Salicornia and other annuals colonizing mud and sand. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*). Embryonic shifting dunes. Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"). Fixed coastal dunes with herbaceous vegetation ("grey dunes") (Priority feature). Dunes with *Hippopha rhamnoides*. Sea lamprey *Petromyzon marinus*. River lamprey *Lampetra fluviatilis*. Grey seal *Halichoerus grypus*.
Flamborough Head SAC.	69 km WNW	Reefs*. Vegetated sea cliffs of the Atlantic and Baltic Coasts* Submerged or partially submerged sea caves*
Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SACs.	76 km SSW	Shifting dunes along the shoreline with *Ammophila arenaria* (“white dunes”)*. Fixed coastal dunes with herbaceous vegetation ("grey dunes") (Priority feature)*. Dunes with *Hippopha rhamnoides**. Humid dune slacks*. Embryonic shifting dunes.

Site Name	Distance and bearing to Platypus installation	Qualifying Features
The Wash and North Norfolk Coast SAC.	95 km SSW	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*. Salicornia and other annuals colonizing mud and sand*. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)*. Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)*. Coastal lagoons (Priority feature)./ Harbour seal (*Phoca vitulina*)*. Otter (*Lutra lutra*).
Special Protection Areas (SPA)		
Greater Wash SPA.	51 km SW	Breeding: sandwich tern, little tern, common tern (*Sterna hirundo*). Non-breeding: red-throated diver, little gull, common scoter (*Melanitta nigra*).
Humber Estuary SPA.	65 km WSW	Breeding: Eurasian bittern (*Botaurus stellaris*), Western marsh harrier (*Circus aeruginosus*), Pied avocet (*Recurvirostra avosetta*), Little tern (*Sterna albifrons*). Over-wintering: Eurasian teal (*Anas crecca*), Eurasian wigeon (*Anas penelope*), Mallard (*Anas platyrhynchos*), Ruddy turnstone (*Arenaria interpres*), Common pochard (*Aythya farina*), Greater scaup (*Aythya marila*), Eurasian bittern (*Botaurus stellaris*), Black brant goose (*Branta bernicla bernicla*), Common goldeneye (*Bucephala clangula*), Sanderling (*Calidris alba*), Red knot (*Calidris canutus*), Common ringed plover (*Charadrius hiaticula*), Hen harrier (*Circus cyaneus*), Eurasian oystercatcher (*Haematopus ostralegus*), Bar-tailed godwit (*Limosa lapponica*), Black-tailed godwit (*Limosa limosa islandica*), Eurasian curlew (*Numenius arquata*), European golden plover (*Pluvialis apricaria*), Grey plover (*Pluvialis squatarola*), Pied avocet (*Recurvirostra avosetta*), Common shelduck (*Tadorna tadorna*), Common redshank (*Tringa totanus*), Northern lapwing (*Vanellus vanellus*). Concentrations of European Importance: Sanderling (*Calidris alba*), Red knot (*Calidris canutus*), Common ringed plover (*Charadrius hiaticula*), Hen harrier (*Circus cyaneus*), Black-tailed godwit (*Limosa limosa islandica*), Whimbrel (*Numenius phaeopus*), Ruff (*Philomachus pugnax*), Grey plover (*Pluvialis squatarola*), Common greenshank (*Tringa nebularia*), Common redshank (*Tringa totanus*).
Flamborough Head and Bempton Cliffs SPA.	75 km WNW	Breeding Black-legged kittiwake (*Rissa tridactyla*).
Hornsea Mere SPA.	78 km WSW	Breeding Mute swan (*Cygnus olor*). Over-wintering Gadwall (*Anas strepera*).

Site Name	Distance and bearing to Platypus installation	Qualifying Features
Gibraltar Point SPA.	98 km SSW	Breeding Little tern (*Sterna albifrons*). Over-wintering Sanderling (*Calidris alba*), Bar-tailed godwit (*Limosa lapponica*), Grey plover (*Pluvialis squatarola*).
Marine Conservation Zones		
Holderness Inshore MCZ.	59 km WSW	Maintain in favourable condition: Intertidal sand and muddy sand, Moderate energy circalittoral rock, Subtidal coarse sediment, Subtidal mixed sediments, Subtidal sand, Subtidal mud, Spurn head (subtidal).
Cromer Shoal Chalk Beds MCZ.	96 km SSE	Maintain in favourable condition: Moderate energy infralittoral rock, High energy infralittoral rock, Moderate energy circalittoral rock, High energy circalittoral rock, Subtidal chalk, Subtidal coarse sediment, Subtidal mixed sediments, Subtidal sand, Peat and clay exposures, North Norfolk Coast (subtidal).

**** = Primary reason for site designation***

3.4.3 Species

Four species of marine mammal listed under Annex II of the Habitats Directive are found in UK waters: harbour porpoise, bottlenose dolphin, grey seal and harbour seal. As discussed in Section 3.3.5 and Section 3.3.6, these four species have all been recorded in the vicinity of the Platypus Development. Harbour porpoise and grey seals are the most abundant marine mammals in the region and the most likely to occur within the Development area.

All five cetacean species recorded in the SNS region surrounding the Project (harbour porpoise, white-beaked dolphin, minke whale, Atlantic white-sided dolphin and bottlenose dolphin) are European Protected Species (EPS).

Under the Habitats Directive, it is an offence to:

- Deliberately capture, injure or kill any wild animal that is an EPS; or
- Deliberately disturb wild animals of an EPS in such a way as to:
  - > Impair their ability to migrate, hibernate, survive, breed, or rear or nurture their young; or
  - > Significantly affect the local distribution or abundance of the species to which they belong.

Other marine species listed as EPSs include turtles (see Section 3.3.3) and the European sturgeon (*Acipenser sturio*), both of which are unlikely to be present.

Harbour porpoise and grey seal can reasonably be expected to occur regularly in the vicinity of the proposed development during Project activities. Minke whale, white-beaked dolphin, white-sided dolphin, bottlenose dolphin and harbour seal may occur but probably not in significant numbers. No Annex II species were identified in the benthic surveys that have been conducted in the area (Fugro, 2019b; Gardline, 2009, 2011a, 2011b; OGUK, 2017). There is no evidence for the presence of OSPAR (2008) threatened and/or declining species or species listed in the UK BAP.

3.5 Socio-Economic Environment

The SNS has the potential for socio-economic consequences related not only to fisheries and commercial shipping but also to other oil and gas activities, renewable energy systems, aggregate extraction and military activities. This section provides information on these activities as investigated for the EIA.

3.5.1 Commercial fisheries

The SNS has important fishing grounds used by the fishing fleets of the UK and other nations, targeting demersal, pelagic and shellfish species. The Platypus Development and proposed pipeline route are located in ICES rectangles 36F0, 36F1 and 37F0.

The most frequently caught species in the Development area include: lobster, crab, scallop, whelk and herring (Table 3-8). Lobster is a high value species which contributed nearly 40% of the total value of catches in the region. In ICES rectangle 36F0 lobster catches averaged £4.7M per year between 2014 and 2018 (Scottish Government, 2019). Crab had the highest liveweight tonnage across the Development area, and was caught in high quantities in all three ICES rectangles, particularly rectangle 36F0 (>2,000 Te every year) (Scottish Government, 2019).

The 2018 provisional UK liveweight landings from these ICES rectangles show that the area is targeted predominantly for shellfish (Table 3-9; Scottish Government, 2019). For ICES rectangles 36F0 and 36F1, shellfish represented over 94% of the total value and liveweight landings in the UK in 2018. For ICES rectangle 37F0, shellfish represented approximately 99% of the total liveweight of UK landings in the same year (Scottish Government, 2019).

Fisheries landings varied dramatically across the Development area, with the highest overall value and liveweight tonnage being landed from ICES Rectangle 36F0 across the five most recent fishing years (Table 3-9). Landings within this rectangle were greater than the average across the UKCS for each fishing year (2014-2018). The average annual liveweight tonnage for each ICES rectangle across the Platypus Development between 2014-2018 was 2,197 Te, which was low compared to the rest of the UK (64% of the UKCS average tonnage). The average value of those landings however was £5,062,156 which was higher than the UK average landings value (131% of the UKCS average landings value) (Scottish Government, 2019). This reflects the high proportion of high-value shellfish caught within the Development area.

Table 3-8: Landings value and liveweight tonnage by species over the period 2014-2018 across the Development area averaged across ICES rectangles 36F0, 36F1 and 37F0 (Scottish Government, 2018)

Species	Value (£)	Proportion of total value (%)	Species	Liveweight (Te)	Proportion of total liveweight (%)
Crab	1,966,944	39.2	Crab	1,366	56.4
Lobster	1,897,940	37.9	Scallop	337.2	13.9
Scallop	732,387	14.6	Herring	257.5	10.6
Whelk	224,670	4.5	Whelk	252.8	10.4
Herring	94,176	1.9	Lobster	158.0	6.5

Table 3-9: Liveweight and value of fish and shellfish from ICES rectangles 36F0, 36F1 and 37F0 between 2013 and 2017 (Scottish Government, 2019)

Species type	2018[7]		2017		2016		2015		2014	
	Liveweight (Te)	Value (£)	Liveweight (Te)	Value (£)	Liveweight (Te)	Value (£)	Liveweight (Te)	Value (£)	Liveweight (Te)	Value (£)
ICES rectangle 36F0										
Demersal	9	10,192	6	9,000	8	15,310	26	44,537	27	37,352
Pelagic	162	87,222	<1	165	<1	18	4	9	11	12,557
Shellfish	3,640	10,901,804	3,859	11,132,493	3,728	9,433,068	3,468	7,760,575	3,719	7,690,636
Total	**3,811**	**10,999,219**	**3,865**	**11,141,658**	**3,736**	**9,448,396**	**3,498**	**7,805,121**	**3,757**	**7,740,545**
ICES rectangle 36F1										
Demersal	1	1,578	1	505	6	13,192	10	24,511	44	76,336
Pelagic	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shellfish	1,146	2,334,560	1,218	2,023,677	1,050	4,405,270	1,266	1,584,931	1,010	1,276,886
Total	**1,147**	**2,336,138**	**1,219**	**2,024,182**	**1,056**	**4,418,462**	**1,276**	**1,609,442**	**1,054**	**1,353,222**
ICES rectangle 37F0										
Demersal	10	12,168	90	125,294	7	15,371	35	92,398	64	83,869
Pelagic	0	76	12	19,325	1	848	544	176,032	327	114,403
Shellfish	1,889	4,522,793	1,389	3,356,414	1,128	2,445,614	1,677	3,351,358	1,359	2,739,987
Total	**1,899**	**4,535,037**	**1,491**	**3,501,033**	**1,136**	**2,461,833**	**2,256**	**3,619,788**	**1,750**	**2,938,259**
UKCS (Mean)										
Demersal	730	1,246,297	661	1,176,983	684	1,201,447	690	1,080,052	650	1,043,579
Pelagic	2,406	1,898,964	2,329	1,653,994	2,202	1,677,125	2,147	1,147,687	2,331	1,496,884
Shellfish	402	1,157,016	464	1,230,564	523	1,235,173	490	1,042,124	492	1,087,826
Total	**3,538**	**4,302,277**	**3,454**	**4,061,541**	**3,409**	**4,113,745**	**3,327**	**3,269,863**	**3,473**	**3,628,289**

[7] 2018 provisional data

In 2018, 62.6% of fishing effort within the Development area took place in ICES rectangle 36F0, which is crossed by the proposed pipeline route. The remaining fishing effort for the Development area comprised 8.6% in ICES rectangle 36F1 (the proposed Platypus installation location) and 28.8% in ICES rectangle 37F0 (CW platform location) (Table 3-10; Scottish Government, 2019). Fishing effort in 2018 peaked between July and September for ICES rectangles 36F0 and 36F1, and during March and April for ICES rectangle 37F0 (Table 3-10).

Mean annual fishing effort in hours between 2014 and 2016 across the Development area is presented in Figure 3-16 for static gear and Figure 3-17 for mobile gear. Effort for static gear is concentrated in ICES rectangle 36F0 in an area approximately 4 km to the southwest of the proposed Platypus manifold location. Effort for mobile gear is low in the vicinity of the proposed development, concentrated in ICES rectangle 37F0, approximately 30 km northwest of the Cleeton platforms. The majority of fisheries in the Development area are static gear fisheries which use traps and pots for shellfish. Traps were the most utilised gear type in 2018, representing 83% of total effort across the Development area (Scottish Government, 2019). Dredges also represented an important gear type, particularly in ICES rectangle 37F0, where they were deployed for a total of 405 days in 2018, representing 68% of the 2018 fishing effort for that rectangle (Scottish Government, 2019). Dredging vessels target scallops in the region, which are a high value species (Table 3-8).

Table 3-10: Number of days fished per month (all gears) in ICES rectangles 36F0, 36F1 and 37F0 between 2014 and 2018 (Scottish Government, 2019)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ICES rectangle 36F0													
2014	114	85	192	272	244	208	295	249	314	211	207	125	2518
2015	118	131	184	263	273	234	279	297	300	267	193	128	2666
2016	106	116	162	158	192	240	299	334	281	227	209	182	2506
2017	167	141	212	230	260	274	309	430	255	259	241	160	2938
2018	136	116	207	248	238	211	286	382	285	245	156	136	2647
ICES rectangle 36F1													
2014	D	15	36	40	D	53	52	42	51	46	51	27	412
2015	D	D	D	34	51	37	52	67	82	86	42	43	494
2016	14	25	D	D	D	28	42	86	67	18	35	D	315
2017	16	D	15	23	23	25	89	87	70	44	33	33	456
2018	29	D	D	27	29	37	70	84	29	35	D	25	366
ICES rectangle 37F0													
2014	70	82	143	49	69	33	33	55	38	74	84	94	824
2015	178	106	161	167	98	47	52	67	66	72	63	91	1169
2016	62	33	35	45	48	98	102	95	80	117	99	62	874
2017	49	42	152	162	66	79	61	76	73	75	73	95	1001
2018	52	59	96	106	161	64	92	153	132	120	87	95	1217
Key: **green** – 0–100 days; **yellow** – 101–200 days; **orange** – 201–300 days; **red** – ≥301 days; **D** – Disclosive data[8].													

[8] Disclosive data are provided for rectangles in which the records are from fewer than five vessels (>10 m); detailed records are not published for reasons of commercial confidentiality.

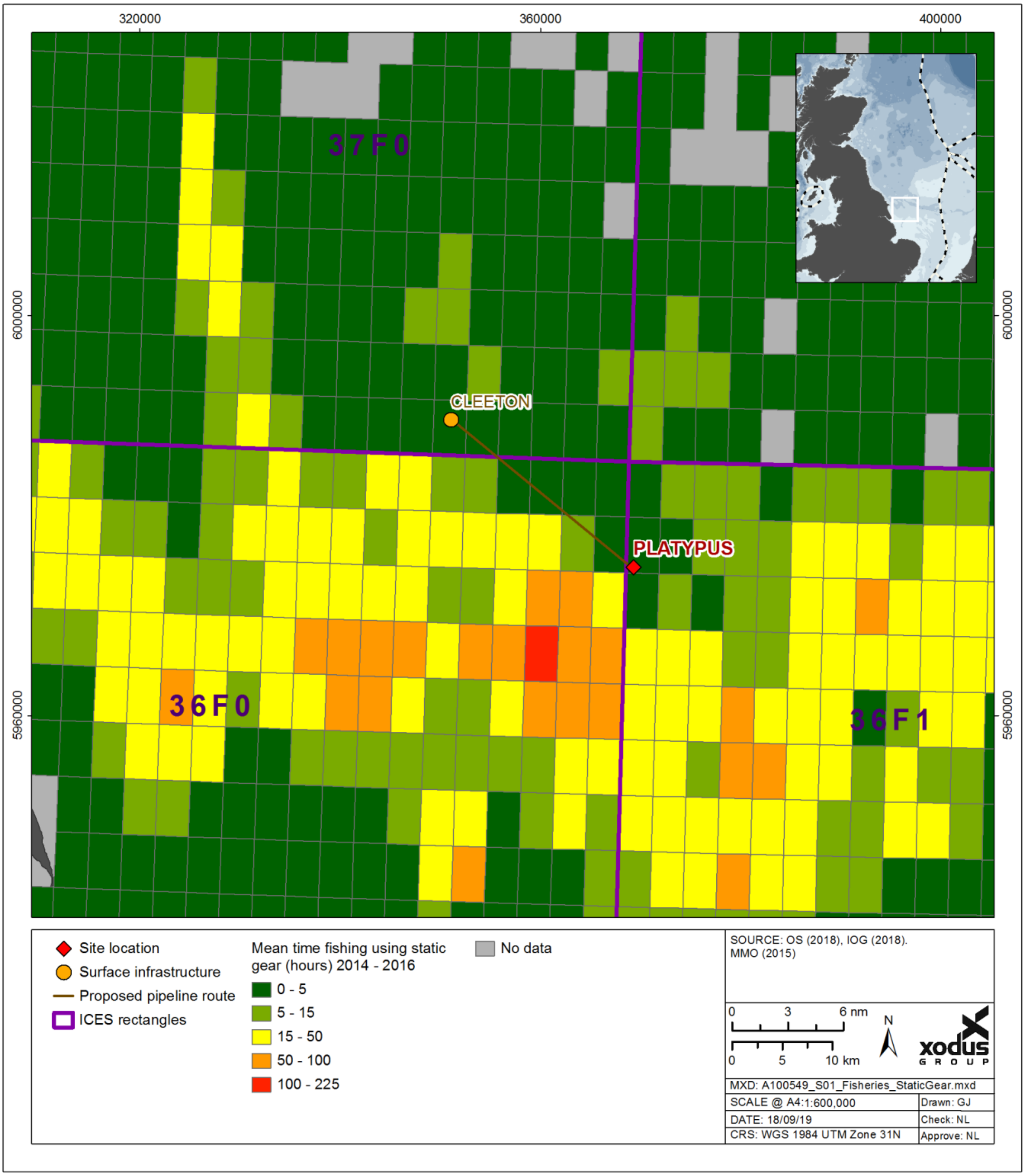

Figure 3.16: Average number of hours fished per month in ICES rectangles 36F0, 36F1 and 37F0 between 2014 and 2016 by static gears (Scottish Government, 2018)

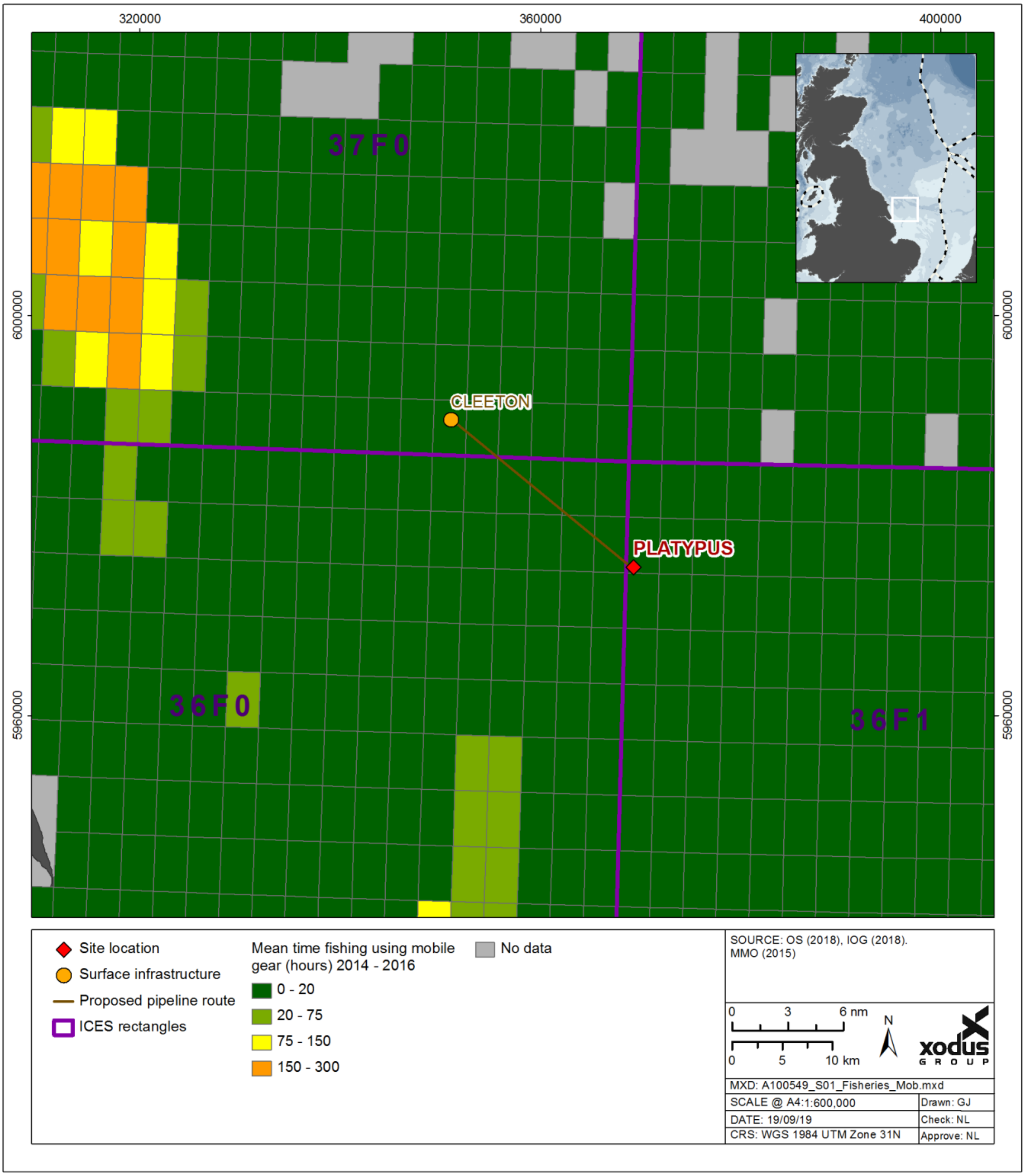

Figure 3.17: Average number of hours fished per month in ICES rectangles 36F0, 36F1 and 37F0 between 2014 and 2016 by mobile gears (Scottish Government, 2018)

3.5.2 Shipping activity

The North Sea contains some of the world's busiest shipping routes, with significant traffic generated by vessels trading between ports at either side of the North Sea and the Baltic Sea. North Sea oil and gas fields also generate moderate vessel traffic in the form of support vessels (DECC, 2016).

Shipping density at the Platypus field (Block 48/1), and along the proposed pipeline route (crossing Blocks 42/29, 42/30 and 47/5) is high compared to the rest of the UK, but these blocks do not contain traffic separation schemes or deep-water routes (OGA, 2017). The Platypus Development area lies to the NE of several shipping routes emanating from ports at Hull and Grimsby. Additionally, an active scheduled services route transects the proposed pipeline route (MIS, 2018). Figure 3.18 illustrates the vessel activity which takes place in the Development area. The majority of traffic comprises cargo vessels and tankers. Fishing, passenger and recreational vessels are also recorded within 10 nm of the Development area.

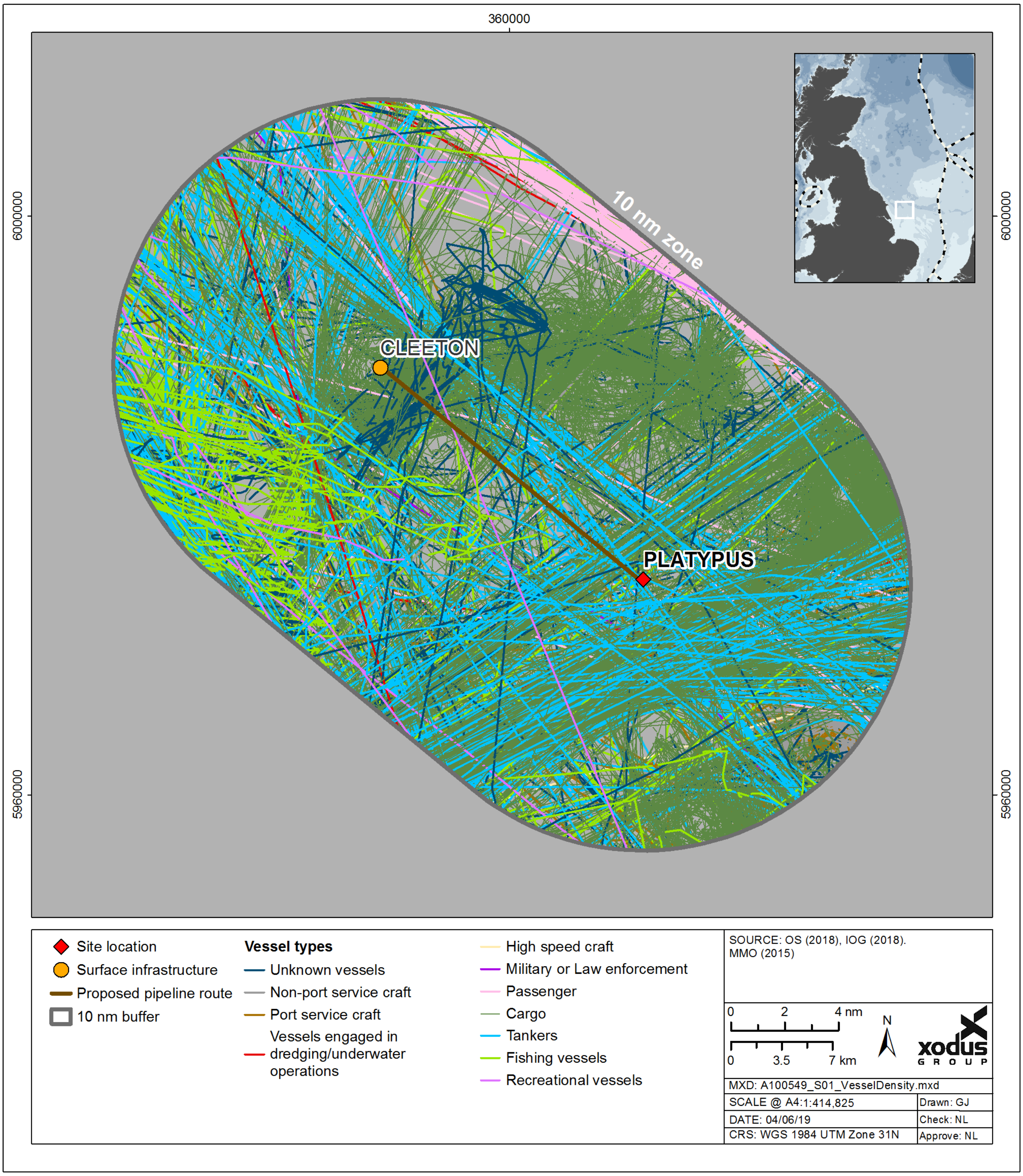

Figure 3.18: AIS tracks of commercial (non-fishing) and recreational vessels operating in the vicinity of the Platypus Development (MMO, 2015a)

3.5.3 Oil and gas activities

The proposed Platypus Development is located in an area of past and present oil and gas exploration and production and there are numerous wells, pipelines and platforms in the region. Oil and gas developments within 20 km of the proposed Platypus installation location include the Perenco-operated Hyde, Ravenspurn North and South, Neptune, Hoton, and West Sole, and the Premier Oil operated Babbage development. Oil and gas installations within a 50 km radius are detailed in Table 3-11 and Figure 3.19 (NDR, 2019).

Table 3-11: Active Oil and Gas installations within 50 km of the Platypus Development

Installation	Operator	Distance and bearing from Platypus manifold
Hyde	Perenco	11 km SSE
Ravenspurn South A, B, C	Perenco	14 km NNW
Babbage	Premier	15 km ENE
Ravenspurn North ST2, CC, ST3, CCW	Perenco	17 km NNE
Neptune	Perenco	17 km WNW
Hoton	Perenco	17 km ESE
West Sole A (8 leg & 6 leg), B, C, PP, SP	Perenco	18 km SSE
Cleeton	Perenco	23 km NW
Minerva	Perenco	28 km WNW
Rough AP, AD, BD, BP, CD	Spirit Energy	37 km WSW
Amethyst A1D, A2D, C1D	Perenco	38 km SSW
York	Spirit Energy	38 km WSW
Amethyst B1D, C1D	Perenco	39 km SSW
Pickerill A, B	Perenco	40 km SSE
Garrow NUI	Alpha Petroleum	41 km NNW
Tolmount HGS platform	ODEAM Limited	41 km WNW
Mallory	Perenco	43 km SSE
Galahad	Perenco	46 km SSE
Barque PB	Shell	47 km ESE
Kilmar NUI	Perenco	48 km NNE
Mimas MN	ConocoPhillips	48 km ESE

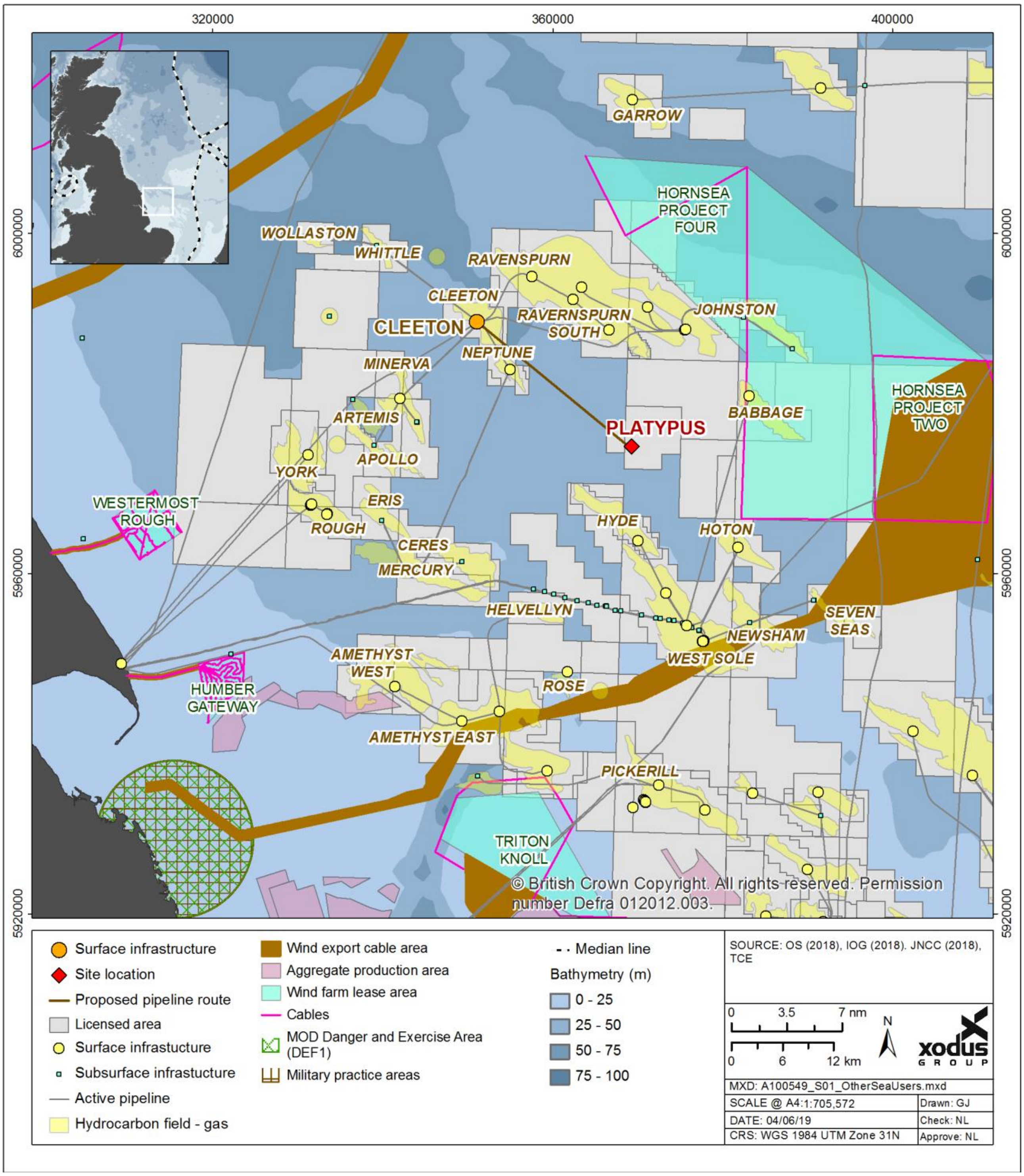

Figure 3.19: Other sea users in the vicinity of the Platypus Development

Decommissioning of nearby oil and gas installations could potentially increase interactions between the Project and nearby developments due to increased vessel presence and activities in the waters surrounding the Platypus Development area. Pickerill A and B platforms, located approximately 40 km SSE of the Platypus installation have been approved for decommissioning which is expected to be ongoing from Q2 2019 up to Q4 2023 (Perenco Gas (UK) Ltd., 2018; BEIS, 2019).

3.5.4 Renewables

The UK Offshore Energy Strategic Environmental Assessment 3 (OESEA3) Consultation (DECC, 2016) considers licensing and leasing for renewable energy, oil and gas, and carbon transportation and storage throughout UK waters. The conclusion of OESEA3 is to restrict the areas offered for leasing and licensing, temporally or spatially through the exclusion of certain areas together with a number of mitigation measures to prevent, reduce and offset significant adverse impacts on the environment and other users of the sea.

Table 3-12 below describes the wind farm developments within 55 km of the Development area. Additionally, there is a designated wind export cable area to the south of the Development area (Figure 3.19). The cables across the wind export cable area are undistributed, following a narrow route WSW towards the Humber Estuary. Given the low environmental impact associated with submarine power cables (ICPC, 2016), this cable export area is not anticipated to interact with Project activities.

Table 3-12: Wind farm leases within 55 km of the Platypus Development

Installation	Operator	Project status	Distance and bearing to Platypus installation
Hornsea Project Four (HOW04)	Ørsted Hornsea Project Four Limited	In consultation	13 km ENE
Hornsea Project Two (HOW02)	Breesea Limited	Offshore construction 2023	29 km ENE
Triton Knoll	Triton Knoll Offshore Windfarm	Consented	42 km SSW
Hornsea 1 (West)	Hornsea 1 Limited	Under construction	43 km ESE
Hornsea 1 (Centre)	Hornsea 1 Limited	Under construction	51 km ENE
Humber Gateway	E.ON Climate & Renewables UK Humber Wind Limited	Developed	52 km WSW
Westermost Rough	Westermost Rough Ltd	Developed	54 km WSW

3.5.5 Carbon capture and storage

The only site for carbon capture and storage in the vicinity is the Endurance site. Endurance lies 11.7 km NNE of the Cleeton platform, for which the National Grid has been awarded an agreement for lease.

3.5.6 Military activity

The Platypus Development is approximately 61.3 km NE from the nearest Ministry of Defence (MoD) practice area (Figure 3.19; UK Government, 2015). This MoD site is a designated Practice and Exercise Area (PEXA), wherein surface danger and firing danger areas are located.

Additionally, the OGA Block where the Platypus manifold is proposed to be located (Block 48/1), as well as one of the blocks crossed by the proposed pipeline route (Block 47/5) are within MoD training ranges (OGA, 2018). Given the concern for potential interference with MoD activities, the OGA has attached the following special condition to licensing applications occurring in these blocks:

"*The Ministry of Defence (MoD) must be notified, at least twelve months in advance, of the proposed siting of any installation anywhere within Blocks(s) 48/1 and 47/5, whether fixed to the seabed, resting on the seabed or floating, that is intended for drilling for or getting hydrocarbons, or for fluid injection. MoD will, within thirty days of receipt of such notification, either notify the Licensee that it is content with this location or else notify it that an MoD activity at the location would require re-siting of the installation from the requested location. In the case of potential difficulties identified either by MoD or by the Licensee, discussion should be held between the parties within three months of the original notification with a view to achieving a mutually acceptable location.*"

3.5.7 Telecommunication cables

The Development area is more than 100 km from the nearest telecommunications cables (MIS, 2018). The predominant cables which exist within the vicinity of the Platypus Development are those which connect renewable energy infrastructure at the nearby wind farms discussed in Section 0.

3.5.8 Aggregate extraction

The SNS is exploited for a variety of sands, gravels and sediments through aggregate extraction. The nearest aggregate extraction site is located outside the Humber Estuary, approximately 40.8 km WSW from the proposed Platypus installation location. Table 3-13 describes the aggregate extraction sites within 55 km of the Platypus Development.

Table 3-13: Aggregate Extraction sites within 55 km of the Platypus Development

Installation	Operator	Distance and bearing from the Platypus installation
Humber 4	CEMEX UK Marine Ltd	41 km SSW
Outer Dowsing	Westminster Gravels Ltd	47 km SSE
Humber 3	CEMEX UK Marine Ltd	49 km WSW
Humber 2	CEMEX UK Marine Ltd	50 km WSW
Outer Dowsing	Westminster Gravels Ltd	54 km SSW
Humber 1	CEMEX UK Marine Ltd	54 km WSW

3.5.9 Archaeology

Although the SNS is known for containing many historical wrecks (MIS, 2018), there are no known sites of archaeological significance, including wrecks, in the immediate vicinity of the Platypus Development. Benthic habitat surveys around the proposed platform location and along the proposed pipeline route, as described in Section 3.3.1, confirm this finding.

4 EIA Methodology

The following sections provide details of the methodology applied in the EIA.

4.1 EIA Overview

Offshore activities can involve a number of environmental interactions and impacts due, for example, to operational emissions and discharges and general disturbance. The objective of the EIA process is to incorporate environmental considerations into Project planning, to ensure that best environmental practice is followed and, ultimately, to achieve a high standard of environmental performance and protection. The process also allows for any potential concerns identified by stakeholders to be addressed appropriately. In addition, it ensures that the planned activities are compliant with legislative requirements and Dana's HSSE policy.

4.2 ENVID and stakeholder consultation

The main objective of the ENVID process is to identify the key potential environmental issues requiring discussion and assessment, and to agree practicable measures (mitigation) to eliminate or minimise harm to the environment. The ENVID process formed an integral part of the scoping phase with the relevant consultees. To solicit feedback on the proposed activities, Dana issued a letter to relevant stakeholders, which outlined the proposed activities and EIA scope and requested feedback on the proposals. Key issues that were raised included:

- Consideration of commercial fishing activities in the vicinity of the proposed pipeline route, minimising snagging risks from trenching activities;
- Use of the most up to date, relevant baseline environmental and societal data for the assessment of potential impact, with specific survey data used when available;
- Where data gaps exist these should be acknowledged with strategies to address these gaps prior to development;
- Consideration of marine protected sites, habitats and species which may be impacted by the proposed activities;
- Use of relevant data sources for seabird and marine mammal assessments;
- When conducting noise assessments, methodology should include recent National Oceanic and Atmospheric Administration (NOAA) thresholds (NMFS, 2018) and mitigation planning for piling where required; and
- Potential introduction of hard materials on the seabed should be minimised where possible and specific consideration provided on their actual nature conservation impact.

A full list of issues raised by statutory consultees and stakeholders, along with Dana's response, is provided in Appendix A.

The results of the ENVID process were considered during the EIA, with mitigation revised as understanding of the Project increased and with feedback from consultees. The key issues that were assessed in this ES are therefore a combination of issues identified as significant during the early ENVID process (including ENVID workshop, the output of which is detailed in Appendix B[9]), issues of importance raised by consultees, and issues that have become clearer with enhanced Project definition.

[9] Note: the ENVID workshop appendix reflects the information available at the time the workshop was undertaken and should not be viewed as a record of the final impact assessment (the final record is presented within the main body of this document).

4.3 Human Health

Human health impacts from routine and accidental events were considered during the EIA and were determined to require no further assessment within the EIA process since activities will be managed to meet industry requirements for safe operations. Section 5.5 describes possible local air quality issues associated with the Project.

4.4 Environmental Significance

The following sections provide information on how environmental significance is determined and applied.

4.4.1 Overview

The EIA Regulations require that the EIA should consider the likely potentially significant impacts of a project on the environment. The decision process related to defining whether or not a project is likely to significantly impact on the environment is the core principle of the EIA process. The EIA Regulations themselves do not provide a specific definition of significance. However, the methods used for identifying and assessing potential impacts should be transparent and verifiable.

The method presented here has been developed by reference to the Institute of Ecology and Environmental Management (IEEM) guidelines for marine impact assessment (IEEM, 2010), the Marine Life Information Network (MarLIN) species and ecosystem sensitivities guidelines (Tyler-Walters *et al*., 2001), guidance provided by Scottish Natural Heritage (SNH) in their handbook on EIA (SNH, 2013) and OPRED's updated (rev 4, March 2018) EIA Guidance, "The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – The Guide".

Once the scope of the EIA studies has been established, it is important to standardise the assessment of potential impacts. Despite being a subjective process, the use of a defined methodology framework, as outlined below, makes the assessment of environmental significance as objective and transparent as possible and consistent between different topics.

The significance of any potential impact, whether direct or indirect (both of which are considered within this EIA), is determined through the use of a risk assessment approach which employs the standard risk assessment philosophy of:

- Magnitude of potential impact (consequence) x likelihood of occurrence (frequency/probability) = Risk.

The following sections describe the criteria that have been used to assess the significance of potential impacts.

4.4.2 Consequence of potential impact

Each potential impact (Table 4-1) is considered against the following two consequence drivers:

- **Potential environmental impact**: Consideration of potential environmental sensitivities and scientific evidence on potential environmental impacts; and

- **Stakeholder concern**: Consideration of other users (potential conflict/ concern resolution), interest groups, media and the general public (wider concern), and perceived potential impacts.

This approach allows important consideration of public perception of a project as well as quantitative risk assessment of potential environmental sensitivity based on available data.

Once a potential impact has been assessed against each of the two consequences, a final single consequence rating for the potential impact (prior to mitigation) must be assigned. Overall ranking is undertaken using agreed rules applied by experienced assessors. Key rules employed are:

- A potential impact rated as severe by either of the consequence drivers remains severe;

- A potential impact rated as moderate for one of the two drivers is seriously considered for major ranking in the overall ranking;

- All lower rankings are examined for important negative criteria before overall ranking can be considered negligible; and

- In cases of uncertainty, the higher ranking of the two should be taken as the final ranking.

Table 4-1: Environmental consequence criteria definitions

Category	Potential environmental impact	Stakeholder concern
Severe	• Regional (widespread) potential impact on the quality or availability of a habitat and/or wildlife with no recovery expected or irreversible alteration (permanent). • Long-term effect on the conservation objectives of nationally / internationally protected sites, habitats or populations. • Major transboundary effects expected. • Major contribution to cumulative effects.	• International concern and extensive international media interest likely. • Well established and widely held areas of concern, including perception of threat to the global environment. • Decrease in the availability or quality of a resource to the extent of affecting over five plus years the wellbeing of the persons using that resource (e.g., fishing access or recreational use). • Potential major effect on health.
Major	• Regional (widespread) potential impact on the quality or availability of habitat / wildlife and where recovery may take place over the long term and involve significant restoration effort. • Short-term potential impact on the conservation objectives of nationally / internationally protected sites, habitats or populations. • Moderate transboundary effects expected. • Moderate contribution to cumulative effects.	• National public concern and extensive national media interest likely. • Well established and widely held areas of concern in national society. • Decrease in the availability or quality of a resource to the extent of affecting over two to five years the wellbeing of the persons using that resource. • Potential moderate impact on health.
Moderate	• Regional (widespread) change in a habitat or species beyond natural variability with recovery likely within the short-term following cessation of activities, or localised degradation with recovery over the long-term following cessation of potential impact / activity. • Potential impact on the conservation objectives of locally important sites or species. • Possible transboundary effects. • Possible contribution to cumulative effects.	• Regional concerns at the community or broad interest group level. • Decrease in the availability of a resource to the extent of affecting over one to two years the wellbeing of the persons using that resource. • Possible but unlikely effect on health, may result in or be perceived to result in a minor potential impact.
Minor	• Regional (widespread) change in habitats or species which can be seen and measured, but is at the same scale as natural variability, or localised change in a habitat or species beyond natural variability with recovery expected in the short term following cessation of potential impact or activity. • Unlikely to contribute to transboundary or cumulative effects.	• Issues that might affect individual people or businesses or single interests at the local level. Some local public awareness and concern. • A short-term decrease in the availability or quality of a resource likely to be noticed by persons using it, but does not affect their well-being.

Category	Potential environmental impact	Stakeholder concern
Negligible	• Effects unlikely to be discernible or measurable. • No contribution to transboundary or cumulative effects.	• No noticeable stakeholder concern and only limited public interest. • A possible short term decrease in the availability or quality of a resource, which is unlikely to be noticed by persons using it, or those who live in the immediate area, and does not affect their well-being.
Positive	• An enhancement of some ecosystem or population parameter.	• No public opposition / positive support. • An enhancement in the availability or quality of a resource to the extent of potentially benefiting the wellbeing of the persons using that resource or benefiting from it in some way.

4.4.3 Likelihood of potential impact

In order to assess the significance of a potential impact, the overall consequence is combined with the likelihood (frequency / probability) of the potential impact occurring. Frequency (for routine events) and probability (for non-routine events) categories are defined in Table 4-2.

4.4.4 Overall risk and potential impact significance

For every potential impact, the potential risk is obtained by combining the consequence and likelihood via the matrix presented in Table 4-3. Both significance and likelihood are semi-quantitative representing best judgements on the basis of knowledge and experience available. A matrix allows a consistent basis for presenting such a broad-based risk assessment. Interpretation of the overall risk in terms of potential impact significance can then be undertaken (Table 4-4).

Table 4-2: Likelihood guidance

Likelihood category	Routine (planned) operation frequency	Accidental event probability
5	Continuous emission or activity over life of field or Project.	Likely. More than once per year. Event likely to occur more than once on the facility.
4	Regular emission or activity. Once per year for ≤ 6 months, OR Once per month for ≤ 15 days, OR Once per day for ≤ 12 hours.	Possible. One in 10 years. Could occur within the life time of the project.
3	Intermittent emission or activity. Once per year for ≤1 month, OR Once per month for ≤ 3 days, OR Once per day for ≤ 2 hours.	Unlikely. One in 100 years. Event could occur within life time of 10 similar facilities. Has occurred at similar facilities.
2	Infrequent emission or activity. One-off event or activity over the life time of development > 10 days duration, OR Once per year for ≤ 5 days, OR Once per month for ≤ 8 hours.	Remote. One in 1,000 years. Similar event has occurred somewhere in industry or similar industry but not likely to occur with current practices and procedures.
1	One-off event or activity of ≤ 10 days duration.	Extremely remote. One in 10,000 years. Has never occurred within industry or similar industry but theoretically possible.
0	Will not occur.	Not applicable[10].

[10] It is not possible to conclude with complete certainty that an accidental event would not happen and thus this option is not made available in the EIA.

Table 4-3: Potential environmental risk

Consequence	Environment	Stakeholder	Likelihood (frequency / probability)					
			5	4	3	2	1	0
			Continuous / likely	Regular / possible	Intermittent / unlikely	Infrequent / remote	One-off event/ extremely remote	Will not occur
Severe	Severe magnitude / sensitivity	International concerns	**Severe**	**Severe**	**Major**	**Moderate**	**Minor**	**N/A**
Major	Major magnitude / sensitivity	National concerns	**Severe**	**Major**	**Moderate**	**Minor**	**Negligible**	**N/A**
Moderate	Moderate magnitude / sensitivity	Regional concerns	**Major**	**Moderate**	**Minor**	**Minor**	**Negligible**	**N/A**
Minor	Minor magnitude / sensitivity	Local concerns	**Moderate**	**Minor**	**Minor**	**Negligible**	**Negligible**	**N/A**
Negligible	Negligible magnitude / sensitivity	Individual concerns	**Minor**	**Negligible**	**Negligible**	**Negligible**	**Negligible**	**N/A**
Positive	Positive benefit or enhancement	No public interest or improves aspect of community importance	**Positive**	**Positive**	**Positive**	**Positive**	**Positive**	**N/A**

Table 4-4: Potential impact significance

Environmental risk		Potential impact significance (as defined by the EIA Regulations)
Severe	Elevated risk - requires major consideration in the design process and / or operational planning.	Considered significant.
.Major	Elevated risk - requires immediate attention and major consideration in design process and / or operational planning.	Considered significant.
Moderate	Moderate risk - requires additional control measures where possible or management / communication to maintain risk at less than significant levels.	Not significant with additional management measures in place.
Minor	Minor risk – however, will require some management / commitment to maintain risk at less than significant levels.	Not significant.
Negligible	Negligible risk - no action required.	Not significant.
Will not occur	No risk – no action required.	Not significant.
Positive	Positive - to be encouraged.	Positive significance.

4.5 Cumulative Impact Assessment

The European Commission (EC) has defined cumulative impacts as being those resulting "…from incremental changes caused by other past, present or reasonably foreseeable actions together with the project," (EC, 1999). As outlined in EC (1999) and the United States Council on Environmental Quality (US CEQ, 1997), identifying the cumulative impacts of a project involves:

- Considering the activities associated with the project;
- Identifying potentially sensitive receptors / resources;
- Identifying the geographic and time boundaries of the cumulative impact assessment;
- Identifying past, present and future actions which may also impact the sensitive receptors / resources;
- Identifying impacts arising from the proposed activities; and
- Identifying which impacts on these resources are important from a cumulative impacts perspective.

To assist the assessment of cumulative impacts, a review of existing and forthcoming developments (including oil and gas, cables and renewables) that could have the potential to interact with the Project was undertaken; the output of this review is reported in the Environment Description (Section 3.5). The impact assessment has considered these projects when defining the potential for cumulative impact (Chapter 5).

4.6 Transboundary Impact Assessment

The EIA Directive requires special procedures in the case that a project may have potentially significant impacts on the environment of other countries. For the purposes of providing adequate and effective consultation, any country which may be an affected party should be consulted. The impact assessment presented in Chapter 5 contains sections which identify the potential for, and where appropriate, assessment of transboundary impacts. For the

Platypus Development, this is an important issue for consideration given the proximity to the UK/Netherlands median line (approximately 121 km).

4.7 Habitats Regulation Appraisal

Under Article 6.3 of the Habitats Directive, it is the responsibility of the Competent Authority[11] to make an Appropriate Assessment of the implications of a plan, programme or in this case project, alone or in combination, on a Natura site (SAC or SPA) in view of the site's conservation objectives and the overall integrity of the site.

As part of the assessment of impacts on key receptors, for those receptors that are a qualifying feature of a Natura site, relevant information on SACs or SPAs has also been provided as part of the impact assessment process. This information will then be used by the Competent Authority to determine the need for, and subsequently carry out (if required), an appropriate assessment of the project.

As outlined in Section 1.4, there is an analogous process for MCZs that are designated under the Marine and Coastal Access Act 2009.

4.8 Data Gaps and Uncertainties

The North Sea has been extensively investigated by numerous researchers, meaning that this EIA has been able to draw on a significant volume of published data. This bank of published data has been supplemented by a site survey programme and studies undertaken on behalf of Dana to collect Project specific baseline data, ensuring an appropriate baseline is available against which to assess impact.

The EIA process aims to identify and characterise potential impacts using information on the current status of the environment as a basis. As potential impacts are predicted based on currently available Project and environmental information, there is some uncertainty in predictions. Impact predictions are based on Project specific surveys and the most up to date scientific knowledge and data analysis techniques currently available. Where appropriate, studies have been commissioned to inform the impact assessment, including:

- Drill cuttings dispersion modelling, to assist in predicting the fate and impacts of cuttings discharged to the seabed from the drilling process;
- Accidental hydrocarbon release modelling, to facilitate assessment of the impacts from worst case scenarios regarding a possible condensate release from a well blowout or loss of export pipeline inventory; and
- Underwater noise propagation modelling, to predict the impacts of loud underwater noise on marine mammals resulting from hammer piling and vessel use during the Project.

When evaluating and characterising potential impacts that could be associated with the Project, a variety of inputs are used, including baseline environmental data, engineering design data, worst case assumptions, modelling results, estimation of emissions and Project footprint. These inputs carry varying levels of uncertainty and conservatism (e.g., the final dimensions of seabed structures will not be confirmed until later in the Detailed Design phase of the Project) and although potential impacts may occur, they are not certain to occur (for example, there is some uncertainty in marine mammal response to certain noise emissions). As such, all potential impacts (whether predicted, residual, cumulative or transboundary) described in this ES are to a greater or lesser extent potential impacts which may or may not occur. To account for this uncertainty, worst-case assumptions have been made, and where key uncertainties exist they have been outlined within the relevant section of the impact assessment (Chapter 5).

[11] Competent Authority is the authority responsible for determining all permit/licence applications. For oil and gas projects located in UK waters, the Competent Authority is OPRED.

5 Impact Assessment

The following impact assessment examines potential impacts to six key issues identified during the EIA process and presents proposed mitigation to offset impacts.

5.1 Introduction

The key issues identified for assessment during the EIA process are as follows:

1) Discharges to sea

   Discharge of drilling muds, cuttings, cementing and completion chemicals from drilling operations, and discharge to sea during pipeline installation and commissioning, resulting in changes in water quality, localised and temporarily increased suspended solid concentrations, and possible impacts to organisms in the water column and on the seabed.

2) Seabed disturbance

   Direct loss of benthic species and seabed habitat through installation of structures and placement of rock, with wider indirect disturbance to the benthic environment through the suspension and re-settlement of sediments, and introduction of new habitat in the form of steel items and rock.

3) Other sea users

   Potential interference with other sea users including shipping and fishing during drilling and installation activities, with increased risk of vessel collisions, and loss of access to other sea users on a long-term basis during the operational phase for the life of the Project.

4) Underwater noise

   Possible injury and disturbance to marine mammals and fish through noise from vessel use and the hammered piling of some seabed structures during installation operations. For the small-scale nature and duration of the proposed drilling activities, the noise emissions are of little concern for cetaceans and they are not considered further in this assessment in isolation (MMO, 2015b). However, vessel noise has been considered as part of the assessment of cumulative noise emissions.

5) Atmospheric emissions

   Contribution to global greenhouse gases through emission of CO_2 and generation of acid rain from nitrogen oxides (NO_x) and sulphur oxides (SO_x) resulting from fuel use during installation and operation and from flaring during well testing, commissioning and operation.

6) Accidental events

   Potential for toxicity and smothering impacts to marine species and habitats through the release of hydrocarbons and chemicals from a well blowout or export pipeline inventory loss and accidental release of chemicals and fuel from vessels.

5.2 Discharges to Sea

The impact assessment for discharges to sea follows below.

5.2.1 Description and quantification of potential impact

Discharges to sea during the drilling phase of the Project include mud, cuttings, cement and clean-up and well test chemicals. Discharges due to installation of subsea infrastructure include chemicals used in pipeline flooding and cleaning, and installation and commissioning of the manifold, spools and umbilical. These discharges may lead to potential impacts to the seabed or water column through the following mechanisms:

- Increased suspended solids in the water column;
- Settlement of cuttings and muds on the seabed that may:
  - Alter the seabed topography and physical and chemical nature of the habitat due to the introduction of foreign material with different grain sizes;
  - Smother the benthic organisms where deposition and settlement are high;
  - Impair the feeding and respiratory systems of benthic organisms due to deposition of fine particles and increased concentrations of suspended particles near the seabed; and
  - Have potential toxic impacts from the muds and chemical additives.

There will be no discharge of produced water or other operational discharges from the Development; operational discharges are therefore screened out of this assessment.

5.2.1.1 Drilling discharges

5.2.1.1.1 Drilling programme

Overview

As outlined in Section 2.2, the Project will be developed by the drilling of two wells from one drill centre. The first two sections of a well (the 36" and 17½" sections) will be drilled before a marine riser is installed (Table 2-1). This means that all drilling fluids, rock cuttings and residual cement returns from these top two sections will be discharged directly onto the seabed in the immediate vicinity of the well. These sections will be drilled using seawater sweeps with periodic slugs of barite and bentonite[12].

The remaining sections will be drilled with a marine riser connecting the drill rig to the blowout preventer. As such, the mud and cuttings will be circulated back to the drill rig.

The third and fifth sections of each well (the 12¼" and 6" sections) will be drilled using LTOBM. The cuttings will be removed from the LTOBM in shale shakers, contained and shipped to shore for further treatment and ultimate disposal. The LTOBM will be treated and recycled back into the LTOBM system for re-use in the well.

The fourth (8½ ") section will be drilled using SSWBM. Mud and cuttings will be separated using shale shakers, with SSWBM recycled for further use and cuttings batch discharged from the rig near the sea surface.

An estimate of the cuttings and WBM that will be generated / used and subsequently discharged to sea is presented in Table 5-1. This table also presents the quantity of LTOBM that will be generated, treated and shipped to shore. The volumes are approximate estimates that will vary depending on final drilling fluids design and well trajectories, but that are representative for the planned wells.

[12] Bentonite is an absorbent clay which forms a viscous, shear thinning material when small quantities are added to water. This makes it a useful drilling fluid additive as it aids in preventing borehole instability.

Table 5-1: Estimate of cuttings generated, WBM discharged and LTOBM shipped to shore for one well

Section	Discharge point	Cuttings generated (Te)	WBM discharged (Te)	LTOBM shipped to shore (Te)
36"	Seabed	120	275	0
17½"	Seabed	267	1,050	0
12¼"	N/a (transported to shore)	423	0	1,315
8½"	Sea surface from rig	53	1,018	0
6"	N/a (transported to shore)	68	0	220
Total		**931**	**2,343**	**1,535**

Cementing

Steel casings will be installed in the wells to provide structural strength to support the wellheads and xmas trees, isolate unstable formations, and separate formations which have different pressures and fluids. Each steel casing will be cemented into place to provide a structural bond and an effective seal between the casing and formation. During cementing, excess cement may be produced and will be treated in the same way as WBM and discharged to sea. To limit discharge of cement, it is anticipated that all cement will be mixed as required, but as a worst-case for this assessment it has been assumed that up to a total of 534 m^3 of cement may be used across all two wells and that up to approximately 10 m^3 per well could be discharged.

All chemicals to be used within the cement will be selected based on their technical specifications and environmental performance. It is a Dana policy to avoid use where possible of all chemicals with SUB warnings. The cementing chemicals to be used have not yet been determined but will be selected following Dana's chemical management and selection policy.

Well completion chemicals

Chemicals to be used during well completion (the point at which the downhole equipment is assembled to enable production from the well) will be limited to a maximum of 80 m^3 of sodium chloride (NaCl) brine. It is expected that up to 8 m^3 of solids-free LTOBM will be recovered to the drill rig during completion activities (it will be subsequently shipped to shore). None of this material will be discharged to sea.

5.2.1.1.2 Behaviour of drill cuttings at sea

Modelling overview

An assessment of the potential impacts from the drilling of two wells at one location was conducted to inform the EIA with the aid of the Scandinavian Independent Research Organisation Stiftelsen for industriell og teknisk forskning (SINTEF) Dose Related and Effect Assessment Model (DREAM) ParTrack model. The parameters used to undertake the modelling are briefly described here to provide some context to the findings and their relevance to the realistic drilling scenario. Whilst the results of modelling cannot be directly substituted for observed impacts occurring during an actual drilling situation, modelling is a useful tool to help assess the risk of potential impacts.

The modelling has been undertaken based on the discharge from the two top sections (36" and 17.5") and the fourth section (8.5") of the planned wells only, due to there being no discharge at the seabed from the third and fifth sections. The top-hole cuttings will largely affect the seabed immediately around the wellbore only (i.e., the location of discharge), whilst the material from the 8.5" section will be released from the rig, and descend through the water column before settling on the seabed over a wider area. It has been assumed that the two wells will be batch drilled, so the discharge of material from the first section of the first well was simulated, then the first section of the second well and so on. When drilling a new section, the discharge was assumed to commence six hours after the completion of the previous section. While in reality the two wells will be drilled at two separate locations in the same general area, as a worst case the model was set up so that the discharge from bothwells occurs at the same location.

The DREAM model determines the relative risk to the marine environmental compartments by calculating an Environmental Impact Factor (EIF). Further details regarding the EIF calculation are provided in the box below.

Environmental Impact Factor (EIF)

EIFs are a relative measure of impact to the biota in the marine environment. They are calculated using the PEC / PNEC approach, where the predicted environmental concentration (PEC) of a contaminant is divided by the predicted no effect concentration (PNEC). The PNEC is the highest concentration at which no environmental effect is predicted. A result of >1 indicates there may be an environmental risk.

The PNEC values within the ParTrack model have been calculated using laboratory toxicity tests of a range of contaminants on a range of species. The PNEC for each substance has been defined within the model as the concentration at which the no observed effect concentration (NOEC) was exceeded in 5% of tests. In other words, the PNEC for any given chemical within the model would be expected to have an impact on 5% of all species tested. Pseudo-PNECs for non-toxic stressors such as burial and oxygen depletion which are relevant to benthic biota have also been calculated from experimental data.

The PEC for each contaminant is determined within the model using a number of calculations to simulate the behaviour of contaminants in the water column. Processes including dilution, partitioning, degradation and deposition into the sediment are simulated in order to generate a PEC for each contaminant over time. EIFs for the sediment compartment are more complex, incorporating toxicity of contaminants, but also processes such as oxygen depletion, change in median grain size and burial effects.

For the water column, an EIF of 1 is equal to 5% risk of impact to all species in 100,000 m^3 of water, whilst for sediments, an EIF of 1 is equal to 5% risk of impact to all species in 0.01 km^2 of seabed.

Sediment impact

Burial of benthic organisms may result in their mortality depending on the depth of cuttings deposition. Filter feeding organisms (for example hydroids and bryozoans) that rely on suspended particles as a source of food may be more vulnerable to the potential smothering impacts of the drilling discharges than deposit-feeding organisms that rely on material that has already settled. More mobile species may be able to avoid unfavourable conditions, and to work their way back through the cuttings to the surface.

Feeding structures may become clogged with increased suspended solids in the water column just above the seabed and therefore feeding could be temporarily limited. Due to the short-term and one-off nature of drilling activities the increased suspended solids loading is not expected to persist.

After deposition, the particulate material would be subject to re-distribution through the action of seabed currents. It is anticipated that recovery of the seabed will start immediately following cessation of drilling due to bioturbation and recolonisation of smothered sediments as species move back into the disturbed area. However, the short-term impact could affect the composition of the benthic community in the immediate vicinity of the drilling location.

The modelled thickness of the deposited drilling mud from the two wells is presented in Figure 5.1 and Figure 5.2, in plan and section view, respectively. The modelled cuttings pile is predicted to have a maximum thickness of 3.3 m, rapidly decreasing as the distance from the discharge point increases such that, within approximately 100 m of a wellbore, the cuttings thickness has decreased to less than 0.3 m and within approximately 1.3 km it has decreased to less than 2 mm thick. Wider scale deposition of small amounts of finer material are also predicted by the modelling; however, the amount of material deposited is very small and spread over a very large area such that it would be patchy and not easily detectable in the environment. The thickest area of the mud and cuttings pile was predicted to be formed to the immediate SW of the drilling location. The sediment EIF is predicted to be zero throughout the drilling activities.

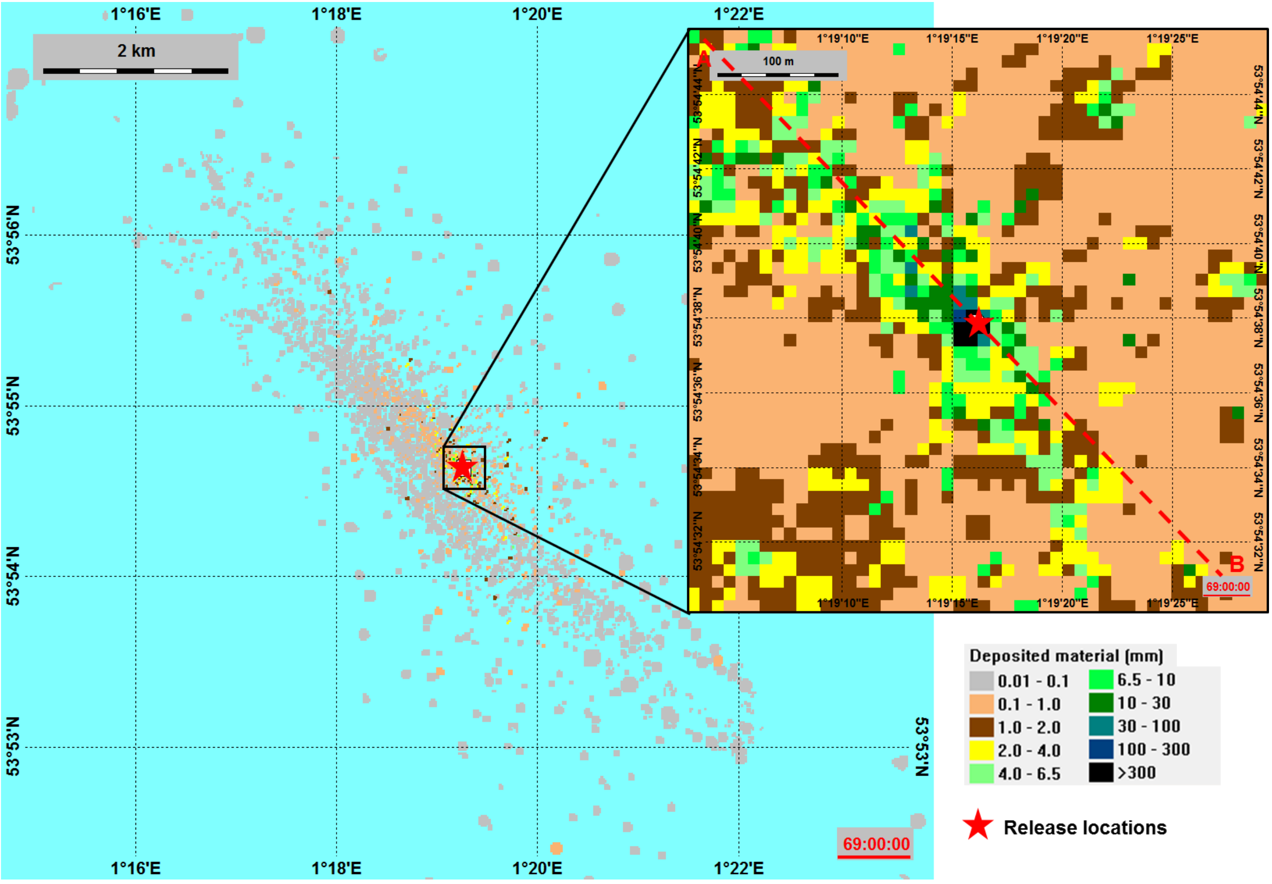

Figure 5.1: Mud and cuttings accumulation on the seabed

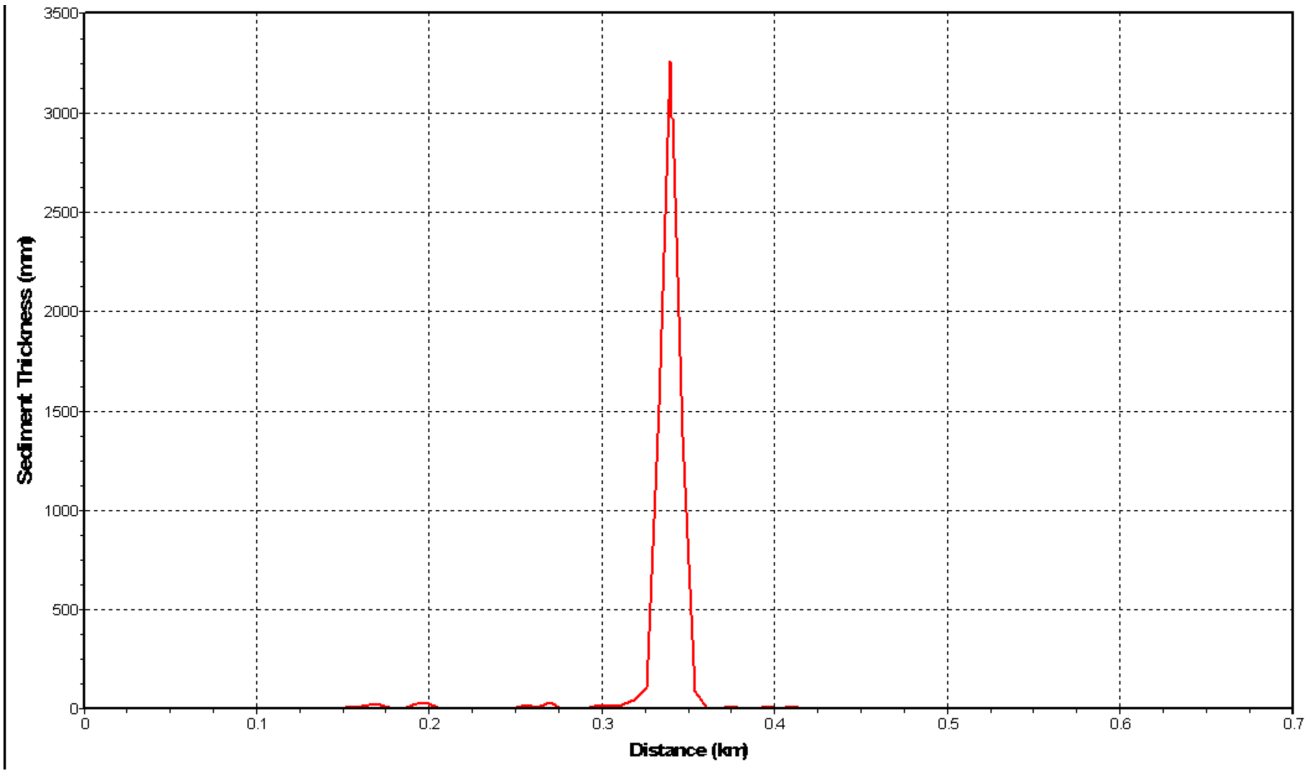

Figure 5.2: Mud and cuttings accumulation on the seabed along transect A-B shown in Figure 5.1

Water column impact

Both the physical and chemical impacts of drilling discharges in the sea can also result in potential impacts to the water column. Discharges to the water column have the potential to affect fish, planktonic organisms and organisms living at or near the seabed. Organisms affected could experience interference with feeding, respiration and migration due to increased concentrations of suspended particles near the seabed and in the water column.

Increased suspended solids, especially near the seabed, may result in direct irritation to certain types of marine organisms, abrading protective mucous coatings and increasing their susceptibility to parasites and infections, as well as affecting growth, reproduction and feeding.

The magnitude of the water column EIF varies with the metocean conditions and composition of the discharge. Three peaks in EIF are predicted, with the highest (5052) predicted to occur during the drilling of the tophole sections of the wells (when discharges will occur at the seabed). The EIF returns to zero approximately three days after the end of the final discharge. Bentonite is the main contributor to the water column EIF (82%), followed by biocide (13%) and barite (5%). This indicates that the short-term, spatially limited, predicted impact is predominantly due to particle stress caused by the discharge of fine clay particles in the drilling fluids rather than toxicity from any chemicals present.

5.2.1.2 Aqueous discharges

Installation and commissioning

A variety of chemicals will be discharged to sea during installation and commissioning of the pipelines. These will include hydrotest inhibitor, neutralising chemicals and tracer dye, and may include methanol and MEG.

5.2.2 Mitigation

A number of management and mitigation measures will be adopted by Dana to reduce, where possible, the potential impacts from discharges to sea:

- Where possible there will be zero discharge of LTOBM contaminated cuttings, but should discharge become inevitable, Dana will ensure these are cleaned to within the legislative limit applying at the time of operation;
- A rig audit will be conducted to the ensure rig is in compliance with all relevant guidelines and legislation;
- During well clean-up, water/hydrocarbon interface fluids will be captured and tested:
    - If oil in water concentration is equal to or below 30 milligrams per litre (mg/l) then the fluids will be discharged overboard in accordance with permits; or
    - If oil in water concentration is above 30 mg/l fluids will be filtered until they are below 30 mg/l for overboard discharge; and
- Chemicals with benign environmental profiles (those that carry CEFAS Gold or OCNS Group E or D rankings) will be selected where technically feasible.

5.2.3 Cumulative and transboundary impact

The thickness of mud and cuttings deposition on the seabed will rapidly decrease with increasing distance from the well. Deposit thickness will be less than 0.3 m (30 cm) within 100 m of the discharge point, and less than 2 mm within 1.3 km from the discharge point. There is good recovery potential due to natural processes such as physical redistribution including resuspension or bioturbtion in the high-energy shallow water environment. Whilst there is potential for similar oil and gas drilling activity at other locations in the SNS, the impacts from these activities on the benthic environment will be similarly limited both spatially and temporally. These factors, together with the absence of known imminent drilling projects in the close vicinity of Platypus, limit the likelihood of benthic impacts from drilling discharges in the area acting additively or synergistically in terms of footprint or persistence.

The limited quantity of chemicals discharged during the life of the Project, for example during well clean-up, and the use of appropriate management and mitigation measures, limits the likelihood of measurable impacts. For this reason, no significant cumulative impacts are expected due to chemical discharges. The transient nature of impacts to the water column, the short duration of the proposed operations and the management and mitigation measures that Dana will have in place will also mean that no significant cumulative impacts are expected with regard to the water column.

Drilling discharges will take place approximately 121 km from the UK/ Netherlands transboundary line and as such, no transboundary impacts are expected.

5.2.4 Decommissioning

The Development Area exhibits strong seabed currents and high seabed sediment mobility and so it is not expected that a persistent cuttings pile will be formed. As such, there is little potential for environmental impacts due to cuttings pile disturbance during decommissioning. If any mud or cuttings material is still present when decommissioning occurs, the impacts from disturbance of this material are likely to be smaller than those caused by the initial discharge. The mitigation measures described in this section with respect to selection and optimisation of chemical use will also apply to the decommissioning process and chemical risk assessments will be conducted in line with the applicable regulations at the time.

Considering the above, the potential impacts from decommissioning are thus likely to be no greater in magnitude to those experienced during drilling and installation and thus not significant.

5.2.5 Protected Sites

The conclusions on the impacts presented in this section have taken account of relevant protected sites. Discharges associated with the Platypus Development will occur within the boundary of the SNS SAC. Harbour porpoises, which are the designated feature of this site, are not expected to be vulnerable to the temporary and small scale increase in water column turbidity and toxicity that is expected from the drilling and pipeline installation discharges, and as such, no significant impacts are expected on the protected feature of the site.

Modelling indicates that water column impact will not spread far enough to interact with any other protected sites. As such, there is considered to be no likely significant effect (LSE) on SACs, SPAs and MCZs and hence no impact on any conservation objectives or site integrity.

5.2.6 Residual impact

Seabed impacts

The accumulation of cuttings greater than 30 cm thick will be restricted to within 100 m of the discharge point. The seabed around the drill location has been characterised as sand (Section 3.2.2). The area within which direct seabed and habitat impacts will occur as a result of the Project is small relative to the wider occurrence of similar habitats within the areas surveyed and across the SNS. As described in Section 3.3.1, no evidence of any threatened or declining species or habitats (whether Annex I, OSPAR (2008) or UKBAP (Maddock, 2008)) was recorded in the vicinity of the Platypus Development during the environmental surveys. Consequently, the drill cuttings will not interact with, or impact upon any sensitive habitats.

Various studies have indicated that there are only limited and transient impacts to seabed infauna from the deposition of drill cuttings and entrained WBMs from single well sites (e.g., Daan and Mulder, 1993). Although Daan and Mulder (1993) investigated a well site with more sections drilled, causing a larger impact than in this Project, the results are still applicable. Similarly, Neff (2005) reported that as WBM is non-toxic or practically non-toxic to marine animals, the impacts of WBM cuttings piles on bottom living biological communities are caused mainly by burial and resultant low sediment oxygen concentrations, rather than inherent toxicity of the drill cuttings. These conclusions are reflected in the predicted sediment EIF from the modelling described here. Recovery of benthic communities from burial occurs by recruitment of new colonists from planktonic larvae and migration from adjacent undisturbed sediments. Such recovery typically begins shortly after completion of drilling and is often well advanced within a year.

Water column impacts

Water column residual impacts relate to both the physical and chemical affects experienced predominantly by biota within the water column, including marine mammals, fish and planktonic species. Plankton are particularly susceptible to impacts from drill cuttings because they are generally non-motile, depending upon currents within the water column to travel, and cannot move away from an affected area (Ikpeme *et al.*, 2013). Considering the relatively limited area over which the water column is predicted to be affected, drilling activity at Platypus is not considered to represent a significant residual impact to impact to the water column.

Although there are likely to be a number of discharges of inhibited seawater during in-field operations (e.g., installation and commissioning of infrastructure), discharges will be limited in quantity and occur only intermittently. These are likely to be rapidly dispersed in the turbulent offshore environment meaning that there is no possibility of significant impact to species in the water column.

5.2.7 Conclusion

5.2.7.1 Installation and commissioning

Considering all of the above, including that there will be no impact on protected sites or on species from protected sites, the residual consequence of discharges to sea due to the drilling involved with the Platypus Project together with the discharge of commissioning chemicals, is ranked as minor. The drilling of the two wells and commissioning activities are considered infrequent events. As a result, the residual impact of discharges to sea by the Platypus Project during installation and commissioning will be negligible and is therefore not significant.

Consequence	Likelihood/frequency	Residual risk	Significance
Minor	Infrequent	Negligible	Not significant

5.3 Seabed Impacts

The assessment for seabed impacts follows below.

5.3.1 Description and quantification of potential impact

The area of seabed that may be directly and indirectly impacted by the Platypus Development is quantified in Table 5-2. Direct impacts are those caused directly by disturbance of the seabed during Project activities such as seabed excavation and rock placement on the seabed. Indirect impacts are those caused by sediment resuspension and re-settling due to Project activities, and will occur both within the direct impact footprint and in the area immediately adjacent to the direct impact footprint.

Physical disturbance caused during drilling activity and installation of the manifold, pipeline, umbilical and spools can cause mortality or displacement of benthic biota in the direct impact footprint. The significance of direct habitat loss or mortality of sessile organisms (those that are attached and unable to move about freely) seabed depends on the footprint of the area of disturbance, the level of tolerance of the affected habitat and species to direct disturbance, the conservation value of the affected habitat or species, and the uniqueness of the affected habitats or species assemblages to the area.

The drilling of two wells from one drilling location at the Platypus installation will be conducted from a jack-up drilling rig. Jack-up rigs use spud cans on the bottom of the legs to support the rig on the seabed. There is the possibility that scour protection, in the form of rock placement, will be required to prevent scour from undermining the spud cans and destabilising the rig (Section 2.2.3). After the rig has finished operations and been removed, this rock material will be left *in situ*, constituting a long-term but localised seabed impact.

It is also likely that a jack-up vessel will be used to provide accommodation for personnel working on the Cleeton topsides modifications, and this may also require spud can scour protection, resulting in an additional area of localised long-term impact, 24 km from that required for the drilling rig In both cases, scour protection will be placed around the outside of the spud cans, not underneath them, such that when the spud cans are lifted from the seabed at the end of operations, a ring-shaped area of rock placement will remain. The new manifold structure and the two new subsea wellheads will also have a long-term direct impact on the seabed. The areas affected by each activity are detailed in Table 5-2.

The 12" production pipeline and umbilical will be laid in the same trench and will be buried for the full route except at the tie-in points at either end. Crossings of existing infrastructure at the Cleeton end will occur after the pipeline and umbilical exit the trench on approach to the Cleeton tie in points. The width of the trench is expected to be 5 m, but the full width of seabed disturbance including backfilling operations will occur within a corridor of up to 25 m, since backfilling of the spoil heaps may generate up to 10 m of disturbance on either side of the trench.

The trenching and backfilling is expected to be a temporary impact, however as discussed in Section 2.4.5 there is a possibility that rock armour will be required to mitigate areas of insufficient burial and prevent upheaval buckling. Rock placement is expected to result in long-term impact as it will change the character of the seabed.

The two ends of the pipeline and associated tie-in spools will be surface laid. These sections of pipeline will be protected by rock placement and concrete mattresses. While there may be some overlap in mattress and rock armour cover, it has been assumed as a worst case that there is no overlap, maximising the estimated area of seabed impacted.

The intention is to use a pipelay vessel with a dynamic positioning (DP) system, so that no additional anchoring is anticipated at the Platypus Development area. If no DP vessel is available at the time of pipeline installation activities, an anchored barge may be used and the associated seabed impact will be considered in the consent to locate permit application and associated EIA justification document submitted to OPRED.

In addition to the direct loss and / or disturbance of benthic habitats, seabed disturbance will also potentially lead to the smothering of benthic species and habitats due to sediment suspension and re-settlement. Rock placed on the seabed, installation of subsea facilities, especially the backfilling of the pipeline trench, and installation and retrieval of spud cans associated with the jack-up rig and accommodation jack-up is likely to result in some sediment suspension and re-settlement. Exposure to higher than normal loads of suspended sediment has the potential to negatively affect adjacent habitats and species. The re-settlement of sediments can result in smothering (Gubbay, 2003), with the degree of impact related to the ability of buried species to regain the sediment surface or to clear particles from their feeding and respiratory surfaces. However, DEFRA (2010) states that impacts arising from sediment re-suspension are short-term (generally over a period of a few days to a few weeks); in addition, infaunal communities are naturally habituated to sediment transport processes and are therefore less susceptible to the direct impacts of increased sedimentation rates and will work their way back to the seabed surface through blanket smothering.

As a precautionary estimate, it has been assumed that indirect impacts will occur across an area twice that of the direct impact footprint. All indirect impacts from sediment re-suspension are expected to be short-term as discussed above.

Spool and umbilical installation at the Cleeton platform will result in the disturbance of approximately 0.01 km^2 of seabed within the Cleeton safety zone, supporting an well distributed historical drill cuttings accumulation. This disturbance is included in the areas presented in Table 5-2.

Table 5-2: Quantification of the area of seabed that may experience direct or indirect disturbance

Parameter and assumptions	Direct area (km^2)	Indirect area (km^2)
Placement of 2 x subsea wellheads and trees each measuring 9.5 m x 9 m.	0.0002	0.0004
Placement of subsea manifold measuring 10 m x 7 m.	0.0001	0.0002
Siting of 3 Platypus jack-up rig spud cans on the seabed	0.001	0.002
Rock placement at the Platypus jack-up rig for scour protection (up to 1,300 Te).	0.005	0.011
Siting of 4 Cleeton W2W jack-up vessel spud cans on the seabed	0.001	0.002
Rock placement at the Cleeton W2W jack-up vessel for scour protection (up to 1,300 Te).	0.005	0.011
110 x concrete mattresses (6 m x 3 m each) protecting spools, umbilicals and crossings at Platypus and Cleeton.	0.002	0.004
13,500 Te of rock armour protected protecting untrenched pipeline sections, umbilicals and crossings at Platypus and Cleeton.	0.009	0.018
23,300 m trenched and backfilled pipeline and umbilical within a 25 m wide corridor (this also includes impact from pre-sweep dredging and will be co-located with 22,000 Te of rock armour deposited to prevent upheaval buckling).*	0.583	1.165
Total impact (note that the indirect impact will be short-term)	**0.606**	**1.214**[13]

* Impact outside 500 m safety zone

5.3.2 Mitigation

The following management and mitigation measures will be adopted by Dana to reduce, where possible, the potential Project impacts on benthic habitats and species:

- The volumes and locations of rock and mattress used will be refined during Detailed Design to reduce the footprint on the seabed to the minimum extent practicable;
- The spread of rock placement will be restricted through the use of a fall pipe system held a few metres above the seabed to accurately place rock material;
- The pipeline and umbilical will be installed in the same trench; and
- The trench will be backfilled to prevent berms that may modify the seabed landscape.

5.3.3 Cumulative and transboundary impact

DECC (2016) identifies that the sources of cumulative physical disturbance to the seabed associated with oil and gas activities include drill rigs, wellhead placement and recovery, subsea template and manifold installation and

[13] Indirect impact area is estimated to be twice the direct impact area, however due to rounding, the total indirect impact area shows as slightly more than twice the total direct impact area.

piling, umbilical and pipeline installation and trenching and decommissioning of infrastructure. Of these, pipelay is considered to account for the largest spatial extent. Whilst the Platypus Development will result in a predicted direct total disturbance of approximately 0.606 km^2 and an indirect impact of approximately 1.214 km^2 of seabed, the majority of this area will only be temporarily disturbed, and the area affected is small relative to the available similar habitat in the vicinity of the Project and in the wider SNS. There are a number of other oil and gas projects within a 40 km radius of the Project and it is likely that these projects will have similar magnitudes of seabed footprint to the Platypus Development. The offshore wind project HOW04, located 13.2 km ENE, will result in a maximum area of temporary habitat disturbance offshore of 41.7 km^2 (Ørsted, 2019). The total area of direct disturbance resulting from the Platypus Project equates to 0.014% of the area disturbed by HOW04.

Ørsted (2019) concluded that the potential impacts arising from the construction, operation and decommissioning of Hornsea Four (including cumulatively) on subtidal benthic ecology receptors would result in a significance of minor or negligible. The potential effects on subtidal benthic ecology receptors were therefore not significant. This, combined with the lack of sensitive seabed habitats in the vicinity of the Platypus and Hornsea projects, and small relative increase in disturbance to sediment from the Platypus project in addition to the offshore wind and other oil and gas projects in the vicinity, indicates that the cumulative impact of the project on the seabed is considered to be negligible.

OESEA3 (DECC, 2016) states that seabed impacts are unlikely to result in transboundary effects and even if they were to occur, the scale and consequences of the environmental effects in the adjacent state territories would be less than those in UK waters and would be considered unlikely to be significant. Given the distance from the Platypus Development to the UK / Netherlands median line (121 km), direct and indirect seabed impacts will not extend this far from the Platypus Development and transboundary impacts will not occur.

5.3.4 Decommissioning

Any potential impacts that decommissioning operations (e.g., removal of Project infrastructure) may have through seabed disturbance will occur in an area that experienced seabed disturbance during the installation operations. The potential impacts from decommissioning operations are likely to be similar in magnitude to those experienced during installation and thus not significant.

5.3.5 Protected sites

It is important to note that seabed impacts associated with the Platypus Development will not occur within any SAC, SPA or MCZ designated for seabed features (Figure 3.15). In addition, seabed impacts will not spread sufficiently far to interact with any protected areas.

Sandeels, which are an important food source for harbour porpoise protected by the SNS SAC, are expected to use the Project area as a spawning and nursery ground. Review of the sediment sampling results at the Platypus site and along the pipeline route indicated that only one station had sediment characteristics that would be suitable for sandeel spawning and juvenile recruitment. Seabed disturbance at Cleeton will occur between Q2 2021 and Q1 2022, and will be a one-off event. As such, it is not expected to result in a significant impact on sandeel spawning, or have any significant indirect effect on the SNS SAC harbour porpoise population.

Herring (*Clupea harengus*) is a UKBAP priority species and spawning areas for this species are known to occur on gravelly sediments. Assessment of the sediment characteristics across the Platypus site and along the pipeline route revealed that the sediments were unsuitable for herring spawning, indicating that the proposed activities will not have a significant impact on the population.

As such, there is considered to be no LSE on SACs, SPAs and MCZs and hence no impact on conservation objectives or site integrity.

5.3.6 Residual impact

5.3.6.1 Seabed and habitat impacts (direct impacts)

All biotopes, including those found in the seabed type, A5.25 “circalittoral fine sand”, in the Platypus Development area are by definition sensitive to permanent change to another physical sediment type because this fundamentally changes the nature of the habitat in an area (Tillin and Tyler-Walters, 2014). The areas of seabed covered with rock placement or concrete mattresses, as well as the areas covered by the new manifold and wellheads, will experience a long-term loss of the biotope complex initially present, however the area impacted will be extremely localised and therefore unlikely to be significant. The penetration of the jack-up rig and jack-up vessel spud cans in the seabed will cause surface and sub-surface abrasion. The circalittoral sand and circalittoral coarse sediments expected in the area show a low to moderate sensitivity to increased levels of siltation, a moderate sensitivity to change in seabed type and a moderate sensitivity to surface and sub-surface abrasion and penetration. Given that the area will be small, and the abrasion and re-suspension of sediments will be temporary, the potential impact is not expected to be significant.

Several of the most common infaunal species identified across the survey area (Fugro, 2019b) are tolerant of smothering. These include *A. alba*, *F. fabula* and *S. bombyx* (Budd, 2007; Rayment, 2008; Ager, 2005). This is probably because the Development area is within a generally dynamic environment, with fairly regular sediment deposition and removal events occurring due to storms, thus favouring species that are tolerant of frequent sediment redistribution.

Along the pipeline route, seabed trenching and backfilling activities will disturb a corridor up to 25 m wide, where surface and sub-surface abrasion will occur, and may create species displacement. However, this disturbance will be temporary and the fact that the pipeline will be buried means that benthic species will have continued access to surface sediments following the installation phase. The only deposits causing long-term impact will be the wellheads, the manifold and the areas of rock and concrete mattress protection. Long term impact is expected to occur over approximately 0.6 in total, which is not expected to constitute a significant impact.

5.3.6.1.1 Cuttings disturbance

Whilst the Cleeton wells were originally drilled using OBM that were discharged to sea, there is no evidence of any remaining cuttings around the platforms. In addition, because there will be no excavation to the sediments within the 500 m zone during the installation of the pipelines, it is concluded that the installation of Platypus infrastructure will not result in disturbance to any cuttings contaminated material.

5.3.6.2 Suspension and re-settlement of sediments (indirect impacts)

An estimate of the area of seabed likely to be indirectly impacted by the Project is provided in Table 5-2. Installation activities, primarily through trenching of the pipeline, will likely result in the raising of sediment plumes into the water column, which will then re-settle onto the seabed.

Defra (2010) states that impacts to the benthic environment in general arising from sediment re-suspension are short-term (generally over a period of a few days to a few weeks). The total area affected by indirect disturbance from installation of the Platypus infrastructure is expected to be limited (up to 1.2 km^2), and the local fauna is expected to be generally tolerant of increased sediment deposition as discussed in Section 5.3.6.1. This disturbance will be temporary, and re-settled material is expected to be rapidly entrained into the naturally energetic sediment transport regime. As such, impacts from indirect disturbance are not expected to be significant.

5.3.6.3 Impacts on herring spawning

As noted in Section 3.3.2.4, investigation of the Platypus site and pipeline route indicated that the area was unsuitable for herring spawning, and as such, no impact on herring spawning is expected.

5.3.7 Conclusion

Considering all of the above, noting that there will be no impact on protected sites or on species from protected sites, that the footprint of the Project for the life of field will be localised and that the affected habitat is expected to be widespread in the region, the residual consequence of seabed disturbance is ranked as minor. Direct seabed disturbance and indirect impacts due to sediment re-suspension will occur only during the drilling and installation activities and are thus considered an infrequent activity in terms of likelihood. As a result, the residual risk to seabed species and habitats from the Platypus Development is considered negligible and not significant.

Consequence	Likelihood/frequency	Residual risk	Significance
Minor	Infrequent	Negligible	Not significant

5.4 Other sea users

The impact assessment for other sea users follows below.

5.4.1 Description and quantification of potential impact

5.4.1.1 Increased vessel traffic and collision risk

The temporary physical presence of Project vessels has the potential to interfere with other sea users in the area and may increase the risk of vessel collision.

Drilling and well completion activities are expected to start in Q4 2021 and finish by Q2 2022. Installation of subsea structures, the pipeline, and the umbilical is expected to occur over Q3 2021 to Q1 2022. As such, Project vessel activity will be highest between Q3 2021 and Q4 2021 when both drilling and subsea installation activities are ongoing.

5.4.1.2 Exclusion from Development area

The Platypus Development will involve drilling two wells in close proximity to each other. The jack-up drilling rig will remain jacked up in one location during the drilling campaign, and a temporary 500 m safety exclusion zone will be implemented around it. This temporary exclusion zone will be cancelled upon completion of drilling operations. However once the new subsea manifold is installed, this will have a new permanent 500 m safety exclusion zone applied to it, which will be maintained throughout the life of the field.

The purpose of the drilling safety zone is to ensure the safety of all personnel involved in the drilling activities and to minimise the risk of collisions between the vessels involved with the drilling activities and other vessels in the area. The purpose of the manifold 500 m safety zone is to minimise the risk of fishing gear snagging on the manifold, which could both endanger fishing vessels and risk damage to the manifold and associated pipework.

The pipeline and umbilical installation vessels, including the pipelay, rock placement, installation and associated support vessels will exclude other sea users around their immediate vicinity between Q2 2021 and Q1 2022.

5.4.1.3 Snagging risk

Disturbance of the seabed resulting in raised or depressed areas and steep changes in gradient can increase the risk of deployed fishing gear pulling through large masses of sediment instead of travelling over the surface. This may result in recovery to vessel of sediment in nets; damage to gear; loss of gear and danger to vessel and crew if gear becomes snagged. The degree of snagging risk caused by seabed disturbance depends partly on the consistency of the sediment. Sandy, loose sediment will provide relatively little resistance to towed gear. Gear is more likely to be able to pull through sandy sediment, and any sediment that is collected in the gear is likely to wash out. Cohesive clay sediment is likely to generate more resistance to gear, and if it becomes caught in the gear, is less likely to wash out, so is more likely to contaminate gear and catches. In addition, mounds, depressions and berms formed in clay sediments are likely to persist for longer, while features formed in sand are likely to be re-worked by the currents fairly rapidly. As discussed in Section 3.2.2, the seabed sediments in the Development area comprise coarse rippled sand with shell fragments. Consequently, depressions and berms formed during Project activities will be short-lived, and are unlikely to pose a significant snagging risk.

Placement of infrastructure on the seabed, whilst unlikely to cause contamination, can increase the risk of snagged gear with potential risk to safety of vessel and crew. The installation of the Platypus Development will involve the placement of infrastructure that has the potential to form a snagging risk; these are detailed in the sections below.

Pipeline installation

No permanent safety exclusion zone will be in place along the pipeline and, as such, once the installation and support vessels have moved out of the area, there will be no statutory restrictions on fishing in the vicinity. The vast majority of the pipeline will be trenched and buried, with surface laid sections limited to the 500 m safety exclusion zones surrounding the CW platform at one end of the route, and the new Platypus manifold at the other. Crossings will be protected by a combination of rock and mattresses designed to be over-trawlable.

The pipeline and umbilical will be trenched to a minimum depth of 0.6 m and will subsequently be backfilled. Backfilling should eliminate any berms formed during the trenching process, however, a post-lay survey will be completed which will identify any remaining snag hazards for subsequent mitigation. All deposits of concrete mattresses and rock armour will be over-trawlable. The installed infrastructure will be monitored throughout its operational life, ensuring pipeline stability and burial is maintained. As a result, there will be minimal risk of snagging post-installation.

Spud can depressions

The jack-up rig used for drilling the Platypus wells and the jack-up vessel expected to be used to provide accommodation during the Cleeton topsides modifications will be supported on spud cans. The spud cans will be forced into the sediment during the jacking up process. When the rig and vessel are eventually moved off station, the spud cans will leave large depressions in the seabed which may form a potential snagging risk. The spud can depressions will, however, be inside the 500 m safety exclusion zones associated with the CW platform and the new Platypus manifold and as such are not expected to cause a snag risk.

5.4.2 Mitigation

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

- A vessel traffic survey will be undertaken for the area closer to the proposed start of drilling as part of the standard permitting process, together with a collision risk assessment;
- During installation the number of vessels and length of time they are required on site will be reduced as far as practicable through careful planning of the installation activities;
- A safety zone of 500 m in radius will be established around the drill rig during drilling and around the Platypus drill centre for the life of the Project;
- A standby and support vessel will operate during the period that the drill rig is in place. These vessels will ensure that other sea users are aware of the presence of the rig and the 500 m safety exclusion zone;
- Information on the location of subsea infrastructure and vessel operations will be communicated to other sea users (via the United Kingdom Hydrographic Office) through the standard communication channels including Kingfisher, Notice to Mariners and Radio Navigation Warnings;
- Where applicable, infrastructure will be marked as hazards on admiralty charts and entered into the FishSafe system so that it may be avoided by fishing vessels;
- Regular maintenance and pipeline route inspection surveys will be undertaken;
- The majority of the pipeline and umbilical will be trenched and/or buried, eliminating snag risk. Crossings will be designed to be overtrawlable and will be protected with rock cover. The surface laid sections of the pipeline at either end of the route will be within the 500 m safety exclusion zones;
- Any exposed sections of pipeline will be protected using concrete mattresses and / or rock deposited at a gradient designed to allow fishing gear to pass without snagging; and
- A post-development survey of the drill rig location and the pipeline route will be conducted, and any spud can depressions and trench berms that are considered to pose a snagging risk will be appropriately mitigated.

5.4.3 Cumulative and transboundary impact

Although there is high shipping activity across the Development area (Section 3.5.2), the wide expanse of water available to navigate in and the limited number of vessels to be deployed for the Project will minimise the cumulative impacts associated with vessel collision risk.

DECC (2016) report that snagging hazards and safety exclusion zones may generate cumulative impacts with those resulting from natural obstructions, shipwrecks and other debris. As noted in Section 5.4.1 however, the area of exclusion during the Project will be small in comparison with the total fishing area available and will be largely temporary and thus the impact is likely to be low.

Dana will be engaging with key stakeholders including the National Federation of Fishermen's Organisations (NFFO), Crown Estate and the MMO through established channels to ensure notice of all Project activities is issued prior to work commencing, providing other users in the area the opportunity to modify their activities or through awareness of the project activities, either avoid the area for the short period of time or work with increased vigilance.

The Hornsea Project Four (HOW04) will be located 13.2 km ENE of the Platypus project location. Construction of HOW04 will not commence until August 2023 at the earliest, and therefore there will be no cumulative interaction of vessel traffic resulting from installation activities of the two projects.

Considering the above, significant cumulative impacts are not expected due to the Project.

The area in which the Project is located is regularly fished by vessels of other nations and any effect on their landings could constitute a transboundary impact. However, the potential impact on fisheries is considered not significant and it is unlikely that the Project will result in any transboundary impacts.

5.4.4 Decommissioning

Any potential impacts on other sea users regarding collision risk and temporary exclusion from the Development area from decommissioning operations will occur at a similar level to impacts during installation operations. However, removal of Project infrastructure will act to remove any potential snagging risk in the longer term.

5.4.5 Protected Sites

Project activity will occur within the boundary of the SNS SAC, which was designated to protect harbour porpoise. Harbour porpoise in the vicinity of the Project will be exposed to increased vessel and subsea activity during the drilling and installation phases. Note: this exposure is to the physical presence of vessels and physical exclusion from areas where activity is ongoing, rather than noise exposure which is discussed in Section 5.5. Harbour porpoise regularly make use of busy coastal waters and are not expected to be particularly sensitive to the physical presence of the extra vessels or Project related subsea activity. Given the large size of the SAC and the relatively low density of harbour porpoise expected in the area, disturbance is expected to be minimal, affecting very few individual animals on a temporary basis. This is not expected to constitute significant disturbance at the population level. No impacts are expected during the operational phase when vessel activity in the Development area will be almost back to baseline levels.

Project activity is not expected to disturb species protected by other sites in the vicinity as these are all at least 12 km from the Development.

Considering the above, no LSE is expected for SACs, SPAs and MCZs and hence no impact on any conservation objectives or site integrity.

5.4.6 Residual impact

5.4.6.1 Increased vessel traffic and collision risk

Although there will be an increase in the number of vessels in the area during the Project life, numbers will be small and these activities will be of a relatively limited duration. As noted in the mitigation measures above, standard communication and notification procedures will be in place to ensure that all vessels operating in the area are aware of the activities, including the presence of the drill rig, vessels required to install subsea facilities and vessel requirements during maintenance activities.

As detailed in Section 3.5.2, the Project is located in an area of high shipping activity. The vessels using the waters around the Development area are primarily small to medium sized cargo ships and tankers but fishing vessels and dredging / underwater operation vessels also pass through (Figure 3.18; MMO, 2015a). With the limited vessel requirement and the mitigation measures to be deployed, there will be a negligible increase in the risk of vessel collision as a consequence of Project activities. In addition, many of the activities associated with the Project will be both spatially and temporally constrained and there is sufficient sea area around both the drilling locations and pipeline route for route adjustments by non-Project vessels during drilling and installation activities.

5.4.6.2 Exclusion from Development area

As outlined in Section 5.4.1, other sea users will be excluded from an area of 0.79 km^2 around the Platypus drill centre during drilling, and then from a 0.79 km^2 area around the new Platypus manifold throughout the life of the Development (these areas represent the 500 m safety exclusion zones). In addition, sea users will be excluded from the pipeline route on an *ad hoc* basis during the subsea installation period in Q3 2021 and subsequently during routine inspection and maintenance over the life of the Project. The area of permanent exclusion is considered extremely localised. Taking into account the localised nature of the permanent access restrictions posed by the Project and the temporary nature of the pipeline installation, inspection and maintenance exclusion, the overall impact of exclusion is not expected to be significant.

5.4.6.3 Snagging risk

Spud can depressions will occur only within the permanent 500 m safety exclusion zones at Cleeton and Platypus and as such are not expected to pose a snagging risk. Surface-laid sections of pipeline or areas of insufficient burial will be covered with concrete mattresses and / or rock armour designed to be overtrawlable. The pipeline route will be surveyed following pipeline installation, and any potential snag hazards will be appropriately mitigated. As such no snagging hazards from sediment berms or depressions are expected to persist and snagging risk due to the development is expected to be negligible.

5.4.7 Conclusion

Considering all of the above, the residual consequence of the Development on other sea users is ranked as negligible. The exclusion zone will be present for the entire Development life and, for this reason, the frequency has been ranked as continuous. As a result, the residual risk to other sea users is expected to be minor and not significant.

Consequence	Likelihood/frequency	Residual risk	Significance
Negligible	Continuous	Minor	Not significant

5.5 Underwater Noise

The impact assessment for underwater noise follows below.

5.5.1 Description and quantification of potential impact

Due to the exceptional sonic properties of seawater, many animal species found in the marine environment use sound to gather information about their surroundings, track prey and communicate with members of their own species. Hearing is the primary sense for toothed whales, dolphins and porpoise, which use reflective sound to build up an image of their environment and to detect prey and predators through echolocation (Berta *et al.*, 2005).

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 (Deecke *et al.*, 2002). In addition to responding to natural sounds, fish and marine mammals may also respond to man-made noise.

Strong evidence exists that sound may have a biological impact on fish and marine mammals. Noise from man-made sources may affect animals to varying degrees depending on the sound source, its characteristics, and the sensitivity of the species present (e.g., Nowacek *et al.*, 2007, report this specifically for cetaceans).

The potential impacts of noise on marine mammal species include direct impacts to hearing which elicit a behavioural response that impacts upon normal activities, known as a disturbance, or injury, which may result in mortality. Potential indirect impacts from noise emissions include the displacement of prey species or secondary infections from noise-related injuries.

Disturbances from noise emissions also have the potential to generate behavioural changes which can have population-level consequences for marine species. A disturbance halts an individual’s normal activities, such as resting, socializing, nursing, or feeding, or may cause undue stress which can leave the animal physiologically impaired (Broucek, 2014). Prolonged behavioural disturbance or physical impairment can impact on an individual’s ability to survive and reproduce, which can affect population stability. Noise disturbances may also interfere with or mask communication between animals or inhibit their ability to echolocate for prey. Such disturbances may cause the animals to leave important habitat, which may have significant effects on the greater population.

In addition to potential behavioural disturbance, marine mammals and fish exposed to an adequately high sound source may experience physical effects to their hearing ability which may be temporary (termed a temporary threshold shift (TTS); Finneran *et al.*, 2005) or, if the source level is sufficiently high, may cause physical damage to the hearing apparatus which cannot be reversed, generating a permanent threshold shift (PTS) in hearing ability (Southall *et al*., 2007). A PTS is considered to be an injury to the animal. Injury is caused by sounds which have frequencies or amplitudes which are vibrationally strong enough to cause physical damage to the soft tissues or hearing structures. Injury to marine mammals can include acute trauma leading to permanent hearing loss, gas or fat embolisms in the body or brain, and injuries acquired while trying to evade a sound (i.e., those acquired from stranding or diving beyond an animal's aerobic dive limit) (Ketten, 1995; Fernandez *et al*., 2005).

Noise sources that have been identified as likely to occur during the development of the Project and which, depending on the specific nature of the sources, could cause injury or disturbance to marine mammals and fish are limited to:

- Short-term continuous noise from the jack-up rig (drilling of the wells) and Project vessels (includes a variety of different vessels for pipeline installation); and
- Short-term impulsive noise from piling of the new subsea manifold.

In general, these activities will be undertaken at discrete intervals with piling will taking place at a different time to the pipe laying operations. Four piles will be installed for the subsea manifold. The 0.61 m diameter piles will be piled using a Cape Holland IHC S-90 impact hammer, or similar deployed from piling vessel. Each 20 m pile is expected to take 4 minutes to install i.e. approximately 40 hammer blows. The piling schedule is expected to take one day in total. However, there may well be a number of vessels of various type on site at any one time.

Few data appear to be available in the public domain relating to the source noise level and characteristics for acoustic transponders. Vickery (1998) describes a typical source level as being greater than 195 dB re 1 µPa @ 1 m, but notes that the frequency range can vary anywhere between 8 to 300 kilohertz (kHz) depending on the system type and range requirements. A datasheet for the Nautronix NASNET system shows a typical source level of up to 196 dB re 1 µPa @ 1 m, but no information appears available relating to the typical "on time" of the system and pulse lengths. It was, therefore, considered not appropriate to undertake detailed modelling of this source and, instead, a qualitative assessment was undertaken.

To understand the potential for these noise sources to affect marine mammals, noise propagation modelling has been undertaken. The noise propagation modelling, detailed in full in Appendix C, provides the assessment with a set of ranges within which potential injury or disturbance may occur. However, it is important to bear in mind when reviewing these impact ranges that they are not absolute — the actual amount of noise received by an animal, individual variations in hearing ability, and uncertainties regarding behavioural response, mean that the actual impact zone is more complicated than simply drawing a contour around the source location. The impact ranges provided by the noise propagation modelling thus offer a means of describing the likely spatial extent of noise-related impacts under normal conditions. The impact assessment presented here uses these spatial extents to define the magnitude of impact for each noise source.

Noise propagation modelling was undertaken for both continuous and impulsive noise sources for each of the four different hearing groups of marine mammals (low-frequency, mid-frequency, high-frequency and pinnipeds). This modelling enabled identification of the distances at which injurious peak Sound Pressure Levels (SPLs) and Sound Exposure Levels (SELs), as well as strong behavioural disturbances, would be incurred from the various noise sources based on the most recent accepted noise impact criteria (National Marine Fisheries Service (NMFS), 2018). Potential injury and disturbance ranges were defined for piling activity (an impulsive noise source, detailed in Table 5-3) and for continuous noise associated with dredging operations at the Platypus Development, which was deemed to be the worst case continuous noise activity (detailed in

Table 5-4). Table 5-3 illustrates the potential area of injury and disturbance from four manifold piles at the Platypus manifold being driven over a period of 6 hours, with a blow rate of 10 blows per minute (Appendix C).

These models also assume a marine mammal moving away from the source of the noise at a constant speed of 1.5 ms^{-1} after the first hammer blow. A swimming speed of 1.5 ms^{-1} is considered highly conservative, as the swimming speed of the cetaceans and pinnipeds likely to be encountered during project activities varies between 3.25 ms^{-1} and 5 ms^{-1} (Cooper *et al*. 2008; Gallon *et al*. 2007; and Otani *et al.* 2000). This speed has been selected to allow for the following situations: animals which are not swimming away from the source in a direct, linear pattern (such as those which are startled); animals which may not be able to maintain a fast swimming speed over distance or for a prolonged period (such as those with young); or those which are swimming against a current.

Table 5-3: Summary of potential marine mammal injury and disturbance distances for Platypus Development piling (with soft start and assuming 1.5 ms^{-1} swim speed)

Situation	Radius of potential injury zone			
	High-frequency Cetaceans	Mid-frequency Cetaceans	Low-frequency Cetaceans	Pinnipeds in Water
Peak pressure (SPL) physiological damage.	9 m	<1 m	1 m	1 m
Peak pressure (SPL) physiological damage with a 5-minute soft start.	3 m	<1 m	<1 m	<1 m
SEL of swimming mammal (at 1.5 ms^{-1}).	6 m	<1 m	3 m	1 m
SEL of swimming mammal with a 5-minute soft start (at 1.5 ms^{-1}).	2 m	<1 m	1 m	<1 m
Strong behavioural reaction (disturbance)	176 m			

Table 5-4: Summary of potential marine mammal injury and disturbance distances for marine mammals exposed to continuous noise from TSHD and support vessel

Situation	Radius of potential injury zone			
	High-frequency Cetaceans	Mid-frequency Cetaceans	Low-frequency Cetaceans	Pinnipeds in Water
SEL of swimming mammal (at 1.5 ms^{-1})	<1 m	<1 m	<1 m	<1 m
Strong behavioural reaction (disturbance)	635 m			

The results of the noise propagation modelling suggest a marine mammal strong behavioural response (disturbance) impact area of 0.097 km^2 for impulsive noise emissions and 1.27 km^2 for continuous noise emissions from Platypus Development activities (Table 5-3;

Table 5-4). In terms of the potential impacts on fish, review of published potential impact zones from vessels and piling suggest they are likely to be limited to tens or hundreds of metres from the noise source, if any responses do occur (e.g. De Robertis and Handegard, 2012; Mueller-Blenkle *et al.*, 2010; Schulze and Ring Pettersen, 2007).

5.5.2 Mitigation

The primary measure of reducing potential impacts from continuous and impulsive noise sources will be to limit the duration of the noise emitting activities. For example, vessels will only be deployed where necessary and the number of acoustic beacons used for positioning will be limited as far as is practicable during installation activities.

Dana will additionally adhere to the JNCC guidelines for reducing the potential for injury and disturbance to marine mammals from piling (JNCC, 2010). The measures from the JNCC (2010) guidance are summarised below:

- A suitably trained marine mammal observer (MMO) will conduct a pre-piling search over a 30-minute period prior to the commencement of piling. This will involve a visual assessment to determine if any marine mammals are within the 500 m mitigation zone (measured from the location of the piling). In addition, a Passive Acoustic Monitoring System (PAMS) will be used concurrently with the MMO to monitor for submerged marine mammals within the mitigation zone;
- Should any marine mammals be detected within the 500 m mitigation zone during the pre-piling search, operations will be delayed until marine mammals have moved outside the 500 m mitigation zone. In this

case, there will be a 20 minute delay from the time of the last marine mammal sighting to the commencement of activities;

- The piling will be commenced with a five minute soft start in order to give any undetected marine mammals time to leave the 500-m mitigation zone.
- A visual watch and PAMS monitoring will be maintained during piling operations. As such, if piling is paused for more than 10 minutes, it will be allowed to re-commence immediately with another soft start as long as no marine mammals have been observed within the mitigation zone in the 20 minutes leading up to the re-start. If marine mammals are observed within the mitigation zone in the 20 minutes prior to the propose re-start time, re-start will be delayed until 20 minutes have elapsed since the last observation; and
- MMOs will keep an open line of communication with the appropriate operations staff to ensure mitigation procedures are adhered to. MMOs will record all survey and sightings data on relevant forms for entry into the JNCC Noise Registry database.

JNCC (2010) recommends a soft start period of 20 minutes, which is considered disproportionate in this case. Each pile will take approximately four minutes to drive in, and therefore a 20 minute soft start preceding each pile drive would increase the total number of hammer blows, and the total noise energy emitted into the environment, by five-fold. The modelling summarised in Table 5-3 indicates that a five minute soft start would be sufficient to prevent injury and significant disturbance. With a five minute soft start, the most sensitive marine mammals would need to be within 3 m of the noise source at the start of the soft start in order to be injured, which is extremely unlikely, and made more unlikely by use of a pre-piling visual search and PAMS monitoring. Marine mammals would need to be within 176 m of the noise source at the beginning of the soft start to experience disturbance. With the use of a pre-piling visual search and PAMS monitoring it is extremely unlikely that a significant number of marine mammals would be present within the disturbance radius when the soft start begins.

5.5.3 Cumulative and transboundary impact

As noted in Section 4.5, a list of other offshore projects was identified which, together with the Platypus Development, have the potential to result in potential cumulative impacts. In theory, any project that regularly emits underwater noise has the potential to act cumulatively with activities from the Platypus Development.

In reviewing other sea users around the Development area, only shipping vessels were identified as other potential noise sources which have the potential to overlap with noise sources from project activities. Shipping traffic will remain outside the 500 m safety exclusion zone around the Development area and is not anticipated to come into close range of the project vessels. As such, there is potential for marine mammals to be disturbed by the cumulative noise emissions of multiple vessels. However, as vessel activity in the region is already very high, animals will have encountered vessels at various instances and should not exhibit a strong behavioural response (such as startle) from such an interaction. Moreover, mitigation measures will minimise the potential for marine mammals to be strongly disturbed by vessel activities.

In terms of impulsive noise (piling), which will be of very short duration (6 hours total operation time with 16 minutes of actual pile driving activity), it is very unlikely that other activities taking place in the area will affect the results of the impact assessment with piling noise the dominant source. This is due to the fact that the only other noise sources which animals may encounter in the Development area are limited to vessels (as piling and drilling will not take place concurrently), which will be masked by piling activities.

Cetacean and fish populations are free-ranging and long-distance movement is likely to be frequent. Any animal experiencing a significant impact from one project is likely to belong to a much wider-ranging population and may subsequently come into contact with noise from other projects. However, potential injury and disturbance impacts resulting from activities from the Platypus Development are not expected to be significant (Section 5.5.6), and significant cumulative impact from an animal encountering noise emissions from multiple projects within a short period of time is therefore considered highly unlikely. As a result, the cumulative impact is considered to be not significant.

It is possible that the various noise sources *within* the Platypus Development could act cumulatively to result in a significant impact to marine mammals. As such, modelling has been conducted on a number of possible scenarios (detailed in Section 5.5.1). The results of the noise modelling indicate noise levels are sufficiently low that injury is not predicted from any activity whilst employing the above mitigation measures (Section 5.5.2), cumulatively or otherwise. Moreover, the potential disturbance zones are small and, for the most part, highly limited in temporal extent. Cumulative impacts from noise sources within the Platypus Development are therefore not anticipated.

The Platypus Development area is 121 km from the UK / Netherlands median line. Since sound emissions capable of potentially causing injury or disturbance to marine mammals or fish will not be received directly by any animals across these median lines, direct transboundary impacts are not anticipated. An animal experiencing an impact in UK waters has the potential to belong to a much wider ranging population which may cross median lines, such a potential impact could qualify as a transboundary impact. However, since injury is not expected to occur, and any disturbance will be trivial, potential transboundary impacts are considered not significant.

5.5.4 Decommissioning

Any potential noise impacts that decommissioning operations may have will occur in an area which previously experienced noise emissions during the installation operations. When the wells are ultimately abandoned, these will be cut off below the seabed; these cutting activities would result in some noise emissions. Such noise emissions would be of short-term duration and are considered to be masked by cutting vessels (Nedwell and Edwards, 2004). Given the residual impact from installation and operation is considered to be not significant, the potential impact from decommissioning is also considered to be not significant.

There will be no noise emissions from the Platypus Development post-decommissioning, as Project infrastructure will have been removed.

5.5.5 Protected sites

As marine mammals are expected to be the only receptor at risk of significant impacts from underwater noise, this section focuses on protected sites that host marine mammals as designated features.

As described in Section 3.4, UK waters host four species of marine mammal which are listed on Annex II of the Habitats Directive, enabling their protection through the designation of protected sites. Of these, the only species that are expected to be present in the Development area in significant numbers are the grey seal from the Humber Estuary SAC and harbour porpoise from the SNS SAC.

Grey seal density is expected to be up to 50 individuals per 25 km^2 (or 2 individuals per km^2) in the vicinity of the Project (Figure 3.14). It is likely that grey seals foraging in the Development area form part of the population protected by the Humber Estuary SAC. Modelling indicates that there is no scope for injury to grey seals as the maximum injury range from Project noise is 1 m from the noise source (Table 5-3), and this would not occur in practice. However, a strong behavioural reaction (disturbance) could occur at up to 635 m from the continuous noise source (

Table 5-4). The disturbance range of 635 m equates to a disturbance area of 1.27 km^2, and assuming a population density of 2 individuals per km^2 this suggests that between 1 and 2 individuals could be disturbed as a worst case. Temporary disturbance of up to two grey seals during dredging operations in Q3 2021 is expected to be minor as there will be no lasting impact and individuals affected would have ample alternative foraging area. As such the proposed activities are not expected to have any potential for LSE on the Humber Estuary SAC.

Harbour porpoise are expected to be present throughout the Development area, which sits within the SNS SAC designated for the protection of this species. The Conservation Objectives of the SAC include addressing pressures which would: (1) kill or injure significant numbers of individuals (directly or indirectly); (2) prevent their use of significant parts of the site (disturbance/displacement); (3) significantly damage relevant habitats; or (4) significantly reduce the prey base (JNCC, 2016b). As noted in Table 5-3, the activity with the greatest potential to injure harbour porpoise is piling which, without the application of a soft start or pre-operational watch, has the potential to injure harbour porpoise that are within 9 m of the pile impact[14]. The activity with the highest potential to cause a strong behavioural reaction (disturbance) is dredging activity, which could elicit a reaction up to 635 m from the noise source.

[14] A recent judgement in case C 323/17 of the Court of Justice of the European Union interpreted Article 6(3) of the Habitats Directive. The judgement determined that it is not appropriate to take into account measures intended to avoid or reduce the harmful effects of a plan or project (mitigation measures) on Natura sites at the Screening (determination of LSE) stage.

Table 5-5 shows the numbers of harbour porpoise that could be injured or disturbed by the worst-case Project noise emissions, and presents these numbers as a proportion of the total population of the SAC. The areas of the impact zones are calculated from the radii of impacts for injury and disturbance referenced above and in Table 5-3 and

Table 5-4.

Table 5-5: Estimated number of harbour porpoise experiencing injury or disturbance as a result of Project activities

Activity	Impact	Area of impact zone (km^2)	SCANS-III Density estimates[15] per km^2	Maximum number of animals predicted to be impacted (impact area x density estimate)	Predicted population within SAC[16]	Percentage of reference population affected
Piling	Injury	0.00025	0.888	<0.001	19,326	<0.001
	Disturbance	0.097		0.09		<0.001
Dredging	Injury	-		0		0
	Disturbance	1.27		1.13		0.006

As shown in Table 5-5, there is no prospect of injury to any harbour porpoise as a result of the proposed operations. Only dredging operations have the potential to disturb harbour porpoise, with one animal expected to be disturbed at any one time, comprising 0.006% of the population of the SAC. This disturbance will be temporary, lasting for the duration of dredging operations which are estimated to take 16 days during Q3 2021 (see Figure 1.2 and Table 2-7). This is not expected to be a significant impact and as such there is no potential for LSE on the SNS SAC.

5.5.6 Residual impact

5.5.6.1 Impulsive noise

For marine mammals, the unmitigated potential for injury from impulsive noise is limited to within 9 m of the piling location for the most sensitive group (high-frequency cetaceans) and between 1 m and 3 m for other groups. The JNCC "Guidelines for minimising the risk of disturbance and injury to marine mammals from piling" (JNCC, 2010) include a soft start procedure and visual monitoring of a 500 m mitigation zone. The soft start will reduce the injury zone to 3 m for high frequency cetaceans and 1 m or less for other groups, and in conjunction with the pre-operation visual monitoring this will effectively eliminate the scope for injury.

Disturbance of marine mammals could occur within 176 m of the piling noise source, equating to a disturbance area of 0.097 km^2, although this is also likely to be further reduced by the soft start and pre-operation visual monitoring.

To understand the significance of disturbance, it is important to consider a number of factors, including: the size and location of the potential disturbance zone (larger areas increase the likelihood of interactions); and length of time for which the sound source will be present (longer durations are more likely to have significant effects). 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 signify the onset of detrimental effect which would significantly impact the wellbeing of those individuals (JNCC, 2010). Additionally, temporarily affecting a small proportion of a population would be unlikely to result in population level effects which would constitute a significant disturbance.

[15] Density estimates from Hammond *et al.,* (2017) (SCANS-III area O).

[16] The UK portion of the harbour porpoise North Sea Management Unit supports approximately 110,433 individuals (JNCC, 2015). The Southern North Sea SAC supports approximately 17.5% of the UK North Sea Management Unit population (JNCC, 2017), equivalent to 19,326 individuals.

To understand residual impacts to populations from vessel presence or drilling operations, it is therefore important to understand what proportion of the population is likely to be disturbed.

Determining this proportion for marine mammals is in itself not a simple task since it is not clear how north-east Atlantic marine mammal populations act at a local level. For example, minke whales are likely to make use of the entire north-east Atlantic, so the population can be viewed as one, whilst other species may be more likely to remain in a more local area and be viewed as a series of sub-populations. The Statutory Nature Conservation Bodies (SNCBs, 2013) note that marine mammals of almost all species found in UK waters are part of larger biological populations whose range extends into the waters of other States and/or the High Seas. In order to obtain the best conservation outcomes for many species, it is necessary to consider the division of populations into smaller Management Units (MUs). This requires an understanding of the geographical range of populations and subpopulations, in order to provide advice on impacts at the most appropriate spatial scale. MUs have been defined for all commonly occurring cetacean species in UK waters (IAMMWG, 2015) and seal populations have been estimated for each country in the UK (SCOS, 2018). The potential disturbance zones can therefore be interpreted in the context of these population estimates to determine the significance of potential impacts to marine mammal populations.

Estimates of population-level impacts from the predicted disturbance range indicate that <1% of the regional population of each species of interest will be affected (Table 5-6). In addition, piling activity is anticipated to be limited in duration to approximately 4 minutes per pile, across a total operations period of six hours. This small scale and temporary disturbance is to represent a negligible impact and is therefore not significant.

Table 5-6: Estimated proportion of marine mammal populations to be affected by piling activities

Species	Density estimates per km^2 (Hammond *et al*., 2017; Russell *et al*., 2017)	Maximum number of animals predicted to be in behavioural impact zone (0.0973 km^2)	Regional population size (IAMMWG, 2015; SCOS, 2018)	Proportion of regional population potentially affected (%)
Harbour porpoise	0.888	0.086	227,298[17]	<0.001
White-beaked dolphin	0.002	<0.001	15,895	<0.001
Minke whale	0.010	0.001	23,528	<0.001
Atlantic white-sided dolphin[1]	0.010	0.001	69,293	<0.001
Bottlenose dolphin[1,2]	0.030	0.003	195	0.002
Grey seal	0.24	0.023	6,900	<0.001
Harbour seal	0.025	0.002	5,200	<0.001

Note 1: As there are no density estimates available for these species in the SNS, data from the Central North Sea have been used.

Note 2: For the Greater North Sea bottlenose dolphin Management Unit (MU), very few animals are seen in the SNS and, although there is no conclusive evidence, at this time, those seen are thought to belong to the Coastal Scottish group (IAMMWG, 2015), and as such, the regional population size has been taken to be that of the Coastal Scottish MU.

For fish species, potential impact zones are likely to be limited to tens or hundreds of metres. Whilst estimates of fish populations are generally not available, it is likely that many millions of individuals make up the populations of most fish species (e.g., Mood and Brooke, 2010). The injury to small numbers of fish would not constitute a significant reduction in population size nor cause a significant displacement of fish species from critical habitats. As such, impacts to fish species from piling activities will be negligible.

[17] Note, in this instance the harbour porpoise population is taken to be the wider North Sea Management Unit population rather than just the proportion of the population using the Southern North Sea SAC.

5.5.6.2 Continuous noise

As shown in the data reported in

Table 5-4, there is effectively no scope for injury to marine mammals from dredging noise, which would be the worst case continuous noise source associated with the Project.

Disturbance of marine mammals could occur within 635 m of the dredging noise source, equating to a disturbance area of 1.27 km^2. Based on population density estimates, less than one individual of each species will be present in the disturbance area at any one time, with the exception of harbour porpoise, of which one individual is expected to be present (Table 5-7). This equates to less than 1% of the regional population of each species being affected (Table 5-7). Furthermore, the worst case disturbance zone is not expected to represent a barrier to wider, regional movements of marine mammals. Dredging activity will be limited to approximately 16 days in Q3 2021, although other vessel activity producing lower noise levels will occur between Q2 2021 and Q1 2022.

Only a very small number of animals could potentially be disturbed by vessel activities. Any impact would be temporary and undetectable against natural variation. As such, residual impacts are deemed to be negligible and not significant.

Table 5-7: Estimated proportion of marine mammal populations to be affected by continuous noise emissions

Species	Density estimates per km^2 (Hammond *et al.*, 2017; Russell *et al.*, 2017)	Maximum number of animals predicted to be in behavioural impact zone (1.9 km^2)	Regional population size (IAMMWG, 2015; SCOS, 2018)	Proportion of regional population potentially affected (%)
Harbour porpoise	0.888	1.128	227,298	<0.001
White-beaked dolphin	0.002	0.003	15,895	<0.001
Minke whale	0.01	0.013	23,528	<0.001
Atlantic white-sided dolphin[1]	0.01	0.013	69,293	<0.001
Bottlenose dolphin[1,2]	0.03	0.038	195	0.02
Grey seal	0.24	0.305	6,900	0.004
Harbour seal	0.025	0.032	5,200	<0.001

Note 1: As there are no density estimates available for these species in the SNS, data from the Central North Sea have been used.

Note 2: For the Greater North Sea bottlenose dolphin Management Unit (MU), very few animals are seen in the SNS and, although there is no conclusive evidence, those seen are thought to belong to the Coastal Scottish group (IAMMWG, 2015). As such, the regional population size has been taken to be that of the Coastal Scottish MU.

For fish species, potential impact zones are likely to be limited to tens or hundreds of metres. As noted above, it is likely that many millions of individuals make up the populations of most fish species. The injury to small numbers of fish would not constitute a significant reduction in population size nor cause a significant displacement of fish species from critical habitats. As such, impacts to fish species from vessel activities will be negligible.

5.5.6.3 Transponder noise

Injury and disturbance ranges from acoustic transponder noise are expected to be substantially less than those typically predicted for sub-bottom profiling activities, such that for the low-frequency whales, the potential injury ranges will be only several metres and even for the most hearing sensitive species (harbour porpoise) it may only be tens or the very low hundreds of metres. Since such injury zones tend to require animals to remain in the vicinity of the sound source for 24 hours, injury is not expected from use of the acoustic transponders. In terms of disturbance to marine mammals from use of acoustic transponders, this would likely be limited to hundreds of metres. Even if disturbance were to occur within hundreds of metres of the transponders, this is not a great distance in the context of the available waters in the SNS and the noise emissions would not represent a barrier to wider, regional movements of marine mammals. Moreover, the acoustic transponders would only be deployed for the short periods when installation vessels are on site. For these reasons, noise from acoustic transponders is likely to have a negligible impact. For fish, as for vessel noise, the predicted limited impact zones and the large population sizes of species likely to encounter noise emissions mean there will be no impacts at the population level.

5.5.6.4 European Protected Species

The highly restricted injury zones and the short term nature of the noise generating activities reduce the risk associated with the Platypus development. Although, there is anticipated to be a low to moderate density of marine mammals, including two EPS species (grey seal and harbour porpoise) within the Development area, the proposed mitigation measures generate a negligible risk of injury or disturbance as a result of the Project activities. As such, there will be no injury or significant disturbance to any EPS and no requirement to apply for an EPS licence.

5.5.7 Conclusion

Considering the above, the residual consequence of underwater noise emissions as a result of the worst case manifold piling and dredging activity is ranked as negligible. Although most vessel use will occur during the drilling and installation periods, there is likely to be a limited requirement for vessel use during maintenance activities and the residual impact will therefore occur intermittently over the life of the Platypus Development. As a result, the residual impact of the noise emitted by the worst-case scenario for the Platypus Development will be minor and is therefore not significant.

Consequence	Likelihood/frequency	Residual risk	Significance
Negligible	Intermittent	Negligible	Not significant

5.6 Atmospheric Emissions

The impact assessment for atmospheric emissions follows below.

5.6.1 Assumptions

The following assumptions have been necessary to provide an estimate of expected noise emissions:

- There will be five return helicopter flights per week during the drilling period (fifteen months), with an additional one flight per week during the well hook-up period (three weeks per well);
- Helicopter departure airport is assumed to be Norwich;
- Vessel fuel use per day has been taken from the vessel types listed in Institute of Petroleum (2000), where an exact match is not available, a sensible approximation has been made;
- Cleeton topsides modifications will be completed by either a walk to work vessel working for 90 days or a walk to work vessel working for 60 days plus a jack-up rig working for 20 days. While in other sections, the use of a jack-up rig has been assumed as a worst case (for seabed impacts), use of the walk to work option has been assumed in this section as worst case since the overall days working is higher and since a jack-up rig is expected to use less fuel than a walk to work vessel holding station on DP; and
- No allowance has been included for additional power requirements on the CW platform as the increase is expected to be negligible against the Cleeton baseline power use.

5.6.2 Description and quantification of potential impact

The emission of gases to the atmosphere from the Platypus Development could potentially result in impacts at a local, regional, transboundary and global scale. Local, regional and transboundary issues include the potential generation of acid rain from nitrogen and sulphur oxides (NO_X and SO_X) released from combustion, and the human health impacts of ground level nitrogen dioxide (NO_2), sulphur dioxide (SO_2), both of which will be released from combustion, and ozone (O_3), generated via the action of sunlight on NO_X and volatile organic compounds (VOCs). On a global scale, concern with regard to atmospheric emissions is increasingly focused on global climate change. The Intergovernmental Panel on Climate Change (IPCC) in its fifth assessment report states that "…more than half of the observed increase in global average surface temperature from 1951 to 2010 is very likely (90 - 100% probability) due to the observed anthropogenic increase in well-mixed greenhouse gas (GHG) concentrations." Climate change projections included in the IPCC report forecast a global mean surface air temperature increase of between 1.0°C (±1.64 standard deviations) and 3.7°C (±1.64 standard deviations) in the period 2080 – 2099 compared to the period 1986 – 2005 depending on the trajectory of future anthropogenic climate forcing. GHGs include water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3) and chlorofluorocarbons. The most abundant GHG is water vapour, followed by CO_2. IPCC (2013) reports a 40% increase in CO_2 concentrations compared to pre-industrial concentrations and states that the combustion of fossil fuels is the primary contributor.

Atmospheric emissions from the Platypus Development during the drilling, installation and commissioning phases will include fuel consumption by the drill rig, installation vessels and helicopters and flaring during well testing. During the operational phase, further emissions will be generated by cold gas venting during maintenance operations and fuel combustion by survey vessels. A summary of predicted atmospheric emissions for the Platypus Development is provided in Table 5-8. Emissions of individual GHGs are presented, as well as a value for carbon dioxide equivalent (CO_2e). CO_2e is a term for describing different GHGs in a common unit. For any quantity and type of GHG, CO_2e signifies the amount of CO_2 which would have the equivalent global warming impact. This allows total Project emissions to be compared to total CO_2 emitted from UK offshore activities, and to UK carbon budgets (see Section 5.6.4.2).

5.6.3 Mitigation

Dana will ensure that correct management procedures are in place to for the following:

- All vessels will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2014;
- Operations will be carefully planned to reduce vessel numbers and the duration of operations;
- All vessels will have the appropriate UK Air Pollution Prevention or International Air Pollution Prevention certificates in place as required;
- The duration of well testing will be limited as far as is practicable to reduce the requirement to flare; and
- Operating procedures will be in place in order to reduce emissions during maintenance operations, process upset conditions, system depressurisation and start-up.

Table 5-8: Atmospheric emissions from the Platypus Development based on current estimates of likely vessel requirement (fuel use and emissions factors derived from Institute of Petroleum (2000), EEMS (2008) and IPCC (2013)

Activity	Source	Details	Emissions (Te)							
			CO_2	CO	NOx	N_2O	SO_2	CH_4	VOC	CO_2e
Drilling and completion	Drill rig	165 in 2021 and up to 55 in 2022	35,143.68	91.15	148.26	2.42	0.14	1.21	13.18	35,926.51
	ERRV	165 days in 2021 and up to 55 in 2022	2,816.00	13.82	73.92	0.19	0.88	0.16	2.11	2,880.45
	Supply vessel	165 days in 2021 and up to 55 in 2022	7,040.00	34.54	184.80	0.48	2.20	0.40	5.28	7,201.13
	Helicopter	668 trips in 2021 and 2022	550.60	0.89	2.15	0.04	0.00	0.01	0.14	562.76
	Well testing	Maximum of two well tests in 2021 and 2022	8,571.23	23.78	4.41	0.24	0.04	129.40	21.40	11,879.03
Pipeline and umbilical installation	Survey vessel	7 days in 2021	492.80	2.42	12.94	0.03	0.15	0.03	0.37	504.08
	TSHD or equivalent	16 days in 2021	1,126.40	5.53	29.57	0.08	0.35	0.06	0.84	1,152.18
	Pipelay vessel	4 days in 2021	192.00	0.94	5.04	0.01	0.06	0.01	0.14	196.39
	Umbilical lay vessel	5 days in 2021	240.00	1.18	6.30	0.02	0.08	0.01	0.18	245.49

Activity	Source	Details	Emissions (Te)							
			CO_2	CO	NOx	N_2O	SO_2	CH_4	VOC	CO_2e
	Trenching support vessel	14 days in 2021	985.60	4.84	25.87	0.07	0.31	0.06	0.74	1,008.16
	Rock placement vessel	8 days in 2021	256.00	1.26	6.72	0.02	0.08	0.01	0.19	261.86
	Fishing guard boat	40 days in 2021	89.60	0.44	2.35	0.01	0.03	0.01	0.07	91.65
Platypus manifold installation	DSV	29 days in 2021 and up to 15 days in 2022	2534.40	12.43	66.53	0.17	0.79	0.14	1.90	2,592.41
Cleeton topside modifications	Walk to work vessel	Up to 90 days in 2021	7,200.00	35.33	189.00	0.50	2.25	0.41	5.40	7,364.79
Operation	Survey vessel	25 days over life of field	1,440.00	7.07	37.80	0.10	0.45	0.08	1.08	1,472.96
	Cold venting from commissioning and planned maintenance	Over life of field	0.00	0.00	0.00	0.00	0.00	70.09	7.79	1,752.37
Totals			**68,678.31**	**235.62**	**795.66**	**4.38**	**7.81**	**202.09**	**60.81**	**75,035.80**[18]

[18] Note: CO_2e total is calculated from the individual emissions totals and does not account for the rounding of CO_2e totals of individual activities.

5.6.4 Cumulative and transboundary impact

5.6.4.1 Local air quality

Throughout the drilling, installation, commissioning and operation of the Platypus Development there will be atmospheric emissions, which may have local or regional (including transboundary) effects. Release durations from drilling, installation and commissioning vessels will be temporary, whilst emissions from operational activities will intermittent throughout the life of the field.

While the Platypus Development area is in close proximity to other industrial activities (including other offshore oil and gas activity, Table 3-11), the low levels of emissions expected, and the spreading of the emissions over space and time within the Development area suggest there will not be any likely cumulative effects in terms of local air quality. The drilling activities associated with the Platypus Development will be at closest approximately 121 km from the UK / Netherlands median line, and as such there will be no significant transboundary impacts.

5.6.4.2 Global climate change

To understand the potential impact from the atmospheric emissions associated with the Platypus Development, it is useful to set the emissions in the context of wider UK emissions. An exact figure for offshore emissions in UK waters does not exist, however, the contribution of emissions from shipping activities can be summed with oil and gas industry emissions to provide a benchmark against which the Platypus Development can be considered.

The total CO_2 emissions estimate for 2018 from oil and gas exploration and production is 14,630,000 Te (Oil and Gas UK, 2019) and the latest total annual CO_2 emissions estimate for UK shipping is approximately 11,000,000 Te (for 2013 (Committee on Climate Change, 2015)), giving a total of 25,630,000 Te of CO_2. The average annual CO_2e emissions from the Platypus Development over the installation and operation periods are estimated to be approximately 36,030 Te CO_2e and 165 Te CO_2e respectively. Installation activities will equal approximately 0.14% of the atmospheric emissions associated with UK offshore shipping and oil and gas activities on an annual basis, whilst operation activities will account for approximately 0.00066%. A Project installation period of two years (2021 and 2022) was used to calculate the average annual emissions for installation and a Project operations period of 18 years was used to calculate the average annual emissions between 2023 and 2040 (the expected cessation of production).

While the UK Government has set a target of reducing the UK's CO_2e emissions to net zero by 2050, no guidance has yet been published on how this will be achieved. As such, the following section focuses on the previous target, set out in the Climate Change Act 2008, of a reduction of CO_2e emissions by 80% by 2050 compared to a 1990 baseline. This target was accompanied by a series of phased 5-year carbon budgets with each budget further reducing the acceptable UK carbon emissions over the 5-year budget period. The 5th, and currently final carbon budget requires a 57% reduction by 2030 (Table 5-9). It is likely that the total annual emissions from the UK will decline over the life of the Platypus Development and it is important therefore to examine how the Development will sit within the context of declining UK emissions.

Table 5-9: UK carbon budget

Budget	5-year carbon budget (MT CO_2e)	Reduction below 1990 base year (%)
1st carbon budget (2008 to 2012)	3,018	23
2nd carbon budget (2013 to 2017)	2,782	29
3rd carbon budget (2018 to 2022)	2,544	35 by 2020
4th carbon budget (2023 to 2027)	1,950	50 by 2025
5th carbon budget (2028 to 2032)	1,765	57 by 2030

Table 5-10 presents the Platypus Development average annual CO_2e emissions that will occur during carbon accounting periods three to five as percentages of the UK carbon budgets over those periods. The maximum contribution occurs during the 3rd carbon budget; Platypus emissions during this accounting period account for

0.0028% of the UK carbon budget for the period. The emissions contributions reduce to ≤0.00005% during the subsequent two budget periods. It is noted that, to an extent, the additional emissions from the Platypus Development will be offset by reducing emissions associated with currently declining production in other UK oil and gas fields.

Overall, this assessment shows that the potential emissions from the Platypus Development will likely have a limited cumulative effect in the context of the release of GHGs into the environment and contribution to global climate change, and no significant cumulative impact.

Table 5-10: Platypus Development CO_2e emissions against UK carbon budget

Emission item	Carbon accounting period		
	2018 to 2022	2023 to 2027	2028 to 2032
UK carbon budget for the period (Te CO_2e).	2,544,000,000	1,950,000,000	1,765,000,000
Platypus Development CO_2e emissions per accounting period as % of the total UK budget for the period.	0.00283	0.00004	0.00005

5.6.5 Decommissioning

At the end of field life, the Platypus Development will be decommissioned. The decommissioning process will generate atmospheric emissions both directly from cessation operations and associated vessel traffic, and indirectly through the reuse and recycling of materials (such as steel). At this time, it is not possible to fully quantify the likely atmospheric emissions, and exact emissions will depend on the removal technologies available at the time, as well as the regulatory requirements. It is anticipated that energy use and atmospheric emissions will be less than those produced during installation and commissioning activities.

5.6.6 Protected sites

Atmospheric emissions associated with the Platypus Development will occur within the boundary of the SNS SAC and within approximately 12.2 km of the Holderness Offshore MCZ (see Section 3.4.1). The protected features of these sites (harbour porpoise and various benthic habitats) are not expected to be sensitive to atmospheric emissions and given the small scale of emissions associated with the Development, no significant impacts are expected. As such there is considered to be no LSE on the SAC and since there is no potential for atmospheric emissions to interact with benthic protected features of the MCZ, there is no significant risk to the conservation objectives of the site.

5.6.7 Residual impact

Given the temporally restricted nature of the majority of the atmospheric emissions from the Project and taking into account the distance that the Platypus Development is from any potentially sensitive receptors, it is not expected that atmospheric emissions will negatively impact local air quality. In terms of global climate change through cumulative and transboundary impacts, the Platypus Development will add a small increment to the overall offshore emissions of the UK. The release of GHG into the environment and the Project’s contribution to global warming will be negligible in relation to that of the wider offshore industry and outputs at a national or international level. Any cumulative impact is therefore considered not to have a significant direct impact on climate change.

5.6.8 Conclusion

Considering all of the above, including that there will be no impact on protected sites or on species from protected sites, the residual consequence of atmospheric emissions is ranked as negligible. As emissions will occur throughout the life of the Platypus Development, the frequency is defined as regular. As a result, the residual risk of atmospheric emissions from the Platypus Development will be negligible and is therefore not significant.

Consequence	Likelihood/frequency	Residual risk	Significance
Negligible	Regular	Negligible	Not significant

5.7 Accidental Events

The impact assessment for accidental events follows below.

5.7.1 Description and quantification of potential impact

5.7.1.1 Introduction

The potential impact of any accidental hydrocarbon and chemical release will be determined by the location of the release, characteristics and weathering properties of the released material, the direction of travel and whether environmental sensitivities lie in the path of the release. These environmental sensitivities will have spatial and temporal variations. Therefore, the likelihood of any accidental release having a potential impact on the environment must consider the likelihood of the release occurring against the probability of that hydrocarbon or chemical reaching a sensitive area and the environmental sensitivities present in that area at the time of hydrocarbon or chemical release. The probability definitions presented in Table 4-2 in Section 4 have been developed to take account of this.

Note: It is considered that the implication of any natural disasters affecting the offshore region, such as an earthquake or extreme sea conditions, would most likely be the accidental events described in this section. As such, natural disasters are not considered separately. Mitigation relevant to minimise the risk of accidental events occurring from operational failure is likely to be appropriate in reducing the impact of accidental events resulting from natural disasters.

5.7.1.2 Sources and likelihood of occurrence

Blowout and well releases

Primary well control is the process which maintains a hydrostatic pressure in the wellbore greater than the pressure of the hydrocarbons in the formation being drilled via a drilling fluid/mud. If the formation pressure is greater than the hydrostatic pressure of the drilling fluid in the wellbore, the well will flow and the hydrocarbons will enter the wellbore. If the primary well control fails this flow may be stopped by closing the BOP, which is the initial stage of secondary well control. Secondary well control is completed by circulating out the hydrocarbons and displacing the wellbore to a new kill weight drilling fluid / mud. If primary and secondary well control fail, a blowout may occur.

A surface blowout is defined as an uncontrolled flow of formation hydrocarbons from the reservoir to the surface which occurs as a result of loss of primary and secondary well control, and may lead to the potential for release of hydrocarbons to the environment. An underground blowout is when downhole pressure exceeds the fracture pressure of a formation and hydrocarbons flow into the weaker formation.

Blowouts are extremely rare events in modern drilling (Oil & Gas UK, OGUK, 2009; Table D.2, Appendix D). Over 6,000 development wells were drilled on the UKCS between 1980 and 2010 (UKOOA, 2010), however, the International Association of Oil & Gas Producers (IOGP, 2010) report that only 34 development drilling blowouts were recorded over the same period (and those blowouts also included some in Norwegian sectors of the North Sea). Based on analysis of IOGP (2010) data (detailed in Table D.3 in Appendix D) and on the probability definitions in Table 4-2 in Section 4, the likelihood of a blowout or well release is considered remote to extremely remote. Nevertheless, as the consequence of a hydrocarbon release of any nature is potentially significant, Dana will implement rigorous measures to reduce the potential for a failure of well control and will respond should an incident occur (these are detailed in Section 5.7.2).

Drill rig accidental releases

The proposed wells will be drilled from a jack-up drill rig. Aside from well blowouts, potential accidental releases from drill rigs may be caused by mechanical failure, operational failure or human error, and release sources include drilling muds, oil and chemicals and hydraulic fluids.

During the period 2001 to 2007, 172 years of operational activity were logged by drill rigs on the UKCS with no accidental releases greater than 100 Te recorded. The majority of accidental releases recorded were less than 1 Te (Table D.4, Appendix D). The most common types of accidental release from drill rigs were found to be associated with drilling (42%), of which 94% were less than 1 Te. The second most common type of release was from maintenance / operational activities (27%), with 97% of these less than 1 Te. In addition to accidental releases generally being small volumes, the number and frequency of accidental releases has declined in recent years (Table D.5, Appendix D).

Other than blowouts, the release scenario associated with the greatest environmental impact is the loss of a Project vessel fuel inventory due to incidents such as collisions, explosions or vessel grounding (although the latter is unlikely to be associated with Platypus activities). The largest fuel inventory will be associated with the drill rig, although it is unlikely that the maximum storage capacity of marine diesel would be maintained for any extended period. In terms of collision with drill rigs, available data indicate a reduction in the frequency of such incidents between 1990 and 2007 (Table D.6, Appendix D).

Subsea tie-backs

Of all accidental releases reported from subsea tie-back facilities between 1975 and 2007, the majority (over 70%) were less than 1 Te (TINA Consultants Ltd pers. comm., 2013) (detailed in Appendix D).

Vessel accidental releases

Potential sources of accidental releases from pipelay and support vessel operations include:

- Upsets in bilge treatment systems;
- Storage tank failure of lube oils, fuel oil (diesel), oil-based mud, base oil and chemicals;
- Accidental release during maintenance activities including equipment removal and lubrication;
- Refuelling and cargo loading operations in port; and
- Damage sustained during a collision, grounding or fire.

The most frequently reported accidental releases from vessel traffic are associated with upsets in bilge treatment systems and are usually small (<1 Te). The most recent Advisory Committee on Protection of the Sea report on discharges to sea states that approximately 90% of accidental chemical releases in 2015 were considered under the OSPAR list of substances used and discharged offshore as Posing Little or No Risk to the Environment, that none of the chemicals were included in the OSPAR list of chemicals for priority action (which are considered to pose the greatest potential impact) and that none of the releases resulted in a significant environmental impact (Dixon, 2016).

5.7.1.3 Behaviour of hydrocarbons at sea

The potential environmental impact of an accidental hydrocarbon release depends on a wide variety of factors, which include:

- Accidental release volume;
- Type of hydrocarbon released;
- Direction of travel of the slick;
- Weathering properties of the hydrocarbon;
- Any environmental sensitivities present in the path of the slick (these may change with time); and
- Sensitivity of the sea and beaching locations.

The Oil Spill Contingency and Response (OSCAR) model has been developed by Sintef to model the fate of accidentally released hydrocarbons at sea. It has a built-in oil database, containing over 110 oils, along with various gridded wind and current files, originally produced by the Norwegian Met Office. OSCAR is a three-dimensional model, designed to predict the fate of oil particles at the surface, sub-surface and once dissolved. OSCAR calculates and records the distribution in three physical dimensions, plus time, of a contaminant on the water surface, along shorelines, in the water column, and in the sediments.

Seasonal (Winter – December to February; Spring – March to May; Summer – June to August; and Autumn – September to November) stochastic modelling using OSCAR was undertaken in line with the Oil Pollution Emergency Plans (OPEP) guidance provided by OPRED (BEIS, 2017). Exactly 110 runs were performed for each season, with historical meteorological data used to inform the model spanning a period of 5 years from 2008 – 2013.

The accidental release scenarios modelled for the Project are detailed in Table 5-11. In line with current regulatory and industry commentary and experience with worst-case scenario identification, the following assumptions have been made while undertaking the modelling for the Platypus Development:

- Interactions: All scenarios are run with the assumption that there is no response from any party, operator, local or national government. This approach is taken in order to view the worst-case predictions of a spill and should be used as guidance only to build and define oil spill contingency and response plans; and
- Timeframes: The well blowout scenario model runs were continued for 14 days after the well stopped flowing in order to fully examine the fate of released hydrocarbons. The diesel release scenario model runs were continued for 30 days following cessation of the (instantaneous) release for the same purpose.

In order to set limits for when the spilled hydrocarbon can be considered insignificant in the environment, the following thresholds have been used:

- A minimum sea surface oil thickness threshold of 0.3 µm has been used for all modelled scenarios; and
- No lower threshold was set for shoreline oiling.

No modelling was conducted for a pipeline release. This is because, as a worst case, the maximum release of condensate from a pipeline rupture was calculated at 5 m^3 and, given the offshore location, this was deemed to present a negligible risk to the environment and certainly less than the risk posed by the two scenarios that have been modelled. As such there is no value in including a pipeline loss scenario in the ES.

Oil Spill Modelling is a widely used technique to understand the potential behaviour of a particular hydrocarbon when it is released under a certain set of circumstances. Whilst the modelling conducted here followed the requirements of the UK regulator (BEIS, 2019) there are a number of limitations in the prescribed approach that result in conservative (worst case) predictions and should be taken into account when interpreting the results. These are:

- The modelling was conducted as a stochastic simulation and within this approach the shoreline oiling is an ultimate sink in the model; oil arriving in a shoreline model cell accumulates in the cell with no mechanism for its removal. Therefore, oil can only increase on the shoreline over the model run, producing a conservative estimate of oil onshore. This means that the amounts of oil shown by the model as having the potential to beach is an over-estimate.
- Whilst the 0.3 µm threshold is applied to sea surface oil, this threshold has no effect on any other compartment (a theoretical box that the model uses to partition particles in the sea) and no threshold is applied to shoreline oiling. Thus, the modelled estimate of shoreline oiling is the total for all quantities of oil on the shore and, therefore, whilst a quantity of oil may be predicted to be onshore from a worst-case run this may well be the result of widespread but low-level oiling of the shoreline, rather than large amounts beaching over a very small area. However, it is not possible from the model to determine which scenario might occur during an actual spill as this will depend on the wind, currents and temperature at the time of the release.
- The modelling scenarios are based upon a series of conservative assumptions. For a well blowout these include the nature of the hydrocarbons the well will produce, the quantity of liquid hydrocarbons the well will release, the matching of these to a suitably similar oil in the model database and the assumed absence of any emergency response to the blowout to provide a worst possible case scenario. In the case of the loss of diesel inventory from a drill-rig, the model assumes that the total quantity of fuel will be lost to the sea surface instantaneously and, therefore, takes no account of fuel used to reach the location, the compartmentalisation of fuel tanks or that losses from vessels tend to occur more slowly over a prolonged period.

Table 5-11: Summary of accidental release scenarios modelled for the Project

Scenario	Scenario description	Hydrocarbon type	Release volume	Modelled depth of release	Model type
1	Instantaneous loss of drill rig fuel inventory at Platypus.	Marine diesel	2,400 m^3	Surface	Stochastic
2	Well blowout at Platypus using the highest unconstrained well flow rate for 90 days (time taken to drill a relief well).	Platypus condensate	3,006 m^3	Seabed	Stochastic

Scenario 1: Instantaneous loss of drill rig fuel inventory at Platypus

The probability of sea surface contamination exceeding 0.3 µm for releases occurring in each season is presented in Figure 5.3 (Spring), Figure 5.4 (Summer) and Figure 5.5 (Autumn). There is a <20% probability of surface contamination over the majority of the potential impact area, with probability up to 30% restricted to a small area close to the release point, which is most extensive in the Spring model runs (Figure 5.3). It is expected that most of the contamination would comprise a transient presence of a very thin layer of diesel.

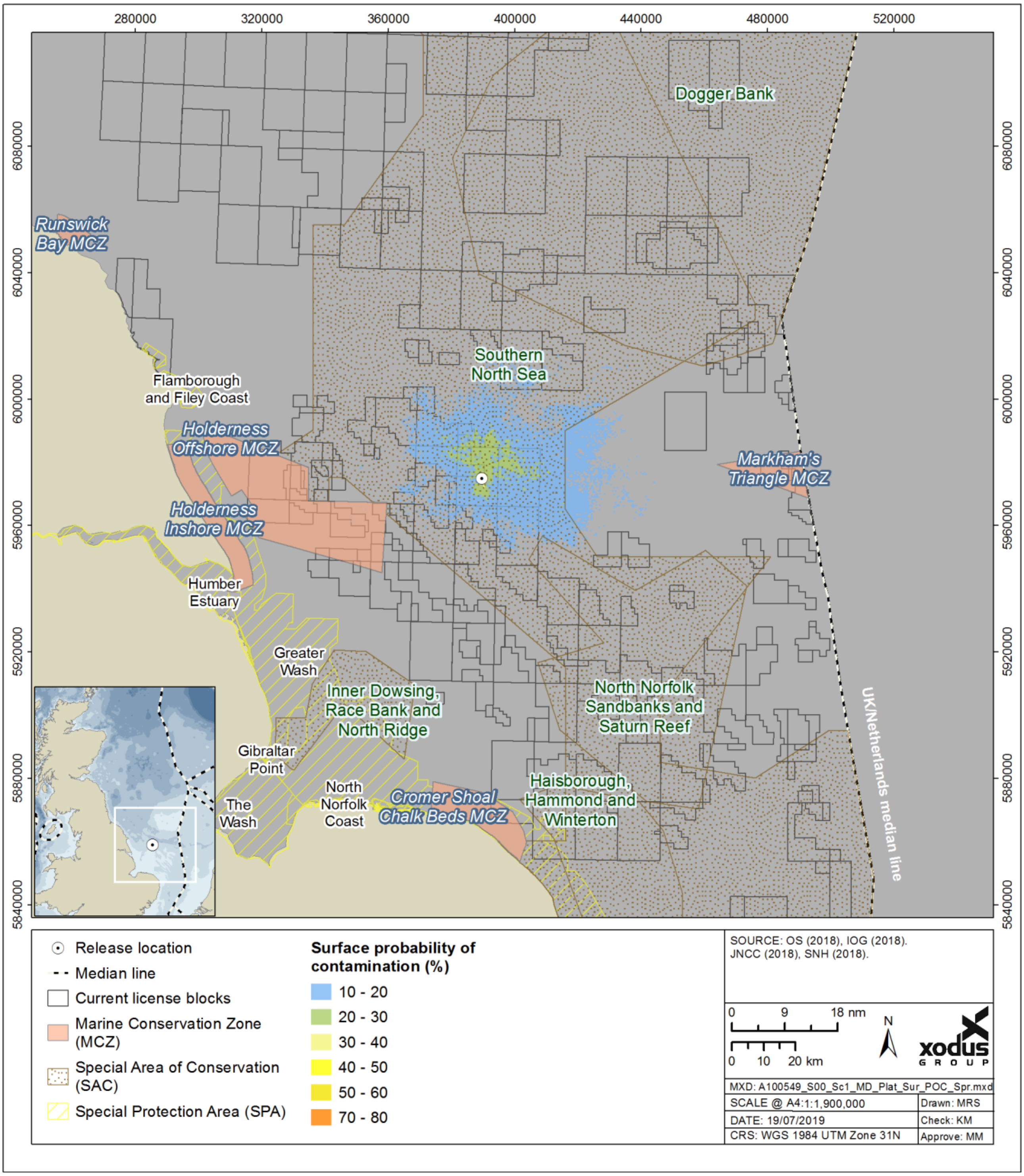

Figure 5.3: Spring drill rig release surface probability of contamination (above 0.3 μm surface thickness)

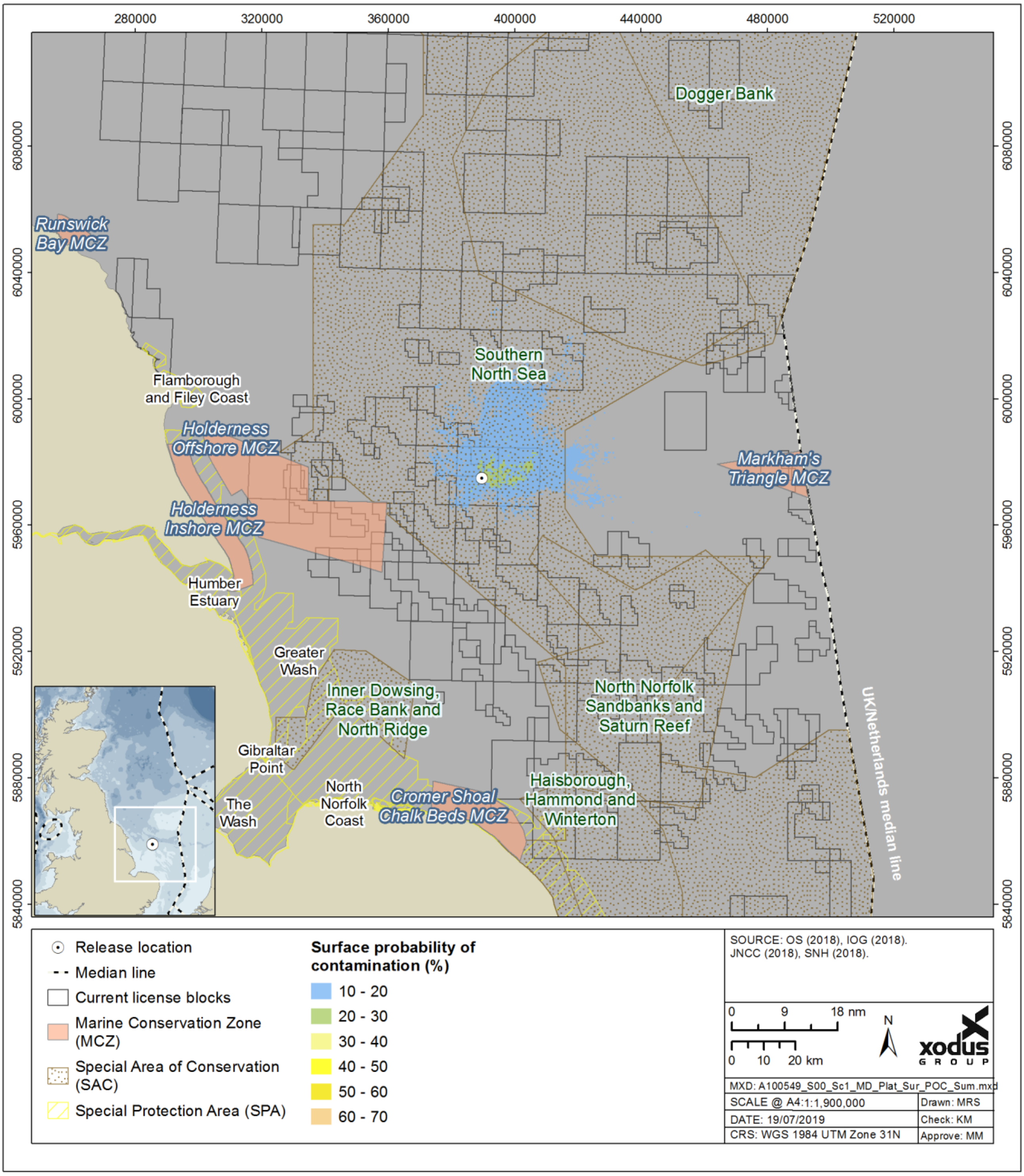

Figure 5.4: Summer drill rig release surface probability of contamination (above 0.3 μm surface thickness)

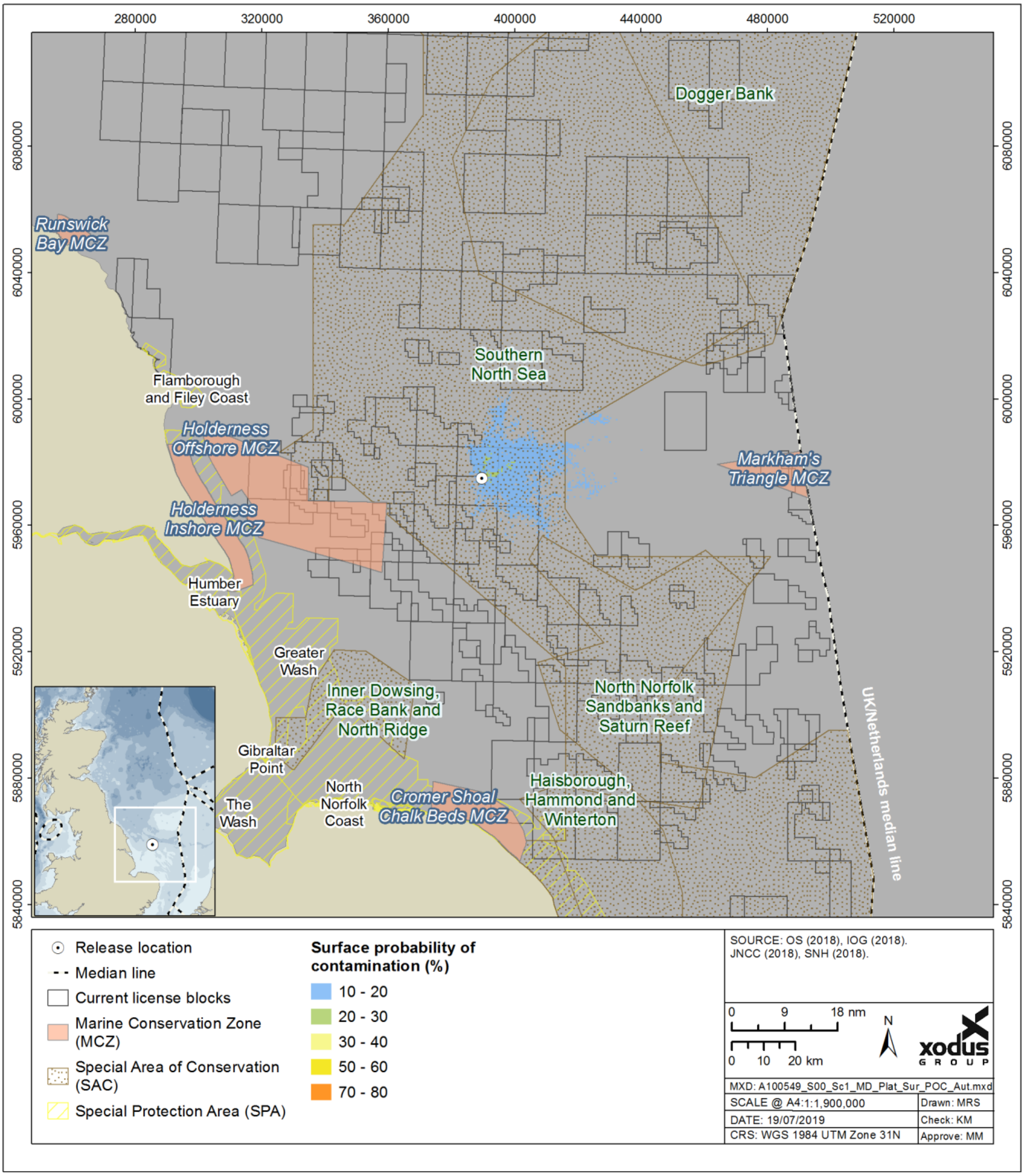

Figure 5.5: Autumn drill rig release surface probability of contamination (above 0.3 µm surface thickness)

Potential for shoreline oiling is summarised in Table 5-12. The maximum probability of shoreline oiling (17.3%) occurred in the spring scenarios and was predicted to affect the Yorkshire and Lincolnshire coasts. The minimum arrival time of hydrocarbon to shore was two days in one of the spring model runs, and the maximum mass of oil predicted to beach was 874.3 Te in one of the summer model runs.

Table 5-12: Shoreline oiling summary

Location / Contamination Metrics		Spring	Summer	Autumn
Yorkshire	Probability of contamination (%)	0.9 – 17.3	0.9 – 4.5	0.9 – 7.3
	Minimum arrival time (days and hours)	2d 0h	4d 1h	2d 13h
Lincolnshire	Probability of contamination (%)	0.9 – 17.3	0.9 – 4.5	0.9 – 6.4
	Minimum arrival time (days and hours)	2d 9h	6d 5h	3d 3h
Norfolk	Probability of contamination (%)	0.9 – 10	0.9 – 6.4	0.9 – 12.7
	Minimum arrival time (days and hours)	3d 6h	4d 20h	2d 15h
Maximum mass of beached oil in any single run (Te)		736.5	874.3	499.9
Maximum mass of beached emulsion in any single run (Te)		745.4	884.8	505.9
Maximum volume of beached emulsion in any single run (m^3)		882.3	1047.3	598.9

Table 5-13 presents the minimum crossing times to all relevant median lines. The single fastest crossing time was two days and four hours in one of the autumn model runs; the maximum probability of crossing occurring during the autumn scenario was 2.7%. The season with the maximum probability of crossing was summer (5.5%), but the fastest crossing time in a summer model run was slower, 3 days and 6 hours.

Table 5-13: Minimum crossing times to median lines

Median line crossed	Probability of crossing (% range)	Minimum crossing time	Season
Netherlands	0.9 – 4.5	2 days 6 hours	Spring
Netherlands	0.9 – 5.5	3 days 6 hours	Summer
Netherlands	0.9 – 2.7	2 days 4 hours	Autumn

Scenario 2: Well blowout at Platypus using the highest unconstrained well flow rate for 90 days (time taken to drill a relief well)

The probability of sea surface contamination exceeding 0.3 µm for releases occurring in each season is presented in Figure 5.6 (Spring), Figure 5.7 (Summer), Figure 5.8 (Autumn) and Figure 5.9 (Winter). The area exposed to >50% probability of surface oiling is mostly offshore, although the area around Spurn Head was exposed to probability around 50% in the spring model runs (Figure 5.6). Although modelling predicts high probability of sea surface contamination over a wide area of the SNS, it is expected that the majority of the contamination, even in the zone of high probability, would comprise a transient presence of a very thin layer of condensate.

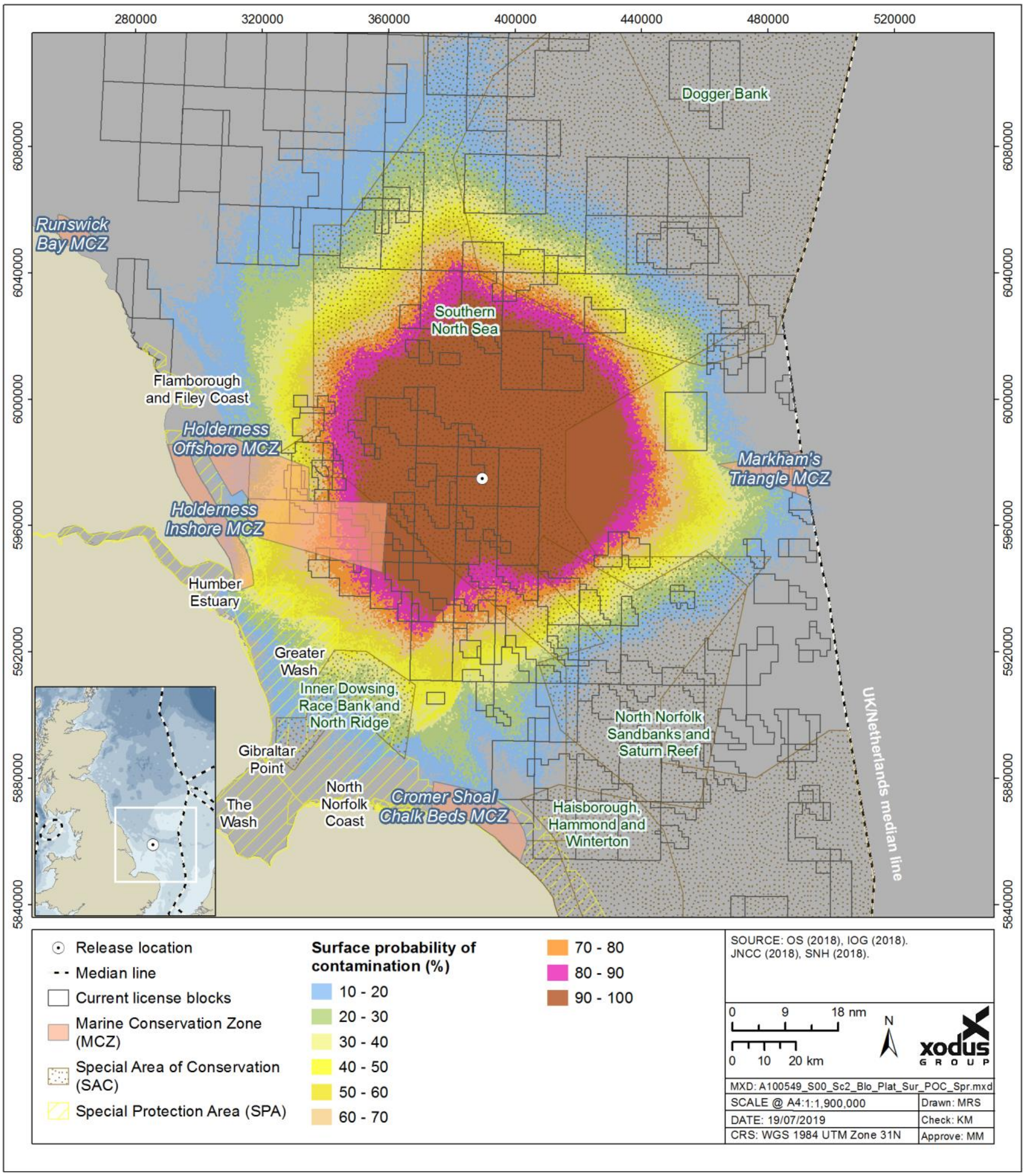

Figure 5.6: Spring well blowout surface probability of contamination (above 0.3 µm surface thickness)

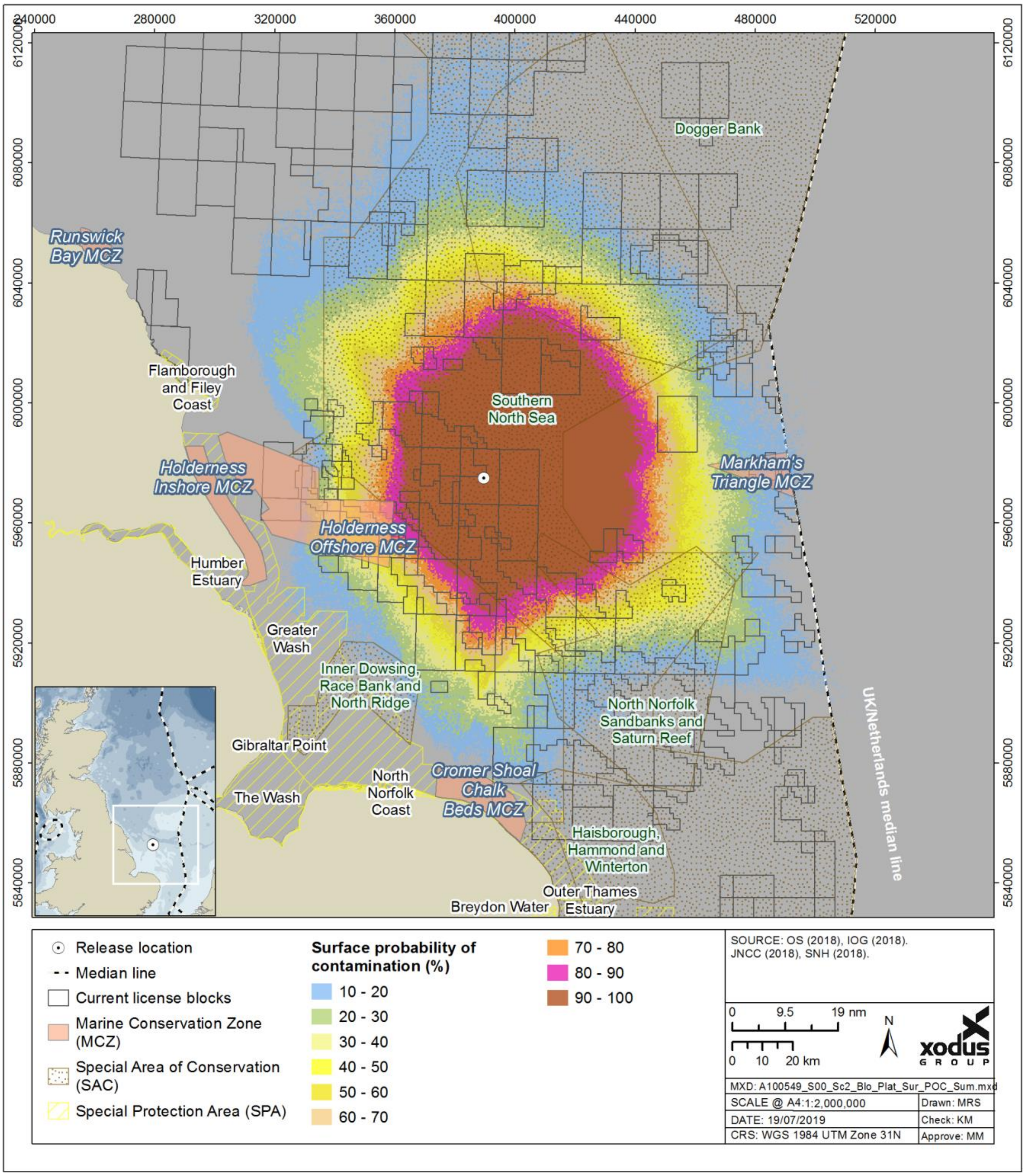

Figure 5.7: Summer well blowout surface probability of contamination (above 0.3 μm surface thickness)

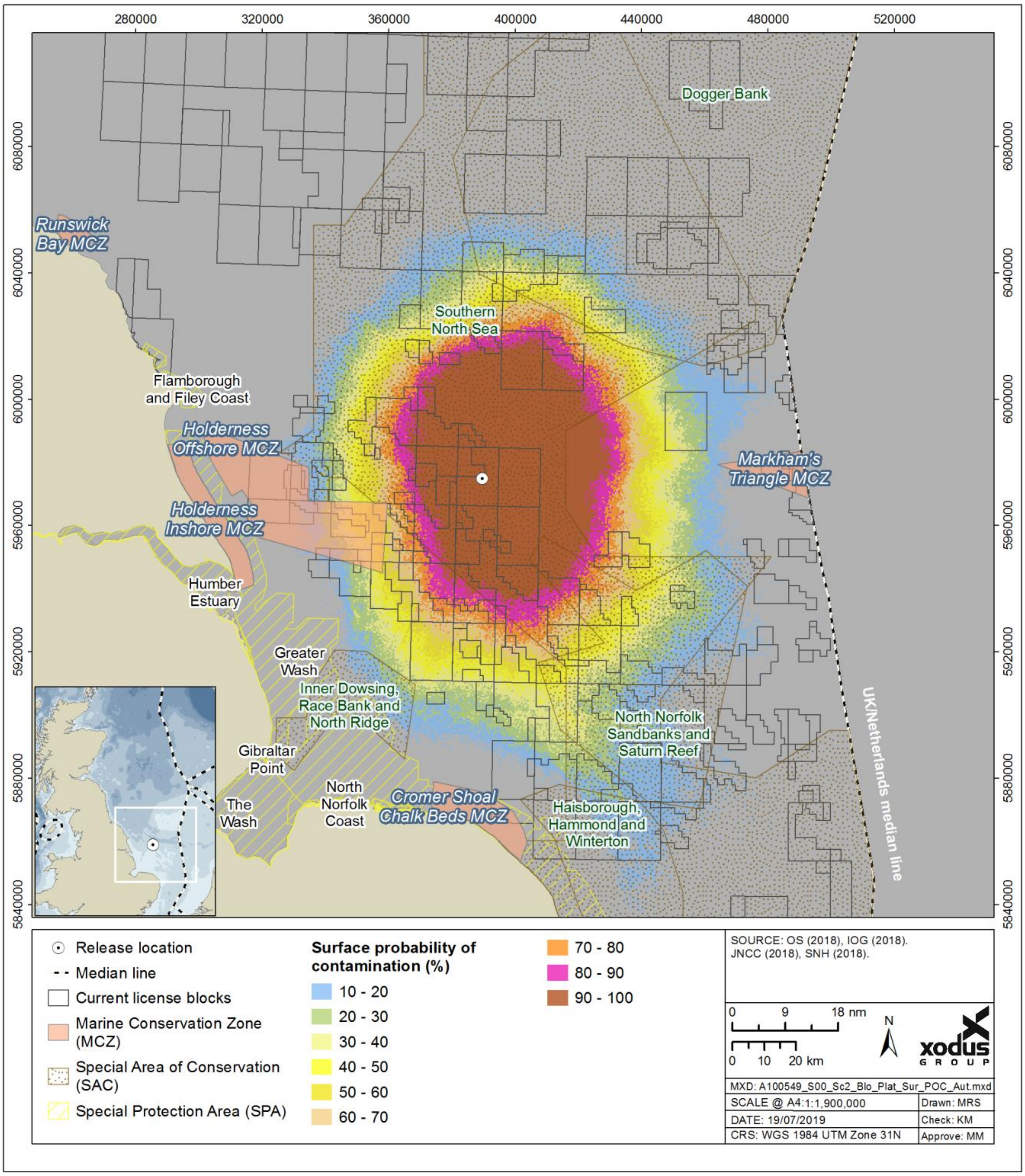

Figure 5.8: Autumn well blowout surface probability of contamination (above 0.3 µm surface thickness)

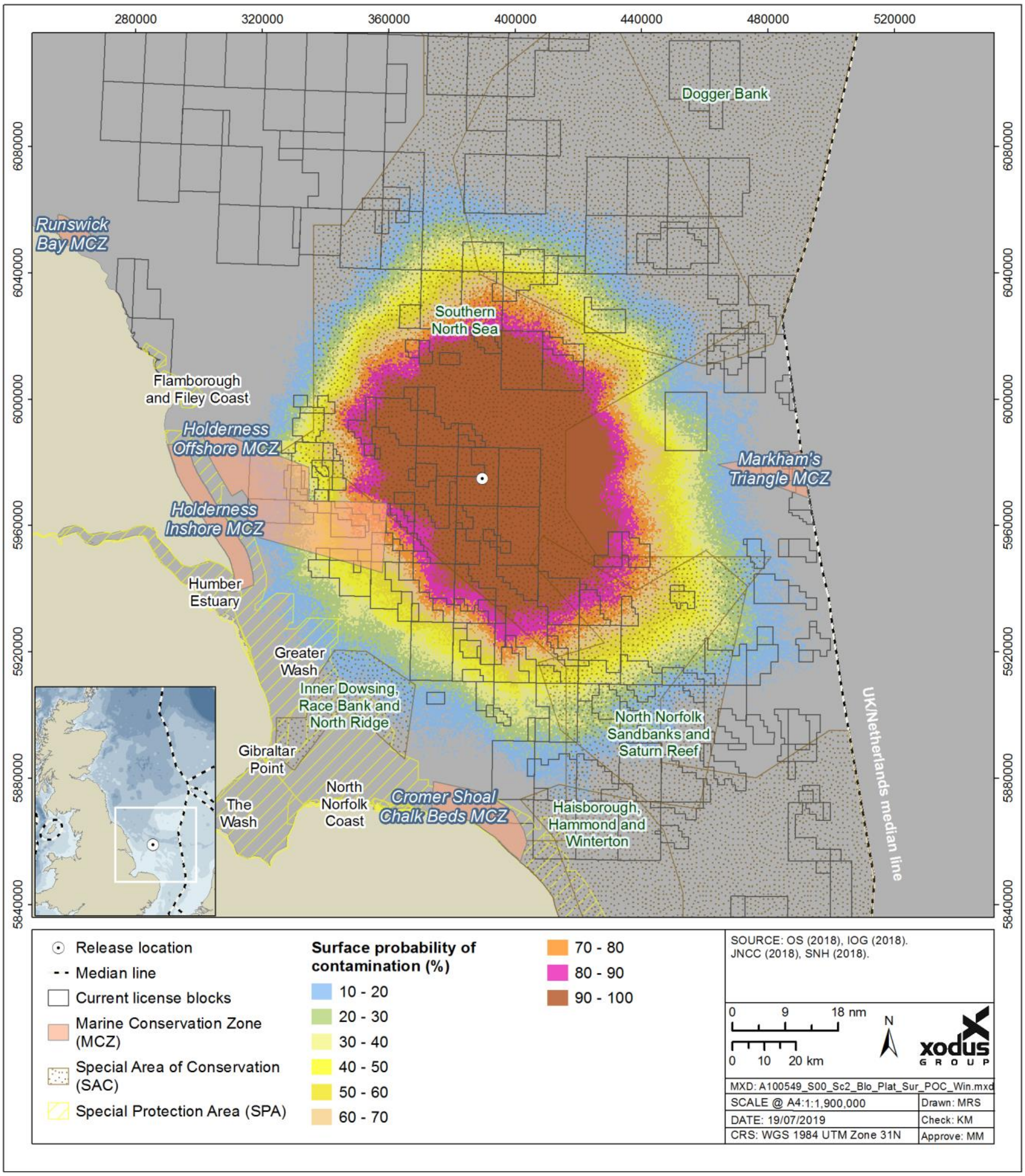

Figure 5.9: Winter well blowout surface probability of contamination (above 0.3 µm surface thickness)

Shoreline oiling is summarised in Table 5-14. The maximum probability of shoreline oiling (50.9%) occurred in the spring scenarios and was predicted to affect the Yorkshire coast (consistent with the pattern of sea surface contamination in Figure 5.6). The minimum arrival time of hydrocarbon to shore was 3 days and 23 hours in one of the autumn model runs, and the maximum mass of oil predicted to beach was 4.4 Te in one of the spring model runs.

Table 5-14: Shoreline oiling summary

Location / Contamination Metric		Spring	Summer	Autumn	Winter
Yorkshire	Probability of contamination (%)	0.9 – 50.9	0.9 – 10	0.9 – 29.1	0.9 – 36.4
	Minimum arrival time (days and hours)	5d 19h	9d 19h	4d 15h	6d 8h
Lincolnshire	Probability of contamination (%)	0.9 – 44.5	0.9 – 13.6	0.9 – 30.9	0.9 – 24.5
	Minimum arrival time (days and hours)	5d 19h	8d 9h	6d 9h	9d 3h
Norfolk	Probability of contamination (%)	0.9 – 31.8	0.9 – 23.6	0.9 – 32.7	0.9 – 23.6
	Minimum arrival time (days and hours)	5d 16h	7d 11h	3d 23h	6d 15h
Suffolk/Essex	Probability of contamination (%)	0.9 – 10.9	0.9 – 15.5	0.9 – 20	0.9 – 10.9
	Minimum arrival time (days and hours)	9d 0h	7d 12h	4d 4h	9d 0h
Maximum mass of beached oil in any single run (Te)		4.4	1.7	1.9	3.5
Maximum mass of beached emulsion in any single run (Te)		7.0	2.7	3.0	5.5
Maximum volume of beached emulsion in any single run (m^3)		8.0	3.1	3.5	6.4

Table 5-15 presents the minimum crossing times to all relevant median lines. The single fastest crossing time was two days and seven hours in one of the winter model runs; the maximum probability of crossing occurring during the winter scenario was 10%. The season with the maximum probability of crossing was summer (16.4%), but the fastest crossing time in a summer model run was slower, 8 days and 4 hours.

Table 5-15: Minimum crossing times to median lines

Median line crossed	Probability of crossing (% range)	Minimum crossing time	Season
Netherlands	0.9 – 15.5	4 days 18 hours	Spring
Netherlands	0.9 – 16.4	8 days 4 hours	Summer
Netherlands	0.9 – 8.2	4 days 15 hours	Autumn
Netherlands	0.9 – 10	2 days 7 hours	Winter

5.7.1.4 Environmental vulnerability to spills

Environmental vulnerability to spills is a function of both the likelihood of impact from a spill (as considered in previous sections) and the sensitivity of the environment.

There can be impacts on plankton in the immediate area of the release for the duration of the release due to the dissolution of aromatic fractions into the water column. Such effects will be greater during a period of plankton bloom and during fish spawning periods. Contamination of marine prey including plankton and small fish species may then lead to aromatic hydrocarbons accumulating in the food chain. These could have long-term chronic effects such as reduced fecundity and breeding failure in fish, bird and cetacean populations. This may affect fish stocks of commercially fished species. A major release could also have a localised effect on the fishing industry, should certain areas be temporarily closed to fishing.

Juvenile fish and eggs are potentially the most sensitive life-stage to hydrocarbon discharges. As outlined in Section 3.3.2, a number of commercially important pelagic and demersal fish species are found in the vicinity of the Project.

The JNCC has stated in a memorandum to the UK Parliament that the greatest risks to nature conservation from oil on the offshore sea surface is to seabirds (JNCC, 2011). The seasonal vulnerability of seabirds to surface pollutants in the immediate vicinity of the Project, derived from JNCC block-specific data, suggest that seabird sensitivity to oil releases in this area ranges from low to extremely high (see Section 3.3.4). The magnitude of any impact will depend on the number of birds present, the percentage of the population present, their vulnerability to spilled hydrocarbons and their recovery rates from oil pollution. The physical impact of a spill is one of plumage damage leading to loss of insulation and waterproofing. A detailed assessment of the potential impacts on local bird receptors is presented in Section 5.7.5.2.

Cetaceans are also present in the vicinity of the Development area (see Section 3.3.5). This includes the harbour porpoise which is the qualifying feature of the SNS SAC, in which the Platypus Development is located. In the event of a spill, the potential impact will depend on the species and their feeding habits, the overall health of individuals before exposure, and the characteristics of the hydrocarbons. Cetaceans are pelagic and migrate over large distances and may not avoid hydrocarbon-contaminated areas. Baleen whales are particularly vulnerable whilst feeding, as oil may stick to the baleen if the whales filter feed near surface slicks. It is thought unlikely that a population of cetaceans in the open sea would be affected by a spill in the long-term (Aubin, 1990). A detailed assessment of the potential impacts on local cetacean receptors is presented in Section 5.7.5.3.

5.7.2 Mitigation

The following provides an overview of proposed measures that either reduce the probability of failure of an accidental release, or reduce the consequences in the event of an accidental release:

- The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 implement the EC Offshore Directive. As part of this, a verification scheme exists for safety and environment critical elements (SECEs). Dana will identify SECEs in future design stages;
- The drill rig will have a minimum 10,000 pound per square inch BOP stack (standard for drill rigs);
- Installation personnel will be given full training in chemical release prevention and actions to be taken in the event of an accidental chemical release;
- An appropriate OPEP will be in place that provides modelling and response planning;
- Shipboard Oil Pollution Emergency Plans (SOPEPs) will be in place where required;
- Appropriate maintenance procedures will be developed and followed;
- Simultaneous operations (SIMOPs) will be actively identified and managed;
- The drill rig will be subject to an audit which will cover oil spill response, procedural controls, bunkering and storage arrangements;
- Bunkering operations will be kept to good light and weather conditions where practicable;
- Observers will be posted during bunkering operations;
- Visual inspection of hoses and connections prior to use;
- All loading hoses and valves used will be within their certified testing periods;
- The pipelines will be constructed to meet the requirements of the Pipeline Safety Regulations 1996;
- Chemical storage areas will be contained to prevent accidental release of chemicals;
- Tool box talks will highlight the importance of minimising the risk of spills occurring; and
- Risks will be subject to ongoing assessment and management as implemented through the Dana Health, Safety and Environmental Management System (HSE MS) (see Section 6 for details).

5.7.3 Cumulative and transboundary impact

Existing hydrocarbon spill risks in the North Sea are associated with various industries such as oil and gas activities, shipping and fishing. As indicated by historical data, the likelihood of one major accidental release occurring is remote or extremely remote, limiting the cumulative impact from the Platypus Development and other existing installations. Detailed OPEPs will be in place, outlining the response measures to be implemented in the event of a spill.

Worst-case scenario spill modelling indicates some probability that in the event of an accidental hydrocarbon release a transboundary impact in Dutch waters could occur. However, based on the remote to extremely remote likelihood of a well blowout or drill rig inventory loss, this scenario is extremely unlikely. Therefore, consultation under the Espoo Convention, is not required as a result of the Platypus Development. The Espoo Convention requires notification and consultation only for projects likely to have a significant adverse environmental impact across boundaries.

The risk of a spill having a transboundary impact, particularly from North Sea operations, is recognised by the UK Government and other governments around the North Sea. International agreements are in place for dealing with transboundary spill incidents. These agreements would operate within the framework of the National Contingency Plans (NCPs) and are oriented towards major spills. This becomes operational when agreement to the request for its implementation is reached. Responsibility for implementing joint action with neighbouring states rests with the Action Co-ordinating Authority (ACA) of the country on whose side of the median line a spill originated. The UK's ACA is the Counter Pollution Branch of the Maritime Coastguard Agency.

5.7.4 Decommissioning

Cessation of production will remove one of the main sources of potential accidental hydrocarbon release since there will no longer be a hydrocarbon flow from the well or through the pipeline system. Vessels will be required to execute decommissioning activities, with potential impacts related to accidental hydrocarbon and chemical release from those vessels likely to occur at a similar magnitude to that of installation activities.

5.7.5 Protected Sites

Sea surface and shoreline probability of contamination data exported from the stochastic oil spill modelling (see Section 5.7.1.3) was examined to identify protected sites which are at risk of hydrocarbon contamination and require further assessment. For the purposes of this assessment it was concluded a protected site required further assessment if the probability of sea surface contamination or of shoreline contamination within the site was equal to or above 10% in either of the release scenarios. Review of the data confirmed that for all sites, the blowout scenario produced the higher probabilities of both surface and shoreline contamination for every site. Protected sites included in the assessment were SACs and MCZs, which are presented in Table 5-16, and SPAs which are presented in Table 5-17.

Table 5-16: SAC and MCZ sites potentially impacted as a result of hydrocarbon contamination (>10% probability of surface or shoreline contamination within site boundary)

Site	Distance to site boundary from release location (km)	Probability of any shoreline oiling (%)	Probability of any sea surface oiling (%)	Primary designation features
SNS SAC	0	29	100	Harbour porpoise
Cromer Shoal Chalk Beds MCZ	96	33	23	Moderate energy infralittoral rock; High energy infralittoral rock; Moderate energy circalittoral rock; High energy circalittoral rock; Subtidal chalk; Subtidal coarse sediment; Subtidal mixed sediments; Subtidal sand; Peat and clay exposures; and North Norfolk Coast (subtidal geological feature).
Holderness Inshore MCZ	59	51	55	Intertidal mixed sediments; Subtidal course sediments; Subtidal sand; Peat and clay exposures; Ross worm reefs; Subtidal chalk; Subtidal sands and gravels; and Spurn Head.
Holderness Offshore MCZ	12	N/A, offshore	100	Subtidal coarse sediment; and Subtidal mixed sediments.
Markham's Triangle MCZ	95	N/A, offshore	39	Subtidal coarse sediment; Subtidal sand; Subtidal mud; and Subtidal mixed sediments.
Dogger Bank SAC	67	N/A, offshore	93	Sandbanks which are slightly covered by seawater all the time.

Haisborough, Hammond and Winterton SAC	106.6	N/A, offshore	26	Sandbanks which are slightly covered by seawater all the time; and Reefs.
Inner Dowsing, Race Bank and North Ridge SAC	57	N/A, offshore	58	Sandbanks which are slightly covered by seawater all the time; and Reefs.
North Norfolk Sandbanks and Saturn Reef SAC	43	N/A, offshore	100	Sandbanks which are slightly covered by seawater all the time; and Reefs.
Benacre to Easton Bavents Lagoons SAC	173.5	12	N/A, onshore	Coastal lagoons.
Flamborough Head SAC	69	36	15	Reefs; Vegetated sea cliffs of the Atlantic and Baltic Coasts; and Submerged or partially submerged sea caves.
Humber Estuary SAC	66	51	27	Estuaries Mudflats and sandflats not covered by seawater at low tide
North Norfolk Coast SAC	102.4	32	<10%	Coastal lagoons; Perennial vegetation of stony banks; Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*); Embryonic shifting dunes; Shifting dunes along the shoreline with *Ammophila arenaria* (marram grass); Fixed coastal dunes with herbaceous vegetation; and Humid dune slacks.
Overstrand Cliffs SAC	111.1	30	<10%	Vegetated sea cliffs of the Atlantic and Baltic Coasts.
Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC	76	45	11	Shifting dunes along the shoreline with *Ammophila arenaria*; Fixed coastal dunes with herbaceous vegetation; Dunes with *Hippophae rhamnoides* (common sea buckthorn); and Humid dune slacks.

The Wash and North Norfolk Coast SAC	95	32	15	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; Salicornia and other annuals colonizing mud and sand; Atlantic salt meadows (Glauco-Puccinellietalia maritimae); Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*); and Harbour seal.
Winterton - Horsey Dunes SAC	135	25	<10%	Atlantic decalcified fixed dunes (Calluno-Ulicetea); and Humid dune slacks.

Table 5-17: SPA sites potentially impacted as a result of hydrocarbon contamination (>10% probability of surface or shoreline contamination within site boundary)

Site	Qualifying features
Benacre to Easton Bavents SPA Distance from release (km): 173.5 Probability of shoreline oiling (%): 12 Probability of sea surface oiling (%): N/A, onshore	**Directive 2009/147/EC Article 4.1 (Annex I) species:** Bittern (*Botaurus stellaris)*: - The most recent mean number of breeding bitterns during the period 2014-18 is 4.4 breeding pairs (Natural England, 2019); Little tern (*Sternula albifrons)*: - 53 breeding pairs representing at least 2.2% of the British breeding population - The 5 year mean from the period 2014-18 is 10.8 nests (Natural England, 2019); and Marsh harrier (*Circus aeruginosus)*: - 6 breeding pairs representing at least 3.8% of the British breeding population - The five-year average 2014-2018 is 40 breeding pairs (Natural England, 2019).
Flamborough Head and Bempton Cliffs SPA Distance from release (km): 75 Probability of shoreline oiling (%): 36 Probability of sea surface oiling (%): <10	**Directive 2009/147/EC Article 4.2 (non-Annex I regularly occurring migratory) species** Kittiwake: - 83,370 breeding pairs representing at least 2.6% of the Eastern Atlantic breeding population. Wetland of international importance.

Gibraltar Point SPA Distance from release (km): 98 Probability of shoreline oiling (%): 31 Probability of sea surface oiling (%): <10	**Directive 2009/147/EC Article 4.1 (Annex I) species:** Little tern: - 23 breeding pairs representing at least 1.0% of the British breeding population; Bar-tailed godwit (*Limosa lapponica)*: - 719 over wintering individuals representing at least 1.4% of the British wintering population; **Directive 2009/147/EC Article 4.2 (non-Annex I regularly occurring migratory) species** Grey plover (*Pluvialis squatarola)*: - 2,017 over wintering individuals representing at least 1.3% of the Eastern Atlantic wintering population; and Knot (*Calidris canutus)*: - 10,155 over wintering individuals representing at least 2.9% of the NE Canada / Greenland / Iceland / NW Europe wintering population. Wetland of international importance.
Great Yarmouth North Denes SPA Distance from release (km): 134.6 Probability of shoreline oiling (%): 25 Probability of sea surface oiling (%): <10	**Directive 2009/147/EC Article 4.1 (Annex I) species:** Little tern: - 220 breeding pairs representing at least 9.2% of the British breeding population.
Humber Estuary SPA Distance from release (km): 65 Probability of shoreline oiling (%): 51 Probability of sea surface oiling (%): 27	**Directive 2009/147/EC Article 4.1 (Annex I) species:** Breeding (as % of British breeding population): - bittern (10.5%), marsh harrier (6.3%), avocet (*Recurvirostra avosetta)* (8.6%), little tern (2.1%); Over wintering (as % of British over wintering population): - bittern (4%), hen harrier (*Circus cyaneus)* (1.1%), bar tailed godwit (4.4%), golden plover (*Pluvialis apricaria)* (12.3%), avocet (1.7%); and, Passage (as % of British passage population): - Ruff (*Philomachus pugnax)* (1.4%). **Directive 2009/147/EC Article 4.2 (non-Annex I regularly occurring migratory) species** Over wintering (as % of regional population): - dunlin (*Calidris alpina)* (1.7%), knot (6.3%), black tailed godwit (*Limosa limosa)* (3.2%), common shelduck (*Tadorna tadorna)* (1.5%) and redshank (*Tringa totanus)* (3.6%); and, Passage (as % of regional population): - dunlin (1.5%), knot (4.1%), black tailed godwit (2.6%) and redshank (5.7%). Wetland of international importance.
North Norfolk Coast SPA Distance from release (km): 102.2 Probability of shoreline oiling (%): 32 Probability of sea surface oiling (%): <10	**Directive 2009/147/EC Article 4.1 (Annex I) species:** Avocet: - 177 breeding pairs representing at least 30% of the British breeding population and 153 over wintering individuals representing at least 12% of the British wintering population; Bittern: - Between 2007 and 2011 there was an average of four territorial males, representing 4% of the British population at that time (Natural England, 2017) Common tern: - 460 breeding pairs representing at least 3.7% of the British breeding population; Little tern: - 377 breeding pairs representing at least 15.7% of the British breeding population; Marsh harrier:

	- 14 breeding pairs representing at least 8.8% of the British breeding population; Mediterranean gull (*Larus melanocephalus)*: - 2 breeding pairs representing at least 20% of the British breeding population; Roseate tern (*Sterna dougallii)*: - 2 breeding pairs representing at least 3.3% of the British breeding population; Sandwich tern: - 3,457 breeding pairs representing at least 24.7% of the British breeding population; Bar tailed godwit: - 1,236 over wintering individuals representing at least 2.3% of the British wintering population; Golden plover: - 2,667 over wintering individuals representing at least 1.1% of the British wintering population; Hen harrier: - 16 over wintering individuals representing at least 2.1% of the British wintering population; and Ruff: - 54 over wintering individuals representing at least 7.7% of the British wintering population. **Directive 2009/147/EC Article 4.2 (non-Annex I regularly occurring migratory) species** Redshank: - 700 breeding pairs representing at least 1.2% of the breeding Eastern Atlantic - wintering population and 2,998 individuals representing at least 2% of the wintering Eastern Atlantic - wintering population. Ringed plover (*Charadrius hiaticula)*: - 220 breeding pairs representing at least 1.4% of the breeding Europe / Northern Africa - wintering population and 1,256 passage individuals representing at least 2.5% of the Europe/Northern Africa – wintering population; Dark-bellied brent goose *Branta bernicla bernicla*: - 11,512 over wintering individuals representing at least 3.8% of the wintering Western Siberia / Western Europe population; Knot: - 10,801 over wintering individuals representing at least 3.1% of the wintering NE Canada / Greenland / Iceland / NW Europe population; Pink-footed goose *Anser brachyrhynchust*: - 23,802 over wintering individuals representing at least 10.6% of the wintering Eastern Greenland / Iceland / UK population; Pintail (*Anas acuta)*: - 1,139 over wintering individuals representing at least 1.9% of the wintering NW Europe population; and Wigeon (*Anas penelope)*: - 14,039 over wintering individuals representing at least 1.1% of the wintering wintering Western Siberia / NW / NE Europe population. Wetland of international importance.
Outer Thames Estuary SPA Distance from release (km): 149 Probability of shoreline oiling (%): 20 Probability of sea surface oiling (%): <10	**Directive 2009/147/EC Article 4.1 (Annex I) species:** Red-throated diver: - 6,446 over wintering individuals representing at least 38% of the British wintering population and being the largest wintering aggregation of this species in the UK; Little tern: - Breeding population representing 19.64% of British breeding population; and, Common tern: - Breeding population representing 2.66% of British breeding population.
The Wash SPA	**Directive 2009/147/EC Article 4.1 (Annex I) species:**

Distance from release (km): 101.2 Probability of shoreline oiling (%): 16 Probability of sea surface oiling (%): 11	Common tern: - 152 breeding pairs representing at least 1.2% of the British breeding population; Little tern: - 33 breeding pairs representing at least 1.4% of the British breeding population; Marsh harrier: - 15 breeding pairs representing at least 9.4% of the British breeding population; Avocet: - 110 over wintering individuals representing at least 8.7% of the British wintering population; Bar tailed godwit: - 11,250 over wintering individuals representing at least 21.2% of the British wintering population; Golden plover: - 11,037 over wintering individuals representing at least 4.4% of the British wintering population; Whooper swan (*Cygnus cygnus)*: - 68 over wintering individuals representing at least 1.2% of the British wintering population; **Directive 2009/147/EC Article 4.2 (non-Annex I regularly occurring migratory) species** Ringed plover: - 1,185 passage individuals representing at least 2.4% of the Europe / Northern Africa – wintering population; Sanderling (*Calidris alba)*: - 1,854 passage individuals representing at least 1.9% of the Eastern Atlantic / Western and Southern Africa - wintering population; Black tailed godwit: - 859 over wintering individuals representing at least 1.2% of the wintering Iceland - breeding population; Curlew (*Numenius arquata)*: - 3,835 over wintering individuals representing at least 1.1% of the wintering Europe - breeding population; Dark-bellied Brent goose: - 22,248 over wintering individuals representing at least 7.4% of the wintering western Siberia / western Europe population; Dunlin: - 35,620 over wintering individuals representing at least 2.5% of the wintering northern Siberia / Europe / western Africa population; Grey plover: - 9,708 over wintering individuals representing at least 6.5% of the wintering eastern Atlantic - wintering population; Knot: - 186,892 over wintering individuals representing at least 53.4% of the wintering NE Canada / Greenland / Iceland / NW Europe population; Oystercatcher (*Haematopus ostralegus)*: - 25,651 over wintering individuals representing at least 2.9% of the wintering Europe and northern / western Africa population; Pink-footed goose: - 33,265 over wintering individuals representing at least 14.8% of the wintering eastern Greenland / Iceland / UK population; Pintail: - 923 over wintering individuals representing at least 1.5% of the wintering NW Europe population; Redshank: - 2,953 over wintering individuals representing at least 2% of the wintering eastern Atlantic - wintering population; Shelduck:

	- 15,981 over wintering individuals representing at least 5.3% of the wintering NW Europe population; Turnstone (*Arenaria interpres*): - 717 over wintering individuals representing at least 1% of the wintering western Palearctic – wintering population; Wetland of international importance.

5.7.5.1 Benthic features

The Platypus Field will produce a condensate with an API Gravity of approximately 47.2. If API gravity is greater than 10, the hydrocarbon is less dense than water and floats; if less than 10, it is more dense and will sink. The Platypus condensate is therefore expected to be very buoyant in seawater. Marine diesel API gravity varies depending on the specific blend but is usually approximately 36, and diesel used at the Project will also therefore be buoyant in seawater.

Due to the buoyancy of the released material, in water depths greater than the wave-induced mixing depth there would not be a pathway to the benthos or seabed features. As such, it is unlikely that hydrocarbons would reach the seabed in the vicinity of the offshore sites listed in Table 5-16, and no impacts on the benthic features of these sites are expected.

Closer to shore, hydrocarbons may be driven down to the seabed by wave induced mixing. Hydrocarbons may also bind to suspended sediments, which are more prevalent closer to shore. The greater density of the sediment particles may overcome the buoyancy of the hydrocarbons, resulting in a neutrally buoyant or negatively buoyant oil-mineral aggregate (OMA), which may then sink to the seabed. While potentially increasing the exposure of benthic features to hydrocarbon contamination, OMA formation has been conclusively demonstrated to enhance biodegradation of residual oil (Colcomb *et al*. 1997).

Shoreline habitats and species exhibit widely varying sensitivity to hydrocarbon pollution and ability to recover. Exposed shores such as the wave-swept sand and exposed clay beach at Holderness Inshore MCZ, or the sea cliffs of the Flamborough Head SAC typically exhibit low sensitivity to hydrocarbon contamination and rapid recovery because oil is quickly removed or degraded by the energetic wave environment. Biological communities on exposed shores also tend to be adapted to periodic disturbance and are capable of rapid recovery.

The coastal lagoons protected by the Benacre to Easton Bavents Lagoons SAC and the North Norfolk Coast SAC are not expected to be impacted as the lagoons are above the high tide mark and are fed by percolation through shingle banks. It is not expected that an ecologically significant amount of condensate or diesel would penetrate through the shingle into the lagoons over the short exposure period expected. The various dune habitats listed in Table 5-16 are not expected to be impacted as they occur above the high tide mark.

Impacts at sheltered intertidal sites may be more severe. Natural removal of hydrocarbons from sheltered shorelines is slower due to lack of wave action (IPIECA, 2015a; IPIECA, 2015b) and the propensity for hydrocarbons to penetrate deeply into muddy sediments. Hydrocarbon residues in marsh environments may persist for years, causing chronic impacts.

Two of the sites listed in Table 5-16 support sheltered habitats that are expected to be sensitive to hydrocarbon pollution. These features are estuaries, mudflats and sandflats not covered by seawater at low tide, and large shallow inlets and bays. The sites supporting these features are the Humber Estuary SAC and The Wash and North Norfolk Coast SAC.

There are historical examples of oil releases affecting habitats within the Humber Estuary. The *Sivand* spill released 6,000 Te of light crude at the Immingham Oil Terminal in 1983. Another release of 51 Te of unidentified crude occurred at the Lindsey Oil Refinery in 2004.

Oil from the *Sivand* spill was driven by wind and tides up the estuary as far as the Rivers Trent and Ouse, whose confluence forms the head of the estuary. Beaching oil contaminated sandflats and muddy shores in the estuary. Little (1987) investigated one sandflat and one muddy shore within the estuary for oil contamination and degradation. The sandflat (Humberston Fitties near the mouth of the estuary) was more heavily oiled initially, and hydrocarbon concentrations reduced from approximately 50,000 ppm directly after the spill to approximately 3,000 ppm after 12 months. In contrast, the muddy shore (Blacktoft Sands in the tidal River Ouse) had initial hydrocarbon concentrations of approximately 2,000 ppm, but this was only slightly reduced after 12 months. The sandflat hydrocarbon contamination was restricted to the superficial layers, while hydrocarbons penetrated deeply into the muddy sediments, aided by root macropores (Little, 1987). The cleanup operation was apparently effective and included heavy use of dispersants, although Little (1987) suggests oil trapped in sediments may have been underestimated. NOAA (1992) reported extensive mortalities of ragworm (various polychaete species in the family Nereididae), indicating potentially significant impacts at the community level.

While some habitats within the Humber Estuary SAC and The Wash and North Norfolk Coast SAC are expected to be sensitive to hydrocarbon pollution, contamination from an offshore well blowout release or drill rig diesel release, would be unlikely to result in significant impacts. Either scenario would release very volatile material that would undergo substantial evaporation and degradation before reaching the shore. Modelling indicates that only a Spring well blowout would result in a >50% probability of some hydrocarbons reaching the Humber Estuary SAC, and the probability of hydrocarbons reaching The Wash and North Norfolk Coast site is <35% in all scenarios. Hydrocarbons entering the turbid coastal waters would be expected to form OMA, promoting degradation. If hydrocarbons were to beach they would continue to undergo rapid evaporation and degradation. As such, impacts on coastal benthic features are expected to be minor and transient.

Considering these data:

- SACs and MCZs would only be at risk in the event of a substantial hydrocarbon release, and the risk of this is extremely low (see Section 5.7.1.2);
- In the event of a substantial hydrocarbon release, there is a low probability of hydrocarbons reaching the majority of benthic features; and
- In the event that features are impacted, the level of impact is expected to be minor and transient; and
- The potentially impacted features have good potential for recovery.

It is concluded that an accidental release will not have a LSE on protected marine habitats at the MCZs and SACs discussed above.

5.7.5.2 Birds

Impacts of sea surface oiling on seabirds is one of the greatest environmental risks posed by oil spills. This is primarily due to the high affinity of oil for seabird plumage. Once oil becomes incorporated into the feathers, there is a very high chance of death due to loss of body heat, starvation, drowning or oil ingestion from preening activity. Plumage is essential to flight, waterproofing and heat insulation and even small effects on any of these functions can result in mortality.

Some groups of seabirds are more vulnerable than others due to their particular behaviours. Guillemots, which spend much of their time on the sea surface and typically dive to avoid danger, are particularly sensitive to spilled oil. Common guillemot are particularly vulnerable in the post-breeding period because the male parents accompany their flightless young in swimming offshore from the breeding colonies. This generally occurs in late spring and early summer. Gannets are also sensitive due to their diving behaviour which can cause them to repeatedly pass oil on the sea surface.

Species that nest on cliffs and cliff tops are unlikely to have their nesting sites directly adversely affected by an oil spill, although following the Sea Empress incident, gannets were observed collecting contaminated nesting material (Santillo *et al*., 1998).

Sheltered habitats that encourage wading or resting on calm water may suffer significant losses of birds in the event of sea surface oiling due to the greater likelihood that large accumulations of birds will be exposed. Following the *Sivand* spill in the Humber Estuary, the Royal Society for the Protection of Birds (RSPB) reported 160 dead oiled birds were found, and estimated that 4,000 birds may have been oiled in total (NOAA, 1992) as it is common that only a small proportion of bird carcasses are recovered following hydrocarbon release mortality events. It is likely that the vast majority of oiled birds would have died due to hypothermia and toxicity.

Sensitivity of particular species also varies in line with the total biogeographical population, which influences the potential for population recovery following an incident.

Seabirds that rest and breed within SPA boundaries commonly feed in waters outside the site boundary, meaning that hydrocarbon releases may impact protected site features without actually entering the site.

The SPAs listed in Table 5-17 support a wide range of species that vary in seasonal presence, breeding, feeding and nesting behaviour. Species such as hen harrier, marsh harrier and golden plover are expected to be less sensitive as they do not habitually interact with the water surface, although they may be exposed through contaminated prey. Waders such as bar-tailed godwit and dunlin are less likely to suffer oiled plumage, but could ingest oil if foraging in oiled mudflats. The most sensitive qualifying species are those that have a strong association with the water surface, like little tern, which dives for fish in coastal waters, and shelduck, which gather in large aggregations on the water surface to moult in late summer.

Modelling indicated that most sites listed are at low risk of hydrocarbon contamination, with both shoreline oiling and sea surface oiling probability limited to <40% for all sites except Humber Estuary SPA. Beached and floating hydrocarbons are expected to evaporate and disperse rapidly. It is therefore considered unlikely that there will be impacts at the population level on receptors at any of the sites listed. However, in a worst case scenario, there could be significant impacts for some of the most sensitive species, although these impacts are expected to be at the lower end of the spectrum of significant impacts since even in a worst case scenario the presence of hydrocarbons of the sea surface and shoreline is expected to be short-term and patchy.

Potential recovery rates will vary depending on the species affected and the extent of population loss (see Piatt et al., 1990; Wiens, 1995). Recovery rates depend on numerous factors including:

- The percentage of the breeding population killed (and therefore numbers remaining);
- Number of juveniles lost (affecting recruitment rates in following years);
- Size of the existing pre-breeding pool and rates of recruitment into the colonies;
- Rates of reproduction of individual species;
- Long-term loss of feeding grounds and prey species; and,
- Sub-lethal effects which may affect reproductive success.

Recovery potential of qualifying species populations varies widely and depends partly on existing population dynamics. For example, the little tern population of Britain declined by approximately 27% between the Seabird Colony Register surveys completed in 1988 and the Seabird 2000 surveys completed in 2002. As such, this species is likely to take longer to recover from population losses due to existing downward population pressure. In a worst case scenario, recovery would be expected to occur within 10 years.

Seabird sensitivity to oil pollution in the region of the proposed Platypus Development is generally very high between February and April, high to extremely high in June, low in May, high in July and August, high to extremely high in September and October and low to extremely high between November and January (Section 3.3.4). However, given the mitigation measures in place, and the spill response measures available, the likelihood of a spill from Platypus adversely affecting seabird populations is very limited..

While the worst case release scenario is expected to result in short-lived and low magnitude sea surface and shoreline contamination with limited potential for significant impacts, a credible worst case accidental release scenario, is highly unlikely to occur. As such, it is concluded that the proposed development does not pose a risk of LSE on protected bird populations at any of the SPAs listed in Table 5-17.

5.7.5.3 Marine Mammals

Two marine mammal species are primary qualifying features for sites listed in Table 5-16: harbour porpoise (SNS SAC) and harbour seal (The Wash and North Norfolk Coast SAC).

The modelled release location is within the boundary of the SNS SAC, and as such there is certain to be contamination within the site if a spill were to occur. The site is extremely large (36,951 km^2), meaning that harbour porpoise within the site will have ample opportunity and space to avoid contaminated areas. As discussed in Section 5.7.1.4, it is unlikely that a population of cetaceans in the open sea would suffer significant long-term impacts from a hydrocarbon release (Aubin, 1990). The worst-case release possible from the proposed development is expected to disperse and degrade quickly and as such significant impacts on harbour porpoise within the SNS SAC are not expected.

The Wash and North Norfolk Coast SAC, for which harbour seals are a designated feature, was predicted to be exposed to a 32% probability of shoreline oiling and a 15% probability of sea surface oiling (Table 5-16). Light hydrocarbons such as diesel and condensate can be toxic to seals, especially in the early hours after release when the volatile components are still present, as the seals can inhale or ingest these, causing respiratory problems and organ damage. As the fastest arrival time to shore for any of the modelled scenarios was two days, it is expected that the majority of the more toxic volatile components would have evaporated before seals became exposed. The less volatile material that is more likely to be present in hydrocarbons approaching the shore may cause skin or mucous membrane irritation, but is unlikely to cause serious health impacts. As such, significant impacts on harbour seals within The Wash and North Norfolk Coast SAC are not expected.

Taking into account:

- That the SNS SAC is extremely large and that harbour porpoise within the site will have ample opportunity and space to avoid contaminated areas;
- That The Wash and North Norfolk Coast SAC would only be at risk in the event of a worst case accidental release, which is highly unlikely to occur (see Section 5.7.1.2); and,
- That the worst case release scenario is expected to result in short-lived and low magnitude sea surface and shoreline contamination which is not expected to have significant impacts on the marine mammal qualifying features of the sites.

It is concluded that an accidental release will not have an LSE on protected marine mammal populations at any of the SACs listed in Table 5-16.

5.7.5.4 Cumulative effects

It is important to consider the potential for cumulative impacts to arise from the Platypus Development acting upon the environment along with other developments. Large hydrocarbon releases, such as could potentially occur from a well blowout or loss of drill rig inventory, may act cumulatively with releases from other oil and gas projects to affect the integrity of protected sites. Although, as described in Section 5.7.1.2, such releases are extremely uncommon, consideration is given both to releases occurring simultaneously and to releases occurring a number of years apart. In the first instance of simultaneous releases, the key to limiting the potential for impact would be restricting interaction between released fluids and the protected sites (as it is for a single release) and a co-ordinated response strategy between involved parties would likely be developed, focussing on the sites most at risk. Where releases occur some time apart, the potential impact would be related to the extent to which sites had recovered from interaction with a previous release. The recovery period of impacted sites could be extended should it be impacted by subsequent spills.

5.7.5.5 Conclusions

Considering the low probability of direct interaction with coastal sites and the low degree of impact expected in the event of hydrocarbon beaching, the lack of effect on mobile receptors from coastal sites (such as marine mammals and seabirds) and the limited interaction expected with benthic features, there will be no LSE on SACs and SPAs and hence no impact on conservation objectives or site integrity. This assessment also considers there to be no potential for significant impacts to protected features of any MCZs and there is therefore no significant risk to the conservation objectives of any MCZ being achieved.

5.7.5.6 Major Environmental Incident assessment

A Major Environmental Incident (MEI) is defined as "…an incident which results, or is likely to result, in significant adverse effects on the environment in accordance with Directive 2004/35/EC of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage." An MEI can only occur as a consequence of a Major Accident (MA) event, as identified in the Safety Case (or Well Notification).

A significant hydrocarbon release, such as from a well blowout, is likely to be the event with greatest potential to cause an MEI, due to the potential for a large volume that could be released. . The results of the oil spill modelling for the Platypus well blowout scenario and jack-up fuel release scenario were reviewed to determine whether such a release could constitute a MEI.

Specifically, evaluated the potential for these scenarios to cause significant adverse change to a protected species or habitat as defined by Annex I of the Directive 2009/147/EC, formerly Directive 79/409/EEC (the Birds Directive), or Annex II and IV of the Directive 92/43/EEC (the Habitats Directive) in accordance with Directive 2013/30/EU [Article 2(37)] (the Offshore Safety Directive).

The MEI assessment is based on the potential impacts associated with shoreline and surface oiling. Impacts on sediments were not assessed as sediment hydrocarbon concentrations are not modelled during stochastic simulations (which were used for the Platypus oil spill modelling report).

Based on the fact that a well blowout at Platypus would result in a release of condensate, and the jack-up fuel inventory scenario would release diesel, and that both these substances would readily evaporate and disperse, the potential to cause significant adverse impacts is considered low. Therefore none of the scenarios modelled for the Project are predicted to constitute an MEI.

5.7.6 Residual impact

5.7.6.1 Accidental hydrocarbon release

Although the probability of a large hydrocarbon release from the Platypus Development is remote on account of the comprehensive prevention measures in place the residual risk of a spill, and potential for impact on the marine environment, still remains. Consequently the preparation of detailed and fully tested contingency response plans is integral to oil & gas drilling and production operations.

Dana will have in place a range of response / mitigation measures to address these risks (detailed in Section 5.7.2). All activities at the Project will be covered by appropriate OPEPs and SOPEPs which will set out the responses required and the available resources for dealing with spills of all sizes. The planning, design and support of all activities for the Project will aim to eliminate or minimise potential environmental risks. As described in Section 5.7.2, these impacts will be mitigated through the equipment design, spill risk reduction measures and provision of appropriate spill response arrangements. Dana's management processes will ensure that these mitigation commitments are implemented and monitored.

The Water Framework Directive requires nation states to manage the water environment on the basis of units that make sense in environmental terms – these are termed 'River Basin Districts' and include all interdependent rivers, lochs, estuaries, coastal waters and associated underground waters. The probability of a loss of hydrocarbons reaching coastal water is low because the likelihood of a sufficiently large spill occurring in the first place is extremely low. Any impact of hydrocarbons on the coastal environment is expected to be minor and transient. As such, no further consideration of such water bodies is required (i.e. there is no significant impact from the proposed activities). The Marine Strategy Framework Directive aims to develop mechanisms to achieve "Good Environmental Status" for EU waters. As part of this, nation states are required to develop a set of targets/indicators for good environmental status and to monitor the status of its water bodies. Specifically, for the UK, this means the Greater North Sea and Celtic Sea areas. The Marine Strategy Framework Directive has a broader remit than the Water Framework Directive, with components such as noise, commercial fisheries and biodiversity being of interest. Through the impact assessment presented in this section, the potential for the Platypus Development to compromise the good environmental status of UKCS waters has effectively assessed the impact on all relevant features considered by the Marine Strategy Framework Directive. As the impact assessment concludes that there is no significant impact from the proposed activities, there will be no negative impact on the good environmental status of the waters within which the activities will take place.

5.7.6.2 Chemical spills

In addition to the risk of hydrocarbon spills, there is also a risk of chemical spills. Chemical spills may occur during chemical transfer, chemical/mud handling, or through mechanical failure. The fate of any chemical entering the water column is dependent upon how physicochemical properties influence its partitioning between seawater and its susceptibility to degradation (DTI, 2001). Given the high energy marine environment of the wider area, chemical spills are expected to disperse in the offshore marine environment with a possible negligible to minor localised and transient impact on plankton or fish egg/larvae, depending on the season.

Spill prevention measures will encompass chemicals as well as hydrocarbons. Pre-mobilisation audits and bridging documentation will ensure that these prevention procedures are in place on drill rigs, support and supply vessels as appropriate. Personnel will also be given full training in environmental awareness and spill prevention methods. Procedures will be in place to further reduce the risk of spillage, in particular written procedures, regular inspection of equipment and provision of spill kits.

To reduce the potential risk of chemicals spills, Dana continually works with its chemical suppliers to ensure that chemical use is minimised without compromising technical performance. Furthermore, Dana recognises that substitution is an important part of the OSPAR Harmonised Mandatory Control Scheme (HMCS) and is committed to use of non-substitution chemicals and to the investigation of alternative where this is not possible. Information on specific chemical use and associated environmental impact assessment will be provided in the relevant permits prior to the commencement of activity. Dana endeavour to use chemicals with a good environmental profile (Poses Little Or No Risk To The Environment (PLONOR), CEFAS Offshore Chemical Notification Scheme (OCNS) group E or Gold banded chemicals) where possible to reduce potential impacts from these chemicals on the marine environment.

5.7.7 Conclusion

Due to the potential for short-term impacts on the conservation objectives of protected sites, the consequence of a worst-case hydrocarbon release is considered major. The likelihood of a worst-case release is considered remote based on historical event frequencies, and as such the residual risk is minor and not significant.

Consequence	Likelihood/frequency	Residual risk	Significance
Major	Remote	Minor	Not significant

6 Environmental Management

6.1 Environmental Management System

The management of environmental risks associated with Dana's activities is integral with the business decision making process. Environmental hazards are identified at all stages in the hydrocarbon lifecycle and risks are assessed and managed via Dana's EMS.

The Dana EMS is the mechanism that communicates the Company standards and allows them to be maintained. It is the mechanism by which the commitments specified in this ES will be tracked — commitments which are above and beyond statutory requirements are listed in Appendix E. This structured management approach will be used to encourage the ongoing process of identification, assessment and control of environmental risks will continue throughout planning and operations.

Dana's EMS has been developed and maintained to meet the principal requirements of the ISO 14001:2015 Environmental Standard. The environmental elements within the management system have been independently verified by approved certification bodies in 2006, 2009, 2013, 2015, 2017 and most recently in March 2019. During all audits the system was found to be in compliance with OSPAR Recommendation 2003/5 and OPRED required industry standards.

An HSSE plan has been developed for the Platypus Development to summarise how HSSE issues will be managed for the Platypus Development and how effective implementation of the Dana HSSE Policy will be achieved. The objective of this HSSE Plan, and the complementary main Subcontractors' HSSE plan, is to ensure that the necessary systems and processes are in place to:

- Ensure compliance with relevant statutory provisions as outlined in the Project's Regulatory Requirements Register;
- Design and install facilities which, in addition to meeting all their technical and business goals, will reduce future risks to personnel, the environment and equipment to a level which is tolerable, and as low as is reasonably practicable; and
- Execute all phases of the work without significant negative impact on the environment.

Through all phases of the Project, the Development Management Team will ensure that effective, practical and achievable measures which provide for the protection of the environment are in place. To implement the HSSE Plan, the following will be undertaken:

- Publicise and communicate Dana HSSE policies and involve all staff, workforce and contractors through participation and consultation, and provide an effective system of communication throughout the Platypus Development;
- Clearly assign responsibility and accountability for the organisation, activities and arrangements to implement the HSSE policies;
- Ensure that HSSE issues are planned and managed with the same priority as other business activities;
- Utilise contractors who have a track record of commitment to recognised HSSE standards and who promote industry best practices, and integrate these contractors into the development organisation to ensure effective operations are delivered;
- Report, investigate and address incidents to prevent recurrence;
- Maintain effective systems for monitoring, performance measurement, audit and review; and
- Learn from the active audits and reviews and reactive investigations to strive for continuous improvement in HSSE performance.

6.2 Environmental Management and Commitments

A commitments register is presented in Appendix E which summarises mitigation and management measures identified during the EIA process above and beyond regulatory requirements. These measures will be implemented as part of the Platypus Development. Each commitment will be reviewed regularly to ensure that it is being met. Objectives and targets are also used for setting goals for continuous improvement in performance as part of Dana's EMS. In this way, environmental management is an ongoing process and will continue beyond implementation of mitigation measures identified during this EIA in order to strive for continuous improvement.

7 Conclusions

7.1 East Inshore and Offshore Marine Plans

The Platypus Development EIA has considered the objectives and marine planning policies of the East Inshore and Offshore Marine Plans across the range of policy topics including natural heritage, air quality, cumulative impacts and oil and gas. Dana considers that the Platypus Development is in broad alignment with such objectives and policies. The extent to which the Project is aligned with the oil and gas objectives and policies is summarised in Table 7-1.

Table 7-1: Alignment between the Platypus Development and the East Inshore and Offshore Marine Plans (oil and gas objectives and policies)

Objective / policy	Platypus Development details
Maximise the recovery of reserves through a focus on industry-led innovation, enhancing the skills base and supply chain growth.	New oil and gas source making use of up to date and innovative technology, providing jobs and training.
An industry which delivers high-level risk management across all its operations and that it is especially vigilant in more testing current and future environments.	Extensive mitigation measures and response strategies developed for identified risks.
Continued technical development of enhanced oil recovery and exploration, and the associated seismic activity carried out according to the principles of Best Available Technique (BAT) and Best Environmental Practice (BEP).	Use of up to date and innovative technology in the development of a North Sea gas reserve, aligned with the principles of BAT and BEP.
Where possible, to work with emerging sectors to transfer the experience, skills and knowledge built up in the oil and gas industry to allow other sectors to benefit and reduce their environmental impact.	Throughout the Development life time, the project will draw on experienced engineers, environmental specialists and other individuals who are not necessarily limited to oil and gas experience.
The Plans are designed to work with OPRED, the Oil and Gas Authority and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of BAT and BEP. Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.	BAT has been used as a key tool in developing Project design. The potentially significant environmental impacts from noise, accidental release and habitat change have been considered within the Platypus Development EIA.
Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process.	Dana will review decommissioning best practice closer to the point at which Platypus will be decommissioned. Full consideration will be given to available decommissioning options, including reuse and removal.
Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints.	The Platypus Gas Development Project will make use of existing infrastructure, including the CW platform, reducing the requirement for further offshore infrastructure.

Objective / policy	Platypus Development details
Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in English waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.	The Platypus Development has been developed in a way that there will not be a significant impact on the physical, biological and socio-economic environment. This demonstrates an appropriate siting within the southern North Sea. The selection of the proposed concept for the Platypus Development gave due consideration to how best to develop the field in the context of existing and future developments in the region.
Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan (NCP) and the Offshore Safety Directive.	Potential environmental impacts have been reviewed as part of this EIA and relevant mitigation measures developed. The Dana response strategy to accidental hydrocarbon release has been developed with due reference to the NCP.

7.2 Protected Species and Sites

The majority of species protected under Annex I of the Birds Directive that are present within the North Sea will generally be found much closer to shore and may only encounter the Project with any regularity during the limited period of the drilling and installation activity.

There will be no significant impact on any Annex I habitat (of the Habitats Directive).

The presence within the Platypus Development area of species protected under Annex II of the Habitats Directive is limited to marine mammals. Marine mammal species that may be present in the Platypus area and along the pipeline route high densities and are regular visitors in the area (harbour porpoise). Dana has assessed whether the noise emitting operations (from vessel use and limited hammer piling) associated with the Platypus Development have the potential to result in injury or disturbance to any species. The assessment concluded that there is a very low likelihood of injury (such as temporary or permanent hearing loss), or disturbance as a result of the activities associated with the Project when using the proposed mitigation measures and that potentially significant environmental impacts would be unlikely to result in population level impacts.

There are a number of offshore and coastal conservation areas on the UK mainland that have been designated under the Habitats Directive as SACs, under the EU Birds Directive as SPAs Marine and Coastal Access Act 2009 as MCZs. The potential for significant impacts on any such sites has been considered within each impact assessment, with particular focus given to the potential for an accidental hydrocarbon release to interact with such sites given the proximity of the Platypus field to shore. However, given the short term duration of installation activities at Platypus, host and pipeline route and the mitigation and management measures in place (including for well blowout), the Platypus Development is considered unlikely to affect the conservation objectives or site integrity of any SAC and SPA and neither is there a significant risk to the conservation objectives of any MCZs.

Considering all of the above, no significant impacts are expected upon protected species and habitats.

7.3 Cumulative and Transboundary Impacts

A review of each of the potentially significant environmental impacts associated with the Platypus Development and the mitigation measures proposed against the range of other activities in the region (detailed in Chapter 5) indicates that no significant cumulative impacts are expected.

A review of each of the potentially significant environmental impacts associated with the Platypus Development and the mitigation measures proposed indicates that no significant transboundary impacts are expected. Hydrocarbon release modelling undertaken for the Platypus Development indicates some probability in the event of a worst case hydrocarbon release that a transboundary impact could result, particularly in Danish, German and Dutch waters. The assessment demonstrates that the likelihood of a release large enough to lead to such a transboundary impact is low and that potential transboundary impacts are much reduced when likely intervention strategies are considered.

7.4 Environmental Impacts

The residual environmental impact for the Platypus Development, following application of any mitigation, is summarised in Table 7-2.

Table 7-2: Summary of residual environmental impact

Impact	Mitigation identified?	Residual risk	Significance
Discharges to sea			
Project impact – installation and commissioning	Yes	Negligible	Not significant
Cumulative	The areas of impact are extremely limited and there will be rapid recovery of receptors. Combined with the absence of known imminent projects in the Development area, there is limited scope for any cumulative impact.		Not significant
Transboundary	The spatial extent of discharges to sea, including primarily drill cuttings, will be extremely limited and will not be detectable across median lines.		Not significant
Seabed			
Project impact	Yes	Negligible	Not significant
Cumulative	The highly localised area of seabed impact, the lack of sensitive seabed habitats in the Development area and the absence of known imminent projects in the Developmentarea means there is no mechanism by which cumulative impact can occur.		Not significant
Transboundary	Platypus is located 121 km from the UK Netherlands median line therefore direct and indirect seabed impacts will not extend this far from the Platypus Development and transboundary impacts will not occur.		Not significant
Other sea users			
Project impact	Yes	Minor	Not significant
Cumulative	Due to the proposed notifications and safety exclusions zones along with the wide expanse of water available to navigate in and the limited number of vessels to be deployed for the project, it is not anticipated that there will be any significant cumulative impacts with respect to vessel collision risk. In addition based on the majority of the fishing activity being attributed to static gear usage and the fact that post installation the seabed outside of the 500-m safety exclusion zones will be overtrawlable there is not perceived to be a significant impact to the total fishing area available and any impact posed will be largely temporary and thus the impact very limited.		Not significant
Transboundary	The Development area may be fished by vessels other nations and any effect on their landings could constitute a transboundary impact. However, the potential impact on fisheries is considered not significant for any vessel regardless of origin.		Not significant
Underwater noise			
Project impact	Yes	Negligible	Not significant
Cumulative	Modelling of project noise sources occurring simultaneously has demonstrated no potential for cumulative impact with regards injury or		Not significant

	disturbance to marine mammals or fish. Whilst cetacean and fish populations are free-ranging and long-distance movement is likely to be frequent, and whilst these animals may subsequently come into contact with noise from other projects, injury and disturbance impacts resulting from the Platypus Development are not expected to be significant. Therefore, significant cumulative impact from the unlikely scenario of an animal encountering noise emissions from multiple projects within a short period of time is considered highly unlikely.		
Transboundary	The Platypus Development area is approximately 121 km from the UK / Netherlands median line at its closest point. Since sound emissions capable of causing injury are unlikely to occur, and the potential for disturbance is considered to be low and will not result in significant impacts, significant transboundary impacts are also not expected to occur.		Not significant
Atmospheric emissions			
Project impact	Yes	Negligible	Not significant
Cumulative	While the Platypus Development area is in close proximity to other industrial activities (including other offshore oil and gas activity), the low levels of emissions expected, and the spreading of the emissions over space and time within the Development Area suggest there will not be any likely cumulative effects in terms of local air quality.		Not significant
Transboundary	Atmospheric emissions will contribute to global anthropogenic emissions totals and arguably constitute a transboundary impact. . However, the emissions from the Platypus Development will have a negligible effect on global GHGs emissions and as such, transboundary impacts are not considered to be significant.		Not significant
Accidental events			
Project impact	Yes	Minor	Not significant
Cumulative	Historical data indicate that the likelihood of one major accidental release occurring is remote or extremely remote; the likelihood of two potentially significant releases occurring is substantially lower and as such cumulative impacts are not expected.		Not significant
Transboundary	Modelling undertaken for the project (refer to Section 5), which assumed no response measures were implemented (in order to understand the worst-case outcome), indicates some probability that in the event of a worst case accidental hydrocarbon release a transboundary impact could result. The risk of a release having a transboundary impact, particularly from North Sea operations, is recognised by the UK Government and other governments around the North Sea and International agreements are in place for dealing with transboundary spill incidents. However, given the remote to extremely remote likelihood of a worst case release occurring, the residual risk of a transboundary impact is considered minor and not significant.		Not significant

7.5 Final Remarks

Based on the findings of the Platypus Development EIA and the identification and subsequent application of the mitigation measures identified for each potentially significant environmental impact (which will be managed through Dana's HSE Management System), it is concluded that the Project will result in no significant environmental impact. The commitments made in this ES commitments which are above and beyond statutory requirements are listed in are summarised in Appendix E.

Appendix A Aspects Raised in Scoping

Aspect raised	Dana response
JNCC	
Use of the most up to date, relevant baseline environmental and societal data for the assessment of potential impact, site specific survey data should be used when available. While environmental description should focus on the proposed site of operations, this area should also be placed in the context of its surroundings. Where data gaps exist these should be acknowledged with strategies to address these gaps prior to development. Consideration of Marine protected sites, habitats and species which may be impacted by the proposed activities. Use of relevant data sources for seabird and marine mammal assessments. When conducting noise assessments, methodology should include recent NOAA (NMFS, 2018) thresholds and mitigation planning for piling where required. Potential introduction of hard materials on the seabed should be minimised where possible and specific consideration provided on their actual nature conservation impact.	A site specific Environmental Baseline Survey (EBS) was conducted between 18th October and 6th November 2018. The resulting EBS report and Habitat Assessment Report have been used to inform this EIA (Chapter 3). The NOAA thresholds have been used in the noise assessments (Section 5.5). The environmental baseline presented in Chapter 3 makes use of the latest seabird and marine sensitivity data. Consideration has been given to protected sites and features (within each relevant Section of the impact assessment (Chapter 5). The design of the project has focused on minimising any requirements for rock deployment and their individual footprints (Chapter 2).
JNCC and OPRED are currently in the process of revising the periods of concern for drilling activities, based on the Seabird Oil Sensitivity Index (SOSI). We therefore ask Dana Petroleum to consider a period of concern, for drilling, within Block 48/1 during the months of June and from September to December when the SOSI is recorded as extremely high. The period of concern is a tool used to ensure the potential implications of drilling operations and/or an accidental release on seabirds are considered during months of extremely or very high seabird sensitivity (as indicated by the SOSI) in a particular area. We would therefore advise that the EIA Justification includes adequate justifications to ensure these implications are fully considered and mitigation measures are identified to minimise potential adverse effects. The 'period of concern' does not prevent any drilling activities during these months, however we would expect additional text in the EIAJ to cover the extremely/very high sensitivity months for seabirds.	The future revision of the periods of concern based on SOSI is included in Section 3.3.2.3. The potential impact on seabirds by an accidental spill is assessed in Section 5.7.
Use of worst case scenarios as best practice in assessment of the full environmental impacts.	The use of worst case scenarios has been used throughout the EIA.

Aspect raised	Dana response
Cumulative impacts should include assessment of approved developments under construction, approved developments that have not yet commenced construction, submitted for approval but not yet approved, as well as any other significant appropriate development for which some realistic figures are available.	All known current and planned activities have been listed in Section 3.5 and have been used to inform cumulative impacts assessed within Section 5 .
Every effort should be made to predict the likely outcome of stabilisation/ protection material requirements and carry out an assessment on that basis.	The site specific EBS conducted in 2018 identified the sediment types present in the study area. The pipeline will be backfilled (buried) to a minimum of 0.6 m below the seabed for protection and to mitigate against upheaval buckling. The exposed sections of the new pipeline and umbilical at either end of the trench (and including crossings) will be covered with concrete mattresses and rock placement to protect from future impacts. Dana recognise that the SNS is a high energy environment. The pipelines will be monitored throughout the life of the field and any mitigation measures will be applied as necessary (Chapter 2).
Confirmation should be made if any of the operations will result in the disturbance of historical drill cuttings. If so, establish if they are water-based muds or oil based muds, and whether they are within the OSPAR Thresholds. Assessment of the total volume of disturbed/ removed drill cuttings should also be considered with the total area of disturbed seabed, both directly and indirectly.	Historic cuttings at Cleeton are well dispersed, with no evidence of cuttings piles and activities are not predicted to result in significant disturbance. See Section 5.3.6.1.1.
NFFO	
Temporary and permanent loss of fishing ground should be assessed.	This has been considered within the impact assessment in Chapter 5.
The pipeline route has fishing effort in and around the area. This is primarily static gear targeting crab and lobster. The heaviest activity is in the vicinity of the Tolmount route given its closer proximity to shore.	The proposed development is now intended to link to the CW platform rather than the Tolmount platform, thereby avoiding the area of heaviest fishing activity. Notwithstanding this, consideration will be given to societal impacts alongside all other contributing factors and any loss of access will be assessed as part of the EIA.
OPRED	
Use of the most up to date, site specific survey data is required.	Please refer to the response above to JNCC regarding site specific survey data.
The particular sensitivities of the area must be considered, including proximity to shore and other designations and within the SAC for harbour porpoise. Sandeels should be consideration as to the potential impacts on the habitat of a key prey species for the Harbour Porpoise, in addition to any noise from construction operations on the cetacean species itself.	The particular sensitivities in the region have been detailed in Section 3. Each receptor, as appropriate has been considered in terms of impact for each activity as appropriate within Section 5.

Aspect raised	Dana response
Site-specific information should be used to consider the risk of the pipeline freespanning/becoming exposed etc. In our experience, (older) published information is highly unlikely to be specific enough to give strong enough evidence of how successful trenching/UHB mitigation of the pipeline may/may not be or whether sediments are desirable for sandeels/spawning in the current environment. The effectiveness of trenching and burial in this area would be a key consideration of the ES and as such, evidence to support the anticipated behaviour of soils would be expected to support any conclusions made.	Please see the response to JNCC detailed above.
Bespoke survey data should be used to assess the potential for Herring spawning.	Site specific survey data confirmed that the sediments within the project data are unsuitable for Herring spawning, as discussed in Section 3.3.2.4.
We would advise that Dana familiarise themselves with the concerns of stakeholders in this area are it is a region where the company has been less involved historically. In particular, Dana should be aware of the different statutory consultees of the region and any different approach/requirements that those consultees may have. Whilst the potential development is unlikely to encroach within 40 km of the shore (as the Tolmount route has not been chosen) it is still possible that we may consult Natural England, who usually require more detailed site data	Dana has sought engagement with both statutory bodies and stakeholders in the region. Please refer to Section 4.2.
Consideration of all current and planned activities that may occur over the life-time of the construction activities and, as far as possible into the production phase to provide a comprehensive cumulative impact assessment. For clarity, this means all industries that operate or may operate in the area that could be impacted. Of particular note, the management of the Harbour Porpoise SAC is challenging where a development must consider cumulative and in-combination impacts of noisy activities. Be aware that a further Habitats Regulations Assessment (HRA) would be required at the time when specific permits are required. The determination of any HRA could restrict the timing of any noisy operations if there is the potential for any significant cumulative effects.	All known current and planned activities have been listed in Section 3.5. Cumulative impacts of noise generating activities are considered in Section 5.3.5. The EIA aims to provide sufficient information for determination of a requirement for HRA.
Wherever possible, Dana should use/ present empirical evidence of noise measurements, rather than just modelling of noisy activities. This will assist greatly in demonstrating the actual noise received, rather than that predicted.	The noise modelling undertaken for this project draws on the best available data of the noise generated by analogous activities. The environmental impacts of underwater noise are discussed in Section 5.5.

Aspect raised	Dana response
Decommissioning options should be considered as early in the design phase as possible, given this sensitive environment. Consideration should be given to the ease of removal of infrastructure.	Dana recognise the importance of forward planning for decommissioning purposed and has considered the decommissioning options available to the Platypus development. This is detailed in Section 2.7.
Ministry of Defence	
No response received to date.	-

Appendix B ENVID Workshop Output

Appendix B.1 – Discharges to Sea

ID	Project aspect	Description of potential effects	Project stage relevance?	Tolmount	Cleeton	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA? Tolmount	Take forward further in EIA? Cleeton
Discharges to Sea									Tolmount	Cleeton
1	Routine use of oil based drill cuttings, including those contaminated with reservoir hydrocarbons	Cuttings, hydrocarbons, dissolved metals, dissolved organics and any chemicals released to sea may cause detrimental impacts on local water quality and marine flora and fauna.	Drilling	Yes	Yes	Return to rig for cleaning and transfer to shore add in potential for discharge to sea - depending on vessel / use of thermal treat <1^% Selection of chemicals with less potential for environmental impact (all) Environmental risk assessment through the MATs/SATs system (OCR and OPPC) (all)	Yes	No	Scoped In	Scoped In
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	No	No					
			Decommissioning	No	No					
2	Routine discharge of water based drill cuttings - top hole cuttings will go direct to the seabed	Cuttings, dissolved metals, dissolved organics and any chemicals released to sea may cause detrimental impacts on local water quality and marine flora and fauna.	Drilling	Yes	Yes	Selection of chemicals with less potential for environmental impact (i.e. PLONOR) (all) Environmental risk assessment through the MATs/SATs system (OCR) (all)	Yes	Yes	Scoped In	Scoped In
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	No	No					
			Decommissioning	No	No					
3	Routine chemical use and discharge to sea during drilling and installation (including cementing during drilling, well completion, pipeline commissioning, subsea structure commissioning)	Chemicals discharged to sea may cause contamination of seawater and disturbance to aquatic ecosystem.	Drilling	Yes	Yes	Selection of chemicals with less potential for environmental impact (all) Environmental risk assessment through the MATs/SATs system (OCR) (all)	No	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes					
			Topsides modifications	Yes	Yes					
			Operations	No	No					
			Decommissioning	No	No					
4	Routine chemical use and discharge to during operation (e.g. well workover, subsea valves, leak detection dyes) and any incremental discharge (e.g. deck cleaning, deck drainage run-off).	Chemicals discharged to sea may cause contamination of seawater and disturbance to aquatic ecosystem.	Drilling	No	No	Selection of chemicals with less potential for environmental impact (all) Environmental risk assessment through the MATs/SATs system (OCR) (all)	Yes	No	Scoped In	Scoped In
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	Yes	Yes					
			Decommissioning	No	No					
5	Routine discharge of ballast water and removal/fall-off of fouling growth from ships	Ballast water and marine growth on ships coming into the Project area may contain non-native organisms. Some species may survive and establish themselves. Non-native species may cause serious ecological impacts, particularly if they become invasive.	Drilling	Yes	Yes	IMO Ballast Water Management Convention, including Ballast water plan and log book (all) Fouling procedures for vessels under hire (all)	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes					
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					
6	Routine blackwater production (i.e. sewage), grey water (i.e. from showers, laundry, hand and eye wash basins and drinking fountains) and food waste (macerated) disposal (from vessels and drilling rig). Walk to work vessel may be required during topsides modifications. Would be located within the 500 m safety zone. Additional survey inspection and maintenance vessels required only periodically.	Discharge of sewage, grey water and macerated food has an associated BOD and may contribute to organic enrichment in the vicinity of the discharge possibly leading to a small increase in plankton and fish population.	Drilling	Yes	Yes	Treatment to IMO standards (all)	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes					
			Topsides modifications	No	No					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					
7	Routine seawater usage for cooling within drilling process (e.g. engine cooling) and any incremental requirement.	Discharge may be at a higher temperature than the surrounding water, however any effect is likely to be minimal due to dilution effects. Potential release of chemicals (mainly biocide) within discharged cooling water to sea may have a negative impact on the marine environment.	Drilling	Yes	Yes		No	No	Scoped Out	Scoped Out
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	Yes	Yes					
			Decommissioning	No	No					
8	Incremental produced water discharges. (no planned discharges but if this were to change it would be scoped in)	Oil, dissolved metals, dissolved organics and chemicals released to sea in produced water may cause detrimental impacts on local water quality and marine flora and fauna. Potential for oily sheens to appear and possible seabird contamination. Also prospect of medium term transboundary pollution issues.	Drilling	No	No		Yes	Yes	Scoped In	Scoped In
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	Yes	Yes	Within existing consent limits Demonstration of BAT				
			Decommissioning	No	No					
9	Incremental sand discharges, scales. (minimal fines in liquid, very tight reservoir with no solids)	Oil, dissolved metals and dissolved organics released to sea in sand and scale may cause detrimental impacts on local water quality, the seabed and marine flora and fauna (e.g. smothering of benthic fauna).	Drilling	Yes	Yes	Control for sand generation by way of sand screens installed during completion	No	No	Scoped Out	Scoped Out
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	Yes	Yes	Within existing consent limits				
			Decommissioning	No	No					

Appendix B.2 – Physical Presence

ID	Project aspect	Description of potential effects	Project stage relevance?	Tolmount	Cleeton	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	
Physical Presence									**Tolmount**	**Cleeton**
1	Installation and burial of pipeline and umbilical (trenched and buried as the base case), spot rock placement for upheaval buckling, mattresses, installation of wellheads, trees, manifolds etc. Seabed preparation work including removal of boulders. and potential presence of mobile seabed features (sandwaves).	Direct damage to benthic habitats and fauna. Increased turbidity of water column and wider smothering caused by the resultant sediment plume. The new structures may also provide an artificial reef effect.	Drilling	No	No		Yes	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes	The volumes and locations of rock and mattress used will be refined during detailed design to reduce the footprint on the seabed to the extent practicable. The spread of rock placement will be restricted through the use of a fall pipe system held a few metres above the seabed to accurately place rock material. DECC have queried whether the pipeline and methanol could be installed in same trench, but there is a temperature issue - will be considered in future design work.				
			Topsides modifications	No	No					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					
2	Renewable Energy Activity interference: Windfarms there are a number of wind farm licensed areas and wind farm projects under development in the vicinity of the proposed operations. The Orsted Hornsea Project Four windfarm is located approximately 14 km to the east of the Platypus site, 20 km east of the Cleeton platform and 38 northeast of the proposed Tolmount location. The Westermost Rough windfarm area is located 29 km to the southwest of the	Short term potential obstruction or exclusion from vessel use may interfere other projects.	Drilling	Yes	Yes		Yes	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes					
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					
3	Positioning of Jack-up drilling rig	Direct damage to benthic habitats and fauna. Increased turbidity of water column and wider smothering caused by the resultant sediment plume.	Drilling	Yes	Yes	Surveys undertaken as part of planning for positioning of vessel. Design will minimise requirement for rock protection and stabilisation where possible.	Yes	Yes	Scoped In	Scoped In
			Subsea installation	No	No					
			Topsides modifications	Yes	Yes					
			Operations	No	No					
			Decommissioning	No	No					
4	Disturbance of features of archaeological interest.	There were no wrecks identified during the survey scope at the proposed SL5 well location (Gardline, 2011a; b). There are four chartered wrecks in the vicinity of the Tolmount field; Lady Anstruther (probably), Varangmalm, Umbe and Lifeguard (possibly). However, there are no sites protected by the Military Remains Act 1986 or Protected Wreck Sites in the vicinity of the proposed survey areas (MIS, 2018).	Drilling	Yes	Yes		Yes	No	Scoped In	Scoped In
			Subsea installation	Yes	Yes					
			Topsides modifications	No	No					
			Operations	No	No					
			Decommissioning	Yes	Yes					
5	Physical presence of the subsea infrastructure, including deposited material, for the life of the development. And platform	Long term potential obstruction or exclusion from structures laid/fixed on seabed, e.g. wells, manifolds, associated pipelines and anchors may impede commercial fishing activities (including through snag risk) and other sea users. Includes permanent (for life of field) safety zones.	Drilling	Yes	Yes	UKHO standard communication channels including Kingfisher, Notice to Mariners and radio navigation warnings (all) Consultation will be undertaken with relevant authorities and organisations (all) Development and implementation of a fishery liaison strategy (all) fisheries Officer	Yes	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes	Berms - back filling should prevent berms that may pose a snag risk being present - overtrawl of area				
			Topsides modifications	No	No					
			Operations	Yes	Yes	Regular maintenance and pipeline route inspection surveys. Fishing friendly structures				
			Decommissioning	Yes	Yes					
6	Temporary physical presence of vessels (including guard vessels during installation and additional supply vessels to provide additional chemicals required) and wet storage (of spools, which would occur within 500 m zones if required)	Short term potential obstruction or exclusion from vessel use may impede commercial fishing activities and other sea users. Includes temporary safety zones (where required).	Drilling	Yes	Yes	As above (all)	Yes	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes	notification and agreement from fisheries				
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes	Regular maintenance and pipeline route inspection surveys.				
			Decommissioning	Yes	Yes					
7	Light emissions from installation, drilling rig and vessel activities. There will be additional permanent additional lighting.	Disturbances to the seabird communities, particularly migrating species.	Drilling	Yes	Yes	Lighting directed below the horizontal plane unless required for technical or safety reasons (all)	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes					
			Topsides modifications	No	No					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					
8	Noise emissions from installation, drilling rig and vessel activities (including operations). E.g. Hammered piling of NUI, transponders for positioning of subsea equipment	Disturbances to the animal communities may occur within a range of several km. Potential injury to fauna (e.g. birds and cetaceans) by short range exposure (<5m).	Drilling	Yes	Yes	Limit the duration of the noise emitting activities (all)	Yes	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes	piling? Soft start mmo, follow JNCC/EA guidance				
			Topsides modifications	No	No					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					
9	Noise emissions during survey: • HR2D Seismic TI airgun array 4 x 40 cu in; • UHR Seismic single 10 cu in TI airgun; • Sub-bottom profiler (SBP) hull mounted 'pinger'; and • Squid 500 towed 'sparker'.	Disturbances to the aquatic ecosystem may occur within a range of several km. Potential injury to fauna (e.g. plankton, fish and cetaceans) by short range exposure (< 5 m). Effects short-term and transient.	Drilling	Yes	Yes	Adoption of JNCC measures. Block restrictions on seismic activity	No	No	Scoped Out	Scoped Out
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	No	No					
			Decommissioning	No	No					
10	Use of explosives in well perforation and abandonment	Down-hole explosions release noise and vibration to surrounding seabed and water. Effects are short-term and negligible.	Drilling	Yes	Yes	Adoption of JNCC measures (all)	No	No	Scoped Out	Scoped Out
			Subsea installation	No	No					
			Topsides modifications	No	No					
			Operations	No	No					
			Decommissioning	Yes	Yes					
11	Physical interaction between vessels and wildlife	Could lead to exclusion of marine species from an area, or to collision between vessel and animals, or to corkscrew injury.	Drilling	Yes	Yes		No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes					
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					
12	Impact on seascape.	Surface infrastructure and the limited vessel presence will be sufficiently offshore not to affect visual amenity.	Drilling	Yes	Yes		No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes					
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					

Appendix B.3 – Atmospheric Emissions

ID	Project aspect	Description of potential effects	Take forward further in EIA?	
Atmospheric Emissions			**Tolmount**	**Cleeton**
1	Use of diesel on drilling rig (operations, transit etc.)	Emissions of CO2, CH4, CO, VOCs, SOx, NOx and particles of carbon (soot) may contribute to global warming, acid precipitation, ozone depletion and deterioration of local air quality. Possible transboundary issues.	Scoped In	Scoped In
2	Use of diesel for transit and working by supply vessel, standby vessel, survey vessels, pipelay barge, trenching vessel, dive support vessel, other support vessels etc.	Emissions of CO2, CH4, CO, VOCs, SOx, NOx and particles of carbon (soot) may contribute to global warming, acid precipitation, ozone depletion and deterioration of local air quality. Possible transboundary issues.	Scoped In	Scoped In
3	Fugitive emissions (e.g. from seals, welds, valves, pipes, pumps, flanges etc., (drilling rig, vessels)	Emissions of VOCs and CH4 may contribute to global warming, formation of localised photochemical smog, and deterioration of local air quality	Scoped Out	Scoped Out
4	Flaring during well testing and clean-up at the drilling rig, extended well cleanup if applicable	Emissions of CO2, CH4, CO, VOCs, SOx, NOx and particles of carbon (soot) may contribute to global warming, acid precipitation, ozone depletion and deterioration of local air quality. Possible transboundary issues.	Scoped In	Scoped In
7	Any incremental operational venting of excess hydrocarbons (e.g. for pressure relief and gas disposal/testing). Flaring during initial start up and planned and unplanned start up and shut downs. Displacement of nitrogen	Emissions of CO2, CH4, CO, VOCs, SOx, NOx and particles of carbon (soot) may contribute to global warming, acid precipitation, ozone depletion and deterioration of local air quality. Dense particles may contaminate seawater. Possible transboundary issues.	Scoped In	Scoped In

Appendix B.4 – Waste

ID	Project aspect	Description of potential effects	Project stage relevance?	Tolmount	Cleeton	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA?	
Waste									**Tolmount**	**Cleeton**
1	Routine generation and disposal of all waste streams	Disposal to land of inert waste materials	Drilling	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes				
			Topsides modifications	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes				
			Operations	Yes	Yes	Modifications to Shearwater waste management plan (if required)				
			Decommissioning	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes				
2	Routine generation and disposal of special/ hazardous wastes, e.g. oily rags, medical waste, solvents, batteries, computers, fluorescent tubes, oil/grease/chemical cans/drums/sacks, contaminated produced sand, contaminated cuttings, pigging waste, and halons. LTOBM cuttings will be skipped and shipped to shore if there is no reinjection facility and Dana does not permit overboard discharge.	Disposal to land of special/ hazardous waste materials	Drilling	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes Skip and ship of LTOBM managed through Danas EMS/existing contractors	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes				
			Topsides modifications	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes				
			Operations	Yes	Yes	Modifications to Shearwater waste management plan (if required)				
			Decommissioning	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes				
3	Routine generation and disposal of wastes for recycling, e.g. paper, card, toner cartridges, fluorescent tubes, wood and clean metal drums	Recycling activities	Drilling	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes				
			Topsides modifications	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes				
			Operations	Yes	Yes	Modifications to Shearwater waste management plan (if required)				
			Decommissioning	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste transfer notes				
4	Routine generation and disposal of radioactive wastes (disposal on- and offshore) (e.g. LSA scale, contaminated cuttings, radiation sources in safety/ detection equipment etc.)	Disposal to land or sea of radioactive wastes	Drilling	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes, further assessment as part of permits to handle such waste	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes, further assessment as part of permits to handle such waste				
			Topsides modifications	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes, further assessment as part of permits to handle such waste				
			Operations	Yes	Yes	Modifications to Shearwater waste management plan (if required), further assessment as part of permits to handle such waste				
			Decommissioning	Yes	Yes	Project waste management plan, use of licensed waste contractors/sites, waste consignment notes, further assessment as part of permits to handle such waste				

Appendix B.5 – Accidental Events

ID	Project aspect	Description of potential effects	Project stage relevance?	Tolmount	Cleeton	Mitigation	Potentially significant in EIA terms?	Stakeholder expectation to assess in ES?	Take forward further in EIA? Tolmount	Take forward further in EIA? Cleeton
Accidental Events									Tolmount	Cleeton
1	CATASTROPHIC Accidental discharge/ spill of oil to sea (e.g. spills of crude oil, fuel oil, diesel from e.g. drilling rig and other vessels, lubricating oil, flare dropout, hydraulic oil, base oil, cable oil, produced water spills over 100 mg/l, well blowout, loss of pipeline containment). Spills caused by e.g. collision, mechanical failure (e.g. hose failure during tanker offload), loss of well control, human error, corrosion & erosion etc. 3b a millions	Larger spills may contaminate/pollute surrounding water and cause disturbance to the aquatic ecosystem and other users / communities. Impact on seabird populations and protected habitats and species (e.g. mammals). Potential shoreline impact and associated environmental concerns. Possible transboundary impacts.	Drilling	Yes	Yes	Blowout preventer OPEP, including modelling and appropriate response planning Maintenance procedures (all) SIMOPS (all)	Yes	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes	SOPEP				
			Topsides modifications	Yes	Yes	SOPEP				
			Operations	Yes	Yes	Platypus OPEP and procedures, including modelling and appropriate response planning				
			Decommissioning	Yes	Yes	SOPEP				
2	SMALL SCALE Accidental discharge/ spill of oil to sea (sources as ID1 and drilling and installation diesel bunkering). There are no additional spill sources introduced at Sheawater. The mothballled Scoter pipeline inventory after cleaning will be less than or equal to 30 ppm, but it will remain buried so there is little likelihood of loss of inventory.	Smaller spills may cause localised, short-term contamination of seawater and limited damage to the aquatic ecosystem.	Drilling	Yes	Yes	Rig drain system will be closed loop Procedures will be put in place for bunker transfer, other bulk storage transfers and mud-handling in order to reduce the risk of release Bulk handling procedures and personnel training (all) Fail safe valves will be installed on hoses (all) Maintenance procedures (all) Vessels will be selected which comply with IMO/MCA codes for prevention of oil pollution (all) Pre-mobilisation audits will be carried out including a comprehensive review of spill prevention procedures (all) 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 (all) SOPEP (all)	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes	Bunkering procedures				
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes	Platypus OPEP and procedures, including modelling and appropriate response planning				
			Decommissioning	Yes	Yes	Bunkering procedures				
3	Accidental discharge/ spill of chemicals to sea including drilling chemicals from the drilling rig.	Chemicals discharged to sea may cause contamination of seawater and disturbance to aquatic ecosystem. (primarily relates to methanol line during commissioning).	Drilling	Yes	Yes	Chemical storage areas contained to prevent accidental release of chemicals (all) Maintenance procedures (all) Pre-mobilisation audits will be carried out including a comprehensive review of spill prevention procedures (all)	No	Yes	Scoped In	Scoped In
			Subsea installation	Yes	Yes					
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes	Platypus OPEP and procedures, including modelling and appropriate response planning				
			Decommissioning	Yes	Yes					
4	Accidental deposit of materials on the seabed (e.g. loss of cables, pipelines, air guns, barrels, stingers, ROV etc.)	Interaction with seabed (direct or indirect) and other sea users (e.g. exclusion, snag risk)	Drilling	Yes	Yes	Installation and SIMOPS procedures will be in place to reduce the potential for dropped objects (all) Training and awareness will be provided to installation contractors (all) 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) All lifting equipment will be tested and certified (all) Procedures will be put in place to make sure that the location of any lost material is recorded and that significant objects are recovered where practicable (all) Debris clearance surveys will be carried out at appropriate points through the Project life-cycle (including following the completion of drilling activities) and reported to DECC using PON 2 notification (all)	No	No	Scoped Out	Scoped Out
			Subsea installation	Yes	Yes					
			Topsides modifications	Yes	Yes					
			Operations	Yes	Yes					
			Decommissioning	Yes	Yes					

Appendix C Noise Propagation Modelling

Appendix C.1 Introduction

As noise is readily transmitted underwater there is potential for sound emissions from construction activities and operations associated with the development of the Platypus project to affect marine mammals. At long ranges, the introduction of additional noise could potentially cause short-term behavioural changes, for example avoidance of the area, or cause changes in the ability of cetaceans to communicate and to determine the presence of predators, food, underwater features and obstructions. At close ranges, there is potential, if the source levels are high enough, to cause permanent or temporary hearing damage, whilst at very close-range gross physical trauma is possible.

This report presents the results and findings of the underwater noise impact study for the development of the wellhead platform and associated construction activities. The objectives of the underwater noise study were to:

- Establish the level of noise likely to result from construction associated with the project;
- Undertake underwater noise calculations to determine the propagation characteristics based on the prevailing environment in the vicinity of the project site and pipeline corridor;
- Assess the spatial range of effects of noise on marine mammals using established criteria for input to the forthcoming impact assessments; and
- Where appropriate, make recommendations to minimise the effects of noise from activities associated with the project including possible mitigation and post consent monitoring requirements.

There will be some interaction between the underwater noise modelling and a number of other studies as part of the development's environmental, impact assessment (EIA). As such, it is important to understand that the potential impacts on marine mammal species (including population level and temporal effects) will be addressed in the relevant chapters of the EIA report / Environmental Statement (ES) and as such do not form a part of this underwater noise modelling study.

Appendix C.2 Thresholds for Assessing the Effects of Sound on Marine Mammals

Appendix C.2.1 Introduction

The oceans are not a silent world, but dynamic, living symphonies of sound. In water, sound travels five times faster, and many times farther than it does in air. Whales, dolphins, porpoises, and other marine mammals have evolved to take advantage of this perfect sonic medium. Just as we rely on sight to survive, they depend on sound to hunt for food, find mates, and detect predators. Over the last fifty years, our increasing ocean presence has dramatically transformed the acoustic environment.

Underwater noise has the potential to affect marine life in different ways depending on its noise level and characteristics. Richardson *et al.* (1995) defined four zones of noise influence which vary with distance from the source and level. These are:

- The zone of audibility: This is the area within which the animal can detect the sound. Audibility itself does not implicitly mean that the sound will have an effect on the marine mammal.
- The zone of masking: This is defined as the area within which noise can interfere with detection of other sounds such as communication or echolocation clicks. This zone is very hard to estimate due to a paucity of data relating to how marine mammals detect sound in relation to masking levels (for example, humans can hear tones well below the numeric value of the overall noise level).
- The zone of responsiveness: This is defined as the area within which the animal responds either behaviourally or physiologically. The zone of responsiveness is usually smaller than the zone of audibility because, as stated previously, audibility does not necessarily evoke a reaction.

- The zone of injury / hearing loss: this is the area where the sound level is high enough to cause tissue damage in the mammals hearing mechanism. This can be classified as either temporary threshold shift or permanent threshold shift. At even closer ranges, and for very high intensity sound sources (e.g. underwater explosions), physical trauma or even death is possible.

For this study, it is the zones of injury and disturbance (i.e. responsiveness) that are of concern; there is insufficient scientific evidence to properly evaluate. To determine the potential spatial range of injury and disturbance, a review has been undertaken of available evidence, including national and international guidance and scientific literature. The following sections summarise the relevant thresholds for onset of effects and describe the evidence base used to derive them.

Appendix C.2.2 Injury to Marine Mammals

To determine the consequence of received sound levels on any marine mammal it is useful to relate the levels to known or estimated impact thresholds. The Joint Nature Conservation Committee guidance (JNCC, 2010a) and Marine Scotland guidance (Marine Scotland, 2014) are now recommending the injury criteria proposed by NOAA 2018 which has built on work by Southall et al. (2007) and others (Lucke et al., 2008 etc.). The injury criteria proposed by NOAA (2018) are based on a combination of linear (i.e. un-weighted) peak pressure levels and mammal weighted sound exposure levels. The hearing weighting function is designed to represent the bandwidth for each group within which acoustic exposures can have auditory effects. The categories include:

- low-frequency (LF) cetaceans (i.e. marine mammal species such as baleen whales with an estimated functional hearing range between 7 Hz and 35 kHz);
- mid-frequency (MF) cetaceans (i.e. marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales with an estimated functional hearing range between 150 Hz and 160 kHz);
- high-frequency (HF) cetaceans (i.e. marine mammal species such as true porpoises, river dolphins and cephalorhynchid with an estimated functional hearing range between 275 Hz and 160 kHz);
- phocid pinnipeds (PW) (i.e. true seals with an estimated functional hearing range between 50 Hz and 86 kHz);
- Otariid pinnipeds and sirenians are also included in NOAA but these categories are not relevant to this study.

These weightings have therefore been used in this study and are presented in Figure C1.

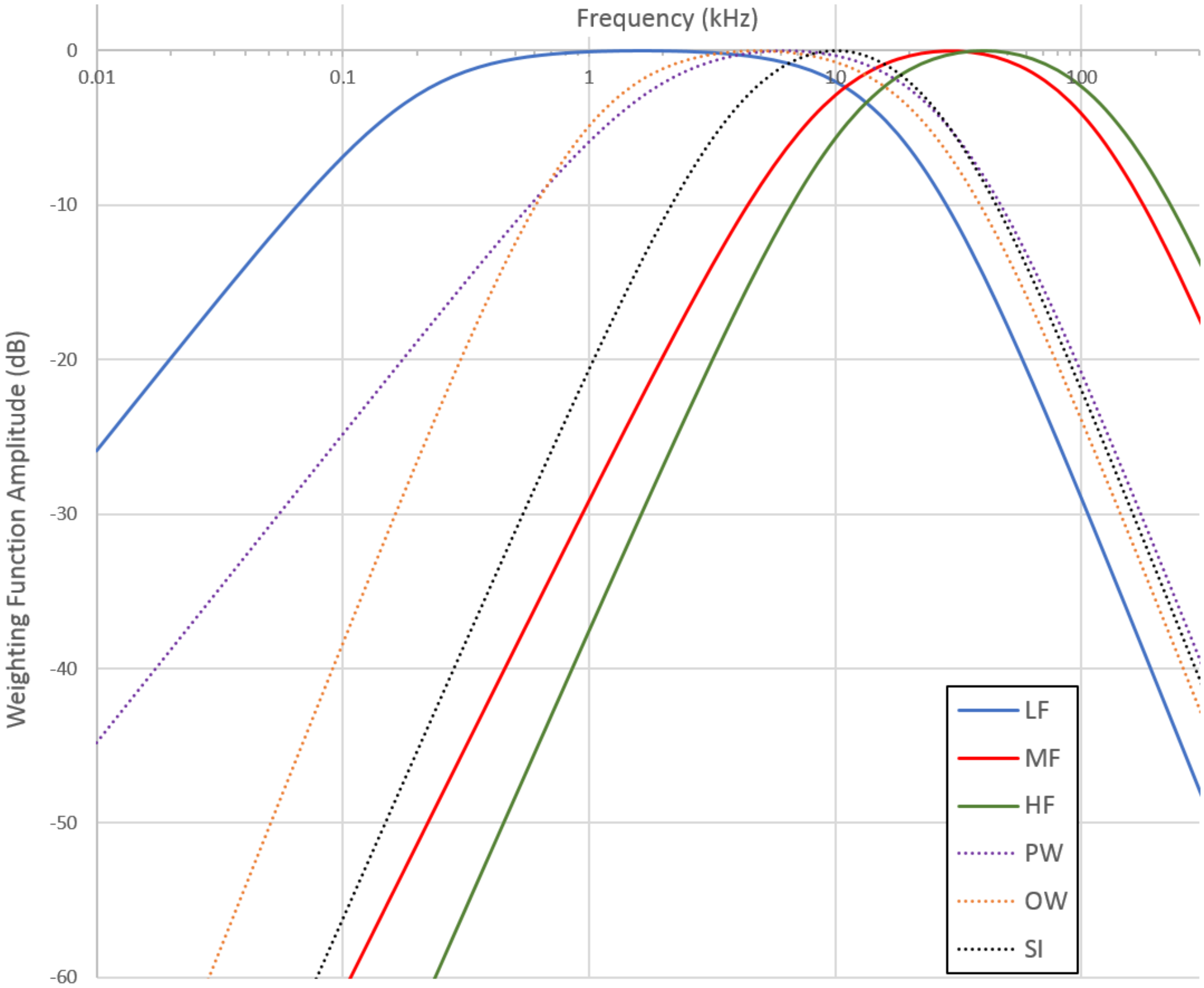

Figure C1 Auditory weighting functions for pinnipeds and cetaceans (NOAA)

The injury criteria proposed in NOAA are based on three different types of sound:

- Multiple pulsed sound - a sound comprising two or more discrete acoustic events per 24-hour period, such as impact piling, seismic activities;
- Single pulse sound - a single acoustic event in any 24-hour period, such as an underwater explosion; and
- Continuous sound - non-pulsed sound such as continuous running machinery, vessels or drilling operations.

The NOAA underwater acoustic thresholds for the onset of permanent threshold shifts for cetaceans and pinnipeds are presented in Table C.

Table C1 NOAA (2018) marine mammal criteria for onset of injury (per 24 hr period)

Marine Mammal Group	Type of Sound	Injury Criteria	
		Peak pressure, dB re 1 µPa[19]	Cumulative SEL[20], dB re 1 µPa2s (LE,HW,24hr)
Low-frequency cetaceans	Single or multiple pulses – e.g. impulsive	219	183
	Non-impulsive e.g. continuous sound	-	199
Mid-frequency cetaceans	Single or multiple pulses – e.g. impulsive	230	185
	Non-impulsive e.g. continuous sound	-	198
High-frequency cetaceans	Single or multiple pulses – e.g. impulsive	202	155
	Non-impulsive e.g. continuous sound	-	173
Phocid Pinnipeds (underwater)	Single or multiple pulses – e.g. impulsive	218	185
	Non-impulsive e.g. continuous sound	-	201

It should be noted that the 2007 Southall study has been revaluated in light of subsequent scientific findings and has published revised noise exposure criteria to predict the onset of auditory effects in marine mammals (Southall *et al*, 2019). The study estimated audiograms and hearing weighting functions have been updated and are in line with the details contained in the NOAA, 2018. The only significant difference is the re-categorisation of mid-frequency and high frequency groups to HF and VHF respectively i.e. very high frequency for greater clarity. This report retains the categorisation used in NOAA, MF and HF.

Appendix C.2.3 Disturbance to Marine Mammals

Significant disturbance may occur when there is a risk of a significant group of animals incurring sustained or chronic disruption of behaviour or are displaced from an area, with subsequent redistribution being significantly different from that occurring due to natural variation.

To consider the possibility of disturbance resulting from the proposed construction activities, it is necessary to consider both the likelihood that the sound could cause disturbance and the likelihood that the sensitive receptors (marine mammals) will be exposed to that sound. Southall *et al*. (2007) recommended that the only currently feasible way to assess whether a specific sound could cause disturbance is to compare the circumstances of the situation with empirical studies. The more severe the response on the scale, the lower the amount of time that the animals will tolerate it before there could be significant negative effects on life functions, e.g. a score of 5 or more on the Southall behavioural response severity scale could be significant

Southall *et al.* (2007) present a summary of observed behavioural responses for various mammal groups exposed to different types of noise (single pulse, multiple pulse and non-pulse).

For non-pulsed, continuous sound (e.g. vessels, drilling etc.), the lowest sound pressure level at which a score of 5 or more occurs for mid frequency cetaceans is 90 - 100 dB re 1 µPa (rms); however, this was for one mammal (a sperm whale) and therefore unrepresentative of its group. For common dolphin, a response score of 3 was encountered for received levels of 110 – 120 dB re 1 µPa (rms), with no higher severity score encountered. For

[19] Peak sound pressure should be unweighted within the generalised hearing range

[20] The recommended accumulation period is 24-hour based on NOAA hearing weighting for each group

high frequency cetaceans, some individuals with a response score of 5 are noted at levels as low as 80 dB re 1 μPa (rms) and upwards. There is a significant increase in the number of mammals responding at a response score of 6 once the received sound pressure level is greater than 140 dB re 1 μPa (rms).

For multiple pulsed sound applicable for piling operations or seismic survey activities. Although these datasets contain relevant data for low-frequency cetaceans, there are no strong datasets for mid-frequency or high-frequency cetaceans. Low frequency cetaceans, other than bow-head whales, were typically observed to respond significantly at a received level of 140 – 160 dB re 1 μPa (rms). Behavioural changes at these levels during multiple pulses may have included visible startle response, extended cessation or modification of vocal behaviour, brief cessation of reproductive behaviour or brief / minor separation of females and dependent offspring. The data available for mid-frequency cetaceans indicate that some significant response was observed at a sound pressure level of 120 – 130 dB re 1μPa (rms), although most cetaceans in this category did not display behaviours of this severity until exposed to a level of 170 – 180 dB re 1μPa (rms). Furthermore, other mid-frequency cetaceans within the same study were observed to have no behavioural response even when exposed to a level of 170 – 180 dB re 1μPa (rms).

Southall *et al.* (2007) notes that, due to the uncertainty over whether high-frequency cetaceans may perceive certain sounds and due to paucity of data, it was not possible to present any data on responses of high frequency-cetaceans. However, Lucke *et al*. (2008) showed a single harbour porpoise consistently showed aversive behavioural reactions to pulsed sound at received sound pressure levels above 174 dB re 1 μPa (peak-peak) or a SEL of 145 dB re 1 μPa^{2}s, equivalent to an estimated[21] rms sound pressure level of 166 dB re 1 μPa.

The High Energy Seismic Survey workshop on the effects of seismic (i.e. pulsed) sound on marine mammals (HESS, 1997) concluded that mild behavioural disturbance would most likely occur at rms sound levels greater than 140 dB re 1 μPa (rms). This workshop drew on studies by Richardson *et al*. (1995) but recognised that there was some degree of variability in reactions between different studies and mammal groups. Although this is based on now outdated studies, the level of 140 dB re 1 μPa (rms) is consistent with the lowest range for onset of disturbance due to multiple pulsed sound identified in Southall *et al.* (2007).

The United States National Marine Fisheries Service current guidance (NMFS, 2005) sets the Level B harassment threshold[22] for marine mammals at 160 dB re 1 μPa (rms) for impulsive noise and 120 dB re 1 μPa (rms) for continuous noise. The value for impulsive sound sits in the upper-mid range for disturbance effects identified in Southall *et al*. (2007).

With respect to pinnipeds the tests conducted by Southall *et al*. (2007) yielded a wide range of results suggesting that the seals exhibit only moderate changes in response (equivalent to a response score of 4) at levels up to 140 dB re 1μPa (rms) for non-pulsing sound. Further Southall found that, based on the limited data on pinnipeds exposed to multiple pulses, exposures in the region of 150 to 180 dB re: 1 μPa (rms values over the pulse duration) elicited a limited potential to induce avoidance behaviour in ringed seals. This range extends beyond the estimated TTS in the closely related harbour seal (171 dB re: 1 μPa^2-s) and therefore guidance from NMFS 2005 is adopted as a precautionary approach.

Clearly, there is much intra-category and intra-species variability in behavioural response. As such, a conservative approach should be taken to ensure that marine mammals remain protected. Considering the paucity and high level of variation of data relating to onset of behavioural effects due to continuous and non-continuous sound, it is recommended that any ranges predicted using this number are viewed as probabilistic and possibly over-precautionary.

The criteria proposed for use in assessing the spatial extent of marine mammal disturbance due to a continuous and multi pulse sound for pinnipeds is presented in Table C2 below.

[21] Based on an analysis of the time history graph in Lucke *et al*. (2007) the T90 period is estimated to be approximately 8 ms, resulting in a correction of 21 dB applied to the SEL to derive the rms T90 sound pressure level. How ever, the T90 w as not directly reported in the paper.

[22] Level B Harassment is defined as having the potential to disturb a marine mammal or marine mammal stock in the w ild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but w hich does not have the potential to injure a marine mammal or marine mammal stock in the w ild.

Table C2 Marine mammal criteria for onset of disturbance

Type of Sound / Criteria Metric	Effect	Criteria
Continuous sound		
RMS sound pressure level, dB re 1 µPa	Potential strong behavioural reaction	>120
Multi pulse		
RMS sound pressure level, dB re 1 µPa	Potential strong behavioural reaction[23]	160
	Low level marine mammal disturbance[24]	140

Appendix C.2.4 Effect of Background Noise

Background or "ambient" underwater noise is generated by a number of natural sources, such as rain, breaking waves, wind acting on the water's surface, seismic noise, biological noise and thermal noise. Biological sources include marine mammals (which use sound to communicate, build up an image of their environment and detect prey and predators) as well as certain fish and shrimp. Anthropogenic sources also add to the background noise, such as fishing boats, ships, industrial noise, seismic surveys and leisure activities. Generalised ambient noise spectra attributable to various noise sources (Wenz, 1962) are shown in Figure C2.

[23] *Based on NMFS 2005 Level B harassment criterion for pulsed sound.*

[24] *Based on HESS 1997 criterion for onset of mild behavioural disturbance due to pulsed sound.*

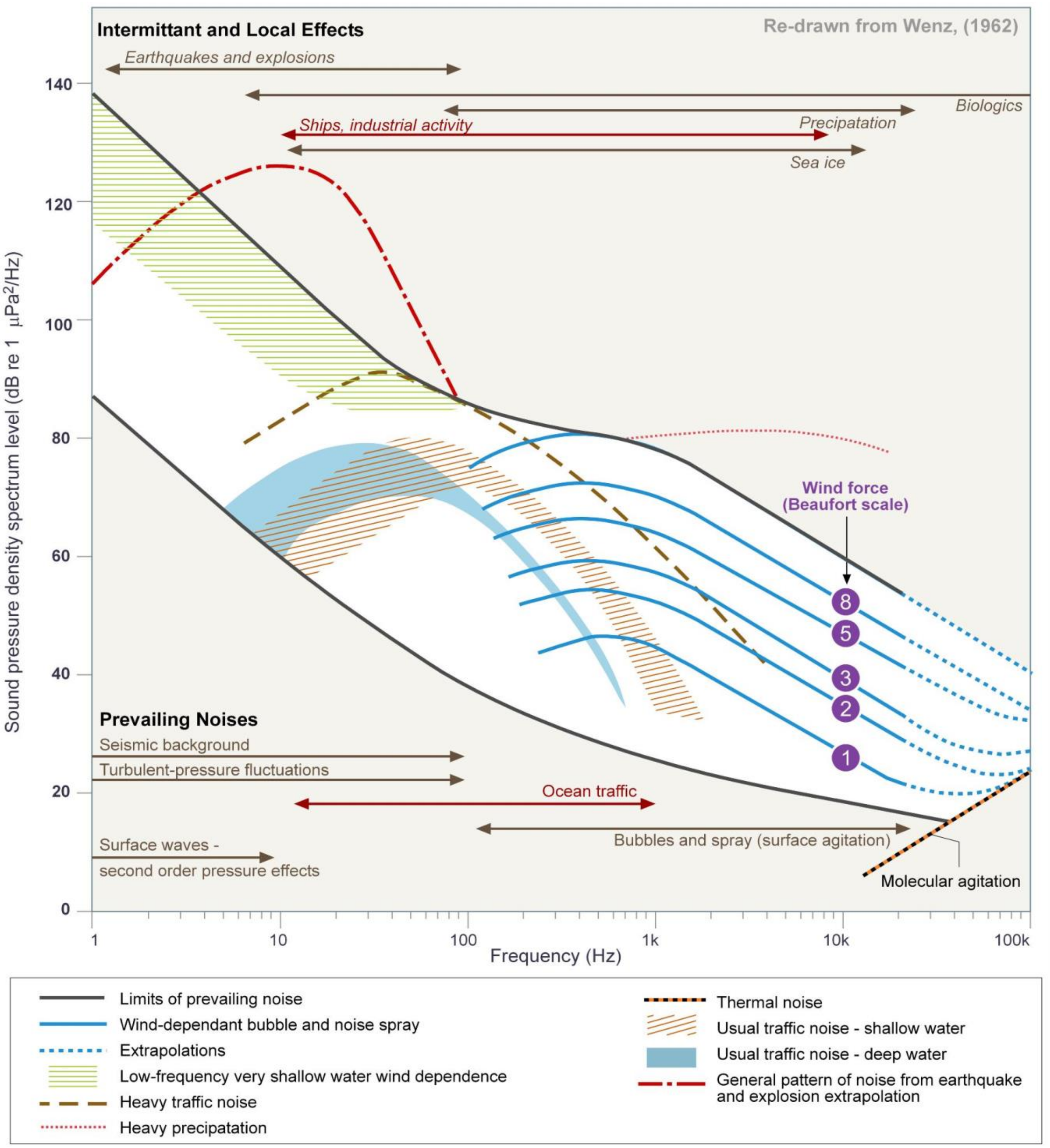

Figure C2 **Generalised ambient noise spectra attributable to various noise sources**

Much of the research relating to both physiological effects and behavioural disturbance due to noise on marine species is based on determining the absolute noise level for the onset of that effect. As a result, criteria for assessing the effects of noise on marine mammals (and fish) tend to be based on the absolute noise criteria, as opposed to the difference between the baseline noise level and the specific noise being assessed (Southall et al. 2007, NOAA 2018). Given the lack of evidence based studies investigating the effects of noise relative to background on marine species, the value of establishing the precise baseline noise level is somewhat diminished. It is important to understand that baseline noise levels will vary significantly depending on, amongst other factors, seasonal variations and different sea states, meaning that the usefulness of establishing such a value would be limited. Nevertheless, it can be useful (though not essential) when undertaking an assessment of underwater noise to understand the range of noise levels likely to be prevailing in the area so that any noise predictions can be placed in the context of the baseline. It is important to note however, that even if an accurate baseline noise level could be determined, there is a paucity of scientific understanding regarding how various species distinguish anthropogenic sound relative to masking noise. An animal's perception of sound is likely to depend on numerous factors including the hearing integration time, the character of the sound and hearing sensitivity. It is not known, for example, to what extent marine mammals and fish can detect tones of lower magnitude than the background masking noise. Therefore, it is necessary to exercise considerable caution if attempting any comparison between noise from the development and the baseline noise level. For example, it does not follow that because the broadband sound pressure level due to the source being considered is below the numeric value of the baseline level that this means that marine mammals or fish cannot detect that sound. This is particularly true where the background noise is dominated by low frequency sound which is outside the animal's range of best hearing acuity. Until such a time as further research is conducted to determine a dose response relationship between the "signal-to-noise" level and behavioural response, a precautionary approach should be adopted.

Appendix C.2.5 Background Noise Environment the Humber Estuary, 2014

Xodus carried out a baseline noise survey between 17th and 22nd of October 2014 in the Humber Estuary as part of a noise impact assessment for the Green Port of Hull port development, with the aim of establishing the existing noise levels at the site.

Noise at the site was found to be highly dependent on the tidal flow speed. Background noise levels (comprising 5 minute rms sound pressure level measurements in dB re 1 µPa) were calculated for high flow speed (where flow speed was greater than the median observed tidal flow speed of 1.1 ms) and low flow speed (flow speed less than 1.1 ms) conditions. Median and interquartile range for all tidal flow speeds, low tidal flow and high tidal flow speeds are given in Figure C3. Lower quartile values are given by the lower boundary of the red box, median values by the boundary between red and grey boxes, and upper quartile values by the upper border of the grey box. Maximum and minimum values are given by the upper and lower tails for each box.

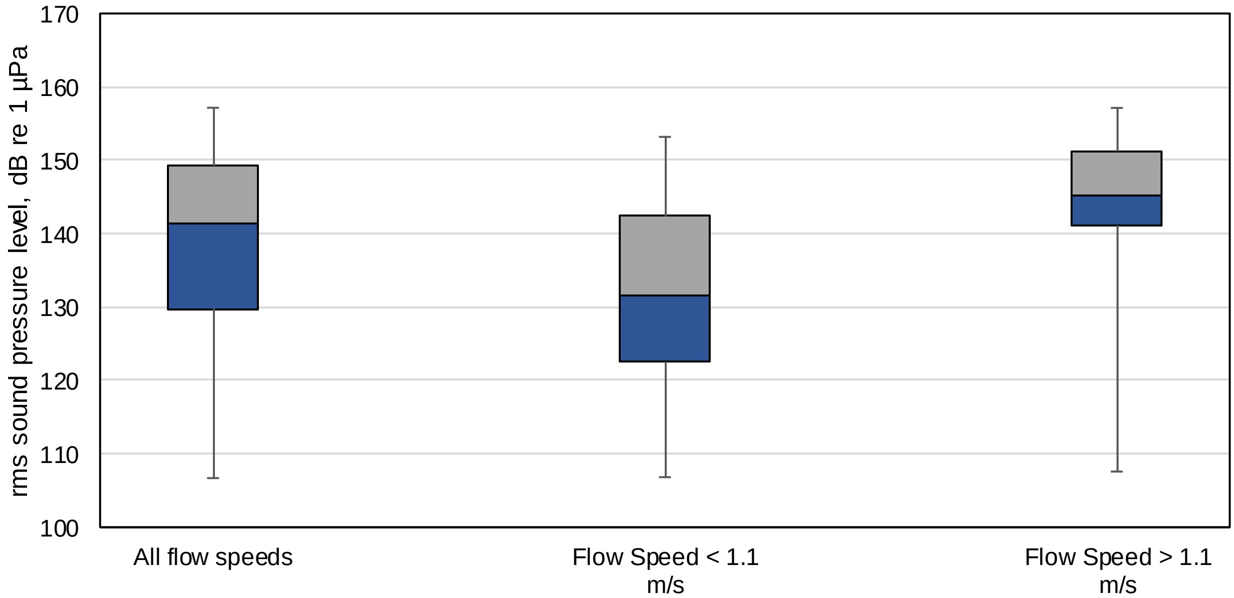

Figure C3 Median and interquartile range of background rms sound pressure levels for all, high, and low tidal flow speeds Humber Estuary

For the entire range of tidal flow speeds, the interquartile range of rms sound pressure levels is approximately 130 to 148 dB re 1 µPa. For low tidal flow speeds, the range is approximately 125 to 142 dB re 1 µPa and for high tidal flow speeds it is approximately 142 to 151 dB re 1 µPa.

While these levels are not relevant to the main contract area, they do show the potential ranges that could occur nearshore as well as illustrating the potential problems when reviewing potential disturbance ranges, see section Appendix C.5

Appendix C.3 Noise Modelling Methodology

Increasing the distance from the noise source usually results in the level of noise becoming lower, due primarily to the spreading of the sound energy with distance. This is analogous to the way in which the ripples in a pond spread after a stone has been thrown in.

The way that the noise spreads will depend upon several factors such as bathymetry, pressure, temperature gradients and salinity, as well as surface and bottom conditions. Thus, even for a given locality, there are seasonal variations to the way that sound will propagate. However, in simple terms, the sound energy may spread out in a spherical pattern (close to the source) or a cylindrical pattern (much further from the source) or somewhere in between, depending on several factors. In shallow waters, the propagation mechanism is also coloured by multiple reflections from the seabed and the water surface.

There are several methods available for estimating the propagation of sound between a source and receiver ranging from very simple models (which simply assume spreading according to a 10 log (r) or 20 log (r) relationship (where r is the distance from source to receiver) to full acoustic models[25] (e.g. ray tracing, normal mode, parabolic equation, wavenumber integration and energy flux models). In addition, semi-empirical models are available which lie somewhere in between these two extremes in terms of complexity. In choosing which propagation model to employ, it is important to ensure that it is fit for purpose and produces results with a suitable degree of accuracy for the application in question, considering the context. Thus, in some situations (e.g. very low risk due to underwater noise, range dependent bathymetry is not an issue) a simple model will be sufficient, particularly where other uncertainties outweigh the uncertainties due to modelling. On the other hand, some situations (e.g. very high source levels, complex source and propagation path characteristics, highly sensitive receivers and low uncertainties in assessment criteria) warrant a more complex modelling methodology.

The first step in choosing a propagation model is therefore to examine these various factors, as set out below:

Balancing of errors / uncertainties

There is a paucity of data relating to the effects of sound on marine life, particularly for behavioural effects. Many of the studies for behavioural disturbance fail to properly define dose-response relationships (concentrating on the animal response with little analysis of the noise "dose"). Taking into account context, location specific factors and habituation, it is extremely difficult to estimate the potential error in the effect thresholds. Referring to the wide ranging spread of onset levels leading to an effect presented in Southall et al., 2007, suggests that the uncertainty due to onset of effects could well be a magnitude of tens of decibels.

Range dependant bathymetry

The water depths within the contract areas of interest vary between 0 and 50 m; for the purpose of the noise calculations a depth of 37.5 m has been assumed. Note shallow water depths can lead to a phenonium which disrupts wave propagation of the wave front; see details below.

Based upon the above factors, it is considered that potential errors due to uncertainty regarding the effects of sound on marine mammals and uncertainties in source data are likely to be greater than the uncertainties inherent in the acoustic modelling. Xodus has therefore chosen to use a semi-empirical sound propagation model which provides a reasonable balance between complexity and technical robustness. It should be borne in mind that calculated noise levels (and associated range of effects) will vary depending on actual conditions at the time (day-to-day and season-to-season) and that the semi-empirical model predicts a typical worst case scenario. Considering factors such as animal behaviour and habituation, any injury and disturbance ranges should be viewed as indicative. Probabilistic ranges to assist in understanding potential impacts on marine life rather than lines either side of which an impact will or will not occur should be adopted. This is a similar approach to that adopted for airborne noise where a typical worst case is taken, though it is known that day to day levels may vary to those calculated by 5 - 10 dB depending on wind direction for example.

[25] It is worth noting that additional complexity does not always equate to greater accuracy and may not always be preferable. Many more complex models work over a limited frequency range and the complexity and range of inputs can make them very context specific. Consequently, the model outputs can vary significantly depending on the input assumptions which in themselves can change day-to-day and season-to-season.

Noise propagation modelling for this assessment was carried out using the Xodus SubsoniX noise model, which implements the sound propagation model developed by Rogers (1981). The Rogers sound propagation model is a semi-empirical, range dependent propagation model which is based on a combination of theoretical considerations and extensive experimental data. Consequently, unlike purely theoretical sound propagation models, the calibration for the Rogers model is built into the model itself and it has subsequently been successfully benchmarked against other sound propagation models (e.g. Etter 2013, Toso *et al.*, 2014, Schulkin and Mercer, 1985) and has been used previously in underwater noise assessments for tidal and wind energy developments (e.g., Dawoud *et al.*, 2015). The model uses several concepts including:

- Refractive cycle, or skip distance;
- Geometric divergence;
- Deflection of energy into the bottom at high angles by scattering from the sea surface;
- A simplified Rayleigh two-fluid model of the bottom for sand or mud sediments; and
- Absorption of sound energy by molecules in the water.

The following inputs are required to the model:

- Third-octave band source sound level data;
- Source directivity characteristics.
- Discreet range (distance from source to receiver);
- Water column depth and sediment layer depth;
- Sediment type (sand/mud); and
- Sea state.

A sediment depth of 2 m has been used and the sediment type has been assumed to be sand, which gives worst-case attenuation. The sea state was assumed to be zero which also gives the lowest value of attenuation.

Another phenomenon is the waveguide effect, which means that shallow water columns do not allow the propagation of low frequency sound (Urick 1983; Etter 2013). The cut-off frequency of the lowest mode can be calculated based on the water depth and knowledge of the sediment geoacoustic properties. Any sound below this frequency will not propagate far due to energy losses through multiple reflections. The cut-off frequency as a function of water depth is shown in Figure C4 for a range of seabed types. Thus, for a water column depth of say 10 m the cut-off frequency would be approximately 70 Hz for sand, 100 Hz for silt, 140 Hz for clayey silt and 40 Hz for bedrock. For a depth of 50 m the corresponding cut off frequencies are lower.

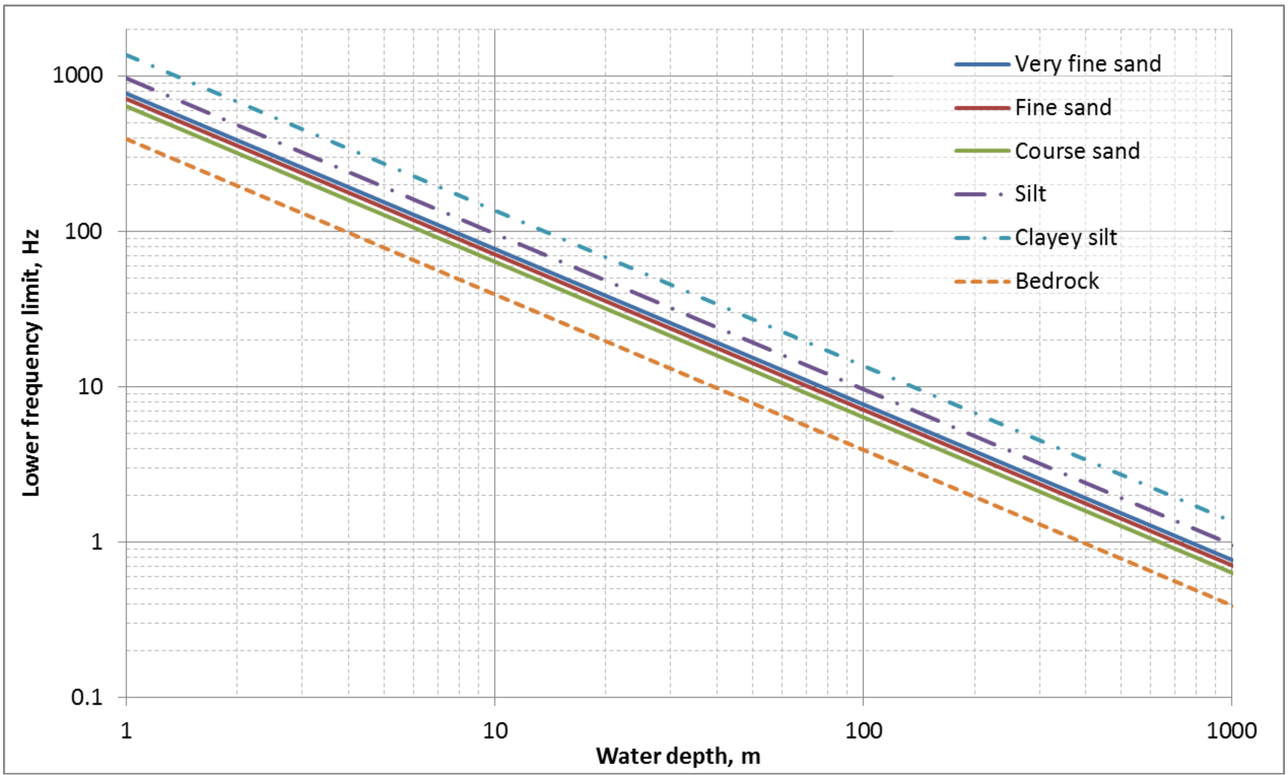

Figure C4: Lower cut-off frequency as a function of depth for a range of seabed types

Based on the above, the lower cut-off frequency is likely to be in the range of 30-50 Hz at depths of 50 m near the development area.

As well as calculating the sound pressure levels at various distances from the source, it is also necessary to calculate the SEL for a mammal using the relevant marine mammals hearing-weightings described previously taking into account the amount of sound energy to which it is exposed over the course of a day. To carry out this calculation, it has been assumed that a mammal will swim away from the noise source at an average speed of 1.5 ms^{-1}. The calculation considers each 1-second period of exposure to be established separately, resulting in a series of discrete SEL values of decreasing magnitude (see Figure C5). As the mammal swims away, the noise will become progressively quieter; the cumulative SEL is worked out by logarithmically adding the SEL to which the mammal is exposed as it travels away from the source. This calculation was used to estimate the approximate minimum start distance for a marine mammal to be exposed to a sufficient sound energy to result in the onset of potential injury. It should be noted that the sound exposure calculations are based on the simplistic assumption that the animal will continue to swim away at a constant relative speed. The real-world situation is more complex and the animal is likely to move in a more complex manner. Swim speeds of marine mammals have been shown to be up to 5 ms^{-1} (e.g. cruising Minke whale 3.25 ms^{-1} (Cooper *et al*. 2008), harbour porpoise 4.3 ms^{-1} (Otani *et al.* 2000) and grey seals up to 3.5 ms^{-1} (Gallon *et al*. 2007). The more conservative swim speed of 1.5 ms^{-1} used in this assessment allows some headroom to account for the potential that the marine mammal might not swim directly away from the source, could change direction or does not maintain a fast swim speed over a prolonged period.

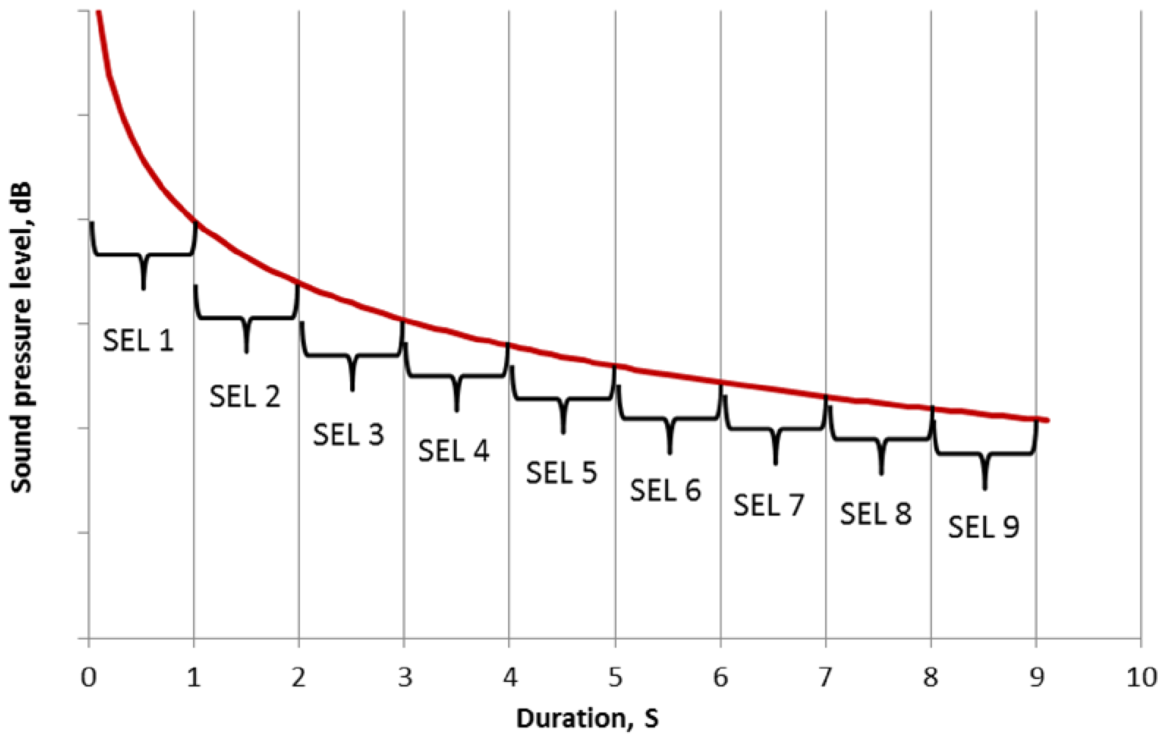

Figure C5 Conversion of continuous noise sources into discrete 1-second windows

Appendix C.4 Underwater Noise Sources

Appendix C.4.1 Underwater Noise Sources and Activities

Noise sources are usually described in dB re 1 µPa as if measured at 1 m from the source. In practice, it is not usually possible to measure at 1 m from a source, but this method allows different source levels to be compared and reported on a like-for-like basis. This method of specification assumes that the source is infinitesimally small so that at 1 m from this imagined point the SPL can be defined. In reality, for a large sound source such as a vessel or seismic array, this imagined point at 1 m from the acoustic centre does not exist or, in the case of an array, is inside the array itself. Furthermore, the energy is distributed across the source and does not all emanate from this imagined acoustic centre point. Therefore, the stated sound pressure level at 1 m does not actually occur for large sources. In the near-field, the sound pressure level will be significantly lower than predicted using this method.

The following section describes the various sources of noise associated with the Platypus Development Project during construction, drilling and operations. Noise source data has been obtained from a combination of specific noise data for the plant and equipment proposed for the Project (where available), publicly available noise data for other similar developments, empirical calculations and theoretical predictions. It should be noted that even where specific noise measurement data is available, this data is often not in a suitable form for assessing the impacts of noise on wildlife. Consequently, it is often necessary to apply empirical corrections to convert from, for example, rms sound pressure levels to SEL or peak pressure levels.

For the underwater noise assessment, the following general activities have been reviewed:

- Piling – part of the construction / installation of the subsea manifold infrastructure;
- Mobile offshore drilling unit – drilling of the 3 wells; and
- Vessels – variety of different potential vessels for pipeline construction and operational support.

In general, these activities will be undertaken at discrete intervals i.e. piling will take place at a different time to the pipelaying operations. That said there may well be a number of vessels of various type on site at any one time.

It should be noted that noise from piling operations can be characterised as impulsive i.e. series of repetitive sounds whereas noise from vessels and drilling operations is continuous in nature. It is therefore necessary to model these two types separately and compare the results against their respective threshold limits presented earlier for multi-pulse (impulsive) noise and continuous noise (non-impulsive). For the latter consideration has been made to one typical scenario when multi vessels are in operation in combination to provide a 'worst-case' example as opposed to looking at all discrete activities.

Appendix C.4.2 Piling Operations - Subsea Manifold Infrastructure

Four piles will be installed for the subsea manifold. The 0.61 m diameter piles will be piled using a Cape Holland IHC S-90 impact hammer, or similar deployed from piling vessel. Each 20 m pile is expected to take 4 minutes to install i.e. approximately 40 hammer blows. The piling schedule is expected to take one day in total.

The sound generated and radiated by a pile as it is driven into the ocean floor is complex, due to the many components which make up the generation and radiation mechanisms. However, a wealth of experimental data is available which allows us to predict with a good degree of accuracy the sound generated by a pile at discrete frequencies. For this study, the source noise levels were based on a combination of measured noise data from other projects and extrapolations.

Third-octave band noise spectra are presented in the literature for various piling activities (e.g. Matuschek and Betke, 2009, De Jong and Ainslie, 2008, Wyatt, 2008, Nedwell *et al.,* 2007b, , Thomsen *et al.,* 2006, Canadian Department of Transport (CDoT), 2001, Nedwell & Howell, 2004, Nedwell *et al.,* 2003). Thomsen *et al*. (2006) derived third-octave sound pressure level at 1 m based on measurements on a 1.6 m diameter pile during piling of the FINO1 platform and these data (both SEL and peak) have been used as the source level spectrum in this assessment.

Reducing the diameter of a pile will result in a reduction in emitted noise, conversely increasing the diameter will increase the noise. It is therefore necessary to correct the noise level for the 1.6 m pile to represent the 0.61 m diameter pile used for this project. Nehls *et al*. (2007) present a comparison of methods for estimating corrections to pile source noise strengths in order to correct for the pile diameter. Although there is no definitive method of making this correction (the actual noise level depends not only on the pile diameter but also on the properties of the sediment, pile driving energy etc.), a quadratic relation between pile diameter and noise emission can be assumed. Thus, the correction to the noise level for the smaller pile diameter, D, is 40 x $\log(D_2/D_1)$. A pile diameter of 2.59 m has been assumed for this Project and this results in an -16.75 dB correction being applied to the noise spectra reported by Thomsen *et al.* (2006). The same spectrum shape is assumed for peak, rms and SEL spectra.

Wyatt (2008) provides a method for estimating the peak-to-peak sound pressure level of a pile of known diameter, D, using the equation $P = 230.25 \times D^{0.0774}$. For a 0.61 m diameter pile, the peak to peak pressure level is 221 dB re 1 µPa (pk-pk). Root mean square (rms) sound pressure levels were calculated assuming a typical T90 pulse duration (i.e. the period that contains 90% of the total cumulative sound energy) of 0.1 second (s).

The SEL exposure resulting from piling noise assumes that each hammer blow will contribute to the overall exposure of the marine mammal, and that the piling operation has a fixed duration over which the number of blows per minute remains constant. Subsequently, the SEL exposure is calculated by considering the total number of blows likely to be experienced by a mammal moving away from the piling operation at a constant speed. It also assumes that there is no hearing recovery between hammer blows and therefore represents a 'worst case' assessment i.e. a conservative approach was taken.

Peak and rms sound pressure levels are not cumulative in the same way as SEL exposure, and assessments are made against levels for individual hammer blows.

Details of the noise data used in the underwater noise assessment are based on the following assumptions:

Table C3 Piling of wellhead platform jacket noise modelling assumptions

Parameter	Input values to modelling	Data source
Pile hammer	Impact hammer	Project
Hammer type	Cape Holland IHC S-90	Or similar
Pile diameter	0.61 metres (m)	Project
Hammer blow rate	10 strikes per minute	Project
Period over which piling will take place per day (hours)	Circa. 40 blows per pile	Project assumption based on manufacturers data
Number of structures to be piled and approx. schedule (no. of piles per day)	1 structure, with four piles, with all 4 piles to be installed in a period of approx. 6 hours from start to finish	Project assumption based on manufacturers data
Soft start period	5 minutes	JNCC guidelines require 20 minutes. Note, given the length of operations this would be considered disproportionately high for the duration of the piling activity.

For the piling noise assessment, the potential for a soft-start procedure is also considered. A five-minute soft period of reduced hammer energy is assumed, which results in a 10 dB reduction per hammer blow. This modelling scenario assumes an instant switchover from low to high energy hammer blows (“on/off”) after a five-minute period. In reality, you would expect to see a gradual “ramping up” of hammer blow energy over the course of the soft start period. It should be noted that based on the requirements of the JNCC, soft start procedures should last approximately 20 minutes but as this will be 5 times longer than the installation of the pile then this is felt to be disproportionate and a shorter time has been used.

Source noise levels used in the calculations are summarised below:

Table C4 Piling noise source data used for this assessment

Description	rms sound pressure level @ 1 m, dB re 1 µPa	Peak sound pressure level @ 1 m, dB re 1 µPa	SEL (per strike) @ 1 m, dB re 1 µPa^{2}s	Source of data/comments
Piling noise source data	199	215 (pk to pk = 221)	189	Spectral shape taken from Thomsen *et al.* (2006) and adjusted for pile diameter

Appendix C.4.3 Continuous Noise Sources

Overview of activities

The following construction activities will be involved in project development:

- Route survey and pre-sweep dredging, involving survey vessel and trailing hopper suction dredger;
- Pipelay, pipeline flood, clean gauge and strength test and post-lay survey, involving pipelay vessel and light construction vessel, the latter will be used to complete the survey;
- Trench excavation and survey, involving trenching support vessel and survey vessel;

- Umbilical lay, involving umbilical lay vessel;
- Trench backfill and survey, involving trenching support vessel (which will also complete the survey);
- Post-lay rock placement and survey, involving a rock dump vessel (which will also complete the survey);
- Platypus manifold installation involving dive support vessel;
- Drilling, involving a jack-up rig, supply vessel, guard vessel and emergency response and rescue vessel;
- Topside modifications using a jack-up accommodation vessel; and
- Guarding of exposed pipeline between pipeline lay and completion of rock dump, involving guard vessel.

At this stage, very little is known regarding the specific vessels to be used to carry out the various phases of construction and therefore it has been necessary to make various assumptions in terms of noise source data. For the purpose of the underwater noise assessment the following scenarios have been selected which are discussed in more detail in section C.3.2 associated with construction activities including:

- Trailer hopper suction dredger and support / survey vessel; and
- Light construction support vessel and support / survey vessel

In addition, because drilling operations will involve a jack up rig (low water depths involved) and not a semi-submersible rig, drilling operations have been scoped out.

Vessel operations

In terms of the continuous noise assessment the two scenarios chosen represent a cross section of the proposed construction activities which involve more than one vessel. At this point, specific vessels have not been contracted. In the absence of specific source data, noise levels for the main construction and support vessels have been based on a limited amount of publicly available data which are listed in Table C5.

Table C5 Manifold installation noise source data used for this assessment

Item	Description/assumptions	Data source	Sound pressure level at 1 m	
			rms dB re 1 µPa	SEL(1s) dB re 1 µPa^{2}s
Construction support vessel	Based Pompei support vessel diesel engine drive and DP	Hannay, MacGillivary, et al. 2004	184	184
Offshore support vessel	Based on tug and offshore support vessel 1894 tonnage	Austin, MacGilliviary 2005	188	188
Trailing suction hopper dredger	TSHD *The City of Westminster*	Parvin et al. 2008	186	186

Note, the above data is also presented in 'Review and Assessment of Underwater Sound Produced from Oil and Gas Sound Activities and Potential Reporting Requirements under the Marine Strategy Framework Directive', document no J71656-Final Report-G2, July 2011, produced on behalf DECC.

Dredging produces broadband, continuous noise, mainly at frequencies of less than 1000 Hz with source sound pressure levels of 160 - 180 dB re 1µPa (Thomsen *et al*., 2009). For most dredging activities, the main source of noise relates to the vessel engine noise. However, for suction dredging techniques such as trailing suction hopper dredgers (TSHD), typically produce louder noise levels with high frequency sound generated as a result of sand

and gravel rising up through the suction pipe, the movement of the draghead on the seabed and splashing from the spillways.

The following figures illustrate the mechanisms of noise produced by the TSHD; see Figure C6. Based on a CEDA (the Central Dredging Association) technical paper on underwtaer sound in relation to dredging, December 2011 quoted levels for TSHD of 186 – 188 dB re 1 μPa rms. In each case the source data has assumed the high end range for each activity. Actual measurement data has been used to provide the spectrum shapes for the dredging activities. Note, based on the waveguide effect (see earlier) which in shallow water columns there is a restriction in the propagation of low frequency sound, the lower cut-off frequencies are likely to be in the range of approximately 30-100 Hz at depths of 50 m.

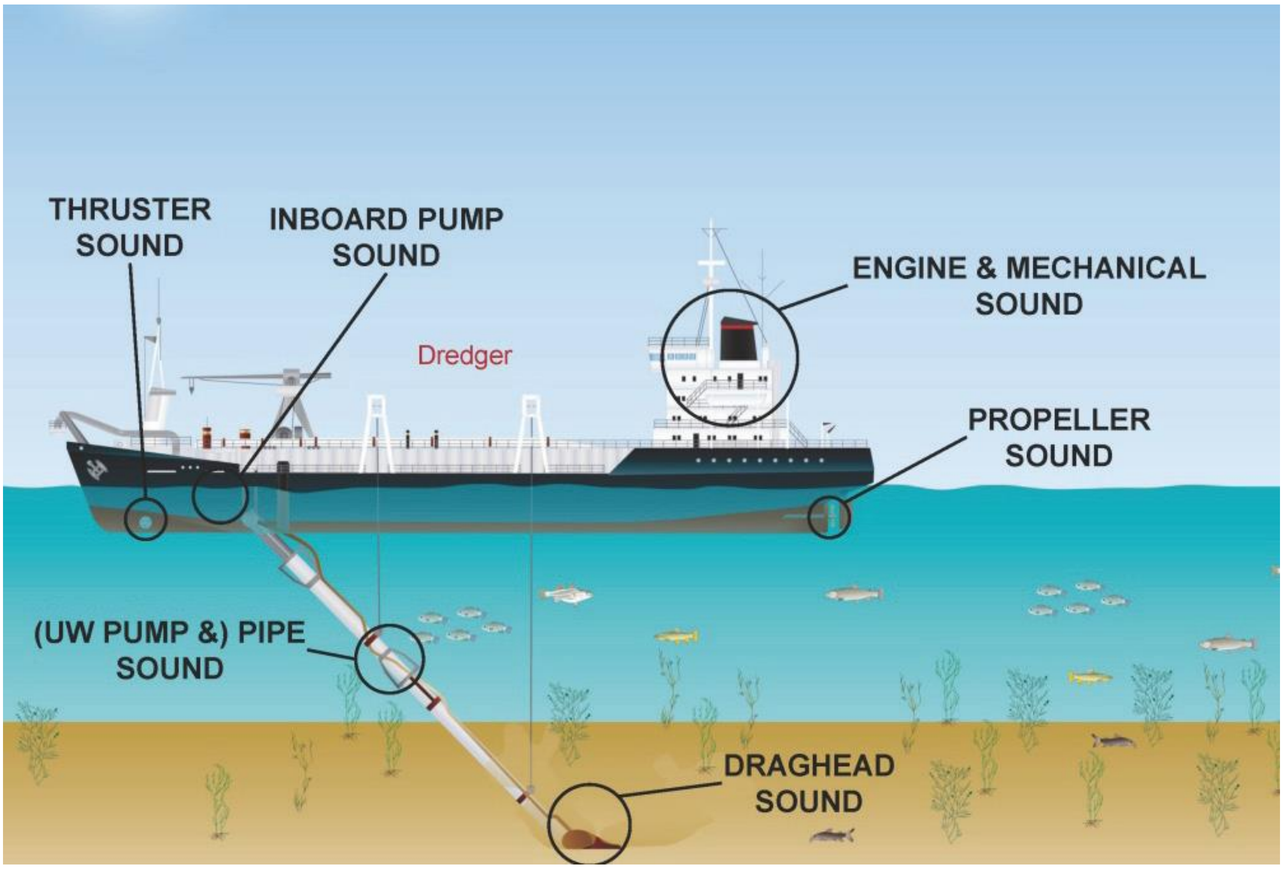

Figure C6 Trailing suction hopper dredger

Mobile offshore drilling unit (MODU)

Although the rig contract has not been finalised, given the water depth at the wellhead location (approximately 40 m mean sea level (MSL)) it is expected that a heavy-duty jack-up drill rig will be used to drill the 3 wells. A jack-up drilling rig is a mobile self-elevating drilling platform that consists of a buoyant hull fitted with a number of movable legs (typically three). The buoyant hull enables transportation of the unit and all attached machinery to any drilling location. Once on location the hull can be raised to the required elevation above the sea surface by jacking itself up on its legs. The legs of such units are typically fitted with enlarged footings (termed spud cans) to provide stable support and to limit penetration into the seabed as the hull is jacked up. Jack-up rigs are generally not self-propelled and rely on tugs or heavy lift ships for transportation to the drilling location.

The use of a jack up as opposed to a semi-submersible drilling rigs means that there will be no noise from dynamic positioning systems (e.g. thrusters). In addition, as the hull will be raised out of the water noise from the main hull mounted machinery will not radiate noise into the surround water. Only noise from drilling operations will affect the marine environment and this has been measured to be low.

As a result of this, drilling operations have been scoped out of the underwater noise assessment in favour of construction activities for the continuous noise assessment.

Appendix C.5 Results and Assessment

Appendix C.5.1 Piling – Impulsive Noise

The results of the noise modelling for piling operations are shown in Table C6. Note, each of the four, 20 m piles is expected to take 4 minutes to install i.e. approximately 40 hammer blows per pile. The piling schedule is expected to be completed in a single day.

The calculations assume the mammal will be swimming away from the source of the noise at a constant speed of 1.5 ms^{-1} after the first hammer blow.

As well as calculating the sound pressure levels at various distances from the source, it is necessary to calculate the SEL for a mammal using the relevant auditory frequency weightings described previously while taking into account the amount of sound energy to which it is exposed over the course of a day. The calculation considers each 1-second period of exposure to be established separately, resulting in a series of discrete SEL values of decreasing magnitude; see Figure C5. The cumulative SEL is worked out by logarithmically adding the SEL to which the mammal is exposed as it travels away from the source.

Table C6 Noise modelling results for piling activities

Situation	Radius of potential injury zone (N/E = criteria not exceeded)			
	High-frequency Cetaceans	Mid-frequency Cetaceans	Low-frequency Cetaceans	Pinnipeds in Water
Peak pressure (SPL) physiological damage	9 m	< 1 m	1 m	1 m
Peak pressure (SPL) physiological damage with soft start	3 m	< 1 m	< 1 m	< 1 m
SEL of swimming mammal (at 1.5 ms^{-1})	6 m	< 1 m	3 m	1 m
SEL of swimming mammal with soft start (at 1.5 ms^{-1})	2 m	< 1 m	1 m	< 1 m
Strong behavioural disturbance	176 m			

Based on the limited piling operations associated with pinning the subsea manifold the overall noise impact is extremely low with radius of potential injury equal to or less than 9 m across all types of marine mammals. No potential injury will occur outside the proposed 500 m mitigation zone. Due to the greater sensitivity of HF cetaceans and the low frequency hearing characteristics of the LF cetaceans with respect to the source levels these hearing types are most at risk when compared with the NOAA limits.

The results are illustrated below in Figure C7 and Figure C8 for peak and SEL respectively.

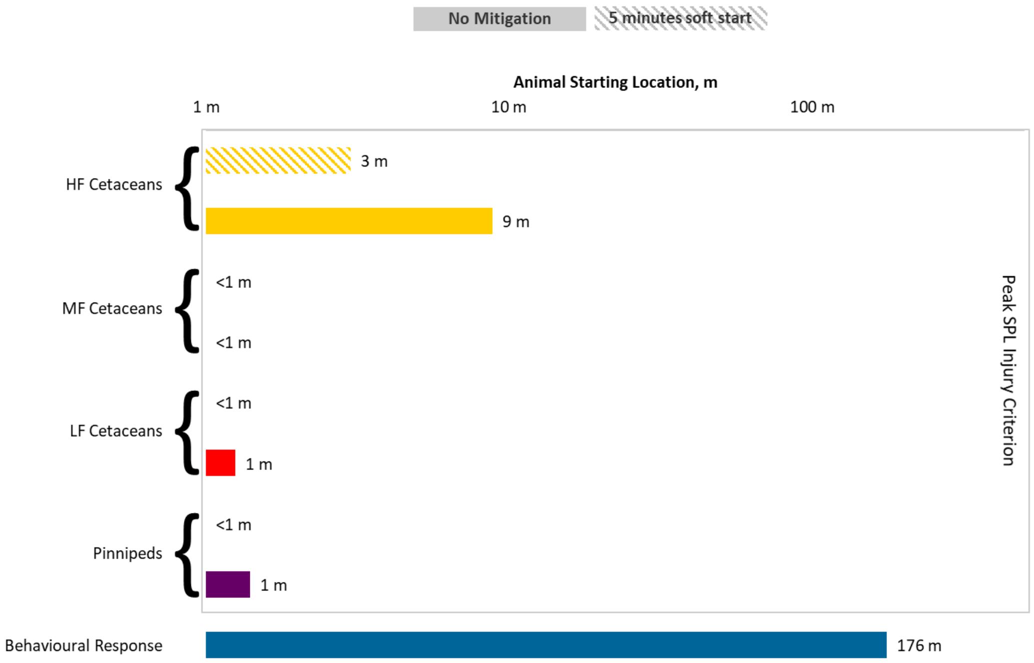

Figure C7 Start distances resulting in exceedance of guideline PEAK criteria for onset of injury (PTS)

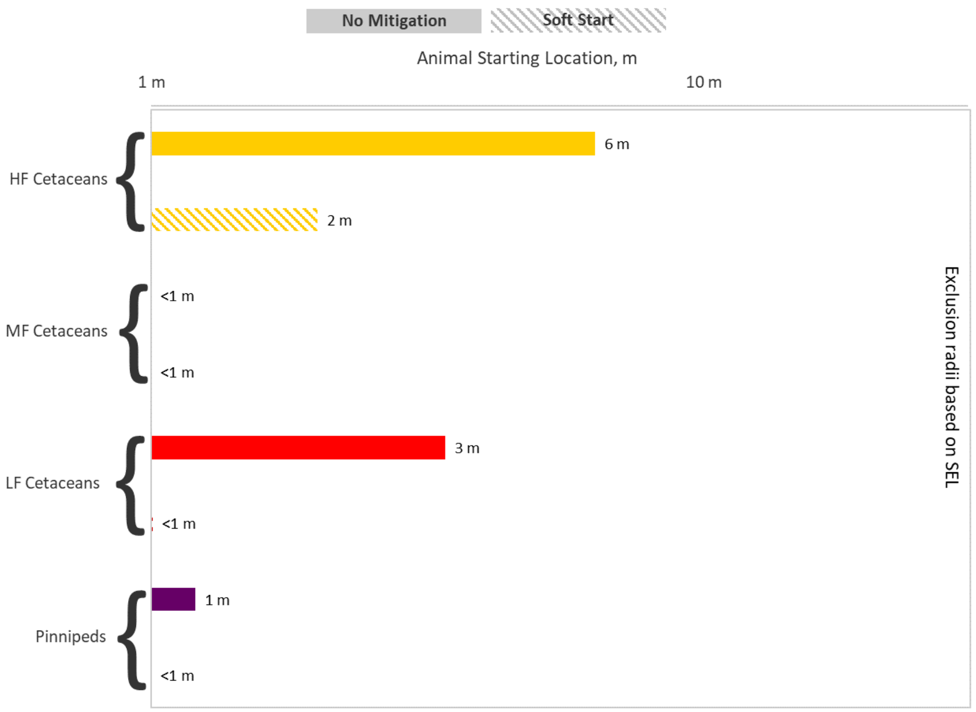

Figure C8 Start distances resulting in exceedance of guideline SEL criteria for onset of injury (PTS)

In terms of disturbance. JNCC (2010b) proposes that a disturbance offence may occur when there is a risk of a significant group of animals incurring sustained or chronic disruption of behaviour or when a significant group of animals are displaced from an area, with subsequent redistribution being significantly different from that occurring due to natural variation.

To consider the possibility of a disturbance offence resulting from the proposed survey operations, it is necessary to consider the likelihood that the sound could cause non-trivial disturbance, the likelihood that the sensitive receptors will be exposed to that sound and whether the numbers exposed are likely to be significant at the population level. However, assessing this is not a simple task due to the complex nature of sound propagation, the variability of documented animal responses to similar levels of sound and the availability of population estimates and regional density estimates for all marine mammal species.

Clearly, there is much intra-category and perhaps intra-species variability in behavioural response. Therefore, this assessment adopts a conservative approach and uses the United States (U.S.) National Marine Fisheries Service (NMFS) Level B harassment threshold of 160 dB re 1 μPa (rms) for impulsive sound. Level B harassment is defined as having the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. This is similar to the JNCC (2008) description of non-trivial disturbance and has therefore been used as the basis for onset of behavioural change in this assessment.

It is important to understand that exposure to sound levels in excess of the behavioural change threshold stated above does not necessarily imply that the sound will result in significant disturbance as defined in legislation. As noted previously, it is also necessary to assess the likelihood that the sensitive receptors will be exposed to that sound and whether the numbers exposed are likely to be significant at the population level.

To understand how the number of animals that might be affected might constitute a non-trivial disturbance offence, it is important to understand what proportion of the population this number represents. Temporarily affecting a small proportion of a population would be highly unlikely to result in population level effects, thus not considered as being qualifying as non-trivial disturbance. In contrast, affecting a large proportion of a population even a relatively small one may be considered non-trivial disturbance. Determining this proportion is not a simple task since it is not clear how northeast Atlantic marine mammal populations act at a local level. For example, minke whales are likely to make use of the entire northeast Atlantic, so the population can be viewed as one, whilst other species, such as bottlenose dolphins, may display more local fidelity and be viewed as a series of sub-populations.

The Statutory Nature Conservation Bodies (SNCB) note that marine mammals of almost all species found in UK waters are part of larger biological populations whose range extends into the waters of other States and/or the High Seas. To obtain the best conservation outcomes for many species, it is necessary to consider the division of populations into smaller management units. This requires an understanding of the geographical range of populations and sub-populations, to provide advice on impacts at the most appropriate spatial scale. The output of the SNCB exercise investigating how marine mammal populations may act is the determination of MMMU for species including harbour porpoise, bottlenose dolphin, white-beaked dolphin, Atlantic white-sided dolphin and minke whale. These MMMUs and associated population estimates can be interpreted in the context of the potential disturbance zones to consider the potential for a significant impact to occur.

Harbour porpoise, minke whale, white-beaked dolphin, Atlantic white-sided dolphin and bottlenose dolphin have all been sighted within the proposed development area. The number of individual cetaceans potentially affected by piling operations is detailed in Table C7. The number of individual animals that are likely to exhibit some form of change in behaviour for the period in which they encounter sound from the proposed activities is small. Therefore, the activities associated with piling operations that are likely to last a period of only four days would be largely undetectable against natural variation and would have no significant effect at the population level.

The radius of the zone for onset of behavioural change effects, using a 160 dB re 1 μPa (rms) threshold criteria will be approximately 176 m from the source array at any particular point in time, equating to an area of approximately 0.097 km^2.

Table C7: Estimated number of cetaceans experiencing behavioural changes because of seismic activities

Species	SCANS-III Density estimates[26] per km^2	Maximum number of animals predicted to be in the behavioural change impact zone at any one time (density x behavioural change area)	Marine Mammal Management Unit Population[27]	Percentage of reference population potentially affected
Harbour porpoise	0.888	0.086	227,298	<0.001
Minke whale	0.01	0.001	23,528	<0.001
White-beaked dolphin	0.002	<0.001	15,895	<0.001
Atlantic white-sided dolphin	0.01	0.001	69,293	<0.001

The information provided indicates that there is an extremely low likelihood of non-trivial disturbance as a result of the proposed piling activity.

Appendix C.5.2 Vessel Activity – Continuous Noise

Estimated ranges for injury to marine mammals from continuous noise sources are presented in Table C8 and Table C9 for dredging activities and general pipeline operations respectively when compared to cumulative weighted SEL limits, assuming a swim speed of 1.5 ms^{-1}. It should be noted that impact range is not a hard and fast 'line' which has impact on one side and no impact on the other; impact is more probabilistic than that. Dose dependency in PTS onset, individual variations and uncertainties regarding behavioural response and swim speed / direction all mean that in reality it is much more complex than drawing a line around a noise source. These ranges are therefore simplistic representations of 'potential impact range' designed to provide an understandable way in which a wider audience can appreciate the complexities and thus inform decision making.

Note that the condition where there are a number of noise sources acting together is modelled as a worst-case scenario which requires all noise produced by the sources to be generated at the same point, which is not indicative of the real-world situation. Consequently, in reality, the near field noise environment will be lower than that modelled and more distributed.

[26] Density estimates from Hammond *et al.,* (2017) (SCANS-III area U)

[27] This is the GNS/CGNS management unit within which the survey area sits from JNCC (2015)

Table C8 Estimated SEL injury ranges for marine mammals exposed to continuous noise – TSHD and support vessel

Situation	Radius of potential injury zone (N/E = criteria not exceeded)			
	High-frequency Cetaceans	Mid-frequency Cetaceans	Low-frequency Cetaceans	Pinnipeds in Water
SEL of swimming mammal (at 1.5 ms^{-1})	< 1.0 m	< 1.0 m	< 1.0 m	< 1.0 m
Strong / mild behavioural disturbance	635 m / 6,506			

Table C9 Estimated SEL injury ranges for marine mammals exposed to continuous noise – construction and support vessels.

Situation	Radius of potential injury zone (N/E = criteria not exceeded)			
	High-frequency Cetaceans	Mid-frequency Cetaceans	Low-frequency Cetaceans	Pinnipeds in Water
SEL of swimming mammal (at 1.5 ms^{-1})	< 1.0 m	< 1.0 m	< 1.0 m	< 1.0 m
Strong / mild behavioural disturbance	578 m / 5,918 m			

That said, based on the results of noise assessment it is extremely unlikely that any injury to marine mammals (PTS) will be caused by deployment of vessels during construction activities associated with the pipeline development. The main impact of such operations is likely to be disturbance. If we compare the likely noise levels with the 120 dB re 1 µPa rms sound pressure level criterion for continuous noise, the disturbances ranges could extend up to 6.5 km. It is important to place the results in the context of the baseline noise environment, i.e. the 120 dB re 1 µPa rms criterion is within the range of likely baseline noise levels in the area; see section Appendix C.2.4. It is therefore important to understand that exceeding the criteria for potential onset of disturbance effects does not in itself mean that disturbance will occur. Southall et al. (2007) notes that:

"*…the available data on behavioural responses do not converge on specific exposure conditions resulting in particular reactions, nor do they point to a common behavioural mechanism. Even data obtained with substantial controls, precision, and standardized metrics indicate high variance both in behavioural responses and in exposure conditions required to elicit a given response. It is clear that behavioural responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning. This reality, which is generally consistent with patterns of behaviour in other mammals (including humans), hampered our efforts to formulate broadly applicable behavioural response criteria for marine mammals based on exposure level alone*."

Consequently, the above behavioural disturbance zones should be viewed as the maximum likely extent within which behavioural change could occur. The fact that an animal is within this area does not necessarily mean that disturbance will occur.

If we compare the likelihood of disturbance at a noise level of 140 dB re 1 µPa rms equivalent to the median level then distances are less than 1 km.

Appendix D Supporting Data for Accidental Events Assessment

Table D 1: Blowout frequency for drill rigs per unit per year on UKCS (OGUK, 2009)

Type of facility	Number of blowout events for a given period					
	1990 – 1999		2000 – 2007		1990 – 2007	
	Number	Frequency per year	Number	Frequency per year	Number	Frequency per year
Drill rig	13	0.020	3	0.0066	16	0.014

Table D 2: Global well blowouts during different operational phases 1980 – 2008 (IOGP, 2010[28])

Descriptor	Drilling			Completion	Workover	Wireline	Production		Total
	Development drilling	Exploration	Other				External(1)	Internal(1)	
Number of well blowouts	34	17	2	9	20	4	7	1	94
Percentage	36.17%	18.08%	2.16%	9.57%	21.27%	4.25%	7.44%	1.06%	100%

(1) External causes include storm, military activity and ship collision whilst internal causes refer to upsets within the production process itself.

[28] Blowout and well release frequencies reported by IOGP are for offshore operations of North Sea standard (i.e., the same type of operations as occur in the North Sea but not necessarily located in the North Sea).

Table D 3: Projected frequency of blowout and well release incidents for the Project

Activity	Blowout			Well release		
	Historical frequency (IOGP, 2010) (individual units given per operation or well-year)	Values for the Project		Historical frequency (IOGP, 2010) (individual units given per operation or well-year)	Values for the Project	
		Estimated average frequency per Project year	Estimated average return period (Project years) (5)		Estimated average frequency per Project year	Estimated average return period (Project years) (5)
Development drilling (1)	7.0×10^{-5}	6.7×10^{-6}	149,980	5.7×10^{-4}	5.4×10^{-5}	18,419
Completion (2)	1.4×10^{-4}	1.3×10^{-5}	74,990	5.8×10^{-4}	5.5×10^{-5}	18,101
Production (3)	3.9×10^{-5}	7.4×10^{-5}	13,460	3.9×10^{-5}	7.4×10^{-5}	13,460
Workover (4)	2.6×10^{-4}	2.5×10^{-5}	40,379	8.3×10^{-4}	7.9×10^{-5}	12,649

(1) *Assumes 2 development wells drilled.*

(2) *Assumes all 2 wells drilled are completed*

(3) *Assumes all 2 wells go into production for 20 years each giving a total of 40 well-years of production*

(4) *Assumes 1 workover per well over production life (20 years)*

(5) *Return period is the reciprocal of the estimated frequency (1 / frequency)*

Table D 4: Number of accidental releases of oil from drill rigs, based on UKCS historical data by release size and source during the period 2001 to 2007 (TINA Consultants Ltd pers. comm., 2013)

Accidental release cause	<1 kg	1 to <10 kg	10 to <100 kg	0.1 to <1 Te	1 to <10 Te	10 to <100 Te	All accidental releases(1)
Maintenance/operational activities	10	14	4	5	1	0	35
Bunkering	2	9	2	9	0	0	22
Subsea releases	1	3	3	1	2	1	12
Drilling	12	6	15	15	2	1	54
ROV associated	1	3	1	0	0	0	5
Other production	0	0	0	1	0	0	1
All accidental releases(2)	35	42	40	42	8	2	179

(1) *Includes accidental releases of unknown size.*

(2) *Includes accidental releases of unknown cause and accidental releases that could not be categorised.*

Table D 5: Number and frequency of accidental releases of fluids or gas per unit year from drill rigs in the UKCS, 1990 – 2007 (OGUK, 2009)

Type of facility	Number of accidental events for a given period					
	1990 – 1999		2000 – 2007		Total for 1990 – 2007	
	Number	Frequency per operational year	Number	Frequency per operational year	Number	Frequency per operational year
Drill rig	160	0.246	78	0.172	238	0.215

Table D 6: Number and frequency of explosions, collisions and vessel contacts per unit year from drill rigs in the UKCS, 1990 – 2007 (OGUK, 2009)

Type of facility	Number of events for a given period					
	1990 – 1999		2000 – 2007		Total for 1990 – 2007	
	Number	Frequency per unit year	Number	Frequency per unit year	Number	Frequency per unit year
Vessel contact – drill rig	108	0.166	25	0.055	133	0.120
Collision – drill rig	14	0.021	1	0.0022	10	0.014
Explosion – drill rig	10	0.015	-	-	10	0.009

Table D 7: Number of accidental releases from subsea tiebacks to oil producing facilities (1975 to 2007) (TINA Consultants Ltd pers. comm., 2013)

Accidental release cause	≥10 g to <100 g	≥0.1 kg to <1 kg	≥1 kg to <10 kg	≥10 kg to <100 kg	≥0.1 Te to <1 Te	≥1 Te to <10 Te	All accidental releases(1)
Fixed	1	1	3	7	5	6	**23**
Floating	0	2	0	0	0	1	**3**
All accidental releases(1)	**1**	**3**	**3**	**7**	**5**	**7**	**27**

(1) *Includes accidental releases of unknown size and of unknown cause.*

Appendix E Commitments Register

No.	ES Section	Topic	Commitment
1	5.2.2	Discharges to sea	Where possible there will be zero discharge of LTOBM contaminated cuttings, but should this become necessary, Dana will ensure these are cleaned to the legislative limit.
2	5.2.2	Discharges to sea	A rig audit will be conducted to the ensure rig is in compliance with all relevant guidelines and legislation.
3	5.2.2	Discharges to sea	Fluids from well clean-up will be cleaned until they are below OIW limits applying to relevant discharge streams.
4	5.2.2	Discharges to sea	Chemicals with benign environmental rankings (CEFAS Gold or OCNS Group E or D) will be selected where technically and economically feasible.
5	5.3.2	Seabed disturbance	The volumes and locations of rock and mattress used will be refined during Detailed Design to ,minimise the footprint on the seabed.
6	5.3.2	Seabed disturbance	The spread of rock placement will be restricted through the use of a fall pipe system close to the seabed to accurately place rock material.
7	5.3.2	Seabed disturbance	The pipeline and umbilical will be installed in the same trench.
8	5.3.2	Seabed disturbance	The trench will be backfilled to prevent berms that may modify the seabed landscape.
9	5.4.2	Interaction with other sea users	A vessel traffic survey and collision risk assessment will be undertaken for the area closer to the proposed start of drilling as part of the standard permitting process.
10	5.4.2	Interaction with other sea users	During installation, the number of vessels and length of time they are required on site will be reduced as far as practicable through careful planning of the installation activities.

No.	ES Section	Topic	Commitment
11	5.4.2	Interaction with other sea users	A safety zone of 500 m in radius will be established around the drill rig when on location and around the Platypus manifold for the life of the Project.
12	5.4.2	Interaction with other sea users	An ERRV (also known as a standby vessel) will operate during the period that the drill rig is in place. This vessel will ensure that other sea users are aware of the presence of the drill rig and the 500 m safety exclusion zone.
13	5.4.2	Interaction with other sea users	Information on the location of subsea infrastructure and vessel operations will be communicated to other sea users (via the United Kingdom Hydrographic Office) through the standard communication channels including Kingfisher, Notice to Mariners and Radio Navigation Warnings.
14	5.4.2	Interaction with other sea users	Where appropriate, infrastructure will be marked on admiralty charts and entered into the Fishsafe system for avoidance by fishing vessels.
15	5.4.2	Interaction with other sea users	Regular maintenance and pipeline route inspection surveys will be undertaken.
16	5.4.2	Interaction with other sea users	The majority of the pipeline will be trenched and/or buried, eliminating snag risk. Crossings will be designed to be overtrawlable and will be protected with rock cover. The surface laid sections of the pipeline will primarily be within the Cleeton or Platypus 500 m safety exclusion zones.
17	5.4.2	Interaction with other sea users	Any exposed sections of pipeline will be protected using concrete mattresses and / or rock deposited at a gradient designed to allow fishing gear to pass over without snagging.
18	5.4.2	Interaction with other sea users	A post-installation survey of the pipeline route will be conducted and snagging risks will be appropriately mitigated.
19	5.5.2	Underwater noise	Dana will adopt the latest JNCC mitigation measures (JNCC, 2010) with respect to piling activities, with a soft start period, PAMS and continuous visual observation during piling operations.
20	5.6.3	Atmospheric emissions	All vessels will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2014.

No.	ES Section	Topic	Commitment
21	5.6.3	Atmospheric emissions	Operations will be carefully planned to reduce vessel numbers and the duration of operations.
22	5.6.3	Atmospheric emissions	All vessels will have the appropriate UK Air Pollution Prevention or International Air Pollution Prevention certificates in place as required.
23	5.6.3	Atmospheric emissions	The duration of well testing will be limited as far as is practicable to reduce the requirement to flare.
24	5.6.3	Atmospheric emissions	Operating procedures will be in place in order to reduce emissions during maintenance operations, process upset conditions, system depressurisation and start-up.
25	5.7.2	Accidental events	The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 implement the EC Offshore Directive. As part of this, a verification scheme exists for safety and environment critical elements (SECEs). Dana will identify SECEs in future design stages.
26	5.7.2	Accidental events	The drill rig will have a minimum 10,000 pound per square inch BOP stack.
27	5.7.2	Accidental events	Installation and supply vessel personnel will be given full training in chemical release prevention and actions to be taken in the event of an accidental chemical release.
38	5.7.2	Accidental events	An appropriate OPEP will be in place, including modelling and appropriate response planning.
39	5.7.2	Accidental events	Shipboard Oil Pollution Emergency Plans (SOPEPs) will be in place where required.
30	5.7.2	Accidental events	Appropriate maintenance procedures will be developed and followed.
31	5.7.2	Accidental events	Simultaneous operations (SIMOPs) will be actively identified and managed.
32	5.7.2	Accidental events	The drill rig will be subject to an audit which will cover oil spill response, procedural controls, bunkering and storage arrangements.

No.	ES Section	Topic	Commitment
33	5.7.2	Accidental events	Bunkering operations will be kept to good light and weather conditions where practicable.
34	5.7.2	Accidental events	Observers will be posted during bunkering operations.
35	5.7.2	Accidental events	Visual inspection of hoses and connections will occur prior to use.
36	5.7.2	Accidental events	All loading hoses and valves used will be within their certified testing periods.
37	5.7.2	Accidental events	The pipeline will be constructed to meet the requirements of the Pipeline Safety Regulations 1996.
38	5.7.2	Accidental events	Chemical storage areas on all vessels will be contained to prevent accidental release of chemicals.
39	5.7.2	Accidental events	Tool box talks will highlight the importance of minimising the risk of spills occurring.
42	5.7.2	Accidental events	Risks will be subject to ongoing assessment and management via Dana's Environmental Management System (EMS).
43	6	Environmental management	Dana will ensure compliance with relevant statutory provisions as outlined in a Project Regulatory Requirements Register.
44	6	Environmental management	Dana will publicise and communicate Dana HSSE policies and involve all staff, workforce and contractors through participation and consultation, and provide an effective system of communication throughout the Platypus Development Project.
45	6	Environmental management	Dana will clearly assign responsibility and accountability for the organisation, activities and arrangements to implement the HSSE policies.
46	6	Environmental management	Dana will ensure that HSSE issues are planned and managed with the same priority as other business activities.

No.	ES Section	Topic	Commitment
47	6	Environmental management	Dana will utilise contractors who have a track record of commitment to recognised HSE standards and who promote industry best practices.
48	6	Environmental management	Dana will report, investigate and address incidents to prevent recurrence.
49	6	Environmental management	Dana will maintain effective systems for monitoring, performance measurement, audit and review.
50	6	Environmental management	Dana will learn from the active audits and reviews and reactive investigations to strive for continuous improvement in HSSE performance.

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