

Platypus Development Environmental Statement

PERENCO

3 Central Avenue | St Andrews Business Park

Norwich | Norfolk | NR7 0HR

Environmental Statement Details

Section A: Administrative information

A1 - Project Reference Number

Number: ES/2026/024

A2 - Developer Contact Details

Company name: Perenco U.K. Limited

Contact name:

Contact title: Senior Environmental Advisor

A3 - ES Contact Details (if different from above)

As above

A4 - ES Preparation

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

Name	Company	Title	Relevant Qualifications/ Experience
[redacted]	Perenco U.K. Limited	Senior Environmental Advisor	9 years' experience in environmental management, 7 years within the oil and gas industry.
[redacted]	Perenco U.K. Limited	Project Manager	19 years' experience of project management, offshore operations, and engineering within the oil and gas industry.
[redacted]	Genesis	Study Manager	20 years' experience in environmental consultancy.
[redacted]	Genesis	Senior Environmental Specialist	6 years' experience in environmental consultancy.
[redacted]	Genesis	Environmental Consultant (EIA Subject Matter Expert)	28 years' experience (15 years' experience in environmental consultancy).
[redacted]	Genesis	Senior Consultant Environmental Engineer	25 years' experience in environmental consultancy.
[redacted]	Genesis	Environmental Consultant (GHG Subject Matter Expert)	20 years' experience (7 years' consultancy).
[redacted]	Genesis	Senior Environmental Specialist	4 years' experience in environmental consultancy.
[redacted]	Genesis	Environmental Engineer	2.5 years' experience in telecommunications / engineering, 1.5 years' experience in environmental consultancy.

A5 - Licence Details

a) Please confirm licence(s) covering proposed activity or activities
b) Please confirm licensees and current equity

Licence Number: P2673	
Licensee	**Percentage Equity**
Perenco U.K. Limited	100%

Section B: Project information

B1 – Nature of project

a) Please specify the name of the project.

Name: Platypus Field Development Project

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

Name: N/A

c) Please provide a brief description of the project.

Perenco U.K. Limited (hereafter referred to as Perenco), propose to develop the Platypus Field. The Platypus Field is located in United Kingdom (UK) Block 48/01, in the Southern North Sea (SNS), c.67 km from the coastline and c. 121 km from the UK/Netherlands median line. The proposed Project involves the installation of a Minimum Facilities Platform (MFP) (constructed from a reused platform), installation of two new pipelines, drilling of two production wells, and brownfield modifications to the existing Neptune Normally Unattended Installation (NUI) and Cleeton Host Facility. Platypus hydrocarbons will be processed at Cleeton before transporting to shore.

The project can be summarised as follows:

- Installation of a MFP at the Platypus field;
- A gas export pipeline and a methanol pipeline (both tied to Neptune), each approximately 16.5 km in length;
- Brownfield modifications at Neptune NUI and Cleeton Host Facility; and
- Drilling of two new production wells to access the reservoir.

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): 47,48

Block number(s): 05,01

Locations	Latitude (ED50)	Longitude (ED50)
Platypus Well (PLA-NW)	53° 54' 42.7" N	01° 00' 18.1" E
Platypus Well (PLA-SE)	53° 54' 42.6" N	01° 00' 18.1" E
Proposed Platypus Platform	53° 54' 42.7 " N	01° 00' 18.1" E
Neptune NUI	53° 59' 00.1 " N	00° 47' 20.8" E

Please note that co-ordinates are provided in ED50, UTM Zone 31N.

Distance to nearest UK coastline (km): 67 km.

Which coast? England

Distance to nearest international median line (km) 121 km.

Which line? UK / Netherlands

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: Platypus Development Environmental Statement (submitted by Dana Petroleum)

Date of submission of ES: October 2019

Identification number of ES: D/4229/2018

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Abbreviations

Abbreviation	Description
%	percentage
”	Inches
°C	degree Celsius
AB3	Fully abandoned well
AHV	Anchor Handling Vessel
AIS	Automatic Identification System
APS	Announced Pledges Scenario
AQ1	Optimum Sites of Aquaculture potential
AR5	Fifth Assessment Report
AR6	IPCC Sixth Assessment Report
BAC	Background Assessment Concentration
BAT	Best Available Techniques
BC	Background Concentration
BEIS	Department for Business, Energy & Industrial Strategy
BOP	Blowout Preventer
c.	Approximately
CAPEX	High capital expenditure
CCC	Committee on Climate Change
CCUS	Carbon Capture Utilisation and Storage
CEFAS	Centre for Environment, Fisheries and Aquaculture
CF	Conversion Factors
CH_4	Methane
CI	Corrosion Inhibitor
CIPs	Communication and Interface Plans
CMID	Common Marine Inspection Document
CNS	Central North Sea
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COLREGS	International Regulations for Preventing Collisions at Sea
CoP	Cessation of Production
COP	Conference of the Parties
CP	Chemical Permit
CPS	Current Policies Scenario
CR	Critically Endangered
CRA	Collision Risk Assessment
CSIP	Cetacean Stranding Investigation Programme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSV	Construction Support Vessel
CtL	Consent to Locate
CurPol	Current Policies
dB	Decibel
dB re 1 µPa	Decibels relative to one micro pascal

dB re 1 µPa²s	Decibels relative to one micro pascal square second
DBB	Double Block and Bleed
DC	Direct Current
DCA	Decommissioning Operations
DD	Data Deficient
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food & Rural Affairs
DepCon	Deposit Consent
DESNZ	Department for Energy Security and Net Zero
DGT	Dimlington Gas Terminal
DMA	Dead Man Anchors
DP	Dynamic Positioning
DR	Drilling Screening Direction
DRA	Drilling Operations
DREAM	Dose-related Risk and Effect Assessment Model
DSV	Diving Support Vessel
ECA	Easington Catchment Area
EDR	Effective Deterrent Ranges
EEA	European Environmental Agency
EEMS	Environmental Emissions Monitoring System
EF	Emission Factor
EIA	Environmental Impact Assessment
ELV	Emission Limit Values
EMODnet	European Marine Observation and Data network
EN	Endangered
ENVID	Environmental Impact Identification
EOWDC	European Offshore Wind Deployment Centre
EPA	Environmental Protection Agency
EPS	European Protected Species
ERAP	Emissions Reduction Action Plan
ERL	Effects Range Low
ERRV	Emergency Response and Rescue Vessel
ES	Environmental Statement
ESIA	Environmental and Socio-Economic Impact Assessment
ESOS	Energy Savings Opportunity Scheme
ESRA	Environmental and Socio-Economic Risk Assessment
ETS	Emissions Trading Scheme
EU	European Union
EUNIS	European Nature Information System
EW	Extinct in the Wild
EX	Extinct
FCS	Favourable Conservation Status
FEAST	Feature Activity Sensitivity Tool
FEED	Front-End Engineering
FEPA	Food and Environmental Protection Act
FOCI	Feature(s) of Conservation Interest

GBP	Great British Pound (£)
GHG	Greenhouse Gas
GHGI	Greenhouse Gas Intensity
GSAT	Global Average Surface Temperature
Gt	Gigatonne
Gt/yr	Gigatonne per year
GWP	Global Warming Potential
HABs	Harmful algal blooms
HF	High Frequency
HLV	Heavy Lift Vessel
HP/LP	High Pressure / Low Pressure
HPIE	Habitats of Principal Importance in England
HQ	Hazard Quotient
HRA	Habitat Regulations Assessment
HSE	Health, Safety and Environment
HSEx	Health and Safety Executive
Hz	Hertz
ICES	International Council for the Exploration of the Seas
IEA	International Energy Agency
IEMA	Institute of Environmental Management and Assessment
IMO	International Maritime Organization
IMP	Illustrative Migration Pathways
INTOG	Innovation and Targeted Oil & Gas
IOGP	International Association of Oil & Gas Producers
IPCC	Intergovernmental Panel on Climate Change
ISEP	Institute of Sustainability & Environmental Professionals
ISS	Instantaneous Sea Surface
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
JUB	Jack up Barge
kg	kilogram
$kgCO_{2e}/boe$	kilograms CO2 equivalent per barrel of oil equivalent
kHz	Kilohertz
kJ	Kilojoule
km	kilometre
km^2	square kilometre
kW	Kilowatt
kW/m	Kilowatts per metre
LAT	Lowest Astronomical Tide
LF	Low Frequency
LiDAR	Laser Imaging, Detection, and Ranging
LNG	Liquified Natural Gas
LPG	liquefied petroleum gas
LTOBM	Low Toxicity Oil Based Mud
m	Metres chp
m	metre

m/s	Metres per second
m^3	Cubic metres
m^3/d	Metre cubd per day
MAP	Methane Action Plan
MarLIN	Marine Life Information Network
MARPOL	International Convention for the Prevention of Pollution from Ships
MAS	Marine Assurance Standard
MAT	Master Application Document
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zones
MEIs	Major Environmental Incidents
MFP	Minimum Facilities Platform
mm/yr	Millimetre per year
mmboe	Million Barrels of Oil Equivalent
mmscf	Million Standard Cubic Feet
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
mmscf	Million Standard Cubic Feet
MMscf/d	Million Standard Cubic Feet per Day
MOD	Ministry Of Defence
ModAct	Moderate Action
MPA	Marine Protected Area
Ms	Milliseconds
MSFD	Marine Strategy Framework Directive
N_2O	Nitrous Oxide
NAEI	National Atmospheric Emissions Inventory
NBSAP	National Biodiversity Strategy and Action Plan
NDC	Nationally Determined Contribution
NFFO	National Federation of Fishermen's Organisations
NMFS	National Marine Fisheries Service
NMP	National Marine Plan
NMPi	National Marine Plan interactive
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NO_x	Oxides of nitrogen
NPD	dibenzothiophenes
NPI	Non-Production Installation
NSTA	North Sea Transition Authority
NSTD	North Sea Transition Deal
NT	Near Threatened
NTS	National gas Transmission System
NUI	Normally Unattended Installation
NZE	Net Zero Emissions
OBIS	Ocean Biodiversity Information System
OCNS	Offshore Chemical Notification Scheme
OCR	Offshore Chemical Regulations

OEUK	Offshore Energies UK
OGA	Oil and Gas Authority
OGCI	Oil and Gas Climate Initiative
OGUK	Oil & Gas UK
OLP	Oil Pollution Prevention and Control Life Permit
OPEP	Oil Pollution Emergency Plan
OPPC	Oil Pollution Prevention and Control
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response model
OSPAR	Convention for the Protection of the Marine Environment of the North East Atlantic
OTP	Oil Discharge Permit
PAH	Polycyclic Aromatic Hydrocarbon
PAM	Passive Acoustic Monitoring
PETS	Portal Environmental Tracking System second
PLA	Pipeline Operations
PLONOR	Pose Little or No Risk
PNEC	Predicted No Effect Concentration
PPC	Pollution Prevention and Control
ppm	Parts per million
PR	Production Screening Direction
PRA	Production Operations
PW	Produced Water
PWA	Pipeline Works Authorisation
PWRI	Produced Water Reinjection
RADICLE	Ravenspurn, Dimlington, Cleeton
RBA	Risk Based Approach
RCP	Representative Concentration Pathway
RFU	Rock Filler Units
ROV	Remotely Operated Vehicle
RQ	Risk Quotient
RSD	Relative Standard Deviation
SA	Standalone Application
SAC	Special Area of Conservation
SACS	Structural Analysis Computer System
SAT	Subsidiary Application Template
SCADA	Supervisory Control and Data Acquisition
SCANS-IV	Small Cetaceans in European Atlantic waters and the North Sea, fourth survey
scf	standard cubic feet
Scf/boe	standard cubic feet per barrel of oil equivalent
SD	Standard Deviation
SE	Stewardship Expectations
SECE	Safety and Environmental Critical Elements
SECR	Streamlined Energy and Carbon Reporting
SEL	Sound Exposure Level
SFF	Scottish Fishermen's Federation
SGMD	Scottish Government Marine Directorate
SHARP	Southern Hub Area Rationalisation Project

SIMOPS	Simultaneous Operations
SNCBs	Statutory Nature Conservation Bodies
SNS	Southern North Sea
SO_2	Sulphur Dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SO_x	Sulphur Oxides
SPA	Special Protection Area
SPIE	Species of Principal Importance in England
SPL	Sound Pressure Level
SSS	Side Scan Sonar
SSP	Shared Socioeconomic Pathway
stb	Stock Tank Barrel
STEPS	Stated Policies Scenario
tCO_2e	tonnes CO_2 equivalent
te	tonnes
te/d	tonnes per day
te/yr	Tonnes per year
$teCO_2/te$	Tonnes of CO_2 per tonne
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
THC	Total Hydrocarbon
TOC	Total Organic Carbon
TOOPEPs	Temporary Operations Oil Pollution Emergency Plan
UCM	Unresolved Material
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UK ETS	United Kingdom Emissions Trading Scheme
UKHO	United Kingdom Hydrographic Office
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
V	Volts
VHF	Very High Frequency
VOC	Volatile Organic Compounds
VTS	Vessel Traffic Survey
VU	Vulnerable
W2W	Walk to Work
WBCSD	World Business Council for Sustainable Development
WBM	Water Based Mud
WDCGG	World Data Centre for Greenhouse Gases
WGI	Working Group I
WGII	Working Group II
WIA	Well Intervention Operations
WMO	World Meteorological Organisation
WMP	Waste Management Plan
WONS	Well Operations Notifications System
WOW	Waiting on Weather

WRI	World Resources Institute
WtT	Well to Tank
µg/g	microgram per gram
µm	micron

Non-Technical Summary

Introduction

This summary outlines the findings of the Environmental Impact Assessment (EIA) conducted by Perenco U.K. Limited (hereafter referred to as Perenco), for the proposed development of the Platypus field via installation of a Minimum Facilities Platform (MFP) tied back to the existing Neptune Normally Unattended Installation (NUI), hereafter referred to as Neptune, via two new 16.5 km pipelines. The Platypus hydrocarbons will be commingled with hydrocarbons from other fields at Neptune and transported onwards through existing pipelines to the Cleeton Host Facility, hereafter referred to as Cleeton. Cleeton is a complex of four bridge-linked platforms where hydrocarbons from nearby fields are received, processed, compressed, and exported. At Cleeton the Platypus hydrocarbons will be processed and routed onshore to the Dimlington Gas Terminal (DGT). The Cleeton Hub refers to the connected fields and associated infrastructure network, including Ravenspurn South and fields in the Easington Catchment Area (ECA); Whittle and Wollaston, Apollo and Minerva and Eres, Ceres, Mercury and Neptune.

The purpose of this Environmental Statement (ES) is to record and communicate the findings of the EIA, which assesses the potential for environmental impacts resulting from project activities. Furthermore, the ES presents and addresses concerns and comments shared by stakeholders. A number of studies and surveys were undertaken to support the proposed Platypus development, and these have been considered during the EIA, as appropriate.

The ES is a supporting document to the Platypus Field Development Plan and will be submitted to the Offshore Petroleum Regulator for Environment and Decommissioning for consideration under the regulatory approval process.

Pathway to Net Zero

The UK Climate Change Act 2008 (amended 2019) legally commits the UK to achieving net zero greenhouse gas (GHG) emissions by 2050 compared with 1990 levels. Supporting this goal, the offshore oil and gas industry and government established the North Sea Transition Deal (NSTD), targeting a three-stage GHG emissions reduction, with a final target of 50% by 2030 against a 2018 baseline, with the UK Continental Shelf (UKCS) becoming a net zero basin by 2050. The North Sea Transition Authority (NSTA) has embedded these targets into its asset stewardship framework through Stewardship Expectation 11: Net Zero. Methane reduction is a key component of this strategy, Offshore Energies UK's Methane Action Plan (MAP) commits the industry to halving methane emissions by 2030 and achieving a methane intensity target of 0.25%, against a 2018 baseline. Perenco supports these objectives and is committed to reducing GHG emissions across its offshore and onshore operations while maximising economic recovery and supporting the UK's transition to a lower-carbon future.

Perenco reports emissions against a 2018 baseline through United Kingdom Emissions Trading Scheme (UK ETS) and other regulatory frameworks, with 76.7% of 2025 combustion emissions independently verified.

Perenco's emissions reduction strategy focuses on reducing fuel use, optimising logistics, and simplifying infrastructure. Targets set out in Perenco's Emissions Reduction Action Plan (ERAP) of 10% reduction by 2025 and 25% by 2027 have already been exceeded, with 2025 emissions reduced to 37% of 2018 levels.

Since 2015, Perenco has delivered a range of decarbonisation projects, including compression rationalisation, infrastructure simplification, renewable power installations, solar energy deployment, and logistics optimisation, significantly reducing operational emissions.

For the Platypus Development, Net Zero principles have been incorporated through the elimination of flaring and venting, electrification of the MFP with renewable power and optimisation of gas recovery.

Option Selection

A number of options were considered for the Platypus Development, with the aim of optimising the value of the field and the surrounding infrastructure. The assessment considered environmental impacts (including greenhouse gas emissions), technical feasibility, safety, cost, execution risks, and future expansion potential, with the objective of identifying a preferred development concept.

Three options were assessed for the Platypus Development: a new-build Minimum Facilities Platform (MFP), re-use of an existing decommissioned platform (as an MFP), and a subsea wellhead development. Of the three options, new build MFP and subsea wellhead development were screened out on the basis of technical feasibility and cost.

- The new-build MFP option was screened out due to:
    - Costs were comparable with other options, however CAPEX cost grew disproportionately beyond the development of the initial two development wells.
    - Higher embodied carbon and energy demand associated with steel fabrication and construction.
    - Procurement risks; for rolled steel due to competition with offshore wind projects.
    - Limited flexibility for future expansion due constrained by platform design limits.
- The subsea wellhead development option was screened out due to:
    - Complex and costly intervention requirements requiring diving campaigns for maintenance.
    - Higher operational risk, with potential for failures to increase emissions over time.
    - Process and design constraints, including challenges with pressure/temperature management.
    - Reduced operational flexibility compared to platform-based solutions.

The preferred option is the re-use of an existing decommissioned platform (MFP) due to the following.

- Reduced capital cost;
- Lower embodied carbon compared to new build;
- Reduced engineering complexity and improved schedule certainty; and
- Lower construction impacts due to reduced steel fabrication requirements.

A detailed assessment of potential tie-in locations was undertaken which considered nearby infrastructure hubs. Neptune was selected as the preferred tie-in location for the following reasons;

- Suitable export capacity and acceptable flow assurance conditions;
- Minimal production disruption;
- Reduced infrastructure constraints and manageable brownfield modifications;
- No requirement for pipeline crossings, reducing installation complexity;
- Compatibility with future developments and operational synergies; and
- Meets chemical injection requirements of Platypus.

Platypus Development Project

The proposed Platypus Development Project (the 'Platypus Development') comprises:

- Installation of a MFP at the Platypus field;
- A gas export pipeline and a methanol pipeline (both tied to Neptune), each approximately 16.5 km in length;
- Brownfield modifications at Neptune and Cleeton; and
- Drilling of two new production wells to access the reservoir.

The development will be delivered in several key phases. These include the installation of the MFP, the pipelay campaign, brownfield modifications at host facilities, and drilling, hook-up and commissioning, with each involving specific offshore activities. Project execution is expected in 2029, with production commencing in Q3 2029. Offshore MFP installation, pipelay, brownfield modifications and drilling will be conducted using specialist vessels.

Processing of Platypus fluids will be undertaken at Cleeton, a complex of four bridge-linked platforms which includes topsides and wellheads producing the Cleeton reservoir and also receives, processes and exports fluids from the wider Cleeton Hub.

During the installation phase, an existing platform jacket and topside frame will be refurbished and re-used, reducing the fabrication of new materials and minimising potential impacts to construction schedule. The MFP will be powered by a proven and reliable renewable energy package (wind, solar, and batteries), eliminating the need for conventional fuel gas or diesel-based power generation, thus significantly reducing operational atmospheric emissions.

Once operational, gas and associated wellbore fluids from the Platypus MFP will be transported to Neptune via a new 12" pipeline and riser, facilitated by limited brownfield modifications on Neptune. The gas will then be transported via existing pipelines to Cleeton for processing and subsequent onshore transport to the DGT.

There is no flaring expected during production at the Platypus Field. During maintenance activities limited venting will occur. No produced water discharge is expected during the operational phase, as the produced water will be managed through reinjection at Cleeton. The production is expected to peak shortly after start-up and then gradually decline over the field life (to approximately 2045).

The project will require a range of support vessels and logistics operations across all phases. These include:

- Drilling rigs, installation vessels, and pipelay vessels;
- Supply vessels and emergency response vessels; and
- Helicopter transport for offshore personnel.

At the end of field life, the offshore infrastructure will be decommissioned in accordance with applicable legislation and industry guidance. The wells will be safely plugged and abandoned, and infrastructure will be decommissioned. A detailed decommissioning plan will be developed closer to cessation of production.

Baseline Environment

The physical environment at the Platypus Project area has been described in the context of its meteorological, oceanographic and bathymetric features.

The physical environment of the project area is characteristic of the Southern North Sea (SNS), comprising relatively shallow waters and a predominance of sandy seabed sediments. Water depths typically range from approximately 38 m to 52 m, and the seabed is largely uniform, consisting of mobile sand features such as mega ripples. Currents are generally low to moderate in strength, although higher velocities may occur during storm conditions, and hydrodynamic processes are influenced by tidal cycles with regional circulation patterns influenced by the Dogger Bank. Wave conditions are moderate, with prevailing directions from the north and northwest, and seawater temperature and salinity are typical of offshore UK waters, exhibiting limited seasonal variation.

The seabed environment is dominated by sand, with low proportions of fines and gravel, and is representative of widely occurring habitats across the UK Continental Shelf. Sediments across the field contain low concentrations of hydrocarbons and heavy and trace metals. While some isolated exceedances of background concentrations were identified, these are limited in extent and consistent with natural or regional conditions, with no evidence of contamination associated with previous offshore activities. Overall, the seabed is considered to be in a favourable condition with no widespread degradation.

The biological environment reflects the relatively homogeneous nature of the seabed and water column. Plankton communities are typical of the SNS, while benthic habitats are classified as 'offshore circalittoral sand' and support diverse communities dominated by annelid worms, alongside crustaceans, molluscs and echinoderms. The ecological diversity ranges from moderate to high within the survey area. No reef-forming habitats were identified.

The wider marine ecosystem supports a range of fish and shellfish species, including both pelagic and demersal populations. The Project area is recognised as supporting spawning and nursery grounds for several commercially and ecologically important species, including cod, herring and plaice. Of particular importance are sand eels, which are considered a key prey species for seabirds and marine mammals and are associated with sandy seabed habitats that is present within the area.

Seabirds are present throughout the year, with densities varying seasonally and typically increasing during the autumn and winter months. The species most frequently recorded includes black-legged kittiwake, common guillemot and northern fulmar. Sensitivity to surface pollution varies temporally, with certain periods, particularly the post-breeding season, associated with increased vulnerability due to behavioural factors such as moulting and increased time spent on the sea surface.

Marine mammals occur within the wider area, with densities varying by species and across the year. Harbour porpoise is the most commonly recorded species, with other cetaceans including bottlenose dolphin, white-beaked dolphin and minke whale also present. Pinnipeds such as grey seals may occur occasionally, while harbour seals even less frequently.

The Project area lies within, or in proximity to, a number of designated conservation sites. The Project is located within the SNS Special Area of Conservation (SAC), designated for the protection of harbour porpoise. The Project is located *c*. 11.5 km from the Holderness Offshore Marine Conservation Zone (MCZ) designated for seabed features and is *c*. 46 km from the Greater Wash Special Protection Area (SPA), which supports internationally important seabird populations.

Commercial fishing represents moderate levels of activity and a seasonal peak during summer months. Shellfish fisheries account for the majority of landings and economic value, and potting and trapping are the dominant fishing methods. Vessel traffic in the Project area is relatively low compared to other parts of the North Sea, and a Collision Risk Assessment (CRA) shows a very low chance of collision. The wider area also contains established oil and gas infrastructure and is located near existing and planned offshore wind farm developments, indicating a well-developed offshore energy context.

Environmental Impact Assessment

A summary of the key findings of the proposed Platypus Project impact assessment is presented below.

Physical Presence

The physical presence of vessels, the drilling rig, the MFP, and subsea infrastructure has the potential to create navigational constraints, restrict access to fishing grounds, and cause disturbance to marine receptors; however, these effects are expected to be localised and in the case of vessels and the drilling rig, temporary.

The pipelines will be trenched and buried during installation, reducing interaction with fishing gear and minimising risks such as entanglement. Any temporary disruption to fishing activity during installation will be short-lived and spatially limited, and overall impacts on fisheries are considered negligible.

Mitigation measures include; optimisation of vessel use, compliance with maritime safety regulations (such as the establishment of exclusion zones), stakeholder engagement with fisheries, and appropriate notification procedures for all operations and notification to other users of the sea regarding the project's activities. The residual impacts of the physical presence of the vessels and infrastructure on other sea users and animals other than the benthic community in the area is considered Low.

Emissions to Air

Emissions to air will arise from pre-production activities, during offshore production and processing and from the subsequent use of exported hydrocarbons.

The main sources of pre-production emissions derive primarily from fuel use in vessels, drilling rigs and helicopters. Pollutants emitted from pre-production activities will have a minor impact on air quality over the short-term in an area that is remote from receptors. Pre-production greenhouse gas emissions are estimated to be approximately 43,420 tCO_2e, with vessel operations being the main source of these emissions.

The development has been designed to minimise emissions during production through mitigation measures including the avoidance of flaring and minimisation of venting, the use of existing infrastructure, installation of renewable power at the MFP, and efficient operations that harnesses reservoir pressure to drive production, processing and export. As a result, the additional operational emissions attributable to the Platypus Development are expected to be less than 1% of existing baseline emissions. Life of field direct emissions of greenhouse gases is estimated to be less than 6,000 tCO_2e. The greenhouse gas intensity of the Platypus Development is consequently predicted to be very low, at 0.11 $kgCO_2e$ per barrel of oil equivalent (boe), compared with the UK industry benchmarks of 28 $kgCO_2e$/boe as well as global benchmarks.

Full life-cycle greenhouse gas emissions are dominated (>99%) by those that occur after the hydrocarbon products have been exported from the facility. These include emissions resulting from the onshore processing, distribution and combustion of exported hydrocarbons as fuel. The impact of these emissions has been assessed in accordance with recognised methods and guidance, in the context of current and future baseline scenarios, and are determined to be fully in line with measures necessary to achieve the UK's trajectory towards net zero.

In addition to the mitigation measures inherent in the design, Platypus production will be covered by Perenco's Emissions Reduction Action Plan for its SNS assets. The development has been designed to industry best practices and its operation is aligned with the broad objectives of the NSTD, the Oil and Gas Authority Strategy and Plan, the North Sea Future Plan as well as specific requirements and targets under the NSTA's Stewardship Expectations.

The impact of atmospheric emissions from the proposed Platypus Development is assessed as 'Low significance' for both local air quality and impacts resulting from global climate change.

Discharges to Sea

The Platypus Development will result in planned discharges to sea across drilling, installation and decommissioning Project phases.

Discharges during the drilling phase primarily comprise water-based mud (WBM) and drill cuttings, limited cement and associated chemicals. Lower section cuttings containing Low Toxicity oil-based mud (LTOBM) will be returned to shore for treatment, thereby reducing offshore environmental exposure. Modelling of drill cuttings dispersion indicates that any effects on the water column would be highly localised and short-lived, with elevated suspended solids settling rapidly and conditions returning to baseline within approximately 24 hours following cessation of discharge.

Cement and cementing chemical discharges may occur in small quantities during routine operations or in contingency scenarios; however, these are expected to disperse quickly and become indistinguishable from ambient conditions within a short timeframe. Similarly, discharges associated with well clean-up activities are limited in volume and duration, and are controlled to meet regulatory discharge criteria, with any non-compliant fluids returned to shore.

During subsea installation and commissioning, potential discharges are limited to treated seawater used for pipeline testing, containing small quantities of chemicals such as biocides and oxygen scavengers. These substances will be selected to meet strict environmental standards and will be subject to risk assessment through the chemical permitting process.

During the Platypus production phase, there will be no routine discharges of produced water to sea, as all produced water will be reinjected at Cleeton, into the Cleeton reservoir.

During decommissioning, some discharges to sea are likely to occur. These may include planned discharges during abandonment, cleaning, disconnection and removal of infrastructure from the project area. Discharges to sea resulting from the decommissioning activities will be described in the environmental impact assessment submitted in support of the Decommissioning Programme.

The mitigation measures includes; strict chemical selection, compliance with MARPOL and OPPC regulations, use of low-toxicity substances wherever possible, and implementation of permitting controls, will be applied throughout the project lifecycle. With the mitigation measures in place, all identified impacts to the water column and associated receptors are assessed to be Low.

Seabed Disturbance

Seabed disturbance will arise from a range of activities, including drilling rig placement (anchors and spud cans), discharge of drill cuttings and cement, installation of the MFP, and trenching and burial of pipelines.

During the drilling phase, seabed impacts are primarily associated with drill cuttings deposition and equipment footprints. Modelling indicates that the area of seabed subject to potential ecological risk from cuttings deposition is limited and reduces progressively over time, with recovery to baseline conditions predicted within approximately four years. Furthermore, the cuttings deposition is largely confined to the immediate vicinity of the wells.

Installation activities, including pipeline trenching and placement of subsea infrastructure, represent the most extensive source of temporary disturbance. Trenching and burial of pipelines will affect linear corridors of seabed, although these areas are expected to recover naturally following completion of works through sediment reworking and recolonisation. Temporary disturbance from anchor lines, and other installation equipment is expected to be localised and reversible, with benthic communities typically recovering rapidly in sandy environments.

Permanent impacts include the footprint of installed infrastructure such as the MFP jacket, drilling template, and stabilisation features. These structures may result in localised loss of soft sediment habitat and introduction of hard substrate; however, the affected area is very small relative to the wider habitat availability. Anchor scars and spud can depressions are also considered a permanent physical disturbance

feature as defined by JNCC due to the potential for long-term persistence of seabed morphology changes and uncertain recovery timescales. However, unlike infrastructure placement, these impacts do not introduce new material and are expected to gradually recover through natural sedimentary processes, albeit over extended periods.

The total area of seabed predicted to be temporarily disturbed indirectly (e.g. by suspended sediment) is approximately 0.0097 km² and directly (physical contact) is approximately 0.7907 km², while the permanently affected area considered to result in habitat modification is approximately 0.0146 km² and the area considered to be permanently impacted by physical abrasion of the seabed is approximately 0.0078 km². These estimates represent a conservative worst-case, as individual disturbance footprints are expected to overlap in practice.

The mitigation measures include; optimisation of installation methods, minimisation of seabed contact, use of trenching rather than rock cover where practicable, and routing of pipelines to reduce disturbance. With mitigation measures in place, the overall impact of seabed disturbance is assessed to be Moderate, reflecting localised and short-term changes to benthic habitats, but without long-term degradation or loss of ecological function.

Underwater Noise

Sources of underwater sound associated with the proposed Platypus Project will result from; drilling, vessel operations, trenching, and piling.

Underwater noise has the potential to affect marine fauna by interfering with their ability to communicate, navigate and detect prey. While a range of sound sources will be present throughout the project lifecycle, most activities, including drilling, vessel movements and trenching, generate predominantly low-frequency noise of relatively low intensity.

Piling activities associated with installation of the platform jacket represent the principal source of impulsive and higher amplitude noise. Modelling indicates that the potential for auditory injury to marine mammals is limited and would be effectively contained within a standard 500 m mitigation zone, particularly when accounting for avoidance behaviour and swim speeds. Behavioural disturbance may extend over larger distances, up to several kilometres, but is expected to be temporary in nature and not result in population-level effects.

A range of standard mitigation measures will be implemented during piling operations, including the use of a 500 m mitigation zone, soft-start procedures, deployment of marine mammal observers and passive acoustic monitoring during periods of poor visibility where practicable.

With mitigation measures in place the underwater noise associated with the Platypus development is not expected to result in significant adverse environmental effects. Overall, impacts are considered to be Low.

Waste

Perenco is committed to reducing waste production and managing all produced waste by applying approved and practical methods. Perenco's waste management procedure emphasises the implementation of waste prevention and source reduction measures. Waste will be managed by means of waste management plans and procedures that will be established by Perenco or company's contractors.

All waste handling, transport and disposal activities will comply with the Duty of Care requirements under the Environmental Protection Act 1990, ensuring that waste is transferred only to appropriately licensed contractors and that full documentation is maintained throughout the waste chain.

Detailed procedures will govern key responsibilities, reporting requirements and method for the collection, storage, processing and disposal of waste. A programme of planned internal and third-party audits will assess the effectiveness of, and conformity to, waste management procedures on a regular basis. A

Decommissioning Programme will be developed by Perenco which will address waste management during the decommissioning phase.

With the application of the above control measures the impact of waste generated during the development and production of Platypus field will be minimised.

Accidental Events

The ES presents a detailed evaluation of two high significance hydrocarbon spill scenarios: a well blowout and a full loss of diesel inventory from the drilling unit. During the ENVID process the likelihood of a well blowout and full loss of diesel inventory were ranked (see Chapter 6: Impact Assessment Methodology) as Remote and Unlikely respectively. These accidental events are highly unlikely due to the application of established engineering controls, operational procedures and industry-standard safeguards.

Hydrocarbon spill modelling has been undertaken to predict the dispersion and fate of hydrocarbons in the marine environment. The results indicate that, in both scenarios, the majority of released hydrocarbons would be rapidly removed from the marine environment through evaporation and biodegradation, with only a very small proportion reaching the shoreline. Hydrocarbons are predicted to disperse widely in the water column and settle to the seabed in limited quantities, with concentrations generally below thresholds associated with significant environmental effects.

Water quality may be temporarily affected over a relatively large area due to dispersion of hydrocarbons, although the open sea environment facilitates rapid dilution and recovery. Seabed sediments are predicted to remain largely unaffected, with no exceedance of impact thresholds and limited risk to benthic habitats.

Overall, accidental events associated with the Platypus development are considered unlikely, and the potential environmental impacts, while potentially significant at a local scale under worst-case conditions, are assessed to result in a Low overall environmental risk.

Overall Conclusion

This ES, based on an assessment of significant adverse effects, finds that the Platypus Development would not cause any significant long-term adverse impact to the environment. Risks and impacts can be readily mitigated and controlled through robust design, effective operating practices and systems implemented by a highly trained workforce. Perenco has a significant track record in the delivery and operation of offshore project developments in the North Sea and is committed to protecting the environment by carefully considering the potential impact new developments may have during the planning of projects and throughout the lifetime of operations.

1 Introduction

1.1 Background

Perenco U.K. Limited (hereafter referred to as Perenco) proposes to develop the Platypus field. The Platypus gas field is located in the UK Continental Shelf (UKCS) Blocks 48/1 and 47/5 in the Southern North Sea (SNS), *c.* 67 km northeast of the English coastline (at Dimlington Gas Terminal (DGT)) and *c.* 121 km from the UK/Netherlands median line, in water depths of *c.* 38 m (Figure 1-1).

The Platypus field was discovered in 2010 with an exploration well (48/01a-5), and an appraisal well (48/01a-6) was subsequently drilled in 2012. These two wells were drilled under a previous licence and do not form part of Perenco's Production Licence P2673. They were drilled and operated by a previous licence holder. Both wells were fully abandoned (AB3) and therefore are not available for reuse. Perenco was awarded the production licence (P2673) in 2024.

The proposed Platypus Development comprises a Minimum Facilities Platform (MFP), two production wells, and two new 16.5 km pipelines (a 12" production pipeline and a 3" methanol/corrosion inhibitor (CI) pipeline) (Figure 1-2). The pipelines will be laid between the Platypus MFP and the existing Neptune Normally Unattended Installation (NUI), hereafter referred to as Neptune. The Platypus hydrocarbons will be commingled with hydrocarbons from other fields at Neptune and transported onwards through existing pipelines to the Cleeton Host Facility, hereafter referred to as Cleeton. Cleeton is a complex of four bridge-linked platforms where hydrocarbons from nearby fields are received, processed, compressed, and exported. At Cleeton the Platypus hydrocarbons will be processed and routed onshore to the DGT. The Cleeton Hub refers to the connected fields and associated infrastructure network, including Ravenspurn South and fields in the Easington Catchment Area (ECA); Whittle and Wollaston, Apollo and Minerva and Eres, Ceres, Mercury and Neptune. Further details are provided in the Option Selection and Project Description chapters (Chapters 3 and 4, respectively).

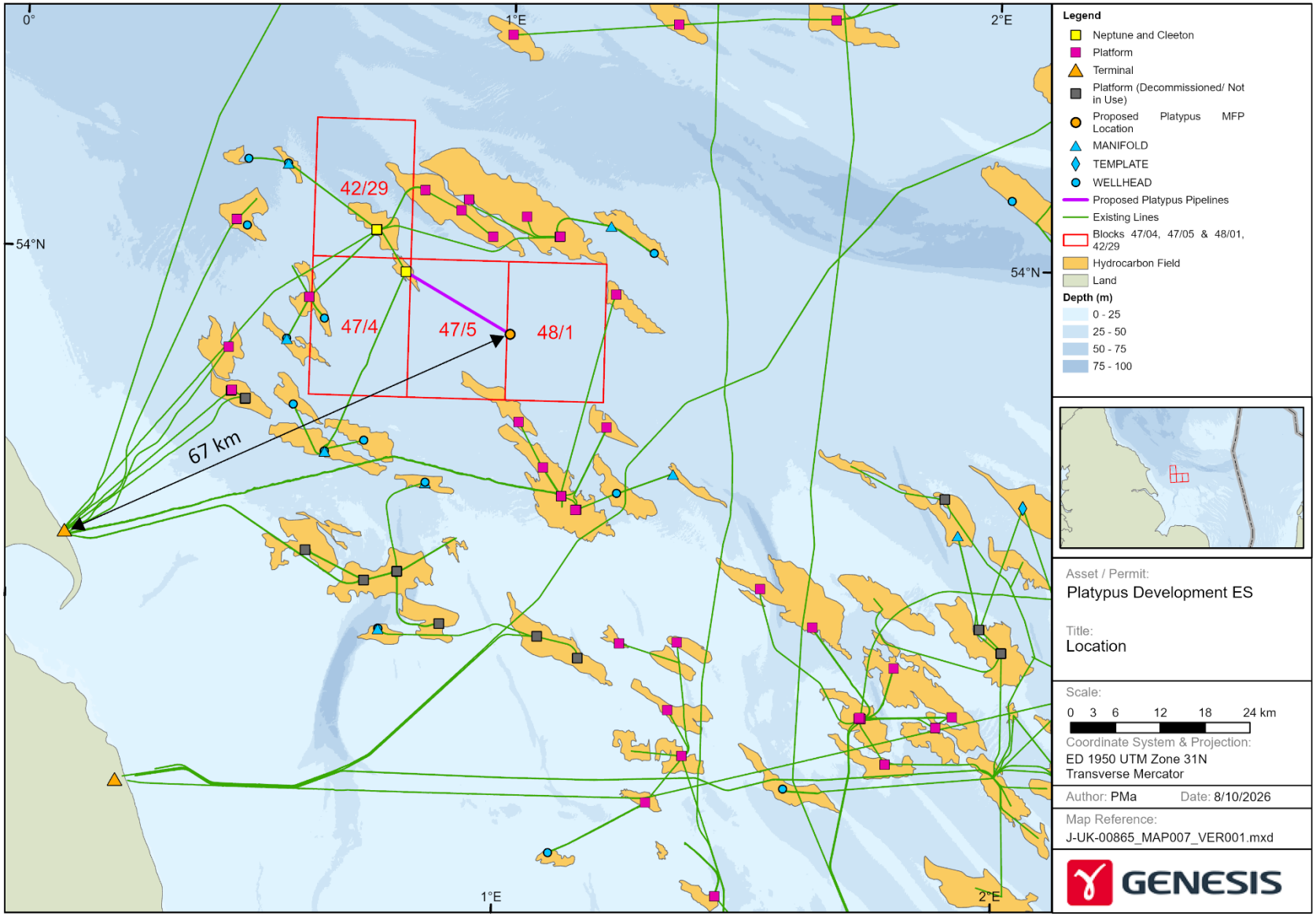


Figure 1-1: Location of Platypus Development.

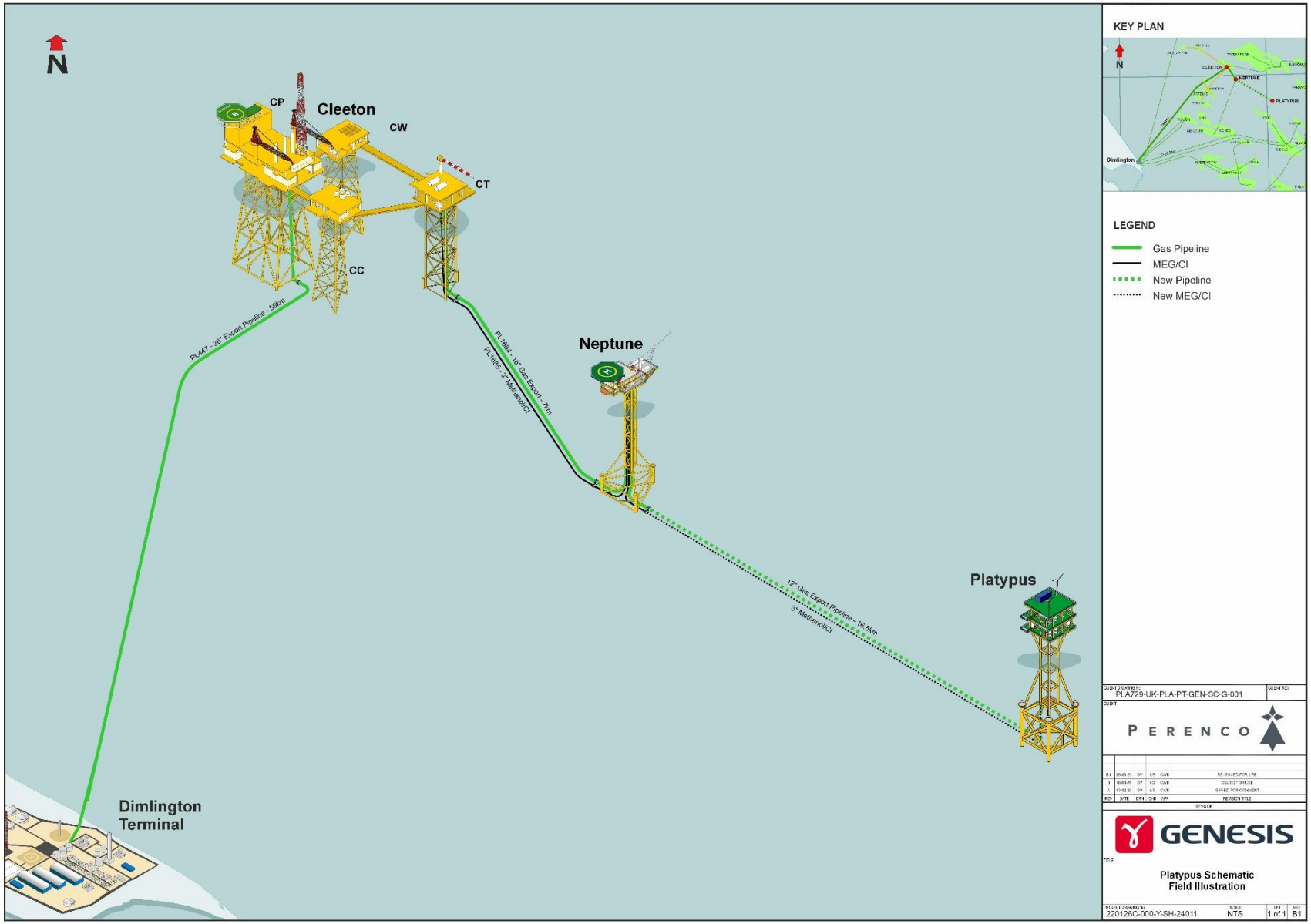


Figure 1-2: Proposed Platypus Field Layout.

1.2 Field Ownership

Production Licence P2673, which contains the Platypus field, is held 100% by Perenco U.K. Limited.

1.3 Purpose of Environmental Statement

Under the 2020 Offshore EIA Regulations, the proposed Platypus Development requires an Environmental Impact Assessment (EIA) and Environmental Statement (ES) to be submitted to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) for approval. This requirement is driven by the anticipated hydrocarbon production volumes. Consequently, consent is sought for 'Extraction of oil and natural gas for commercial purposes where the amount extracted exceeds 500 tonnes per day in the case of oil and 500,000 cubic metres per day in the case of natural gas'.

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

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

The ES has been prepared in accordance with the 2020 Offshore EIA Regulations and supporting guidance from OPRED.

1.4 Scope of the Environmental Statement

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

- Installation of a MFP, a repurposed previously decommissioned asset (jacket and topsides frame);
- Neptune host modifications with the addition of one hydrocarbon riser and one methanol riser;
- Modifications to Cleeton, minor and mainly involve equipment installation;
- Drilling of two production wells;
- Installation of a 12" export pipeline to Neptune;
- Installation of 3" methanol/CI pipeline from Neptune to Platypus MFP.

1.5 Document Layout

To determine the environmental and socio-economic impacts of the proposed Platypus Development, an understanding of the following is required: regulatory context; stakeholder concerns; the proposed activities; and the environmental and socio-economic baseline. Table 1-1 details the structure of the ES.

Table 1-1: Structure of the ES.

Chapter No.	Title	Contents
0	Non-Technical Summary	A summary of the ES.
1	Introduction	Introduction to the project, background, and scope of the ES. Provides an overview of the ES layout. Presents the societal benefits of the proposed project. Furthermore, this chapter also includes a summary of applicable legislation, Perenco's Environmental Management System, and the consultation process to date.
2	Pathway to Net Zero	Perenco's approach to reducing greenhouse gas emissions across their portfolio and specifically for the proposed Platypus Development.

Chapter No.	Title	Contents
3	Option Selection	Details the screening process and options considered for each of the following: • Platypus production asset; • Tie-in location; • Temperature Management; and • Pipeline installation method.
4	Project Description	Provides: • An overview of the Platypus development and reservoir; • Project base case and contingency scenarios • An indicative schedule of the offshore activities; • A description of: – Installation of Platypus MFP; – Topside modifications at Neptune; – Topside modifications at Cleeton; – Drilling phase; – Pipeline installation phase; – Commissioning and production activities; – Production profiles; – Support vessels and helicopters – Key Permits and Consents; and – Decommissioning
5	Baseline Environment	A description of the site-specific and regional physical, biological, and socio-economic receptors relevant to the proposed project, together with climate change projections and key global climate change receptors.
6	Environmental Impact Assessment Methodology	Description of the methodology used to determine the significance of the environmental and social risk of the proposed activities.
7 to 12	Assessment of Aspects	Detailed assessment of the following aspects: • Physical Presence (Chapter 7); • Emissions to Air (Chapter 8); • Discharges to Sea (Chapter 9); • Seabed Disturbance (Chapter 10); • Underwater Noise (Chapter 11); and • Waste Management (Chapter 12).
13	Accidental Events	Details of accidental events identified during the ENVironmental and socio-economic impact IDentification (ENVID) and consideration of Major Environmental Incidents (MEIs).
14	Conclusions	Key findings including a register of commitments.
15	References	Lists sources of information drawn upon throughout the ES.
Appendix A		Marine Plan and Marine Strategy Framework Directive (MSFD) Compliance Assessment. Assessment of the proposed Project against the East Offshore Marine Plan and the MSFD.
Appendix B		Aspects Register: Results from the ENVID workshop.
Appendix C		Drill Cuttings Modelling Report.
Appendix D		Underwater Nose Modelling Report.
Appendix E		Hydrocarbon Release Modelling Report.
Appendix F		Supplementary Climate Baseline Information.
Appendix G		Expected Trajectory of Climate Conditions and the Environment
Appendix H		Greenhouse Gas Baseline Model Assumptions and Limitations
Appendix I		Production Profiles

1.6 Societal Benefits of the Proposed Project

Wider benefits and contributions in the interests of the nation and to the Government's objectives for the North Sea have been considered in relation to the proposed Platypus Development. The socio-economic benefits of proceeding with the proposed Project when compared to the 'Do Nothing' scenario are summarised in the following subsections, with a focus on the Government's Energy and Environmental Objectives.

The Government's stated objectives for the North Sea are to foster a world-leading clean energy industry (including wind, hydrogen, and carbon capture), while managing a sustainable transition for the oil and gas sector. Key goals include creating jobs, supporting the existing oil and gas supply chain, and ensuring energy security, all while meeting climate obligations. The plan includes moving away from new oil and gas exploration licences while ensuring existing fields are supported and managed through their lifespan.

1.6.1 Supporting Existing Oil and Gas Supply Chain / Security of Energy Supply

Development of the Platypus field supports the UK Government's goal of providing a managed transition for existing oil and gas fields and aligns with the remit of the North Sea Transition Authority (NSTA) to maximise the economic recovery from the North Sea basin, within the context of other government objectives, while maintaining high stewardship standards for reducing emissions.

In the UK 24 million homes rely on gas boilers for heating (OEUK, 2025b). Whereas UK government policy is to significantly reduce, or eliminate, domestic reliance on gas boilers for heating, this is planned as a managed transition over at least 25 years. UK gas demand over the transition period has been projected to 2050 (CCC, 2025) and, while this decreases year on year, demand will continue to be considerably higher than UK gas production which is also projected to decrease year on year (NSTA, 2025) due to declining reserves in currently operated fields. While the North Sea cannot fully meet this demand, continued gas production in the basin can help protect UK homeowners from price volatility associated with international imports (OEUK, 2025b). Any oil and gas that is not recovered will increase the anticipated volume of imports with no wider benefits to the Exchequer, UK jobs or the UK economy (OEUK, 2025b). Therefore, developing the Platypus field will support the UKs drive for energy security, the UK economy and will help retain jobs across the UK.

1.6.2 Job Security and Contribution to Wider Economy

It is in the national interest to retain the capability to generate our own energy in the UK, ensuring stability, flexibility, and resilience. The UK Government recognises that homegrown energy, such as that produced from Platypus, plays a crucial role in stabilising prices, reducing reliance on volatile global markets / imports, and enhancing energy security. By developing domestic energy resources, the UK can build a more resilient energy mix, safeguard jobs, and create a stable foundation for long-term growth (OEUK, 2025b). Developing the Platypus field will protect jobs in the North Sea energy sector given that work will be required throughout the duration of project construction, installation and production.

1.6.3 Meeting Climate Obligations

Perenco have embedded Net Zero principles into the proposed Project, using atmospheric emission minimisation as a key driver in concept selection. Chapter 2 of this ES summarises how Perenco, as a UK operating company, supports the UK Government's Net Zero target and how the proposed Platypus Development aligns with the North Sea Transition Deal (NSTD) Policies and Commitments, and Perenco's Net Zero commitments (NSTA, 2021a). The selected concept for the proposed Project will utilise reused steel structures (jacket and topsides frame) and will be fully powered by an onboard renewable package.

1.7 Legislative Overview

This section provides a summary of the current environmental legislation applicable to the project.

1.7.1 Environmental Impact Assessment

Offshore environmental control has developed significantly over the past thirty years and is continuing to evolve in response to increasing awareness of potential environmental impacts. Strands of both primary and

secondary legislation, voluntary agreement, and conditions in consents granted under the petroleum licensing regime and international conventions have all contributed to the current legislative framework.

The main controls for new oil and gas projects are EIAs, which became a legal requirement of offshore developments in 1998. Current requirements are set out in the 2020 Offshore EIA Regulations and accompanying Guidance Notes for Industry (DESNZ, 2021 and 2025).

Schedule 1 of the 2020 Offshore EIA Regulations identifies those projects that require an ES to be prepared. As described previously, the Platypus Development requires an ES due to the anticipated production profiles.

1.7.2 Protected Sites and Species

The EIA needs to consider the impact on the surrounding environment including any protected areas. Many protected areas have been designated in the UK under the European Union (EU) Nature Directives, in particular the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC). Since January 2021 these are now maintained and designated under the Habitats Regulations for England and Wales, Scotland, and Northern Ireland. Amendments to the Habitats Regulations mean that the requirements of the EU Nature Directives continue to apply to how European sites (Special Areas of Conservation [SACs], and Special Protection Areas [SPAs]) are designated and protected. The Habitats Regulations also provide a legal framework for species requiring strict protection, e.g. European Protected Species (EPS). All offshore projects or developments must demonstrate that they are not "likely to have a significant impact on the integrity of the conservation objectives for the protected site" or "significantly disturb European Protected Species (EPS)" either alone or in combination with other plans and projects.

1.7.3 Habitat Regulations

The Habitat Regulations Assessment is a process established under the European Union's Habitats Directive (92/43/EEC), which has been retained in UK law post-Brexit. Its primary purpose is to ensure that plans, projects, or activities do not adversely affect protected habitats and species listed in the directive. The key objectives of the Habitat Regulations Assessment (HRA) are:

- To safeguard designated sites such as SACs and SPAs from damage caused by development or other activities.
- To evaluate whether a proposed plan or project might negatively impact the integrity of protected habitats and species.
- To identify and implement measures that avoid, reduce, or offset potential harm to sensitive habitats and species.
- To facilitate economic and social development while maintaining the conservation status of protected sites.

The HRA process is typically carried out by the competent authority[1] and involves:

- Screening: Determining whether a project or plan could potentially affect protected sites or species.
- Assessment: If likely impacts are identified, a detailed assessment is conducted to examine the nature and extent of potential effects.
- Appropriate Assessment: A thorough evaluation to decide whether the project can proceed, with or without mitigation, or should be modified or rejected.
- Decision Making: Based on the assessment, authorities decide whether to approve, refuse, or modify the project to ensure compliance with conservation objectives.

This ES aims to provide all the information required by OPRED to complete the HRA.

[1] The competent authority refers to the government body or public authority that has the legal responsibility and decision-making power to approve, authorise, or reject a specific plan, project, or activity.

1.7.4 Discharges to Sea

Oil Discharges:

In accordance with the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Recommendation (2001/1), the UK through OPRED has introduced regulatory requirements which reduce the permitted average monthly oil concentration in produced water discharged overboard from oil and gas installations to a maximum of 30 mg/l. OSPAR Recommendation 2001/1 also required contracting parties to reduce the total discharge of oil in Produced Water (PW) by 15% by 2006 measured against a 2000 baseline. The permits replaced the granting of exemptions under the Prevention of Oil Pollution Act 1971 and are issued under the Offshore Petroleum Activities (Oil Pollution Prevention and Control [OPPC]) Regulations 2005 (as amended). Under normal operating conditions, produced water associated with Platypus will be reinjected, and thus not discharged (see Section 4.6.1).

Chemical Discharges:

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

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

OPRED implemented OSPAR Decision 2000/2 on the control of chemical use offshore, through the Offshore Chemicals Regulations (OCR) 2002 (as amended). The regulations require offshore Operators to apply for permits for the use and / or discharge of chemicals during all relevant offshore energy activities, including well operations, production operations, pipeline operations, and decommissioning operations. The 2011 Amendment Regulations extended the provisions to take enforcement action in the event of any unintentional offshore chemical release.

Risk Based Approach:

OSPAR Recommendation 2012/5 for a Risk-Based Approach (RBA) to the Management of PW Discharges from Offshore Installations aims to produce a method for prioritising mitigation actions for those discharges and substances that pose the greatest risk to the environment.

1.7.5 Atmospheric Emissions

Combustion installations on oil and gas platforms with a rated thermal input, including flaring of 20 MW(th) or more require permitting under the UK's Emissions Trading Scheme (UK ETS). The UK ETS replaced the UK's participation in the European Union (EU) ETS system on 1 January 2021. The EU ETS is based on Directive 2003/87EC establishing a scheme for Greenhouse Gas (GHG) emission allowance trading within the Community (the EU ETS Directive) and the UK ETS broadly aligns with the Directive. The UK ETS is implemented by the GHG Emissions Trading Scheme Order 2020 (as amended). The relevant provisions of the Order include the requirement to monitor and report carbon dioxide (CO_2) emissions, surrender allowances and to notify of any changes affecting the allocation of allowances. The Platypus MFP is fully powered by renewable energy and as such is out of scope for UK ETS.

Combustion installations on oil and gas platforms with a rated thermal input of 50 MW(th) or more require permitting under the Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 (as amended). This includes conditions limiting releases notably for carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulphur (SOx), methane (CH_4) and Volatile Organic Compounds (VOCs) and the demonstration of the use of Best Available Technique (BAT). Combustion installations with a rated thermal input of 1 MW(th) to 50 MW(th) also require permitting under Pollution Prevention and Control (PPC) regulations to comply with the Emission Limit Values (ELVs) as stipulated in the Medium Combustion Plant directive EU 2015/2193 of 25th November 2015 for sulphur dioxide (SO_2), NO_x and dust. Platypus is fully

powered by renewable energy and as such is out of scope of the Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 (as amended).

The revised NSTA Strategy (February 2021) retains a binding obligation to secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters. The Strategy also states that in doing so, appropriate steps must be taken to reducing GHG emissions and assist in meeting the UK net zero target. The Strategy is supported by Stewardship Expectations (SE). The NSTA 'Stewardship Expectation 11 – Net Zero' (March 2021) (SE 11) sets out the NSTA's expectations of the steps that should be taken across the exploration and production lifecycle, to reduce emissions and promote Carbon Capture Utilisation and Storage (CCUS) and hydrogen.

An outcome of the UK's Supreme Court ruling of June 2024, on the application of Finch on behalf of Weald Action Group versus Surrey County Council and others, is that EIA for all new oil and gas developments must consider the impact of indirect downstream GHG emissions from the subsequent use of sold products. OPRED has published supplementary guidance for assessing the effects of these emissions on the climate (OPRED, 2025).

1.7.6 Marine and Coastal Access Act

The Marine and Coastal Access Act (MCAA) came into force in November 2009. The Act covers all UK waters except Scottish internal and territorial waters which are covered by the Marine (Scotland) Act (2010), which mirrors the MCAA powers. The MCAA provides the legal mechanism to help ensure clean, healthy, safe, productive, and biologically diverse oceans and sea by putting in place a new system for improved management and protection of the marine and coastal environment. It replaces and merges the requirements of the Food and Environmental Protection Act 1985 (FEPA) Part II (environment) and the Coastal Protection Act 1949 (navigation). The MCAA has enabled:

- Establishment of the Marine Management Organisation (MMO) to operate as the competent marine planning authority in English territorial and offshore waters, and Northern Ireland offshore waters (for matters that are not devolved), such as marine licensing and enforcement of marine legislation;
- A strategic marine planning system to agree marine objectives and priorities and establish a series of marine plans to implement marine policy;
- A new marine licensing system for marine activities; and
- Powers enabling the designation of Marine Conservation Zones (MCZ) in the territorial waters and offshore waters adjacent to England, and offshore waters adjacent to Northern Ireland.

However, the following are exempt from the MCAA as they are regulated under different legislation:

- Activities associated with exploration or production / storage operations that are authorised under the Petroleum Act 1998; and
- Additional activities authorised solely under the OPRED environmental regime, e.g. chemical and oil discharges;

Some oil and gas activities, which are not regulated by the Petroleum Act 1998 or under the OPRED environmental regime, require an MCAA licence.

1.7.7 East Offshore Marine Plan

Within English waters there are 11 Marine Plan Areas. The marine plan authority (the Secretary of State in England) is responsible for preparing marine plans for these 11 Marine Plan Areas, with responsibility for plan development delegated to the MMO.

The marine plans in English waters serve several important functions aimed at sustainable management and development of the marine environment. Their primary functions include:

- Spatial Planning and Allocation: They designate suitable areas for different activities such as offshore renewable energy (e.g., wind farms), shipping, fishing, conservation, and recreation, helping to coordinate activities and reduce conflicts.

- Environmental Protection: Marine plans aim to safeguard marine ecosystems, habitats, and species by integrating environmental considerations into decision-making processes.
- Supporting Sustainable Development: They promote economic growth by facilitating responsible development of industries like offshore energy, while ensuring these activities do not harm the marine environment.
- Regulatory Framework: Marine plans provide guidance for regulators, developers, and stakeholders, streamlining permitting processes and ensuring consistent decision-making.
- Stakeholder Engagement: They involve consultation with local communities, industry, conservation groups, and other stakeholders to reflect diverse interests and promote transparency.
- Climate Change Adaptation: Marine plans help in planning for climate resilience by considering impacts like sea level rise and changing marine conditions.

In 2023, the Secretary of State for Environment, Food and Rural Affairs agreed with the MMO's recommendation to replace the East Inshore and East Offshore Marine Plans. The adopted East Inshore and East Offshore Marine Plans will be replaced with a new 'East Marine Plan' which will be the first of a second generation of plans for English waters. Consultation on the draft East Marine Plan is expected to take place at the end of 2026 and will last for up to 12 weeks. It is expected that the East Marine Plan will be adopted and published by the end of 2027.

The proposed Platypus Development will be located within the new East Marine Plan area, however until the process of replacing the East Marine Plans is complete the Platypus Development will be assessed against the adopted East Offshore Marine Plan. This Marine Plan sets out general policies and objectives as part of the UK's shared framework for sustainable development. The East Offshore Marine Plan objectives and policies are described in Appendix A. The proposed operations, as described in this ES, have been assessed against all NMP objectives and policies (Appendix A).

1.7.8 UK National Biodiversity Strategy and Action Plan for 2030

The Kunming-Montreal Global Biodiversity Framework (GBF), adopted at the 15th Conference of the Parties (COP15) to the Convention on Biological Diversity in 2022, establishes a global roadmap for halting and reversing biodiversity loss by 2030 and achieving the Framework's vision of living in harmony with nature by 2050. The GBF comprises four overarching goals and 23 action-oriented targets addressing the direct and indirect drivers of biodiversity loss, ecosystem restoration, sustainable use of natural resources, and the integration of biodiversity considerations into decision-making across all sectors of society.

The UK National Biodiversity Strategy and Action Plan for 2030 ('UK NBSAP for 2030') implements the goals and targets set out within the Kunming-Montreal Global Biodiversity Framework (GBF) to halt and reverse biodiversity loss by 2030. The UK NBSAP commits the UK to achieving all 23 of the GBF targets.

Critical to the success of the GBF is the capacity for individual Parties and the global community to implement it. Perenco acknowledges their responsibility to support the UK NBSAP and GBF and therefore consideration of biodiversity has been integrated throughout this EIA in accordance with the 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment' under Directive 2011/92/EU[1] (the 'EIA Directive') (European Union, 2013).

1.8 Perenco Environmental Management System

Perenco's Health, Safety and Environment (HSE) Policy is provided in Figure 1-3.



Figure 1-3: Perenco HSE Policy.

1.9 Consultation Process

Consulting with stakeholders is an important part of the impact assessment process as it allows any concerns which stakeholders may have to be communicated and addressed. In March 2026, as part of the informal stakeholder engagement process, Perenco issued a Scoping Report to the following stakeholders; Joint Nature Conservation Committee (JNCC), OPRED, Trinity House, Centre for Environment, Fisheries and Aquaculture Science (Cefas), Maritime and Coastguard Agency (MCA), NSTA, and National Federation of Fishermen's Organisations (NFFO). The Scoping Report provided an overview of the proposed Project and the impacts to be assessed in the ES. Stakeholders were invited to comment on the Scoping Report with respect to any concerns they may have. Comments received on the Scoping Report are summarised in Table 1-2. NSTA responded to state they had no comments and NFFO did not comment.

In addition, a Stakeholder Engagement meeting with JNCC and OPRED was held on the 29th of April 2026, during which an overview of the proposed Project, schedule and available environmental data was shared. During the meeting the environmental survey strategy and results were presented. Following presentations the meeting opened up for discussion generating a series of comments, a number of which were reflected in responses to the Scoping Report.

As required by the 2020 Offshore EIA Regulations, a copy of the ES and the public notice has been made publicly available on the Company's website at the time of submission. In addition, Perenco will continue the process of consultation throughout the Project.

Table 1-2: Comments received on the Scoping Report.

Comments on the Scoping Report	Response
JNCC	
JNCC agree with what has been scoped in for this screening report prior to the submission of the ES and confirm that it is in line with what we would expect to see in an ES.	Acknowledged.
The Conservation Objectives for the Southern North Sea SAC are: to ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that: • Conservation Objective 1. Harbour porpoise is a viable component of the site. • Conservation Objective 2. There is no significant disturbance of the species. • Conservation Objective 3. The condition of supporting habitats and processes, and the availability of prey is maintained.	The proposed Project has been assessed against the Southern North Sea SAC Conservation Objects. The relevant assessments can be found in; • Conservation Objective 1; Chapter 10 and Chapter 11 • Conservation Objective 2; Chapter 11 • Conservation Objective 3; Chapter 10 • The proposed Project may result a short-term temporary displacement of harbour porpoises and their prey species. However, given the scale and duration, the project is not considered to have a long-term impact on the Southern North Sea SAC Conservation Objects
JNCC note that underwater noise has been scoped into the assessment, and the noise sources have been identified. With regards to noise modelling for piling, we highlight that JNCC will be publishing guidance to support such modelling in the upcoming months. Please check the JNCC webpage for updates. We also highlight that an update to the JNCC guidelines for mitigating geophysical surveys will be published in the upcoming months, with an addendum to the piling mitigation guidelines due to be published over the summer. Please refer to the JNCC webpage for updates. When assessing disturbance to harbour porpoise from piling, JNCC advocate the use of Effective Deterrent Ranges (EDRs) rather than noise modelling. Further information on these can be found here [*website link provided in comments*].	Perenco thank the JNCC for highlighting the upcoming guidance on noise modelling, the upcoming update for guidelines for mitigating geophysical surveys, and the addendum on piling mitigation guidelines. Perenco will review these once they are published. The underwater noise assessment (Chapter 11) has incorporated the use of EDRs. These have been used alongside project specific underwater noise modelling (Chapter 11 and Appendix D).

Comments on the Scoping Report	Response
JNCC note that the most recent surveys that were conducted at the time of writing the Scoping Report were in 2019. The Operator has since confirmed that there have been new surveys commissioned – an environmental baseline survey and habitat assessment, which were completed in 2025 and will be included in the ES. The Operator has also confirmed that these surveys will be discussed with as part of our DAS agreement during a meeting with JNCC and OPRED.	The 2025 environmental baseline survey and habitat assessment have been used to inform the baseline within this ES (Chapter 5) and were discussed with OPRED and JNCC during the meeting held on 29th of April 2026.
JNCC expect detailed information on stabilisation operations to be included within the ES to understand the potential nature conservation impacts. This should include: • Location of deposit sites • Size/grade of rock to be used • Tonnage/volume to be used • Contingency tonnage/volume to be used • Method of delivery to the seabed • Footprint of rock • Assessment of the impact • Expected fate of deposit after end of production, i.e. will it be left in situ or recovered. JNCC encourage the operator to work to minimise the amount of hard substrate material used, and reporting the worst-case scenario of impacts wherever possible. We note that the long-term effect of the introduction of substratum into naturally sandy or muddy seabeds is not fully understood at present, and should be carefully considered by the regulators. Where stabilisation material cannot be avoided, we recommend using a targeted placement method, e.g. fall pipe vessel rather than using vessel-side discharge methods.	Assessment of potential impacts relating to the use of stabilisation materials is presented in Chapter 10. Details of contingency stabilisation materials are included in the ES (Chapter 10). Where possible, the project has been designed in a manner which minimises the use of stabilisation materials, however where required, these will be deployed in a considered and targeted manner.
Assessment of cumulative effects of a project is required under EIA regulations, and in-combination assessments are also required for Special Areas of Conservation and Special Protected Areas. JNCC recommends that the proposed operations are assessed alongside approved developments under construction, approved developments that have not yet commenced construction, developments submitted for approval but not yet approved, as well as any other appropriate development for which some realistic figures are available.	Cumulative impacts on environmental (including protected areas) and socio-economic receptors have been considered throughout the assessment (Chapters 7, 8, 9, 10, and 11).
OPRED	
Whilst chemical discharge modelling is not proposed, it is recommended that the ES clearly describes as much as is possible at this stage the types of chemicals expected to be used across all project phases (drilling, completion, commissioning and production), including: • drilling fluids and additives; and • production chemicals (e.g. CI, scale inhibitors, methanol). The ES should also provide an appropriately high-level explanation of the relevant environmental hazard characteristics of these chemicals, with reference to toxicity, persistence and bioaccumulation potential, and describe compliance with the UK offshore chemical regulatory regime (e.g. Offshore Chemical Notification Scheme [OCNS]), including the use of lower-risk substitutions where reasonably practicable.	Potential discharges to sea and their impacts upon the environment are described in Chapter 9.
As the project includes piling associated with installation of the MFP, the ES should demonstrate a robust baseline understanding of fish sensitivities, including:	Biological receptors including fish are detailed in Chapter 5. An assessment of potential impacts is presented in Chapters 9, 10, and 11.

Comments on the Scoping Report	Response
• key species likely to be present; • spatial and temporal patterns of spawning and nursery activity; and • periods of heightened sensitivity to underwater noise. The ES should also clearly explain how this baseline information has informed the assessment, including consideration of how potential effects on fish may influence the supporting processes of the Southern North Sea SAC.	
The project will be subject to a Habitats Regulations Assessment due to potential impacts on the Southern North Sea SAC. Piling activities are likely to need to be undertaken in accordance with the SNS SAC Developers' Coordination Forum and Simultaneous Operations (SIMOPS) process, whereby noisy activities are managed to ensure relevant thresholds in JNCC guidance are not exceeded. This is likely to be a key mitigation measure required to support a conclusion of no adverse effect on site integrity. It is therefore recommended that the ES describes this process and includes a commitment to its use. The noise assessment should also apply the most recent guidance on effective deterrent ranges.	Section 1.7.3 acknowledges that a HRA will be required. Appendix D Underwater Noise Modelling highlights the importance of the potential impacts on the Southern North Sea SAC, and the relevant EDR thresholds in the JNCC guidance. The Appendix also states that an assessment of potential disturbance to harbour porpoise will be undertaken during the permitting stage if piling is going to occur in the summer season (between April and September). The most recent EDR for pin piling without noise abatement (20 km) has been used to assess behavioural disturbance in the ES.
The ES proposes hydrocarbon release modelling for a well blowout scenario. The ES should clearly describe the nature of hydrocarbons that could reasonably be released, including: • whether the Platypus wells are expected to produce dry gas only, or gas with associated condensate; • how this fluid composition has informed the selection of the blowout scenarios modelled and the assumptions used; and • whether the modelled scenario represents a realistic and precautionary worst-case release.	Oil spill modelling has been undertaken in support of the ES (Appendix E). This modelling has been used to inform the assessment of accidental events (Chapter 13). The Platypus wells will produce gas and a small volume of condensate; further details are provided in Chapter 4. Point 2 and 3 are covered in Chapter 13 and Appendix E.
Two existing wells (48/1a-5 and 48/1a-6) are present within the Platypus field and are not proposed for reuse. It is recommended that the ES clarifies: • the current regulatory and physical status of these wells; and • whether plugging and abandonment of the wells is proposed as part of the Platypus Development Project, deferred to a later phase, or excluded from the project scope entirely.	The exploration (48/01a-5), and appraisal (48/01a-6) wells are both plugged and fully abandoned (AB3) (see Section 4.3). These two wells were drilled under a previous licence and do not form part of Perenco's Production Licence P2673. They were drilled and operated by a previous licence holder.
Although the proposed wind turbines are relatively small, they may present a potential bird-strike risk. It is recommended that this risk is considered and discussed within the assessment.	The potential for bird strikes is considered in Chapter 7.
Scope 3 greenhouse gas emissions are likely to represent a significant proportion of the overall lifecycle emissions associated with the Platypus Development please pay close attention to OPRED correspondence and questions on scope 3 emissions on other ES submissions for further information on how to undertake scope 3 assessments.	Acknowledged. Questions and correspondence relating to Scope 3 emissions on other ES's have been considered for this submission.
Trinty House	
Our only comment would be that we would expect to see some form of Navigational Risk Assessment within the Scoping report which recognises any depth reduction created by subsea infrastructure may need marking following consultation with Trinity House, and that the MFP will need to be marked as per the standard marking schedule.	In support of the ES a Vessel Traffic Survey (VTS) and Collision Risk Assessment (CRA) have been undertaken. The results of which are summarised in Chapter 5 and have informed assessments presented in Chapter 7.

Comments on the Scoping Report	Response
Cefas	
Cefas noted an incorrect reference to the Norwegian median line.	Perenco can confirm this error has not been carried forward in the ES.
MCA	
The MCA would expect the EIA and ES Scoping report to consider the impact of the new gas field development during its construction, installation, drilling, operations and decommissioning on shipping, safety of navigation and other marine users with an appropriate Navigation Risk Assessment to mitigate the risks to As Low As Reasonably Practicable. A vessel traffic assessment (shipping and navigation) and a Collision Risk Management assessment must be undertaken as part of the Consent to Locate to minimize the risk of ship collision. The vessel traffic data should be taken from within the last two years.	In support of the ES a VTS and CRA have been undertaken. The results of which are summarised in Chapter 5 and have informed assessments presented in Chapter 7.
During similar projects, there would normally be a guard vessel whilst on location to monitor shipping traffic during installation, however there is no detail provided on such a function in this Scoping report – perhaps the applicant could clarify if this will be provided?	A guard vessel will be in place during pipeline installation, as detailed in Table 4- 13 of Chapter 4.
The MCA would also expect the details of the drilling rig and ultimately relevant contact information for emergency response procedures for HM Coastguard, and we would welcome engagement with the National Federation of Fishermen's Organisations.	Acknowledged, Perenco will ensure all relevant details are provided to the HM Coastguard.
Subject to the Navigation Risk Assessment, the MCA would likely expect the standard conditions as set out below for this development. The conditions used may vary but should be based on the Navigation Risk Assessment, along with any other mitigation measures in respect of trenching, mattressing and over-trawlability protection where required. Any jack up barges, when jacked up, should exhibit signals in accordance with the UK Standard Marking Schedule for Offshore Installations. Commencement of Works: a) The UK Hydrographic Office (UKHO) and the Maritime Coastguard Agency (MCA) must be informed at least 48 hours in advance of the commencement of the Works. b) Kingfisher Information Services and local operators must be informed at least two weeks in advance of the date of commencement of the Works. If determination of the application is made within two weeks prior to of the commencement of the Works, Kingfisher Information Services and Local Operators must be notified immediately following issue of the consent. An Oil Pollution Emergency Plan (OPEP) and Emergency Response Procedure to be in place.	Perenco will ensure all notifications are undertaken as stipulated and that an approved OPEP will be in place for the project.
Other recipients of the Scoping Report	
The Scoping Report was also issued to the NSTA and the NFFO. NSTA responded to state they had no comments and NFFO did not comment.	

2 Pathway to Net Zero

This chapter describes Perenco's approach to Net Zero as a company and at project level.

2.1 Net Zero Pathway

The UK Climate Change Act 2008 (amended in 2019) sets a legal requirement for the UK to achieve a 100% reduction in GHG emissions by 2050 relative to 1990 levels. In support of this, the offshore oil and gas sector has entered the NSTD with government, which sets out an ambitious plan to meet GHG emission reduction targets, committing to significant emissions cuts of 10% by 2025, 25% by 2027, and 50% by 2030, against a 2018 baseline, and committing to becoming a Net Zero basin by 2050. A Net Zero basin refers to a UKCS and North Sea energy system in which GHG emissions from offshore energy activities are reduced as far as possible, with any remaining emissions balanced through mitigation measures to achieve net-zero emissions.

The NSTA has incorporated these targets into its oversight, making emissions performance a core part of asset stewardship. The Stewardship Expectation 11 Net Zero (NSTA, 2021), details the NSTA's expectations of the industry to reduce GHG emissions from all aspects of their operations.

The reduction of methane emissions is an important part of ensuring the offshore oil and gas industry assists the UK with the creation of a Net Zero economy and meets its commitments within the NSTD. Offshore Energies UK (OEUK) developed a Methane Action Plan (MAP), which commits the industry to halving methane emissions by 2030 (set against a 2018 baseline) and adopting the Oil and Gas Climate Initiative (OGCI)'s methane intensity target of 0.25% (with a more ambitious stretch target of 0.2%) by 2025. Methane intensity is determined by dividing the total annual methane emissions, as reported by the National Atmospheric Emissions Inventory (NAEI), (converted from million tonnes of carbon dioxide equivalent ($MtCO_2e$) to billion cubic metres (bcm)) by natural gas production (in bcm) as reported by the Department for Energy Security and Net Zero (DESNZ) to give a percentage of methane emitted per cubic metre (NSTA, 2025).

Perenco is committed to reducing GHG emissions across its offshore and onshore operations and has undertaken a number of projects, listed in Section 2.4 below, to support the UK's transition to a low-carbon future and ensure the provision of gas to meet UK demand.

2.2 Emissions Reporting

Perenco have aligned the base year for emissions reporting and comparison with the NSTD base year, which is 2018. Perenco monitor and report annual emissions via the following reporting methods:

- UK ETS.
- Environmental and Emissions Monitoring System (EEMS) — annual environmental reporting.
- Energy Savings Opportunity Scheme (ESOS).
- Streamlined Energy and Carbon Reporting (SECR).
- OSPAR Annual Public Statement.

During 2025, 76.7% of Perenco combustion emissions were verified under UK ETS.

2.3 Emissions Reduction Action Plan

Perenco's strategy to emissions reduction is through minimising fuel gas consumption, rationalisation and optimisation of logistical operations, simplification of plant and process and reduction of unnecessary waste and emissions. This approach will ensure that the company's low CO_2 intensity supply will continue to be available to contribute to the UK's projected natural gas requirements during the transition to Net Zero.

Perenco's Emissions Reduction Action Plan (ERAP) aligns with the UK government and the NSTD GHG emission reduction targets by setting the following targets:

- 10% reduction in aggregate 2018 baseline emissions by 2025.
- 25% reduction in aggregate 2018 baseline emissions by 2027.
- 50% reduction in aggregate 2018 baseline emissions by 2030.

Through successful emissions reduction projects to date, Perenco has achieved and exceeded two of the three emissions reduction milestones within the ERAP. The 10% emissions reduction by 2025 and the 25% emissions reduction by 2027 targets have both been successfully achieved ahead of schedule. Perenco CO_2e emissions for the 2025 reporting year were at 37% of the baseline levels reported for 2018 reporting year.

2.4 Decarbonisation Projects

Perenco has been focused on emissions reduction since 2015 when it commenced upon its first major decarbonisation project to reduce aviation support and associated emissions. Since 2015, Perenco has reduced emissions by 59 % through the following projects:

2017 - RADICLE (**Ra**venspurn, **Di**mlington, **Cle**eton) project saw the cessation of offshore gas compression associated with Cleeton and Ravenspurn hubs and consolidation of onshore compression at DGT.

2018 - Inde Gas Compression Rationalisation (2018) project rationalised compression facilities on the Inde 23A platform.

2019 - Normally Unattended Installations (NUIs) rationalisation replaced inefficient power generation with lean units and combined with platform loading reviews to downsize power generation requirements across the fleet.

2021 - The Southern Hub Area Rationalisation Project (SHARP) rationalised oversized and complex infrastructure, removing inefficient compression facilities from service and installing a new, fit-for-purpose, compression jacket on the Leman 27B platform.

2021 - Bessemer Simplification, which involved the removal and replacement of the primary diesel generator on the Bessemer platform with a renewable power package (wind and solar).

2024 - The installation of solar panels on Perenco's office building based in Norwich in early 2024 contributed to a 10% reduction in the offices purchased electricity usage during this reporting period.

2025 - Davy Simplification - following the success of Bessemer Simplification, the model was subsequently rolled out to the sister Davy platform.

In addition to the above and in continuation of the focus on logistics in 2015, further emissions savings opportunities have been achieved over 2024 and 2025 within the logistic fleet. Perenco operates a fleet of three walk-to-work capable vessels and implemented changes over 2024 and 2025 to enable the dual role use to also serve as Emergency Response and Rescue Vessel (ERRV) coverage, resulting in a reduction of the equivalent of 1.5 full-time ERRVs within the field.

2.5 Platypus Development Emissions Reduction Evaluation

The estimated emissions generated by the Platypus Development including during drilling, construction, operation and the downstream scope 3 emissions have been assessed in Chapter 8; however, Section 2.6 and Section 2.7 summarise how Perenco has embedded Net Zero principles across the Platypus Development and aligns with the UKCS Net Zero Pathway and NSTA Stewardship Expectation 11.

2.6 Venting, Flaring and Gas Recovery Systems

In alignment with NSTA principles there will not be provisions for flaring on the Platypus MFP. Venting will only occur for maintenance purposes. By focusing on maximising economic recovery during host selection, and with no routine venting or flaring on the Platypus MFP, gas recovery systems are not deemed required. While no flaring is intended during well clean-up, the emissions assessment includes contingency flaring to cover the worst-case scenario.

2.7 Design and Equipment Selection

2.7.1 Re-use/re-purposing of infrastructure and facilities

Platypus incorporates the re-use of a decommissioned NUI structure which reduces emissions associated with embodied carbon.

2.7.2 Existing Infrastructure

Platypus maximises the use of existing offshore infrastructure. Tying into Neptune (explained further in Chapter 4) allows for a shorter length of new pipeline to be laid, resulting in reduced seabed disturbance and emissions associated with pipelay vessels and material construction, thereby reducing the need for new installations and emissions from fabrication, installation, and operation.

Utilising offshore processing at Cleeton (explained further in Chapter 4) allows for use of the existing 3-phase separation, Produced Water Reinjection (PWRI) and methanol systems and negates the need for new compression infrastructure with processed hydrocarbons exported under free flow conditions.

Sufficient ullage within the existing onshore gas compression at the DGT means that Platypus production will not result in a significant increase to fuel gas usage and associated emissions.

2.7.3 The selection of energy efficient equipment for power generation

Perenco have sought to maximise the efficiency of the Platypus MFP using the renewable power package.

3 Option Selection

During the concept and design phase of the Platypus Development several options for the proposed Platypus development were considered, including asset type, tie-in location, temperature management and method of pipeline installation.

The following sections summarise the options considered, evaluated and selected. The selected options were based on balance of cost-efficiency, technical suitability and reduction in environmental impacts.

An evaluation of the proposed Platypus Development when compared to the 'Do Nothing' scenario is provided in Section 1.6. This section therefore focuses on the feasible development alternatives considered for progressing the proposed development.

3.1 Platypus location

The location for the Platypus Development was selected to meet the following criteria:

- Drilling trajectory to reach reservoir targets.
- Existing coverage of shallow seismic data for the identification of shallow hazards.
- Avoidance of any shallow faults/graben1[1].

3.2 Tie-in Location

Platypus is located within proximity of several existing fields operated by Perenco. The following potential tie-in location options were identified:

- Hyde.
- Ravenspurn South Alpha.
- Cleeton.
- Neptune.
- Ravenspurn North.

Perenco reviewed options to determine the most suitable tie-in location based on technical, operational, and strategic considerations listed below:

- Flow assurance.
- Production backout.
- Future expansion potential.
- Compatibility with future projects (drilling campaigns and field development).
- Brownfield modification requirements.
- Methanol availability.
- Pipeline routing (length, pipeline/cable crossings etc.).

Table 3-1 summarises the review.

[1] A graben is a geological feature where a fault block of the Earth's crust has been raised and lowered relative to surrounding blocks, typically bounded by parallel normal faults forming a valley-like structure.

Table 3-1: Summary of Tie-in Assessment.

	Hyde	RSA	Cleeton	Neptune	Ravenspurn North
Production Back out	Ties into West Sole network. Consideration given for Olympus licence and Hoton drilling	Consideration given to RSC future drilling campaigns.	No impact	Back out expected but mitigated with gas ejector.	No impact
Modifications	Extensive topside modification to facilitate tie in.	Extensive topside modification to facilitate tie in.	Topside modification to facilitate tie in.	Topside modification to facilitate tie in.	Topside modification to facilitate tie in.
Methanol Availability	No methanol availability.	No methanol availability.	Methanol available.	Methanol available.	Methanol available.
Export Constraints	Constraints due to pipeline Design Pressure. Velocities at West Sole tie back result in high back pressure.	Constraints due to pipeline Design Pressure	None	Constraints due to temperature limitations on PL1684.	None
Produced Water and Chemical Emissions	Produced water discharged overboard on Hyde.	Produced Water disposal downhole on Cleeton.	Produced Water disposal downhole on Cleeton.	Produced Water disposal downhole on Cleeton.	Produced water discharged overboard on Ravenspurn N.
Pipeline Route	New 12 km pipeline. Risers required. No crossings.	New 13 km pipeline. Risers required. 1 Pipeline crossing.	New 23 km pipeline. Pipeline crossings - at installation. Extensive modification for riser.	New 16.5km pipeline. Risers required. No crossings.	New 15 km pipeline. Risers required Pipeline crossings - at installation.

3.2.1 Selected Option

Neptune was selected as the preferred tie-in location for the Platypus development. The 16.5 km pipeline distance results in acceptable pressure losses and flow velocities and hydrate risk is limited to the initial start-up phase and can be effectively managed. The existing Neptune pipeline system operates at approximately 10 barg, enabling Platypus wellhead pressures to be maintained below 20 barg and the Neptune to Cleeton export pipeline has sufficient capacity to accommodate the anticipated Platypus production rates.

The proposed pipeline route from Platypus to Neptune avoids all known pipeline and cable crossings, reducing seabed disturbance and simplifying installation activities. Tying into Neptune will have minimal impact on existing production and future operations or projects and expected to have a lower back-out impact on Neptune production than alternative host locations. Methanol supply can be provided through the existing 3-inch methanol line between Cleeton and Neptune.

3.3 Platypus Production Asset Assessment

Production asset options considered for the proposed Platypus Development included:

- New-build MFP.
- Use of a repurposed decommissioned platform.

- Subsea wellhead.

3.3.1 New build MFP

A new-build MFP option was considered. The estimated capital expenditure (CAPEX) would be high for a two well installation and there would be limited expansion potential due to riser and surface conductor constraints within the substructure. Items such as rolled steel may face procurement challenges due to competition with wind farm projects and steel fabrication has a high energy demand and associated CO_2 emissions.

3.3.2 Use of a Repurposed Decommissioned Platform

As an alternative to constructing a new MFP, Perenco investigated the repurposing of a decommissioned NUI, retaining the jacket and primary topside framing. The re-use option reduced reliance on external engineering subcontractors, reduced procurement challenges for rolled steel and reduces emissions associated with steel usage and fabrication activities. This option also provides greater flexibility to accommodate additional wells and risers compared to current new build MFP designs, allowing for potential future expansion or third-party tie-in.

3.3.3 Subsea Wellhead

A subsea wellhead development option was also considered. A review of Perenco's 77 existing and historical subsea well portfolio was completed to inform the feasibility of developing Platypus using subsea architecture. The subsea wellhead produced the lowest emissions profile out of the three options considered due to lack of planned maintenance requirements. However, the review identified that intervention utilising a diving support vessel (DSV) had been required for all but 5 of the subsea wells in Perenco's portfolio, during their lifespan and the reliability of Subsea Control Modules was identified as a potential issue. This highlights uncertainty in the predicted lifecycle emissions profile, which could increase when unplanned intervention campaigns are considered. The subsea wellhead option was ruled out due to process and design constraints, including challenges with pressure and temperature management, reduced operational flexibility compared to platform-based solutions and subsequent maintenance and repair works resulting in complex and costly intervention requirements which require diving campaigns for maintenance.

3.3.4 Selected Option

Based on the technical, operational, and scheduling advantages as discussed above, the option to repurpose a decommissioned asset as an MFP was selected as the preferred production asset for the proposed Platypus Development.

3.4 Pipeline Installation

A 16.5 km 12" export pipeline and 3" methanol pipeline will be laid between the Platypus MFP and Neptune. Potential options for installation of the pipelines are:

- Surface lay without protection.
- Surface lay with rock cover.
- Trench and bury.

A summary of the potential and selected option has been provided below.

3.4.1 Surface Lay Without Protection

The SNS is characterised by mobile sediments, sandbanks, and shifting seabed features. These dynamic conditions make surface-laid pipelines vulnerable to exposure or movement, which can compromise their structural integrity and functionality. Strong tidal currents and wave action can also lead to scouring around the pipelines, potentially resulting in unsupported (free spanning) sections that increase the risk of mechanical stress and fatigue.

Additionally bottom trawl fishing gear is used in the area, posing a significant risk of interaction with the pipelines. Unprotected pipelines are susceptible to snagging by fishing gear, which could result in damage to both the gear and the pipelines.

Given the challenges associated with the mobile seabed, strong tidal currents and the risk of fishing gear interaction, the option to surface-lay the pipelines without protective material is deemed unsuitable.

3.4.2 Surface Lay and Rock Cover

The proposed pipeline routes are within the designated SNS SAC for harbour porpoise. The impacts on the designating features associated with both of these sites are discussed in the ES report. Though the rock would not impact directly on harbour porpoise with in the SNS SAC, it would alter the seabed habitat in the area potentially affecting prey availability e.g. sandeels.

Trawl gear in the area could result in damage to the rock berms and although the rock berm profile will be over trawlable and the berm will be monitored, a compromised rock berm could lead to gear snagging before the issue is identified and mitigated.

The cost associated with laying this volume of rock would be significantly greater than the cost of trench and bury.

Therefore, due to the potential environmental and third-party impacts and cost the option to surface lay and rock cover the full length of the pipelines is deemed unsuitable.

3.4.3 Trench and Bury

Trenching and burying the pipelines will provide enhanced stability and protection by embedding the pipelines within the seabed, effectively shielding them from external forces and environmental hazards. By placing the pipeline below the seabed surface, it is protected from physical impacts of fishing gear that could cause damage. Burial also minimises exposure to strong currents, waves, and shifting sediments, reducing the risk of scouring or erosion around the pipelines. The trench itself acts as a natural barrier, preventing lateral movement of the pipeline and ensuring a more stable foundation. This reduces the likelihood of free-spanning sections, which as described previously can lead to mechanical stress, fatigue, and potential damage.

It is estimated that 100 eight-ton rock filler units (RFUs), 2,500 grout bags and 100 mattresses including contingency would be required for the trench and bury scenario at the transition from the trench to tie-ins at both platforms. As a worst case, 5000 te of rock may be required (750 te at each end and 3,500 te along the pipelines) if depth of burial is not achieved. Based on the baseline surveys conducted by Fugro in 2025, Perenco do not envisage requiring rock deposits/remediation, however contingency volumes have been included should the seabed conditions change. The estimate of rock has been made as a worst case based on previous pipeline work scopes in the area.

Furthermore, impacts on fishing activity in the area are expected to be reduced with this option, as the majority of the pipeline will be trenched and buried, allowing normal fishing activity to resume across most of the route after installation.

Finally, trenching and burying the pipelines where technically feasible is considerably less expensive than the surface lay and rock cover option, making it a more cost-effective solution.

3.4.4 Selected Option

Due to the enhanced protection and stability offered, the reduced environmental and third-party impacts, and the lower overall cost, the option to trench and bury the pipelines was chosen. Additional details regarding this option are provided in Section 4.8.

3.5 Low Temperature Mitigation

Based on the high case production, the Platypus Project will require a warming system to warm the gas on start-up for the mitigation of the low temperature potential which could be generated across the new production choke valves. This is due to the Joule-Thompson (J-T) expansion of the initially cold gas and could result in temperatures below -70°C. It will therefore be necessary to warm the gas on start-up, for a period of several hours, until warmer temperature fluids are flowing consistently from the reservoir.

Four potential options for heating the cold Platypus gas on start-up were identified.

3.5.1 Electrical Warming System

An electric warming system would be compact and relatively simple to integrate into the process design. However, increased power demand does not align with the MFP methodology and would require substantial battery storage (weighing approximately 10te) to facilitate power from the proposed renewable generation system. In addition, the batteries would take several days to recharge after each cold well restart, resulting in unacceptable operational constraints. Consequently, this option was not selected.

3.5.2 Excess Methanol Injection

Cold gas could be warmed by injecting methanol at flow rates significantly higher than those required for hydrate inhibition. It is estimated that approximately 13te of methanol would be required per well start if stored at 40 °C, increasing to 33te if stored at 10 °C. These volumes would increase hazards to personnel and require significant electrical power to warm the methanol and power the injection pumps. This would exceed the expected renewable generation capacity, therefore requiring substantial battery storage. Additional methanol supplies would be needed from Cleeton, creating cost and logistical challenges, while the handling of returned methanol remains uncertain. For these reasons, this option was not considered further.

3.5.3 Water Bath Warmer

A water bath maintained above ambient temperature could be used to warm gas from Platypus wells during start-up. If sufficiently large, the thermal mass of the bath could support a single well start without additional warming. Once flowing, warmer gas could restore the bath temperature in preparation for the next start-up.

The bath would contain a glycol-water mixture with suitable corrosion inhibition and would require an estimated 13te of liquid and 70 m of tubing. Agitation or recirculation would be necessary to maintain adequate heat transfer, but the associated power demand is achievable with renewable energy and minimal battery support.

While more practical than the previous options, this solution still requires significant topsides equipment and associated inspection and maintenance.

3.5.4 Subsea Warmer

A subsea warming loop consists of length of pipework attached to the platform jacket and submerged within the water column, through which cold gas would be diverted during well-start up. The latent heat of the surrounding sea water will increase the gas temperature to within export limits. After *c*. 2 hrs of production, gas exiting the reservoir will have increased in temperature such that it can be routed directly to export. This approach requires minimal additional equipment or energy.

3.5.5 Selected Option

The subsea warming loop was selected due to the simpler process, minimal additional equipment and low/no power requirements.

4 Project Description

4.1 Development Overview

As described in Chapter 1, the proposed Platypus Development is an MFP connected to Neptune on the following basis:

- Installation of a MFP, a repurposed previously decommissioned asset (jacket and topsides frame);
- Modifications to Neptune (host), including the addition of one hydrocarbon riser and one methanol riser;
- Modifications to Cleeton where processing of produced hydrocarbons will occur;
- Drilling of two wells; and
- Installation of a 12" export pipeline and 3" methanol/CI pipeline to Neptune[1].

As described in Section 1.1, processing of Platypus fluids will be undertaken at Cleeton before transportation onshore to the DGT.

This chapter describes the activities associated with the proposed drilling, installation and production phases. An overview of the expected decommissioning activities is also provided.

Figure 1-1 illustrates the approximate location of the proposed Platypus Development and a schematic of the project infrastructure is shown in Figure 1-2.

4.2 Project Base Case and Contingency Scenarios

To ensure that the potential worst-case impacts are assessed the project has considered what contingency operations may be required. The review determined that material changes would only be seen in operations associated with MFP installation and drilling, with disruption impacting upon methodology and environmental impact of activities. These changes may impact upon project schedules of pipelay operations and brownfield modifications.

The base case for the proposed Project is installing the MFP first followed by drilling operations, where the drilling rig comes on station and drills and completes the wells through the MFP in a single campaign. In the contingency scenario the drilling operations will occur first, followed by MFP installation. In this contingency scenario completion of the wells will not be undertaken by the drilling rig, but by a separate jack up barge (JUB) vessel following installation of the MFP. There is also another contingency scenario whereby the MFP is installed first but the drilling rig departs prior to hook up and commissioning and this is instead undertaken by the separate JUB.

The key changes in methodology resulting from the change in sequence are; the requirement for a drilling template and the requirement for completions by JUB. If drilling occurs first a drilling template will be required to ensure accurate well locations. The use of a JUB to perform completions increases seabed disturbance and fuel use.

Table 4-1 provides an explanation of why the contingency scenario has been used to assess all potential impact (i.e. physical presence, atmospheric emissions, seabed disturbance, and underwater noise). It should be noted that Table 4-1 and the scenarios presented are only relevant to MFP installation and drilling operations.

A full description of the development activities for the Proposed Platypus Development are provided further on in this chapter.

[1] Note that the diameter of the methanol/CI pipeline is currently unconfirmed, however, 3" is considered worst case.

Table 4-1: Explanation of Scenario Assessed in ES.

Potential Impact	Explanation of Scenario Assessed in ES
Physical presence (Chapter 7)	The contingency scenario has been assessed as the MFP installation and drilling operations would involve a greater number of vessels than the base case.
Atmospheric Emissions (Chapter 8)	The contingency scenario has been assessed as it leads to greater vessel fuel use and the need to flare from the drilling rig during drilling and well commissioning due to the MFP and pipelines not being ready to receive the well-clean up fluids and route them to Neptune for processing. In the base case scenario well-clean up fluids would be directed to Neptune via the MFP for processing resulting in zero flaring.
Seabed disturbance (Chapter 10)	The contingency scenario results in a greater footprint of seabed disturbance, given that in addition to the drilling rig, a JUB would also require to be mobilised (along with associated spud cans and anchors).

4.3 Field and Reservoir Characteristics

The Platypus gas field is characterized by significant recoverable reserves and potential for further development. The reservoir comprises the Permian Lower Leman Sandstone of the Rotliegend Group, with hydrocarbons sourced from Carboniferous Westphalian coals.

Platypus was discovered in 2010 by near-vertical well 48/01a-5, which tested at 7 million cubic feet of gas per day (MMscf/d). This was followed in 2012 by horizontal well 48/01a-6, which tested at 27 MMscf/d. Both wells, located in the main Platypus compartment, have since been plugged and abandoned (AB3), are not available for reuse, and are not included within Perenco's licence. As a result, development of the field will require new wells.

The proposed development plan includes two sub-horizontal wells targeting the Main and South-East compartments of the Lower Leman Sandstone reservoir (Figure 4-1). Following award of the licence, Perenco re-evaluated the available data to identify the most efficient and practical method for developing the Platypus field.

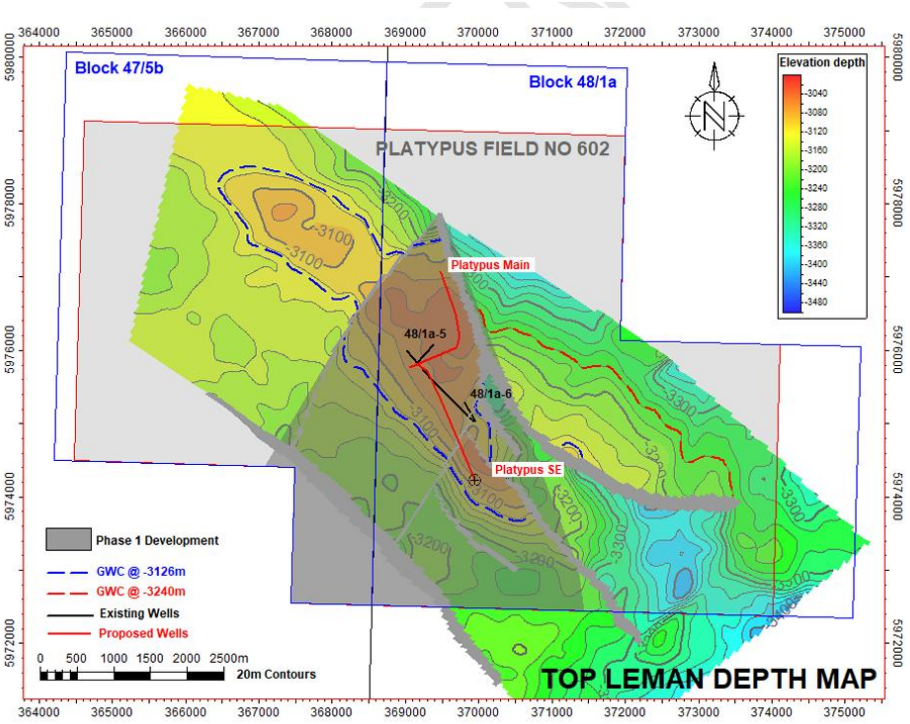


Figure 4-1: Platypus Field Development Area

4.4 Schedule of Activities

The activities associated with the installation, drilling and commissioning of the Platypus Development are currently scheduled to take place between Q1 2029 and Q4 2029 with first gas expected in Q3 2029 (Table 4-2). It should be noted that the schedule presented is for the base case and indicative and may change as the project develops.

Table 4-2: Base case indicative schedule for the proposed Platypus Development.

Activity	2029			
	Q1	Q2	Q3	Q4
Platypus MFP Installation				
Cleeton Brownfield Modifications				
Pipelay Campaign				
Neptune Brownfield Modifications				
Drilling, Hook-up and Commissioning[1]				
First Gas[2]				

[1]The preferred and intended project plan is to drill, hook-up and commission, alongside the completion of brownfield modifications and pipelay which will optimise vessel usage and reduce emissions associated with well clean up and testing. However, this is reliant on a number of factors including optimum vessel availability and weather.
[2]Based on producing from the first well whilst drilling the second.

4.5 Platypus MFP

4.5.1 Overview of the MFP

The Platypus MFP will comprise a jacket and topsides. Both the jacket and topsides frame will be re-purposed from a decommissioned offshore asset. Figure 4-2 demonstrates the proposed Platypus re-use concept for the MFP. The refurbishment and upgrade of the Platypus MFP will be carried out onshore. The jacket and topsides framing to be re-used are approximately 1200 te and 120 te respectively, a total of *c*. 1,220 te. Once on location, the MFP will be *c*. 67 m in height from the seabed to the underside of the cellar deck.

The platform location has been selected in order to meet the following criteria:

- Drilling trajectory to reach reservoir targets;
- Existing coverage of shallow seismic data for the identification of shallow hazards; and
- Avoidance of any shallow faults/graben.

The MFP will be a simplified design consisting of a cellar, mezzanine and weather decks. There will be no helideck, crane, or overnight accommodation. Consequently, a Totally Enclosed Motor Propelled Survival Craft (TEMPSC), and an enclosed temporary refuge will not be required, reducing maintenance requirements and aligning with Perenco's minimal maintenance and intervention philosophy. The re-use approach also contributes to Net Zero goals by reducing steel requirements and power demands associated with fabrication activities (see Chapter 2 for further information). The MFP has been intentionally designed to require low electrical demand, allowing normal operations to be powered by a renewable energy package comprising wind, solar and battery storage systems and therefore eliminating the requirement for combustion engines. The renewable energy package to be installed on the Platypus MFP is described in Section 4.5.1.1. The MFP design contributes to net zero ambitions enabling the installation to operate solely on renewable energy (see Chapter 2 for further information).

During production start-up, the gas temperature is expected to fall below the export pipeline operating limits due to pressure reduction. To increase the gas temperature, production fluids will initially be routed through a subsea warming loop suspended beneath the platform, where the surrounding seawater will be used to warm the pipeline. Following approximately two hours of production, fluid temperatures are expected to

increase sufficiently to allow direct export without the use of the warming loop. The warming loop may be required during future start-up events over the first six years of field operation.

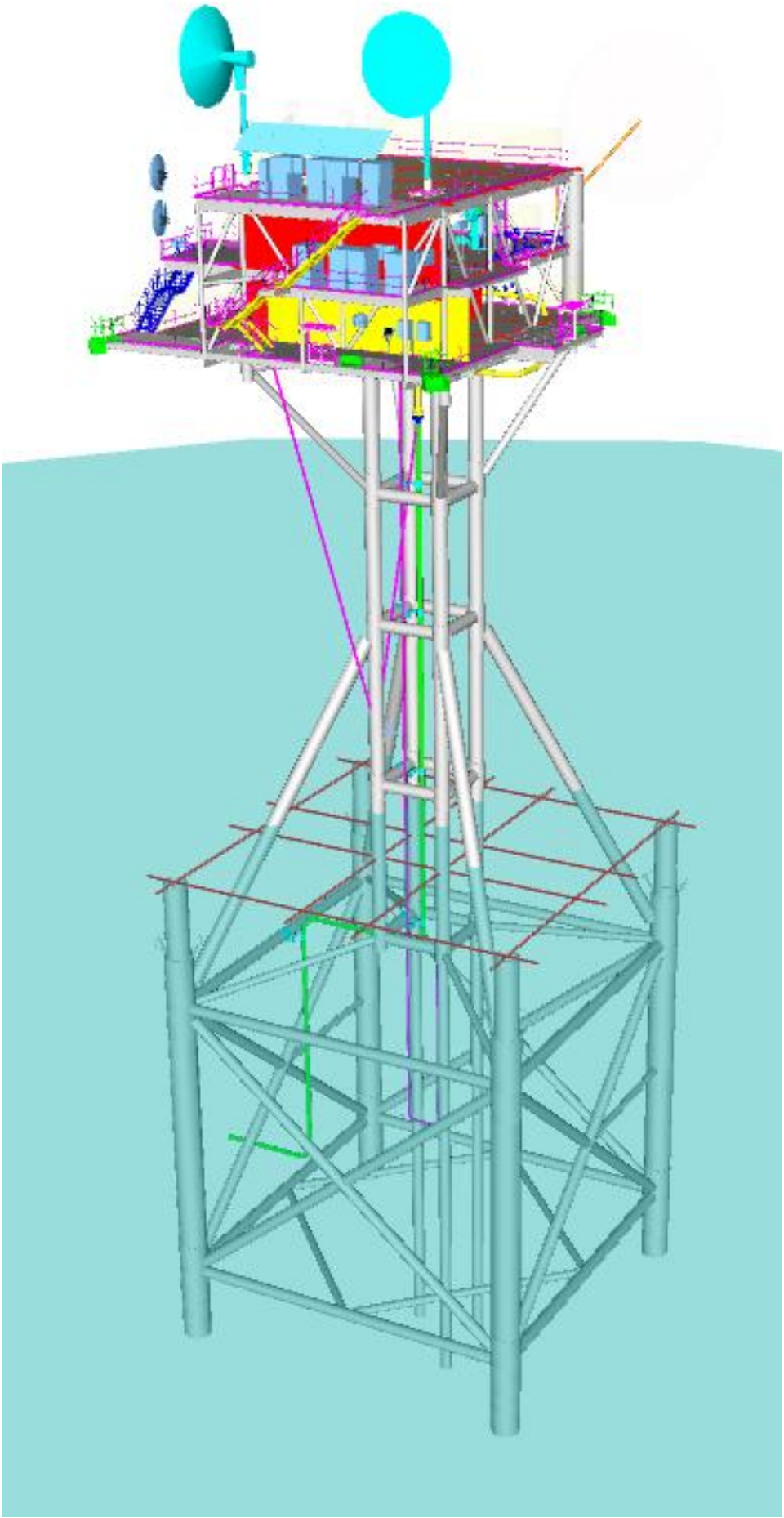


Figure 4-2: Proposed Platypus MFP jacket and topsides.

4.5.1.1 Renewable Energy Package on Platypus MFP

The Platypus MFP will be fully powered by a renewable power generation package designed to support continuous and autonomous operation of the platform. The proposed system will use a combination of wind and solar power generation with battery storage for back-up power supply. Two vertical or horizontal axis wind turbines may be used depending on equipment availability and size/weight constraints on the MFP. Horizontal axis wind turbines have been assessed in the ES given that it would be considered worst-case for bird strike potential.

Table 4-3 summarises key details of the renewable energy package and Figure 4-3 provides a diagram illustrating the wind turbine concept.

The preliminary electrical load assessment indicates that the system will be required to operate under two main load scenarios:

- A normal operating load of *c*. 3 kW for 24 hours; and
- A lower essential load (required to maintain safety of the facility) of *c*. 1 kW for 96 hours.

Table 4-3: Key Details of the wind turbines on Platypus MFP (Note potential exists for values to change as the project matures).

Property	Value/Material
Wind turbine rating	3 kW or 6 kW
Turbine height above sea level	35 m (mounted on helideck)
Number of blades	3
Rotor diameter	5.6 m
Swept area	24.6 m^2
Mast height	6-10 m
Rated system voltage	48, 24, or 230 Volts (V) Direct Current (DC)
Build material and colour	Tower - Galvanised Steel Blades - Glass Thermoplastic Composite

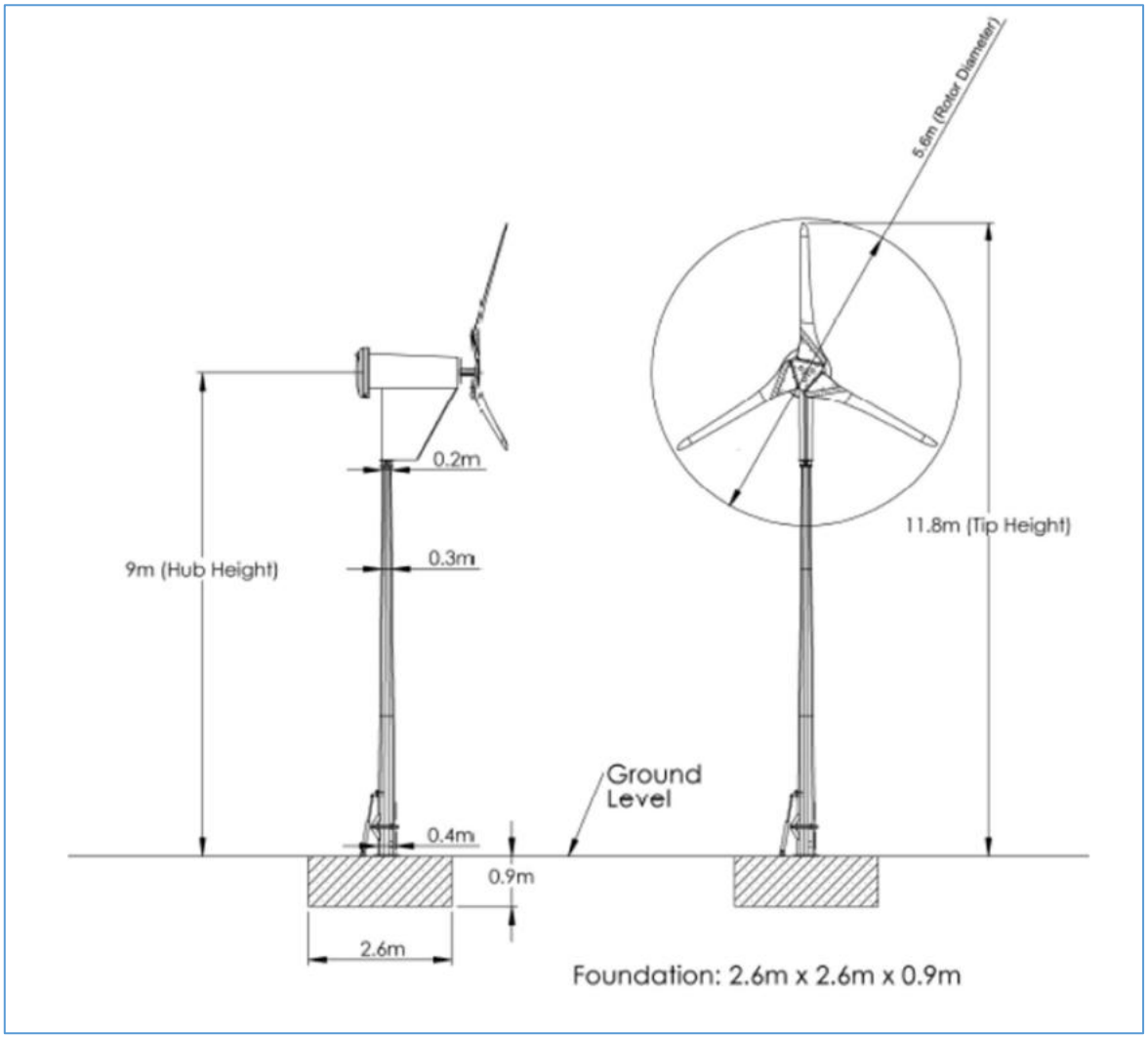


Figure 4-3: Indicative diagram of Horizontal-Axis Wind Turbine (HAWT), two of which are proposed to be mounted on Platypus MFP.

4.5.2 Installation of the MFP

The Platypus MFP will be installed using a Heavy Lift Jack Up Vessel (HLJUV), which as a worst-case will have eight anchors, eight anchor lines, and six spud cans. It is expected that up to 250 m of each anchor line (8 of) would be in contact with the seabed. Support pads (rock or mud mats) may be required to support the HLJUV and therefore this has been accounted for in the impact assessment, although recent projects undertaken by Perenco within the vicinity of the Platypus field have not required additional support. It is also possible that the HLJUV may require to be temporarily set down at a 'stand-off' location before being moved into its final location. Note the temporary set down at the stand-off location will not require the use of anchors.

The HLJUV will be taken on location using four anchor handling vessels (AHVs) / tugs. There will also be an Emergency Response Vessel (ERRV) present during the installation campaign, as well as a supply vessel. Table 4-13 presents a breakdown of vessel days for the installation of the Platypus MFP and Chapter 10 assesses seabed disturbance associated with the anchors.

Installation of the MFP jacket will involve piling and therefore underwater noise modelling has been carried out in support of the impact assessment (Appendix D). The MFP jacket piling is considered to be the loudest source of underwater noise and thus the activity which results in the largest extent of disturbance. It is proposed that four 1.2 m diameter piles (penetration depth of *c*. 62 m) will be installed. Based on previous experience in the SNS, piling time is estimated at 75 minutes (plus 20-minute soft start) per pile, with a maximum of four piles to be installed per day. Prior to commencement of piling, a qualified Marine Mammal Observer will undertake a 1-hour watch.

Note, assuming the base case scenario whereby MFP installation occurs first (i.e. before drilling) four piled well conductors[2] will be installed at the same time as the MFP is installed. In the contingency scenario whereby drilling occurs first, the conductors will be installed during drilling, in which case it most likely only two conductors would be installed as this is all that is required for the initial phase of the project (i.e. a well development).

4.6 Topside Modifications at Neptune

4.6.1 Neptune Overview

Neptune is a single jacket NUI located in the Cleeton Hub production area with four producing wells. Neptune also receives produced hydrocarbons from Mercury, Eres and Ceres subsea facilities. Neptune produces gas and condensate to Cleeton via a 6.9 km 16" pipeline (PL1684).

Two diesel generators are present on Neptune, one of which runs continuously for normal power generation, and one which automatically starts in the event that the primary generator fails, or should a high-power activity be undertaken (i.e. maximum capacity crane lift). Emergency power generation for navigational aids is supplied by secure battery units. The proposed Platypus Development will not require additional power generation equipment on Neptune.

Connecting Platypus to Neptune maximises the use of existing offshore infrastructure. Neptune has utility connections available and functional systems with potential for efficient expansion.

4.6.2 Modifications Required

Neptune (host) modifications include installation of:

- Two risers: one each for the production and methanol/CI risers;
- Topside tie-ins; and
- A gas ejector.

The installation of a gas ejector on Neptune is a strategic measure aimed at minimising back-outs from the Neptune, Mercury, and Eres & Ceres wells. This setup will enhance well control and safety by effectively removing unwanted gases and preventing pressure build-up that could lead to flow interruptions or safety hazards. Implementation of the gas ejector will contribute to improved operational efficiency and reduced downtime for these wells.

Modifications on Neptune shall be undertaken using a JUB with up to four legs, whilst up to four anchors may be used to position the JUB. It is expected that anchor line lengths of 1,213 m (4 of) would be in contact with the seabed. It is also possible that the JUB for Neptune modifications may require to be temporarily set down at a stand-off location before being moved into its final location. Note the temporary set down of the JUB at the stand-off location will not require the use of anchors. Support pads (rock or mud mats) may be required to support the JUB and therefore this has been accounted for in the impact assessment. Table 4-13 presents a breakdown of vessel days required for the modifications of Neptune.

4.7 Topside Modifications at Cleeton

4.7.1 Cleeton Hub Overview

Cleeton is situated within UKCS Block 42/29. It provides facilities for produced fluids from several surrounding NUIs, subsea developments and associated infrastructure such as Neptune NUI (including the Mercury, Ceres and Eris subsea completions), Ravenspurn South NUIs (Alpha, Bravo, Charlie), Minerva NUI, and the Whittle, Wollaston, and Apollo subsea developments (Cleeton Hub).

Cleeton comprises four bridge-linked platforms that house processing and accommodation facilities. Dry gas and condensate are routed to the onshore DGT located on the East Riding of Yorkshire coast, via a 59 km 36-inch export pipeline (PL447).

[2] Four conductors allow for future potential field expansion.

The Ravenspurn North field is produced separately, with fluids processed on the Ravenspurn North platform. Processed fluids from Ravenspurn North flow to Cleeton where they are combined with Cleeton Hub fluids for export to the DGT.

Cleeton primarily uses two fuel gas turbines for power generation. Cleeton supplies power to the Minerva NUI via subsea cable. Normal operation power demand for Cleeton and Minerva is met with one gas turbine in service. The gas turbines normally operate on fuel gas but will automatically switch over to diesel on loss of the fuel gas supply. Diesel generators are present on Neptune and the three Ravenspurn South NUIs. The proposed Platypus Development will not require additional power generation equipment to be added at Cleeton.

Offshore processing of the Platypus fluids at Cleeton will utilise existing 3-phase separation and PWRI. Cleeton already has the facilities required to supply methanol and CI to the field and these chemicals will be disposed of downhole at Cleeton with associated Platypus produced water. In addition, the pressure of the Platypus reservoir is sufficient to allow the gas and condensate to flow through the existing network without the need for new gas compression equipment.

A schematic summarising processing facilities at Cleeton is provided in Figure 4-4.

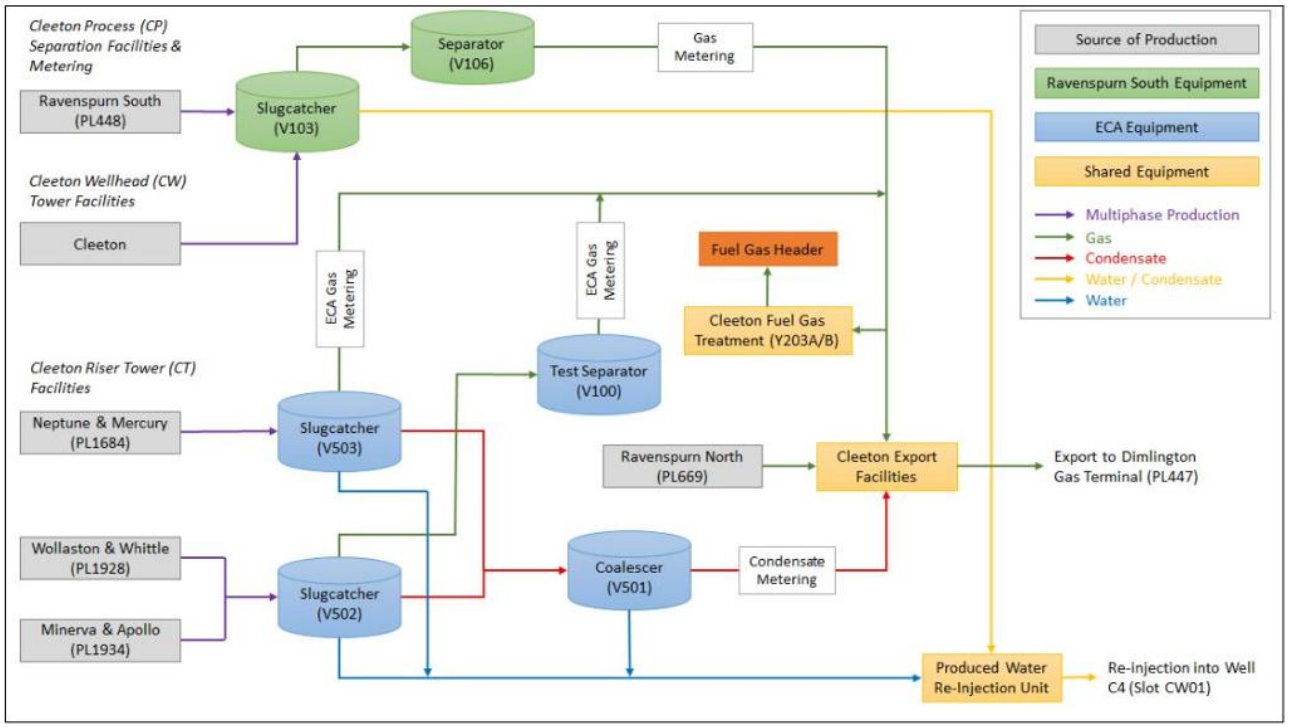


Figure 4-4: Cleeton process schematic summary.

4.7.2 Modifications Required

To successfully export the Platypus hydrocarbons into the Cleeton Hub area network, Brownfield modifications to Cleeton will be required. Modifications include:

- Additional methanol and CI pumps for export to Platypus; and
- New communications interface equipment will be installed and configured to suit requirements between the Platypus communications link and the Cleeton Supervisory Control and Data Acquisition (SCADA).

Modifications on Cleeton can be managed using the existing capacity of the platform accommodation and the platforms supply vessels such that no extra vessels will be required.

4.8 Drilling Phase

Two wells will be drilled as part of the proposed Platypus Development. As discussed in Section 4.2 this section describes the proposed contingency drilling activities, which represent the worst-case scenario.

The Platypus Field reservoir is divided into two compartments referred to as the main compartment and the southeast compartment. The two horizontal production wells will be located beneath the Platypus MFP and indicative coordinates are provided in Table 4-4. Well PLA-NW will target the northwest area of the main compartment, and well PLA-SE will drain both the main compartment and the southeast compartment. The base case for the project is that production from the PLA-SE well will commence while the PLA-NW well is still being drilled (Section 4.2).

Table 4-4: Indicative locations for the Platypus wells.

Well Name	Well Coordinates
PLA-NW	53° 54' 42.7" N
	01° 00' 18.1" E
PLA-SE	53° 54' 42.6" N
	01° 00' 18.1" E

As presented in Section 4.2, the project base case is that the two Platypus Development wells will be drilled through the MFP such that both wells can be drilled, completed and made ready for production within a single drilling rig mobilisation.

Should scheduling result in the wells being drilled ahead of the MFP being installed it will not be possible to carry out the completion activities until after the platform has been installed (the contingency scenario). In this scenario, both wells will be drilled to total depth and then suspended with either mechanical pressure retaining plugs, or a combination of mechanical pressure retaining plugs and cement (depending on the duration). Suspension will be completed in accordance with the OEUK Guidelines for the Abandonment of Wells (2015). Mobilisation of a JUB after installation of the MFP would then be required to complete the wells. In the contingency case where the drilling happens prior to MFP installation, a drilling template would be required to provide the layout for the drilling of the wells. In the project base case scenario, there will still be the option to complete the wells using a JUB instead of the drilling rig.

Irrespective of installation order it is proposed that well conductors will be piled. However, to ensure the worst-case drill cuttings discharge has been captured, this Section assumes that the first section (36") of each well is drilled. This scenario has been used in the drilling cutting dispersion modelling.

4.8.1 Drilling Rig

Various support vessels will be associated with the drilling operations. Table 4-13 presents a breakdown of vessel days required for drilling operations. Estimates provided are based on an indicative mean drilling duration of 161 days.

Whilst on site, the drilling rig will have a 500 m exclusion zone such that unauthorised vessels, including fishing vessels, are not permitted to enter this 500 m zone. The drilling rig will be equipped with navigation lights, radar and radio communications; as well as complying with standard navigational markings.

Once on location, the drilling rig will be serviced by supply vessels which will transport drilling equipment, supplies, water, fuel and food and will backload waste and surplus equipment to shore. Helicopters will also be used to transport personnel to and from the drilling rig.

The drilling rig will be towed to site using up to three tow vessels (tugs). The drilling rig will have three vertical legs fitted through openings on the outer hull that are raised and lowered by a jacking mechanism on the deck. Once on location, the drilling rig legs will be jacked down onto the seabed with the hull raised above the water providing a stable platform. At the base of each drilling rig leg is a “spud can”, these are circular structures which function as feet for the drilling rig’s legs. Spud cans enable a drilling rig to achieve a stable base through controlled penetration of the seabed, preventing sudden or excessive penetration which may lead to instability or leg retrieval issues. It is possible that the drilling rig and the JUB (if used) may require to be temporarily set down at a stand-off location before being moved into its final location. Note the temporary set down of the drilling rig and JUB (if used) will not require the use of anchors. The assessment of seabed

disturbance therefore assesses the impact of two placements of the drilling rig (three legs) and two placements of the contingency JUB (four legs) resulting in the potential for up to 14 spud can depressions remaining at the MFP location. Support pads (rock or mud mats) may be required to support the drilling rig and contingency JUB and therefore this has been accounted for in the impact assessment.

As a worst-case scenario, the ES assumes four anchors may be used to assist with the positioning of the drilling rig and a further four anchor placements may be required during installation of the JUB (if required). Four anchor lines with a combined length of *c*. 3,728 m (*c*. 942 m each) will connect each anchor to the drilling rig and up to 50 % of each anchor line (1,891 m) will be in contact with the seabed. If the JUB is mobilised, the ES assumes similar anchor numbers (four) and anchor line lengths of 1,213 m (4 of) will be in contact with the seabed when positioning the JUB.

The precise anchor mooring spread for the drilling rig and JUB (if required) will be defined by a mooring analysis prior to anchor set down. The mooring analysis will consider the water depth, currents, tides, prevailing wind conditions and any seabed features at the drilling locations. Once the drilling rig is on site, the anchors will be recovered. Details of the placement of the anchors will be provided in the Consent to Locate (CtL) permit applications which will be submitted before the drilling rig is mobilised to the Platypus field.

4.8.2 Blowout Preventer and Well Control Equipment

The drilling rig will be equipped with a Blowout Preventer (BOP) which is rated for pressures greater than the maximum pressure anticipated for the wells being drilled.

The function of the BOP will be as a secondary well control measure to the drilling fluid hydrostatic preventing uncontrolled flow from the well to the surface during drilling by positively closing in the well in the event of a release from the reservoir into the well bore. The BOP is made up of a series of hydraulically operated rams and valves that can be closed in an emergency from the drill floor, or from a safe location elsewhere on the rig.

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

4.8.3 Piling of Conductors

Prior to drilling, up to four well conductors will be hammered into the seabed when the MFP is installed. Underwater noise modelling has been undertaken to assess the impacts of the proposed piling activities at the Platypus Development. As the platform jacket piling activities will use a hammer with a greater maximum energy than the conductor piling activities, the platform jacket piling activities have been modelled to show the worst-case potential impact. It is proposed that four piles will be installed and each pile would have a penetration depth of *c*. 62 m and measure 1.2 m in diameter. It has been estimated that it will take 75 minutes to install a single pile, with a maximum of four piles to be installed per day. Chapter 11 assesses the potential impacts associated with underwater noise. As mentioned in Table 4-1, base case is that conductors will be piled, however there is the potential for all well sections to be drilled. This contingency has been carried through Section 4.8 to ensure that worst case discharges to sea and seabed disturbance are captured.

4.8.4 Well Design

Both of the wells will be of a similar design and are anticipated to be between 4,080 m and 4,550 m in length. Each well is expected to comprise five sections as summarised in Table 4-5. Steel casings will be installed and cemented in place in the wellbores to provide structural strength, isolate drilling hazards, and enable pressure containment.

An indicative schematic of the well design (example used is the PLA NW well, although both wells are similar) is shown in Figure 4-5.

Table 4-5: Indicative Well Design.

	Section Length (m)					Total Depth (m)
Well	36"[1]	17.5	12.25	8.5	6	
PLA SE	130	760	2,587	444	1,419	4,550
PLA NW	130	760	2,610	440	1,135	4,080

Notes:
[1] Note that the 36" section was used for the Drill Cuttings Modelling in Appendix C as it is the worst-case diameter required to install the 26" conductor. The conductor itself is 26" as shown in Figure 4-5.

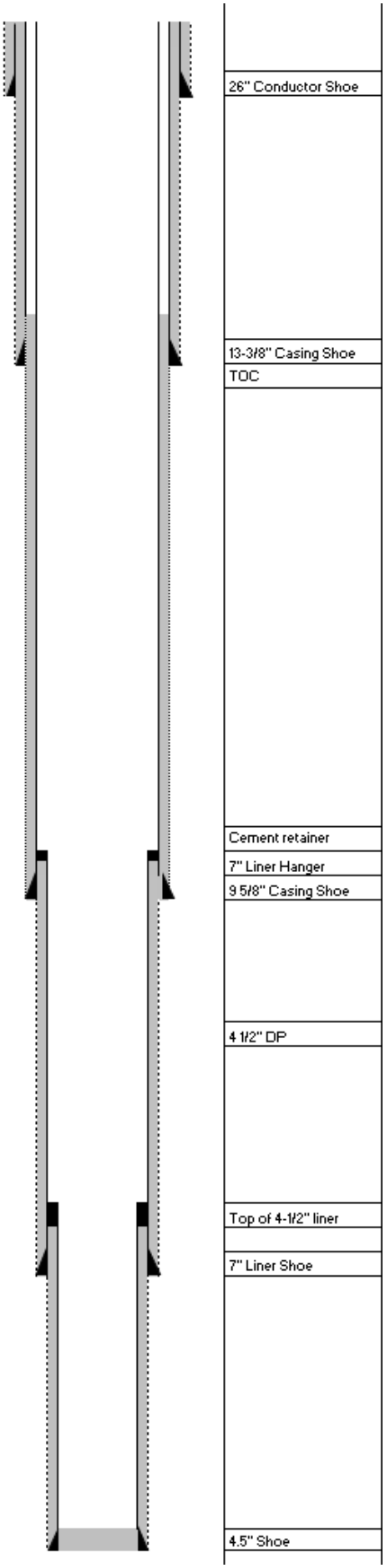


Figure 4-5: PLA NW Well Schematic.

4.8.5 Drilling Fluids and Cuttings

Drilling fluid (also known as drilling mud) is added to the wellbore to facilitate the drilling process. It is required for several reasons including:

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

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

The base case drilling methodology will involve piling the conductor for the top-hole section of each well. In this case only the 17.5" section will be drilled using water-based mud (WBM) with the cuttings and drilling fluid discharged straight to the water column from the drilling rig or platform. Should piling of the conductors not be technically feasible, the contingency case will be to drill the two top hole sections with WBM; with the cuttings from the 36" section being discharged directly to the seabed and those from the 17.5" section being discharged to the water column.

The lower sections of the wells will be drilled using Low Toxicity Oil Based Mud (LTOBM). The LTOBM cuttings will be skipped and shipped to shore for treatment prior to disposal.

Drill cuttings dispersion modelling has been carried out (Appendix C) to support the impact assessment and assumes the same design for the top hole sections of both wells. The modelling includes a contingency scenario whereby there is a requirement to re-spud each well due to unplanned shallow hazards resulting in the discharge of cuttings from the two top hole sections of each well.

The anticipated drilling fluid type, the cuttings quantity (based on previous Perenco experience) and the discharge location of cuttings for each well section is summarised in Table 4-6. Full details of the mud volumes and associated chemicals to be used will be provided in subsequent drilling Subsidiary Application Template (SAT) permit applications.

Table 4-6: Anticipated cuttings Mass associated with the proposed Platypus wells.

Section Diameter (")	Drilling Fluid	Quantity of Cuttings (te)			Discharge Location
		For 1 well	For 2 wells	Modelled scenario (allows for two additional contingency re-spuds[1]	
36	WBM	256.1	512.2	1,024.4	Discharged at seabed
17.5	WBM	325.5	651.0	1,302.0	Discharged at sea surface
12.25	LTOBM	765.3	1,530.6	N/A	Skipped and shipped to shore
8.5	LTOBM	89.4	178.8	N/A	
6	LTOBM	142.4	284.8	N/A	

[1]To assess a worst case, the drill cuttings dispersion modelling assumed that each of the two wells would require to be re-spudded. This column provides the volumes of discharged cuttings allowed for in the model run. Further details are provided in Appendix C.

4.8.6 Cementing Chemicals

Cement is used to secure the steel conductor, casings and liners in the well bore, whilst cementing chemicals are used to modify the technical properties of the cement slurry.

During cementing operations, the majority of these chemicals are left downhole, but a quantity of cement may be discharged onto the seabed. This excess over the annulus volume is required to give confidence that the cement has completely filled the conductor annulus and displaced all the mud present to provide a strong

bond, on which the entire well is structurally supported. Subsequent use of cement is contained downhole as further casings do not require the cement to be pumped into the annulus all the way up to the surface.

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

At the time of writing the detailed cement design has yet to be finalised, however, estimates of spacer and cement volumes are provided in Table 4-7. Both wells will have similar cement and spacer volumes. The volumes listed are the full volumes to be mixed and pumped. In reality, only a small percentage of these figures would end up being discharged to the seabed and therefore this is a very conservative estimate. Based upon industry experience, the ES assumes that at each well location the resultant cement patio will have a radius of 7.5 m.

All cementing chemicals to be used will be selected based on their technical specifications and environmental performance. Class G cements (Stark *et al.,* 2003) have no additions other than calcium sulphate and/or water and are intended for use as a basic well cement. Chemicals with substitution warnings (i.e., chemicals that are considered to be harmful to the environment) will be avoided where possible. The cementing chemicals to be used have not yet been determined but will be detailed in subsequent drilling permit applications.

Like the drilling and cementing chemicals, the chemicals associated with the completion's operations will be captured in the subsequent drilling permit applications.

Table 4-7: Estimated cement requirements per well (similar quantities for both wells)

Section Diameter (")	Conductor Diameter (")	Spacer (te)	Class G cement (te)	Will excess cement be disposed of on the seabed?
36"	26"[1]	19	37	Yes
17.5"	13.375	19	74	Yes
12.25"	9.625	16	85	No
8.5"	7	10	12	No
6"	4.5	6.5	19	No

[1] Note that a figure for the 26" conductor pile has been included, although the base case is that these conductors will be driven as a part of the platform install (depending on Geotechnical results).

4.8.7 Well Clean-up and Testing

Upon completion, the production wells will be flowed to clean up and test. Perenco intend to direct all gas into the process system during the clean-up and test operations, with flaring being minimised and avoided wherever possible, however an option to flare has been included within the ES as a worst-case scenario. A worst-case flaring volume has been estimated as 57 MMscf (1,200 te) per well over a 48-hour flaring period.

4.8.8 Relief Well

A plan will be put in place for the drilling of a relief well to intersect the Platypus wells in the event of a well blowout and will include a proposed drilling rig location from which a relief well could be drilled. Hydrocarbon spill modelling has been undertaken in support of the ES, which has assumed it would take 98 days to drill a relief well. This period is based on the estimated time to drill relief wells for other wells in the area (Perenco, 2025).

4.9 Pipeline Installation Phase

4.9.1 Overview

This section describes the pipelines to be laid as part of the proposed Platypus Development, summarised in Table 4-8.

The proposed export pipeline to Neptune will be 16.5 km long with a diameter of 12”. The proposed methanol/CI pipeline will be 16.5 km long with a diameter of 3”. The proposed pipeline routes from Platypus to Neptune avoids all known pipeline and cable crossings. This reduces interference with other infrastructure and offers a simpler installation. The exact pipeline route will be further refined as engineering progress.

The pipelines will be trenched and buried for stability and over-trawl protection, with the exception of the trench transitions to tie-ins located within the Platypus and Neptune 500 m safety zones. Jet trenching is the preferred installation method, however preliminary survey results indicate ploughing and backfill is likely due to solid/hard seabed. The impact of the use of a mechanical plough and backfill is therefore assessed in the ES as worst-case.

It is assumed as a worst-case that the two lines will be laid in separate trenches, however, the project is continuing to determine if the two pipelines can be laid in the same trench. Survey results indicate that no seabed clearance will be required; it is not anticipated that sand wave sweeping or boulder relocation is required for the pipeline route, however, this will be confirmed through the pre-lay survey.

Various support vessels will be required to support the installation of the pipelines. Table 4-13 provides a breakdown of vessel days for pipeline installation. A dynamic positioning (DP) vessel will be used to lay the pipeline and Perenco are not considering any anchored vessels for these activities. A guard vessel will be on location from when trenching activities commence until back-fill activities have been completed. Note that the working times are based on each pipeline being laid in its own trench and include a waiting on weather allowance.

Table 4-8: Pipelines associated with the proposed Platypus Development.

Item	Description
Platypus 12” export pipeline	16.5 km long pipeline from Neptune to the Platypus MFP.
3” Methanol/CI pipeline	16.5 km long pipeline from Neptune to the Platypus MFP.
Note: Pipeline lengths are inclusive of a 12" spool at each end of the pipeline which runs from the pipeline end to the base of the riser.	

4.9.2 Pipeline Protection and Stabilisation Materials

The proposed route is simple with no cable or pipeline crossings. Stabilisation materials are expected to be required at the transition from trench to riser tie-in which will occur within the 500 m safety zones at the Platypus MFP and Neptune. Table 4-9 summarises the anticipated stabilisation features to be laid at the MFP and Neptune locations. Contingency rock may be deployed on areas along the pipeline where sufficient depth of burial has not been achieved (Table 4-9). The volume of contingency rock is based on baseline information obtained in recent site surveys (Fugro, 2026b).

Proposed protection and stabilisation materials will include; mattresses, grout bags, and rock filler units (RFUs) (Figure 4-6). During installation operations, Deadman Anchors (DMAs) may be used to temporarily stabilise the pipeline before backfilling has occurred (Figure 4-7). The DMAs will be recovered upon completion of the pipeline installation operations. Within the 500 m zones, mattresses may be placed over the top of the pipelines offering dropped object protection close to the platforms.

A summary of the estimated deposits (including contingency) are provided in Table 4-9.

Table 4-9: Required pipeline protection and stabilisation features for Platypus.

Location	Number of Mattresses[1] 6 m (L) x 3 m (W) x 0.15 m (H)	Number of 25 kg Grout Bags[2]	Number of 8-ton RFUs	Number of 10,000 kg DMAs	Contingency Rock (te)
Platypus 500 m zone	50	1,250	50	20	750
Neptune 500 m zone	50	1,250	50	20	750
Pipeline Route	-	-	-	-	3,500
Total	**100**	**2,500**	**100**	**40**	**5,000**

[1]The mattress quantities include a 20 % contingency.
[2]The grout bag quantities include a 10 % contingency.

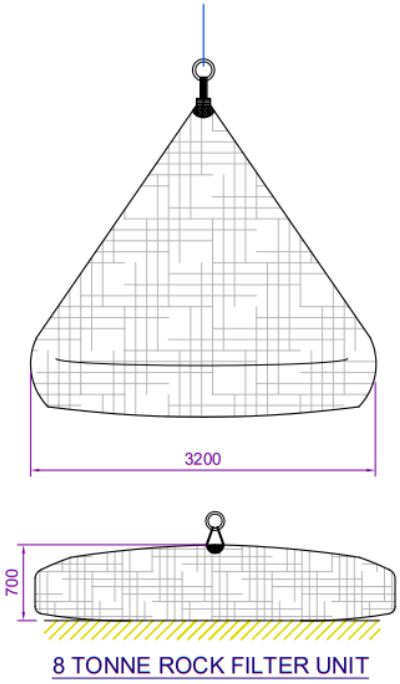


Figure 4-6: Schematic showing an 8-ton RFU.



Figure 4-7: Example photographs of DMAs.

4.9.3 Pipeline Commissioning

Following installation of the pipelines, various commissioning activities will be required, such as, hydrotesting, sphering of pipeline, displacement of the inhibited seawater, and preparation of the system for the introduction of hydrocarbons. It is anticipated the pipelines will be empty prior to installation, inhibited seawater will be introduced to the system following installation of the spools.

Once laid, both pipelines will be cleaned and gauged prior to being pressurised above the Maximum Allowable Operating Pressure, in accordance with design codes. On completion of the testing programme, the pressurisation fluid is expected to be discharged to the sea. The permitted discharge of chemicals to the marine environment is a routine part of subsea installation operations. The quantities of chemicals to be used and their fate will be determined during the project detailed design stage and will be subject to a chemical permit application under the OCR. A risk assessment will be carried out as per the OCR for the relevant chemicals, profiles and associated application.

Introduction of first hydrocarbons will occur only upon full completion of the leak and strength testing and commissioning activities, and all the systems are deemed fit for operation.

4.10 Production Phase

The Platypus well fluids will flow to Neptune, and then onwards to Cleeton for processing and onshore transport. As described in Section 4.6, a gas ejector will be installed on Neptune to minimise the back outs of the Neptune, Mercury and Eris & Ceres wells. Offshore processing occurs at Cleeton, wherein the infrastructure utilises 3-phase separation and PWRI (Section 4.7). Chemicals will be provided to Platypus by the Methanol/CI pipeline, coming from Cleeton via Neptune. Methanol and CI will be exported from Cleeton and injected into the Platypus wells. These chemicals will be returned with produced fluids back to Cleeton and therefore there will be no discharge of these fluids at the Platypus MFP.

4.10.1 Flaring and Venting

There is no flare at Cleeton, Neptune or the proposed new Platypus MFP.

The Platypus project will give rise to infrequent venting at the Platypus MFP to depressurize equipment and topsides piping in the event of certain upsets to production. An allowance of 2.45 te per year for this venting has been included in emissions estimates based on an assumed number of four upsets per year that would require blow down. This is a conservative assumption based on performance of other equivalent Perenco assets in the region and applying a contingency margin. The allowance also includes an increment to account for venting to depressurize the Platypus pipeline. This is anticipated to be no more than once every three years.

The development of Platypus requires the installation of minor equipment on Neptune, thus slightly increasing the total gas inventory of the platform. Consequently, should Neptune require blowdown the introduction of Platypus will result in a small increase in vented gas at each such event.

Conversely, there will be no additional venting at Cleeton as a result of the Platypus development. This is because neither the system volume nor pressure at Cleeton will change and nor will Platypus cause any increase in the likelihood of incidents at Cleeton that would require blowdown.

4.10.2 Produced Water

There will be no produced water processing on the Platypus MFP. Produced water will be separated out at Cleeton and reinjected into a disposal well.

4.10.3 Production Profiles

High Case average production profiles are presented in this section. Mid case and Low case production profiles are presented in Appendix I.

4.10.3.1 Gas Production Profiles

Table 4-10 and Figure 4-8 demonstrate the High Case average gas production rates from the Platypus field.

Maximum gas production from the Platypus wells is anticipated in 2030 during the first full year of production and then is expected to decline until end of field life in 2045. The production rate from the Cleeton Hub with Platypus ranges from 2,424,681 m^3/d in 2030 during first full year of production, to 536,947 m^3/d in 2045.

Table 4-10: Baseline Gas Production for Cleeton Hub with and without High Case Platypus Gas Production in m^3/d.

Gas Production			
Year	**Cleeton Hub Without Platypus**	**Cleeton Hub With Platypus**	**Platypus Alone**
	m^3/d	**m^3/d**	**m^3/d**
2026	1,807,028	1,807,028	
2027	1,602,762	1,602,762	
2028	1,390,490	1,390,490	
2029	1,227,278	1,699,152	471,874
2030	1,117,079	2,424,681	1,307,602
2031	1,020,475	1,969,731	949,255
2032	932,283	1,656,585	724,302
2033	858,728	1,443,750	585,022
2034	790,595	1,283,105	492,511
2035	729,178	1,156,699	427,521
2036	671,685	1,049,605	377,920
2037	623,116	962,831	339,715
2038	577,248	886,195	308,947
2039	535,413	832,262	296,849
2040	495,691	790,767	295,076
2041	461,938	726,524	264,586
2042	429,748	670,055	240,307
2043	400,166	620,726	220,559
2044	371,812	575,634	203,822
2045	347,697	536,947	189,250

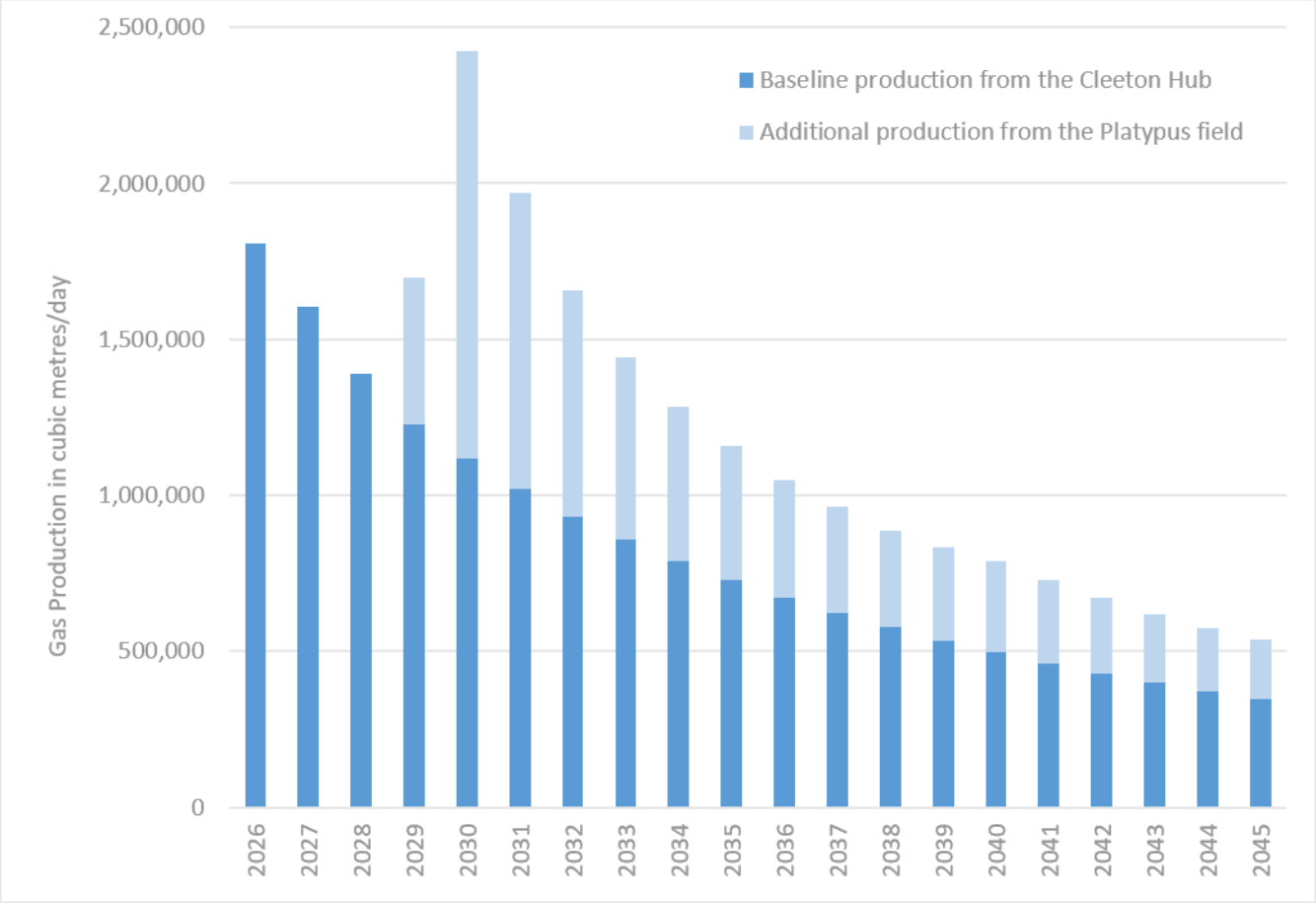


Figure 4-8: High Case average gas production rates from the Platypus field in m^3/d superimposed on baseline production for the Cleeton Hub.

4.10.3.2 Condensate Production Profiles

Table 4-11 and Figure 4-9 demonstrate the High Case average condensate production rates from the Platypus field.

Maximum condensate production from the Platypus wells is anticipated in 2030 during the first full year of production and then is expected to decline until end of field life in 2045. The production rate from the Cleeton Hub with Platypus ranges from 23.8 te/d in 2030 during first full year of production, to 4.0 te/d in 2045.

Table 4-11: Baseline Condensate Production for Cleeton Hub with and without High Case Platypus Condensate Production in te/d.

Condensate Production			
Year	**Cleeton Hub Without Platypus**	**Cleeton Hub With Platypus**	**Platypus Alone**
	te/d	**te/d**	**te/d**
2026	11.9	11.9	
2027	10.0	10.0	
2028	7.9	7.9	
2029	6.3	12.9	6.6
2030	5.6	23.8	18.2
2031	5.0	18.2	13.2
2032	4.5	14.5	10.1
2033	4.0	12.2	8.1
2034	3.7	10.5	6.8
2035	3.3	9.3	5.9
2036	3.0	8.3	5.3
2037	2.8	7.5	4.7
2038	2.5	6.8	4.3
2039	2.3	6.5	4.1
2040	2.1	6.2	4.1
2041	2.0	5.6	3.7
2042	1.8	5.1	3.3
2043	1.7	4.7	3.1
2044	1.5	4.4	2.8
2045	1.4	4.0	2.6

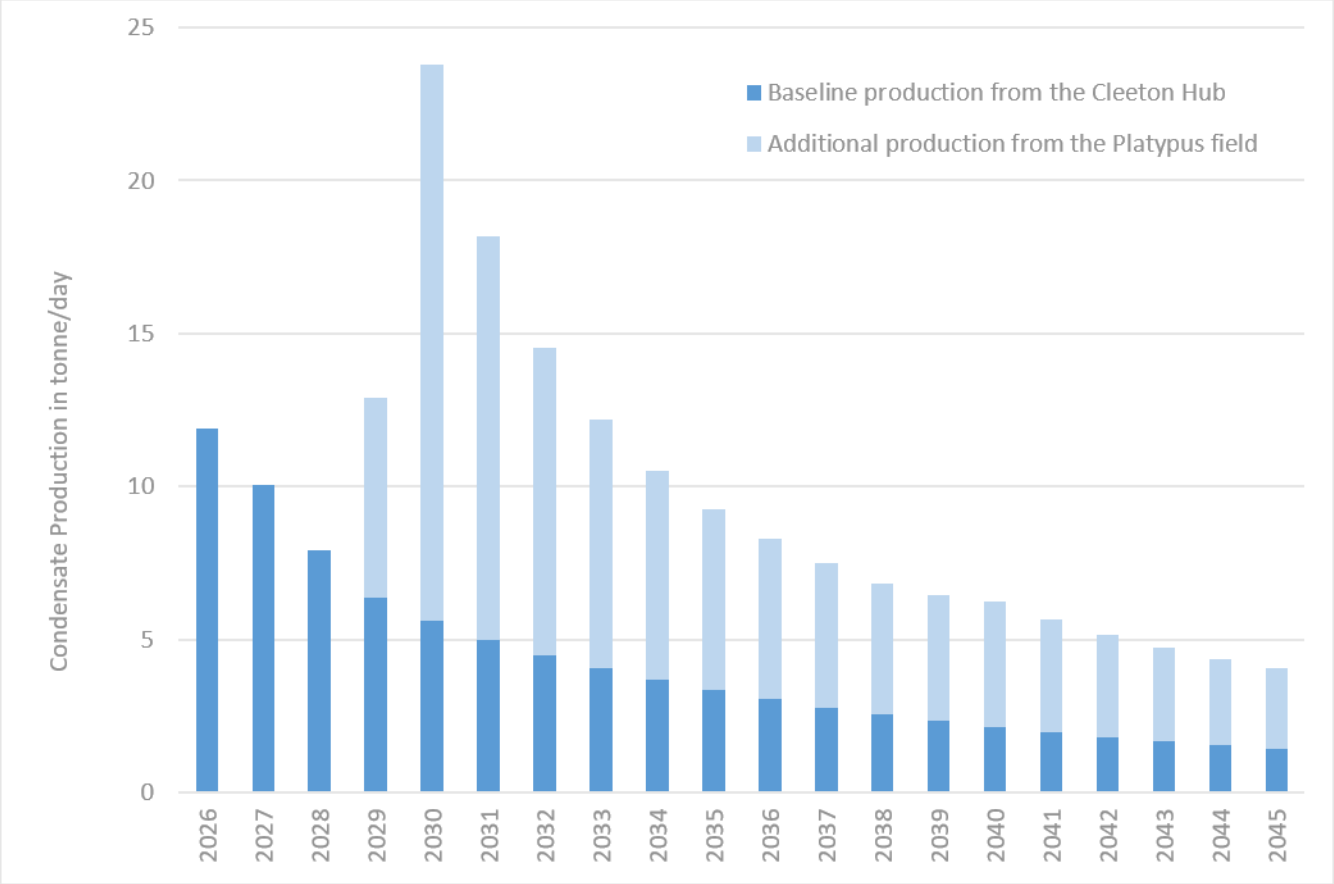


Figure 4-9: High Case average condensate production rates from the Platypus field in te/d superimposed on baseline production for the Cleeton Hub.

4.10.3.3 Produced Water Production Profiles

Table 4-12 and Figure 4-10 demonstrate the worst-case average water production rates from the Platypus field.

The development of Platypus will not add substantially to the baseline produced water production rate from the Cleeton Hub. Produced water production for the Cleeton Hub, with or without Platypus, will decrease from 271.1 te/d in 2026 to 33.4 te/d in 2045.

Table 4-12: Baseline Water Production for Cleeton Hub with and without Worst Case Platypus Water Production in te/d.

Water Production			
Year	**Cleeton Hub Without Platypus**	**Cleeton Hub With Platypus**	**Platypus Alone**
	te/d	**te/d**	**te/d**
2026	271.1	271.1	
2027	222.3	222.3	
2028	192.1	192.1	
2029	167.3	175.1	7.8
2030	146.8	168.5	21.7
2031	129.5	145.3	15.8
2032	114.9	127.0	12.0
2033	102.4	112.1	9.7
2034	91.5	99.7	8.2
2035	82.1	89.2	7.1
2036	73.8	80.0	6.3
2037	66.4	72.1	5.6
2038	59.9	65.1	5.1
2039	54.2	59.1	4.9
2040	49.0	53.9	4.9
2041	44.4	48.8	4.4
2042	40.3	44.3	4.0
2043	36.6	40.3	3.7
2044	33.3	36.7	3.4
2045	30.3	33.4	3.1

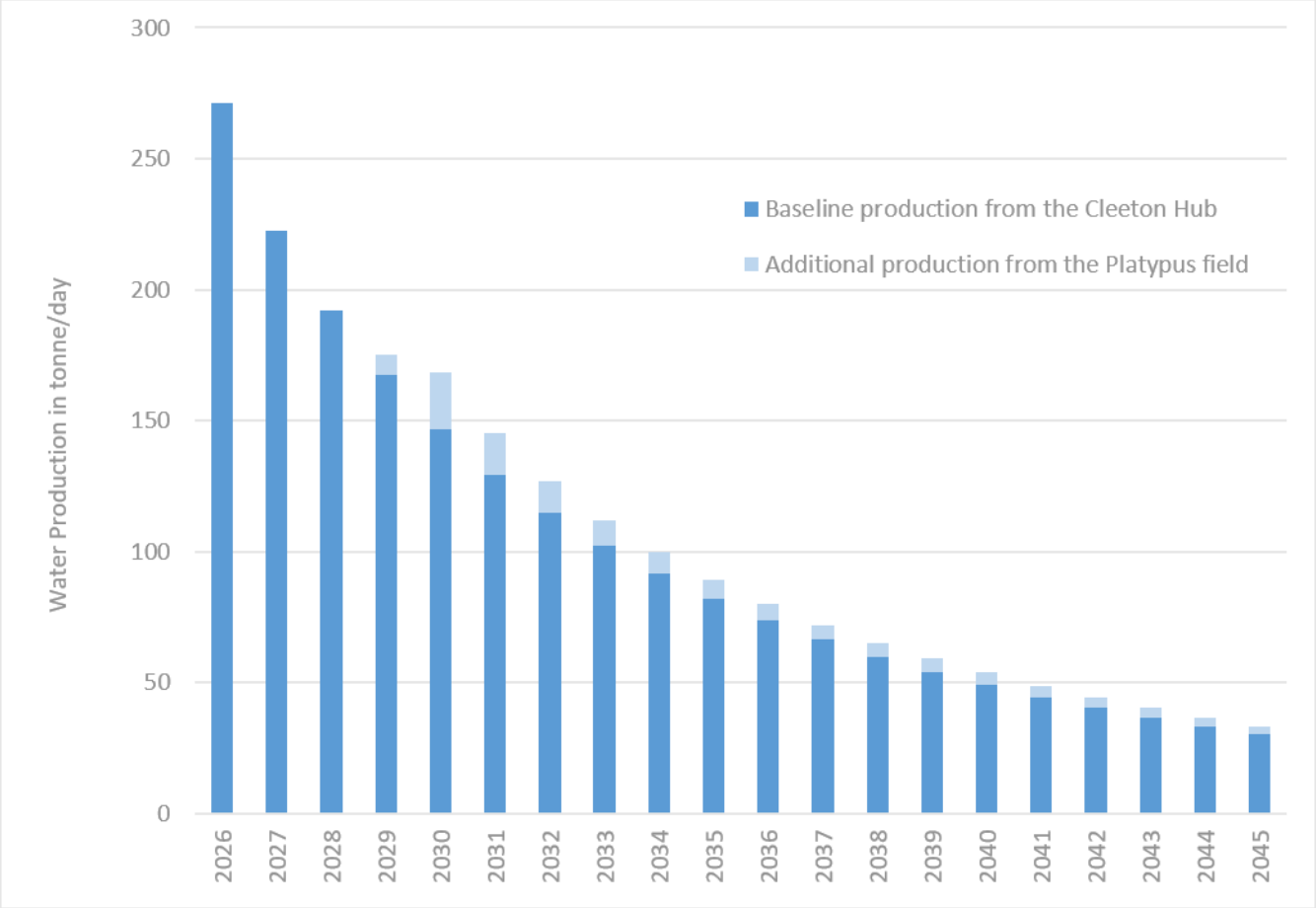


Figure 4-10: High Case average water production rates from the Platypus field in te/d superimposed on baseline water production for the Cleeton Hub.

4.11 Support Vessels and Helicopters

Table 4-13 summarises the support vessel activity required for the Platypus Development, including drilling, pipeline installation, Platypus MFP installation, topside modifications (Brownfield), JUB contingency and operations. Table 4-14 summarises the helicopter activity required for the Platypus Development, note helicopters will only be used during drilling, MFP installation and Neptune modifications.

Table 4-13: Support vessel activity for Platypus Development.

Vessel Type	Active Days	Fuel Consumption (te/d)	Total fuel use (te)
Drilling			
Drilling rig: mobilisation/ demobilisation/ in transit	16	12	192
Drilling rig: on location	161	12	1,932
Tugs: 3 tugs to bring the rig on location.	16 days per tug	14	672
ERRV	187	1.5	281
Supply Vessels (dedicated supply boats) (including transit, skip and ship)	69	7	483
Supply Vessels (on site)	95	1.5	142.5
Total fuel use associated with use of a drilling rig for drilling and completion (wells drilled once MFP has been installed)			**3,702**

Vessel Type	Active Days	Fuel Consumption (te/d)	Total fuel use (te)
Contingency			
JUB Contingency	30	7	210
AHV/Tugs x3 for contingency	12 days per vessel	14	504
ERRV for contingency	30	1.5	45
Supply Vessel for contingency	30	7	210
Total fuel use associated with contingency use of a JUB to complete the wells (wells drilled before MFP has been installed)			**969**
Pipeline Installation			
Pipeline route survey vessel - mob/demob	2	1	2
Pipeline route survey vessel- transit	2	10	20
Pipeline route survey vessel - working	17	1.5	25.5
Pipelay vessel - mob/demob	14	4	56
Pipelay vessel - transit	53	18	954
Pipelay vessel - working	15	11	165
Construction vessel (for trenching and backfill activities) - mob/demob	2	4	8
Construction vessel - transit	2	20	40
Construction vessel - working	24	17	408
Pipelay support vessel - mob/demob	2	4	8
Pipelay support vessel - transit	2	20	40
Pipelay support vessel - working	32	17	544
DSV - mob/demob	2	3	6
DSV - transit	2	18	36
DSV - working	32	15	480
Guard vessel- mob/demob	2	0.8	1.6
Guard vessel - transit	2	3.5	7
Guard vessel - working	32	0.8	25.6
Total fuel use associated with pipeline installation			**2,827**
Platypus MFP Installation			
HLJUV for MFP Installation	30	6	180
AHV/Tugs x4 for HLJUV MFP Installation	12 days per vessel	14	672
ERRV for MFP Installation	30	1.5	45
Supply Vessel for MFP Installation	30	7	210
Total fuel use associated with Platypus MFP installation			**1,107**
Topside Modifications (Brownfield)			
JUB for brownfield at Neptune	60	7	420

Vessel Type	Active Days	Fuel Consumption (te/d)	Total fuel use (te)
AHV/Tugs x3 for brownfield at Neptune	12 days per vessel	14	504
ERRV for brownfield at Neptune	60	1.5	90
Supply Vessel for brownfield at Neptune	60	7	420
Total fuel use associated with topside modifications			**1,434**
Total fuel use overall (excluding operations)			**10,039**
Operations (vessels per year)			
Walk to Work (W2W) maintenance visit (assumes four 2-week long trips per year)	56	1.5	84
Total fuel use per annum during operations			**84**
Note: Days on site indicates the maximum possible number of days as worst case scenarios.			

Table 4-14: Helicopter activity for the Platypus Development.

Operation	Active Hours	Fuel Consumption (te/hr)	Total fuel use (te)
Helicopter flights associated with drilling operations. 5 flights per week and 100 minutes round trip. Therefore, 115 flights and 192 hours of flying.	192	0.7	134
Helicopter flights associated with contingency drilling operations. 7 flights per week and 100 min round trip. Therefore 30 flights and 50 hours of flying.	50	0.7	35
Helicopter flights associated with MFP installation. Helicopter flights: 7 flights per week and 100 min round trip. Therefore 30 flights and 50 hours of flying.	50	0.7	35
Helicopter flights associated with topside modifications at Neptune: 7 flights per week and 100 min round trip. Therefore 60 flights and 100 hours of flying.	100	0.7	70
Total fuel use for helicopter flights			**274**

4.12 Key Permits and Consents

There are a number of permits and consents which will be required during the drilling, installation, production and decommissioning stages of the project. These are summarised in the following sections.

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

- Drilling Operations (DRA);
- Pipeline Operations (PLA);
- Production Operations (PRA);
- Decommissioning Operations (DCA);
- Well Intervention Operations (WIA); and
- A Standalone Application (SA).

Once a MAT has been created it can support various types of applications (referred to as SATs).

Note that Oil Pollution Emergency Plans (OPEPs) and UK ETS permits are not available on the PETS system.

4.12.1 UK Emissions Trading Scheme (UK ETS)

No new GHG Permit under the UK ETS Trading Scheme will be required; however, the existing Cleeton ETS permit will be updated to include the Platypus Development.

4.12.2 Oil Pollution, Prevention and Control (OPPC)

Discharges of oil to sea are controlled under The Petroleum Activities (Oil Pollution, Prevention and Control) Regulations 2005. The existing Cleeton Hub Production Operations OPPC Life Permit (OLP) will be updated as necessary to capture the Platypus Development.

In addition, an OPPC Term Permit (OTP) will be required for hydrocarbon discharges during the drilling activities.

4.12.3 Chemical Use and Discharges to Sea

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

4.12.4 Oil Pollution Emergency Plan (OPEP)

Perenco will submit Communication and Interface Plans (CIPs)/Temporary Operations Oil Pollution Emergency Plan (TOOPEPs) for drilling and brownfield operations which will interface with the existing approved Cleeton Hub OPEP and the Non-Production Installation (NPI) OPEP for the drilling rig.

4.12.5 Consent to Drill

Perenco will submit a Consent to Drill in the Well Operations Notifications (WONS) system to apply for consent to carry out drilling at the proposed Project location.

4.12.6 Consent to Locate (CtL)

Where applicable, Perenco will apply for the following CtLs:

- Mobile Installation, e.g. drilling rig;
- Permanent / fixed structure, e.g. MFP;
- Pipelines; and
- Other (if applicable).

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

Perenco will submit an application for a Pipeline Works Authorisation (PWA) detailing the pipelines and structures to be installed whilst an application for a Deposit Consent (DepCon) will be submitted providing the location of any rock cover (if used), grout-bags and mattresses required on the pipeline route.

4.13 Decommissioning

At Cessation of Production (CoP) the Platypus Development infrastructure will be decommissioned in line with legislation in force at that time. At the time of writing the ES, this would constitute the following:

- The Petroleum Act 1998 (as amended) and other relevant Regulations at the time of decommissioning;
- OPRED Decommissioning Guidance (November 2018);
- The UK Guidelines for Suspension and Abandonment of Wells;
- The Flowline Safety Regulations 1996 requiring the safe decommissioning of flowlines;
- Any additional applicable legislation in place at the time of decommissioning; and
- Any other agreements with OPRED and relevant regulatory bodies.

Nearer the time of CoP, a full decommissioning plan will be developed in consultation with the relevant statutory authorities. The plan will be designed to ensure that potential effects on the environment resulting from the decommissioning of the facilities are considered and minimised. An Environmental Appraisal to

assess the potential effects on the environment from the decommissioning plan would be submitted in line with current guidance.

4.13.1 Pipelines

In line with current guidelines and legislation, the trenched and buried pipelines would be subject to a Comparative Assessment to determine the most suitable approach for their decommissioning. Should the Comparative Assessment determine that the pipelines should be decommissioned in situ, Perenco will agree an ongoing monitoring plan with the relevant authority (currently OPRED).

4.13.2 Platypus MFP

The decommissioning strategy for the Platypus MFP and associated subsea infrastructure will be reviewed at cessation of production, and decommissioning options will be determined following a comprehensive comparative assessment of all feasible alternatives, considering the legislation and regulatory requirements applicable at that time.

4.13.3 Wells

All well programmes will be subject to a Well Notification assessed by the Health and Safety Executive (HSEx) under the Offshore Installations (Offshore Safety Directive) (Safety Case etc). Wells will be plugged and permanently abandoned in accordance with Offshore Energy UK (OEUK) well decommissioning guidelines (Oil & Gas UK (OGUK), June 2018) (or applicable guidance at that time). All well programmes will have been reviewed by the HSEx Offshore Safety Department as required under the Design and Construction Regulations.

On completion of the well abandonment programme each conductor and internal tubing will thereafter be cut below the seabed and returned to shore for management in line with the waste hierarchy.

5 Environmental and Socio-Economic Baseline

The Platypus field is located in Block 48/1 in the SNS, approximately (*c.*) 67 km from the English coastline and *c.* 121 km from the UK/Netherlands median line. The proposed Platypus pipelines traverse Blocks 48/1, 47/5, and 47/4, terminating at Neptune. The produced fluids then flow through existing lines to Cleeton (Block 42/29), where they are processed and exported to shore.

This section describes the current nature and status of the environment in the vicinity of the proposed Platypus Development. An understanding of the baseline is required to identify the potential interactions of the proposed development with the environment, and to assess the potential impacts of the development. The section has been prepared with reference to available literature and survey data.

This section also describes the current and future global baseline status for atmospheric concentrations of GHGs, how concentrations are affected by GHG emissions and the knock-on consequences of atmospheric GHGs for global temperature increase and the indirect consequences of increased temperatures on physical, biological and societal receptors. Both the current baseline status and potential possible future baseline scenarios are described. The future baseline scenarios are for the 'do nothing' case, i.e. in the absence of the proposed Platypus Development.

5.1 Environmental Surveys

The proposed Platypus Development area was subject to environmental surveys between 16th September and 14th October 2025. The survey results were detailed in three reports focusing on each survey location; (1) the proposed Platypus MFP location (Fugro, 2026a), (2) the proposed pipeline route (Fugro, 2026b), and (3) the Neptune 500 m zone (Fugro, 2026c). Table 5-1 provides a summary of each survey report and the sampling locations are shown in Figure 5-1.

Table 5-1 Environmental surveys conducted in the proposed Platypus Development area.

Reference	Survey Details
Fugro, 2026a	**Platypus MFP seafloor survey.** The survey collected geophysical data via side scan sonar (SSS). Seabed sampling was conducted at ten survey stations arranged in a cruciform pattern. Video and still footage was collected at each station along with one physicochemical and three macrofaunal grab samples. At each station, a 50 m video transect was conducted.
Fugro, 2026b	**Platypus pipeline route seafloor survey.** The survey collected geophysical data via SSS. Seabed sampling was conducted at 32 survey stations along the proposed route. Video and still footage was collected at each station along with one physicochemical and three macrofaunal grab samples. At each station, a 50 m video transect was conducted, with two transects extended to 190 m to investigate areas of high SSS reflectivity.
Fugro, 2026c	**Neptune 500 m zone seafloor survey.** The survey collected geophysical data via SSS. Seabed sampling was conducted at five survey stations. Video and still footage was collected at each station along with one physicochemical and three macrofaunal grab samples. At each station a 50 m video transect was conducted.

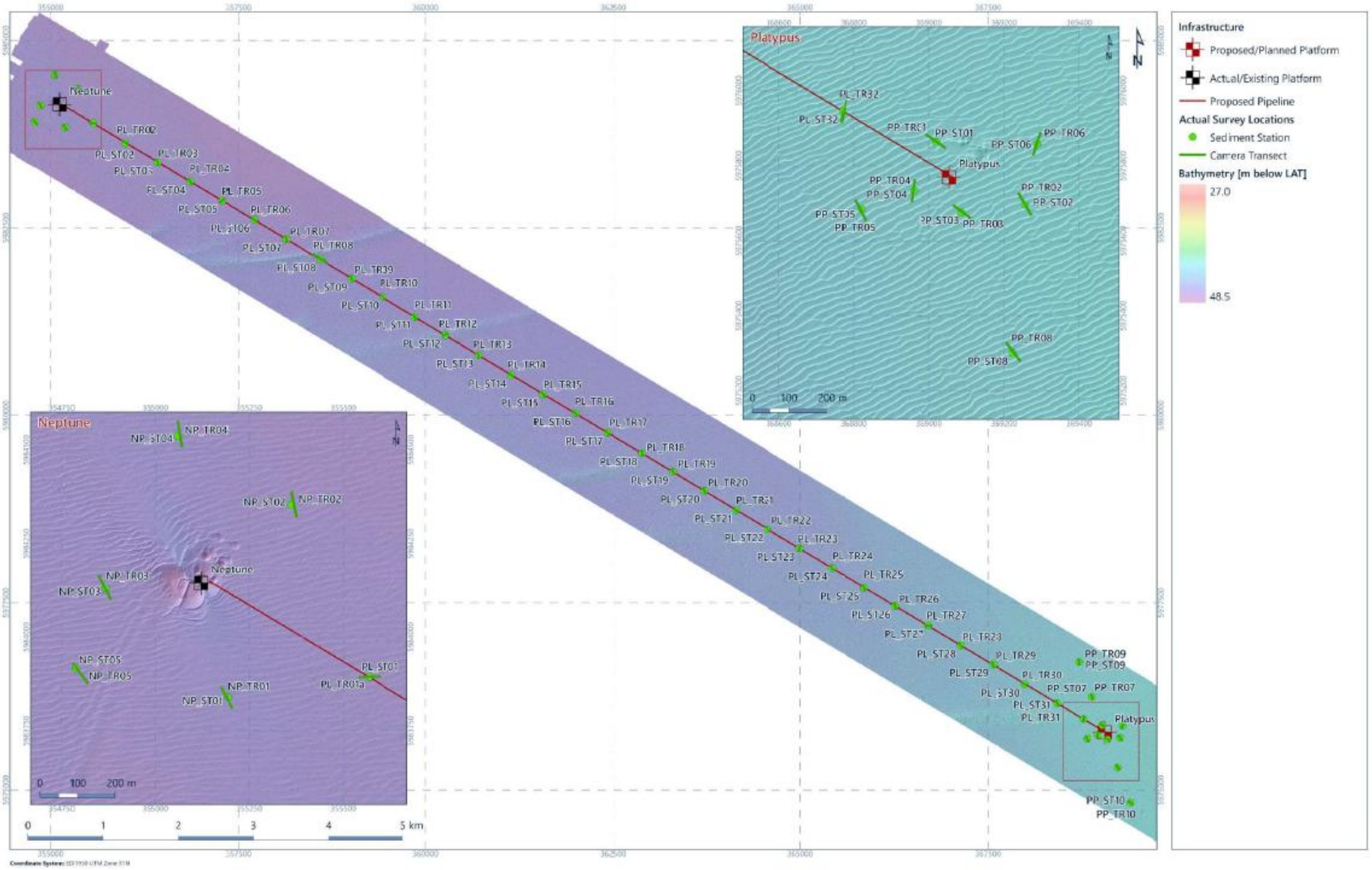


Figure 5-1: Environmental Survey Stations (Fugro, 2026a,b,c).

5.2 Physical Environment

The type and distribution of marine life is influenced by the physical conditions of the surrounding environment, biological interactions, and anthropogenic activities. These physical factors, which include currents, tides, waves, temperature, salinity, and wind also influence the fate and behaviour of emissions and offshore discharges (planned and unplanned) from vessels and installations, and the risks associated with them.

5.2.1 Bathymetry

Bathymetry across the three survey areas ranges from 38.0 m Lowest Astronomical Tide (LAT) on a sediment ridge to the south-east of the Neptune platform, to 48.8 m LAT within a scour associated with the Neptune platform. Depth generally increases from east to west (Fugro, 2026a,b,c).

At the proposed Platypus MFP location, the water depth is 40.7 m LAT. The survey area mostly comprised areas of low reflectivity with some small areas of high reflectivity and was characterised mainly by a flat seafloor. Morphological features were identified on the seafloor, including an identified area of high reflectivity near PP_ST01 and PP_ST02. One area within PP_ST10 included an identified hard contact. From geophysical data, sand with megaripples were observed throughout the survey area (Figure 5-2; Fugro, 2026a).

The water depth along the proposed Platypus pipeline route ranges from 38.0 m LAT to 46.0 m LAT. The SSS data displayed low to moderate reflectivity, with several features identified including; boulders, mobile sediments with megaripples, and seven sand dunes (Figure 5-3; Fugro, 2026b).

At Neptune, the SSS data displays low to moderate reflectivity with sand ripples, scour and rock dump. Depressions observed to the north of Neptune were interpreted as spud can footprints, consistent with the footprint of previous JUB operations (Figure 5-4; Fugro, 2026c).

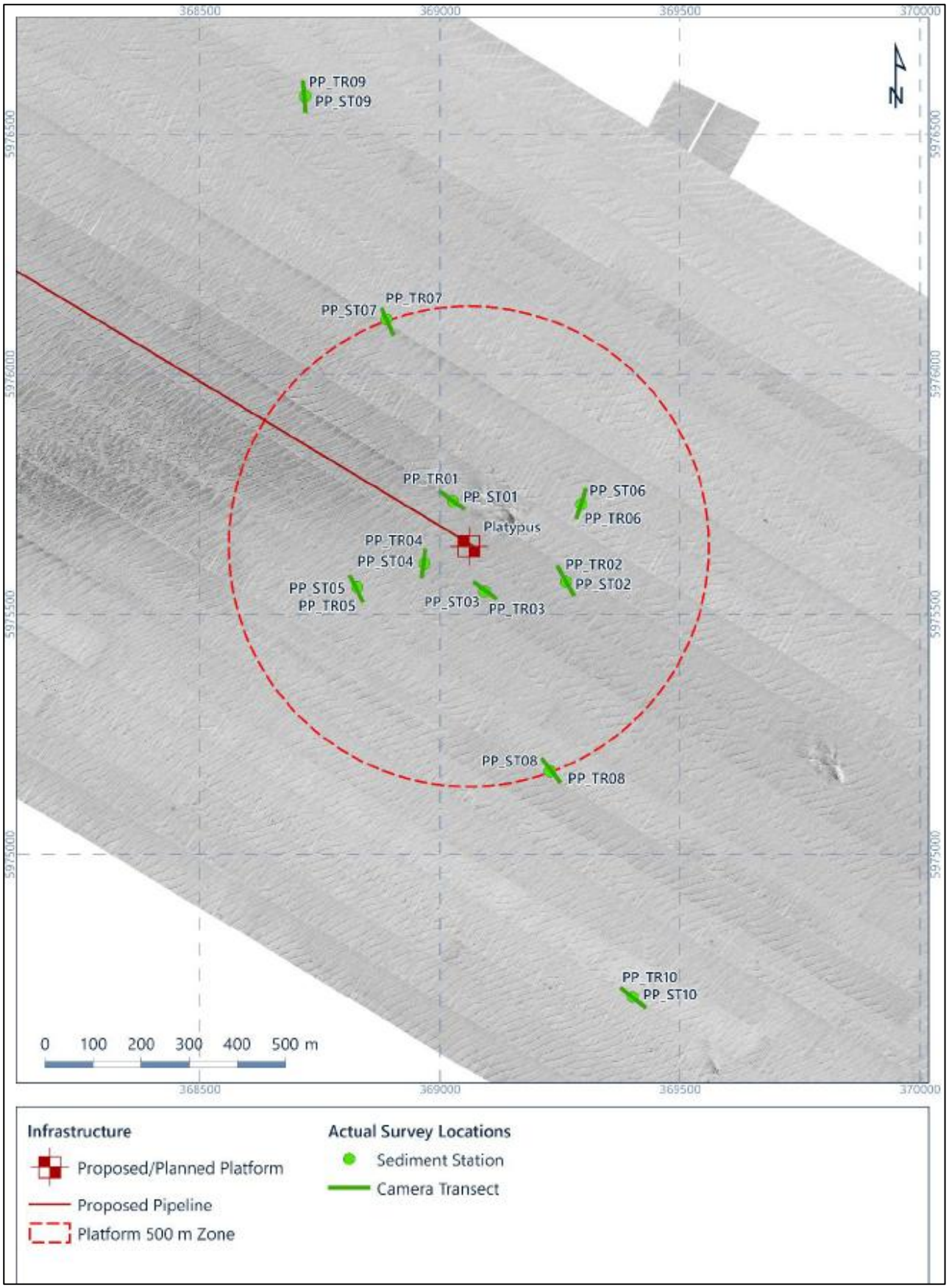


Figure 5-2: Proposed platypus MFP survey locations overlaid on a side scan sonar mosaic (Fugro, 2026a).

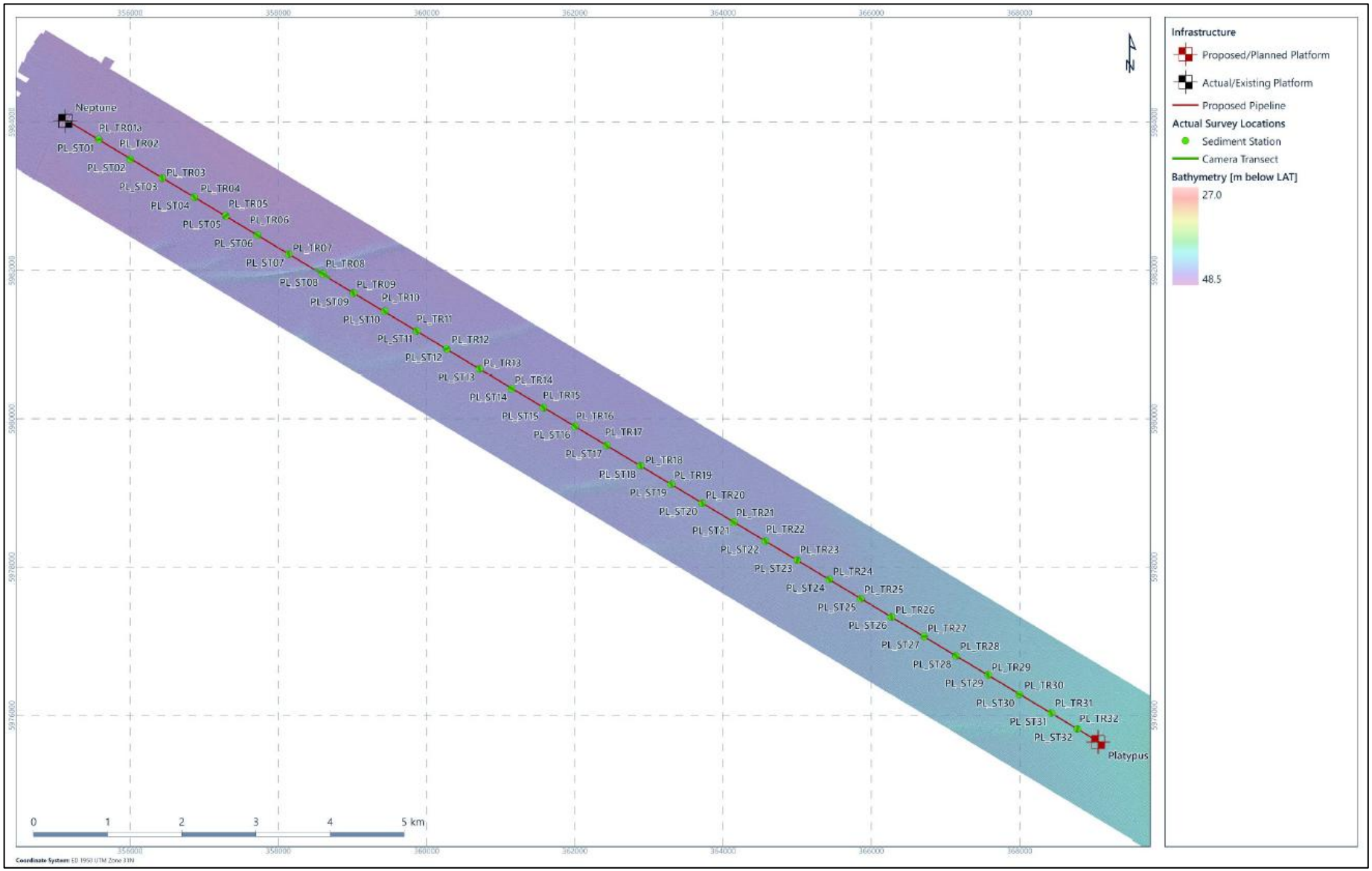


Figure 5-3: Bathymetry along the proposed Platypus pipeline route (Fugro, 2026b).

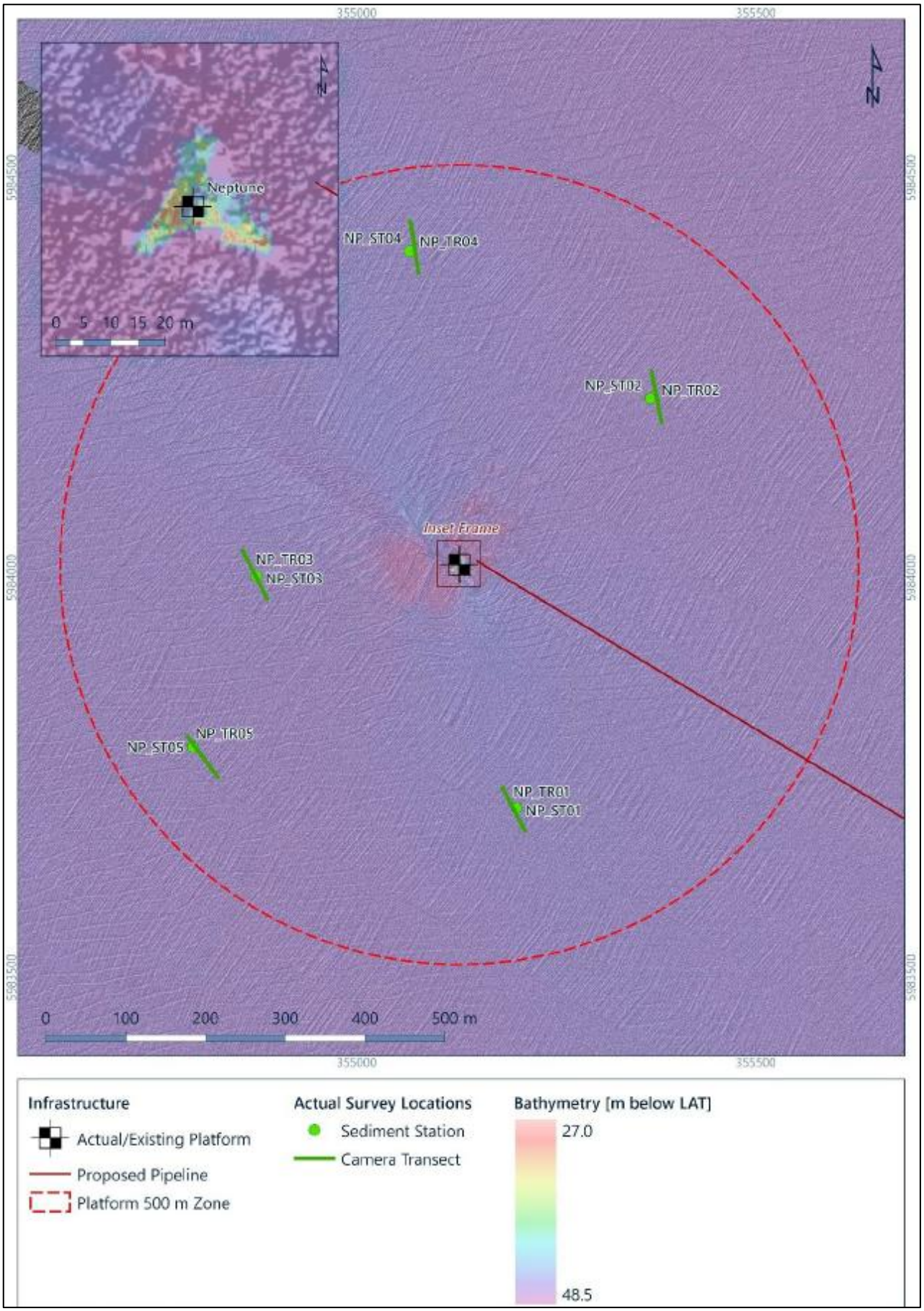


Figure 5-4: Bathymetry in the vicinity of Neptune 500 m safety zone (Fugro, 2026c).

5.2.2 Water Masses, Currents and Tides

Water masses, local current speeds and direction all influence the transport, dispersion and ultimate fate of marine discharges, nutrients, plankton, and larvae (OSPAR, 2010).

The major water masses in the North Sea can be classified as Atlantic, Scottish coastal water, Northern North Sea, Norwegian water, Central North Sea (CNS), SNS, Jutland water and Channel water (Turrell *et al*., 1999). Tidal current velocities tend to decrease with depth and distance from the UK coastline. There is also a weak residual current, caused by a water mass moving south along the English coastline and then east towards the proposed Platypus Development area, which contributes a small eastward drift (Figure 5-5). The tides are semi-diurnal with tidal streams running east-south-east and west-northwest. Generally, in the SNS, storm surge currents tend to move in a southerly direction parallel to the English Coast and can exceed the speeds associated with tides.

Currents are influenced by the presence of the Dogger Bank, which alters the properties of the tidal currents moving over and around it. Tidal current velocities tend to be stronger to the west and south-west of Dogger Bank, reduced over the shallower top. Wave motion is the most erosive force acting on seabed sediments (Section 3.2.1.3) as past research has shown that tidal currents on the Dogger Bank are generally insufficient to transport sediments (von Haugwitz *et al*. 1988).

Typical current speeds in the SNS are 0.1 m/s and the maximum current speed during mean spring tide is between 0.4 and 0.5 m/s. The mean spring tidal range is between 0.1 - 1.0 m (DESNZ, 2022).

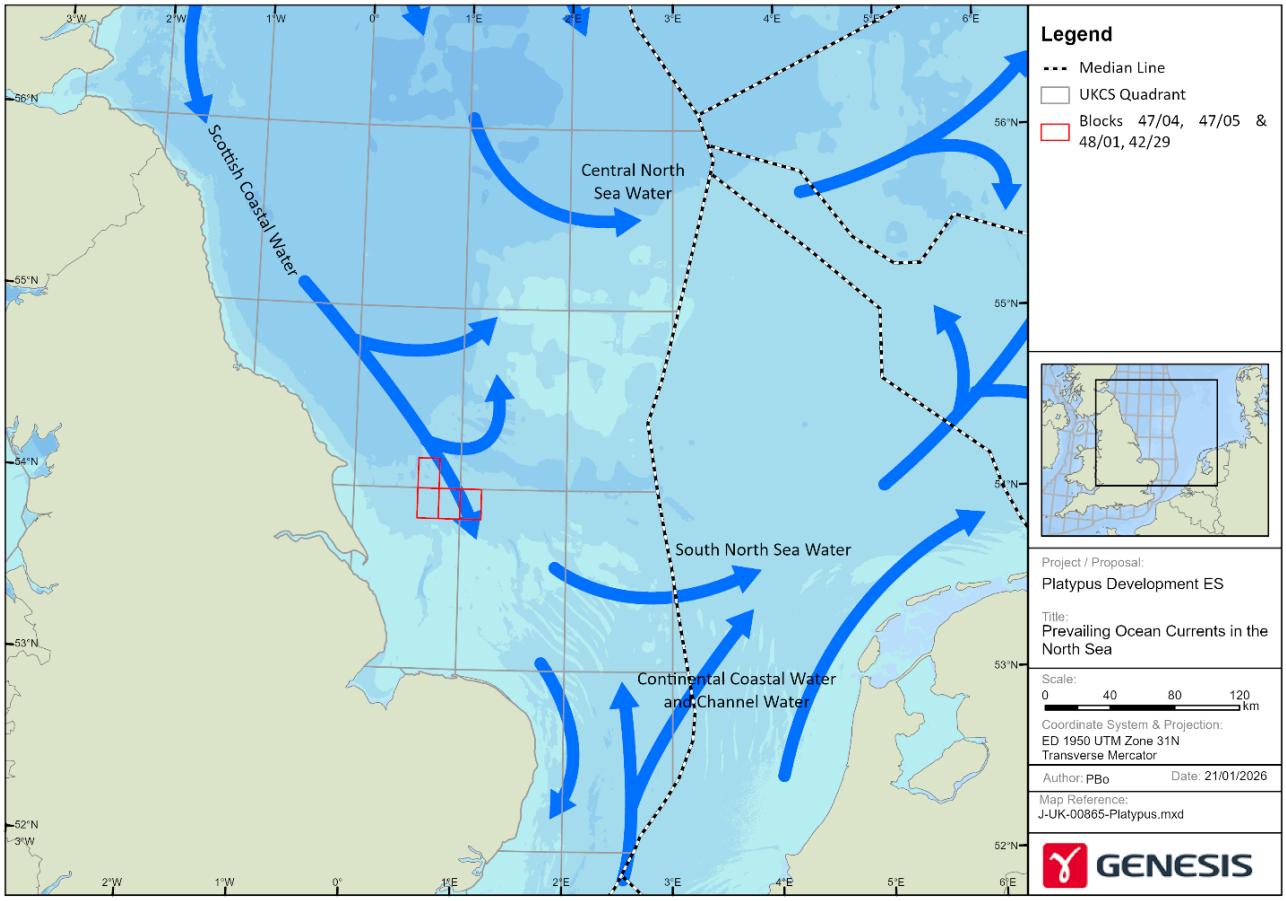


Figure 5-5: General circulation in the North Sea (Turrell et al., 1999).

5.2.3 Wind and Waves

Wind direction and speed influence the transport and dispersion of atmospheric emissions from a development. These factors are also important for the dispersion of marine discharges, including hydrocarbon spills, influencing the movement, direction and break up of substances on the sea surface. The

UK is subject to strong maritime influences with coastal areas being strongly impacted. Figure 5-6 indicates that wind speeds in the proposed Platypus Development area reach over 16 m/s and over 20 % of wind originates from the southwest direction (Figure 5-6; ABPmer, 2013; Saha *et al.,* 2010).

Waves are the result of wind action on the sea surface and wave size is dependent on the distance or fetch over which the wind blows. Rough seas are common in the North Sea, particularly from October to March. The annual mean wave power in the vicinity of the proposed Platypus Development is 12.8 kilowatts per metre (kW/m) and the annual mean significant wave height is 1.5 m. The highest proportion of waves (30 %) originate from a northern direction (Figure 5-6; ABPmer, 2013; Saha *et al.,* 2010).

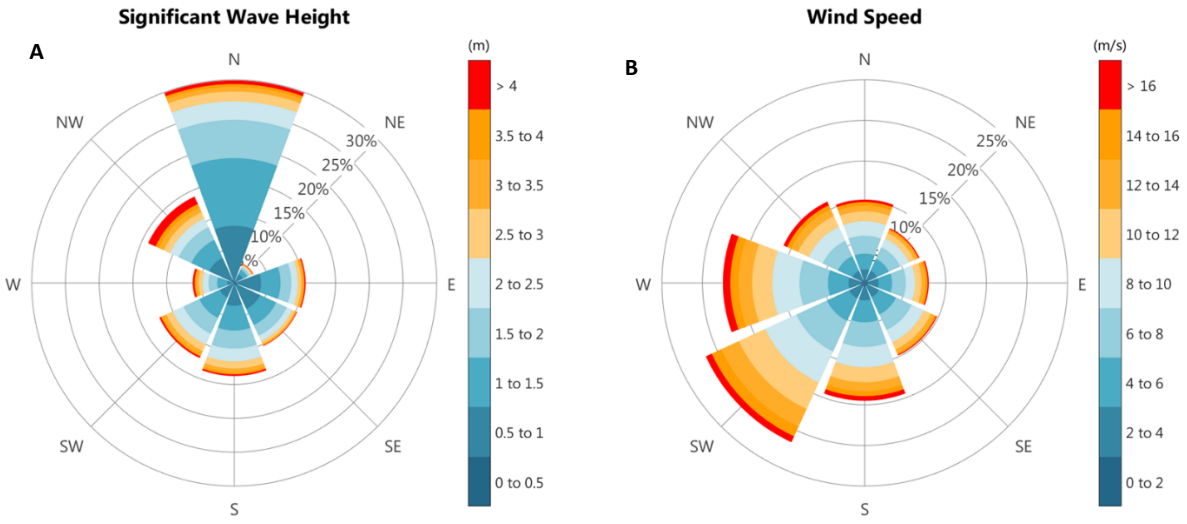


Figure 5-6: Wave rose (A), and Wind rose (B) for the proposed Platypus Development area (ABPmer, 2013; Saha et al., 2010).

5.2.4 Sea Temperature and Salinity

The temperature of the sea affects both the properties of the seawater and the fates of discharges to the environment. Seawater temperatures vary with season, depth, and proximity to land. Sea surface temperature and salinity within the proposed Platypus Development area are governed by the flow of oceanic Atlantic waters into the North Sea through the Fair Isle Channel (Turrell *et al*.,1999).

According to data collected between 1971 and 2000, the annual mean near-bed water temperature at the proposed Platypus Development area is *c.* 9 °C and the annual mean seawater surface temperature at the is *c.* 10 °C (Berx & Hughes, 2009).

Fluctuations in salinity are largely caused by the addition or removal of freshwater to or from seawater through natural processes such as rainfall and evaporation. Salinity increases with water depth and distance from shore. The salinity of seawater around an installation has a direct influence on the initial dilution of aqueous effluents such that the solubility of effluents increases as the salinity decreases.

The water column of the SNS shows vertical stratification during the winter months but are generally well mixed throughout the summer months. Temperatures remain 2-3°C warmer to the south of the region, influenced by proximity to the European land mass and warm water flowing through the English Channel (BEIS, 2022).

Salinity in the vicinity of the proposed Platypus Development area shows little seasonal variation through the water column. Average salinity is *c.* 34.6 % near-bed and *c.* 34.7 % at the sea surface (Berx & Hughes, 2009).

5.2.5 Seabed Sediments

The modelled distribution of seabed sediments in the proposed Platypus Development area are shown in Figure 5-7 (European Marine Observation and Data network (EMODnet), 2023).

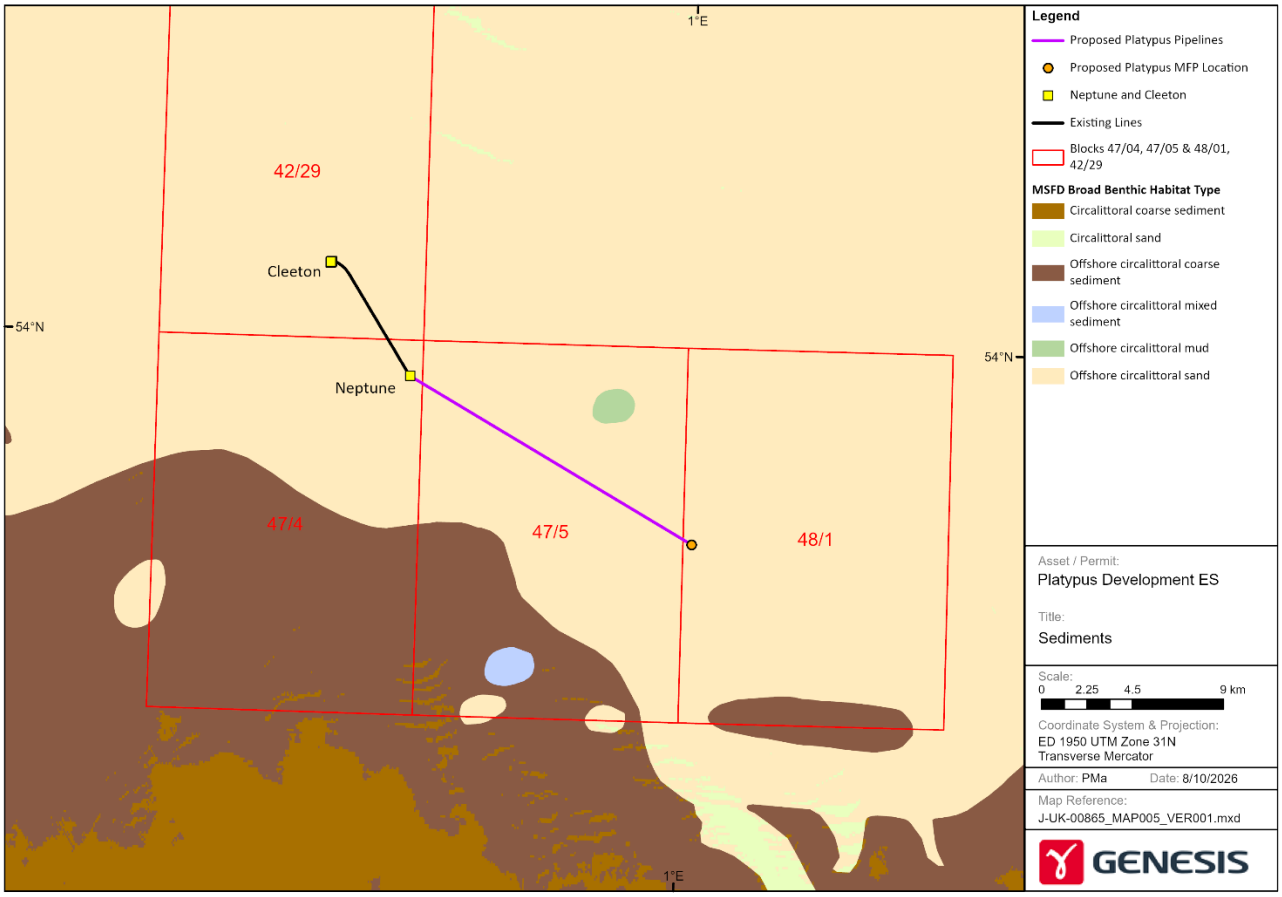


Figure 5-7: Modelled distribution of seabed sediments in the vicinity of the proposed Platypus Development area (EMODnet, 2023).

5.2.5.1 Proposed Platypus MFP Location

Surface seabed sediments at the proposed Platypus MFP location comprise silty fine to medium sand with shell fragments for the first 2.5 m depth before transitioning to slightly sandy slightly gravelly clay (Fugro, 2019).

The sediment across the Platypus survey area is dominated by sand and shows little interstation variability (mean 97.36 %, Relative Standard Deviation [RSD] 2 %). The sediment contains low fractions of fines (mean 2.46 %, RSD 86 %) and gravel (mean 0.18 %, RSD 76 %) however these fractions showed high interstation variability (Fugro, 2026a). All stations were classified under the Folk Description as slightly gravelly sand, and as fine sand under the Wentworth (1992) description (Fugro, 2026a). Four stations (PP_ST01, PP_ST03, PP_ST07, PP_ST09) exhibited above SNS background mean fines content (3.07 %). Mean particle size across the survey area showed low variability (RSD 6 %), ranging from 179 µm to 215 µm, with a mean of 179 µm. Sediment sorting across the area was generally moderately well sorted, with one station (PP_ST09) recorded as well sorted, and one station (PP_ST07) as moderately sorted (Fugro, 2026a). Total Organic Carbon (TOC) showed little variability across the survey area (RSD 10 %), ranging from 0.26 % to 0.35 %, with a mean of 0.30 % (Fugro, 2026a).

Sediments were analysed for hydrocarbons across the survey area including Total Hydrocarbon Content (THC), total n-alkanes (nC_{12} to nC_{36}), total polycyclic-aromatic hydrocarbons (PAHs), US Environmental Protection Agency (EPA) 16 priority PAHs, and phenanthrenes/anthracenes and dibenzothiophenes (NPD) (Fugro, 2026a). Gas chromatography-flame ionisation detection was used to investigate the potential origins of hydrocarbons present in sediments. Results indicated a small "hump" of unresolved material (UCM) peaking between nC_{26} and nC_{36}, a homologous series of low-level resolved n-alkanes, a small, short hump around nC_{21}. The hump between nC_{26} and nC_{36} indicates data that hydrocarbons present likely originate from

plant waxes present in terrestrial run off (Fugro, 2026a). The small, short hump at nC_{21} is consistent with input of biogenic material from the marine environment. The profile is consistent with sediments across the SNS. The samples showed no evidence of the presence of drilling fluids (Fugro, 2026a). THC was generally low across the survey area, ranging from 2.4 microgram per gram (µg/g) to 5.9 µg/g, with a mean of 3.3 µg/g. Only one station (PP_ST09) exceeded the SNS background mean (4.34 µg/g), with a THC of 5.9 µg/g. Variability in THC values across the survey area was moderate (RSD 32 %). UCM concentrations ranged from 1.3 µg/g to 3.6 µg/g, with a mean value of 2.0 µg/g. Variability in UCM values across the survey area was moderate (RSD 33 %) (Fugro, 2026a). The distribution and concentration of aromatic compounds in seafloor sediments were analysed using Gas Chromatography Mass Spectrometry. PAH concentrations are analysed as these compounds exhibit toxic impacts on marine organisms, are carcinogenic, and may bioaccumulate, additionally PAHs serve as indicators of hydrocarbon presence. The US EPA priority 16 PAHs are used globally because they represent the most common, toxicologically relevant, and widely occurring PAHs in the environment. Total 2 to 6 ring PAH concentrations across the survey area were low (mean 0.0110 µg/g) and displayed moderate variability (63%), however PAH concentration exceeded the SNS mean background concentration (0.208 µg/g) at Station PP_ST09. The total US EPA 16 PAH concentrations were low across the area (mean 27.5 µg/g) and exhibited moderate variability (RSD 51 %). NPD concentrations were low across the survey area (mean 0.0561 µg/g) and exhibited high variability (RSD 76%), with only one station (PP_ST09) exceeding the SNS mean background concentration (0.097 µg/g) (Fugro, 2026a).

Sediments collected from grab samples were analysed for heavy and trace metals by inductively coupled plasma–mass spectrometry following preparation by an aqua regia digest. This technique provides a partial digest releasing metals that are not bound within silicate matrices and thus considered to be bioavailable. Additionally, sediments were subject to alkali fusion for total barium content. Note; metal concentrations were not normalised, thus comparison to BC/BAC values is not possible. The elements analysed were aluminium (Al), arsenic (As), barium (Ba), total barium (TBa), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), mercury (Hg), nickel (Ni), lead (Pb), tin (Sn), vanadium (V), and zinc (Zn). Many metals exhibited concentrations under the minimum reporting value. Across the survey area heavy and trace metal concentrations were low exhibiting low variability (RSD >23%), except for Barium which exhibited moderate variability (RSD 51%) (Fugro, 2026a). Furthermore, all metals were below the SNS mean background concentration at all stations, except for Hg. Hg exceeded the SNS mean background concentration (0.02 µg/g) at PP_ST10 and was equal to it at PP_ST06. No spatial patterns were observed for metals across the survey area (Fugro, 2026a).

5.2.5.2 Proposed Platypus Pipeline Route

The sediment along the proposed pipeline route was dominated by sand which showed little interstation variability (mean 95.39%, RSD 2%). The sediment contains low fractions of fines (mean 4.26%, RSD 38%) and gravel (mean 0.34%, 112%) (Fugro, 2026b). All stations were classified under the Folk Description as slightly gravelly sand, and as fine sand under the Wentworth (1992) description, expect PL_ST12 which was classified as medium sand (Fugro, 2026b). Every station except six (PL_ST13, PL_ST19, PL_ST22, PL_ST24, PL_ST30, and PL_ST31) exhibited above SNS background mean fines content (3.07%). Mean particle size along the route showed low variability (RSD 14%), ranging from 174 micron (µm) to 318 µm, with a mean of 187 µm (Fugro, 2026b). Sediment sorting along the route was generally moderately to moderately well sorted, with some stations recorded as well sorted and one station (PL_ST12) recorded as poorly sorted. TOC showed little variability along the route (RSD 19%), ranging from 0.27% to 0.47%, with a mean of 0.35% (Fugro, 2026b).

The same analysis for sediment hydrocarbons as described in Section 5.2.5.1, was conducted along the proposed pipeline route. Gas chromatography-flame ionisation detection results were similar to those shown in Section 5.2.5.1, with a small “hump” of UCM peaking between nC26 and nC36 and a small, short hump around nC21 (Fugro, 2026b). Again, indicative of hydrocarbons originating from plant waxes present in terrestrial run off and biogenic material from the marine environment (Fugro, 2026b). The profile is consistent with sediments across the SNS. The samples showed no evidence of the presence of drilling fluids (Fugro, 2026b). THC was higher along the proposed route than recorded at the proposed platypus MFP location, 20 of the 32 stations exceeded the SNS background mean (4.34) (Fugro, 2026b). Variability in THC

values across the survey area low (RSD 25 %). UCM concentrations ranged from 1.8 µg/g to 5.4 µg/g, with a mean value of 3.1 µg/g. Variability in UCM values across the survey area was low (RSD 28 %) (Fugro, 2026b). Total 2 to 6 ring PAH concentrations along the proposed route were low (mean 0.157 µg/g) and displayed moderate variability (RSD 46%), however PAH concentration exceeded the SNS mean background concentration (0.208 µg/g) at four stations (PL_ST08, PL_ST09, PL_ST22, PLST29) (Fugro, 2026b). The total US EPA 16 PAH concentrations were low across the area (mean 38.5 µg/g) and exhibited low variability (RSD 37 %). NPD concentrations were low along the route (mean 0.0812 µg/g) and exhibited moderate variability (RSD 57%). Six stations (PL_ST08, PL_ST09, PL_ST12, PL_ST14, PL_ST22, PL_ST29) exceeding the SNS mean background concentration (0.097 µg/g).

The same analysis for heavy and trace metals as described in Section 5.2.5.1, was conducted along the proposed pipeline route. The same list of elements was tested for. Note, metal concentrations were not normalised, thus comparison to BC/BAC values is not possible (Fugro, 2026b). Along the survey route heavy and trace metal concentrations were low and exhibited low to moderate variability (RSD 6% - 51%), except for Arsenic which exhibited high variability (RSD 79%). The metals Al, As, Ba, Tba, Cd, and Sn were below the SNS mean background concentration at all stations. The metals Cr, Cu, Fe, Hg, Ni, Pb, V, and Zn exceeded SNS mean background concentrations at a minimum of one station. Cr concentration exceeded the SNS background concentration (10.7 µg/g) at three stations (PL_ST04, PL_ST08, and PL_ST12), however these values were below the SNS background 95th percentile value (44.77 µg/g) and the Effects Range Low (ERL) value (81.0 µg/g) (Fugro, 2026b). Cu concentration exceeded the SNS background concentration (3.83 µg/g) at two stations (PL_ST05 and PL_ST12); however these values were below the SNS background 95th percentile value (13.86 µg/g) and the ERL value (34.0 µg/g) (Fugro, 2026b). Fe concentration exceeded the SNS background concentration (7595.33 µg/g) at three stations (PL_ST08, PL_ST12, and PL_ST32) and station PL_ST12 was also above the SNS 95th percentile value (18555 µg/g) (Fugro, 2026b). Hg concentration exceeded the SNS background concentration (0.02 µg/g) at three stations (PL_ST15, PL_ST23, PL_ST32). Hg concentration was above the 95th percentile value (0.05 µg/g) at stations PL_ST15 and PL_ST32, and above the ERL value (0.150 µg/g) at station PL_ST32 (Fugro, 2026b). Ni concentration exceeded the SNS background concentration (5.47 µg/g) at one station (PL_ST12) was above the SNS mean background concentration (Fugro, 2026b). All values were below the SNS background 95th percentile value (21.45 µg/g). Pb concentration exceeded the SNS background concentration (8.39 µg/g) at two stations (PL_ST08 and PL_ST12). All values were below the SNS background 95th percentile value (21.03 µg/g) and the ERL value (47.0 µg/g) (Fugro, 2026b). V concentration exceeded the SNS background concentration (18.53 µg/g) at six stations (PL_ST08, PL_ST12, PL_ST17, PL_ST18, PL_ST31 and PL_ST32). Station PL_ST12 was also above the 95th percentile value (35.76 µg/g) (Fugro, 2026b). Zn concentration exceeded the SNS background concentration (15.88 µg/g) at three stations (PL_ST08, PL_ST12 and PL_ST32). All values were below the SNS background 95th percentile value (35.80 µg/g) and the ERL value (150 µg/g).

5.2.5.3 Neptune

The sediment across the Neptune survey area was dominated by sand which showed little interstation variability (mean 94.46%, RSD < 1%). The sediment contains low fractions of fines (mean 5.40%, RSD 4%) and gravel (mean 0.15%, 82%) (Fugro, 2026c). All stations were classified under the Folk Description as slightly gravelly sand, and as fine sand under the Wentworth (1992) description (Fugro, 2026c). All stations exhibited fines content above the SNS background mean content (3.07%). Mean particle size across the survey area showed low variability (RSD 1%), ranging from 175 µm to 177 µm, with a mean of 176 µm. Sediment sorting across the area was recorded as moderately sorted (Fugro, 2026c). TOC showed little variability across the survey area (RSD 17%), ranging from 0.27% to 0.38%, with a mean of 0.31% (Fugro, 2026c).

The same analysis for sediment hydrocarbons as described in Section 5.2.5.1, was conducted across the Neptune survey area. The results were similar to those described in Section 5.2.5.1 and 5.2.5.2 with a small "hump" peaking between nC_{26} and nC_{36} and a small, short hump around nC_{21}. Again, indicative of hydrocarbons originating from plant waxes present in terrestrial run off and biogenic material from the marine environment (Fugro, 2026c). The profile is consistent with sediments across the SNS. The samples showed no evidence of the presence of drilling fluids (Fugro, 2026c). THC was generally low across the survey

area and comparable with other surveys (Fugro, 2026a and Fugro, 2026b), ranging from 3.3 µg/g to 5.3 µg/g, with a mean of 4.34 µg/g. Two stations, NP_ST01 and NP_ST02, exceeded the SNS background mean (4.34 µg/g), with THC values of 5.1 µg/g and 5.3 µg/g respectively. Variability in THC values across the survey area was low (RSD 24 %). UCM concentrations ranged from 2.2 µg/g to 3.5 µg/g, with a mean value of 2.9 µg/g. Variability in UCM values across the survey area was low (RSD 24 %) (Fugro, 2026c). Total 2 to 6 ring PAH concentrations across the survey area were low (mean 0.165 µg/g) and displayed moderate variability (48%), however PAH concentration exceeded the SNS mean background concentration (0.208 µg/g) at Station NP_ST02 with 0.257 µg/g. The total US EPA 16 PAH concentrations were low across the area (mean 44.9 µg/g) and exhibited moderate variability (RSD 44 %). NPD concentrations were low across the survey area (mean 0.0831 µg/g) and exhibited moderate variability (RSD 59%), with two stations (NP_ST01 and NP_ST02) exceeding the SNS mean background concentration (0.097 µg/g) (Fugro, 2026c).

The same analysis for heavy and trace metals as described in Section 5.2.5.1, was conducted across the survey area. The same list of elements was tested for. Note, metal concentrations were not normalised, thus comparison to BC/BAC values is not possible (Fugro, 2026c). Across the survey area heavy and trace metal concentrations were low exhibiting low variability (RSD 6% - 32%) (Fugro, 2026c). Furthermore, all metals were below the SNS mean background concentration at all stations, except for V. V exceeded the SNS mean background concentration (18.53 µg/g) at NP_ST02 with 19.1 µg/g. No spatial patterns were observed for metals across the survey area (Fugro, 2026c).

5.3 Biodiversity

Marine biodiversity refers to the variety of life found in ocean and coastal environments, including species of plankton/zooplankton, invertebrates, fish, marine mammals, seabirds, and the habitats that support them such as the seabed, water column, coral reefs, seagrass beds, estuaries, and intertidal zones. Every species contributes to wider ecological function, which encompasses genetic diversity within species, species diversity across ecosystems, and the ecological processes that sustain marine life.

The biodiversity baseline provides an overview of the ecological characteristics within the Project area, forming the foundation for assessing potential impacts on habitats and species. This Section identifies and describes the key ecological receptors, including designated sites, habitats, and species of conservation importance.

The following subsections consider each receptor in more detail.

5.3.1 Plankton

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

The composition and abundance of plankton communities varies throughout the year; influenced by several factors including depth, tidal mixing, temperature stratification, nutrient availability, and the location of oceanographic fronts (BEIS, 2016). The SNS is characterised by shallow, well-mixed waters, which undergo large seasonal temperature variations (JNCC, 2004). The region is largely enclosed by land and, as a result, the environment here is dynamic with considerable tidal mixing and nutrient-rich run-offs from the land (eutrophication).

The phytoplankton community is dominated by the dinoflagellate genus *Tripos*, along with higher numbers of the diatom, *Chaetoceros* (subgenera *Hyalochaete* and *Phaeoceros*) than are typically found in the northern North Sea. Phytoplankton biomass is greater than in the northern North Sea and has been increasing since

the 1988 ecological shift (Edwards *et al*. 2020). Harmful Algal Blooms (HABs) caused by *Noctiluca spp*. are often observed in the region.

The zooplankton community comprises *C. helgolandicus* and *C. finmarchicus* as well as *Paracalanus spp*., *Pseudocalanus spp*., *Acartia spp*., *Temora spp*. and cladocerans such as *Evadne spp*. Commonly seen jellyfish in the region include *A. aurita* and *Chrysaora hysoscella* (Pikesley *et al*. 2014).

5.3.2 Seabed Habitats and Benthic Communities

Activities that result in disturbance to the seabed such as those involved in the proposed development can affect habitats and the associated benthic fauna (Clark, 1996).

5.3.2.1 Seabed Habitats

The seabed within the vicinity of the proposed Platypus MFP, pipeline route, and Neptune 500 m safety zone is homogeneous, deemed to comprise a single main level four European Nature Information System (EUNIS) habitat type: MD521 'Faunal Communities in Atlantic Offshore circalittoral sand', which is equivalent to the JNCC habitat classification 'Offshore Circalittoral Sand (SS.SSa.OSa)' (Fugro, 2026a, b&c). The habitat 'Faunal communities in Atlantic offshore circalittoral sand' (MD521) describes offshore (deep) circalittoral habitats with fine sands or non-cohesive muddy sands with faunal assemblage comprising a diverse range of polychaetes, amphipods, bivalves, and echinoderms (EEA, 2022). The results across all survey stations were consistent with this habitat type (Fugro, 2026a, b&c). The 'Faunal communities in the Atlantic offshore circalittoral sand' (MD521) habitat is an illustrative biotope of the Habitats of Principal Importance in England (HPI) (Department for Environment, Food & Rural Affairs [DEFRA], 2022) habitat 'subtidal sands and gravels'.

No Annex I habitats were observed within the vicinity of the proposed Platypus MFP location, along the proposed pipeline route, or within the Neptune 500 m safety zone (Fugro, 2026a, b&c).

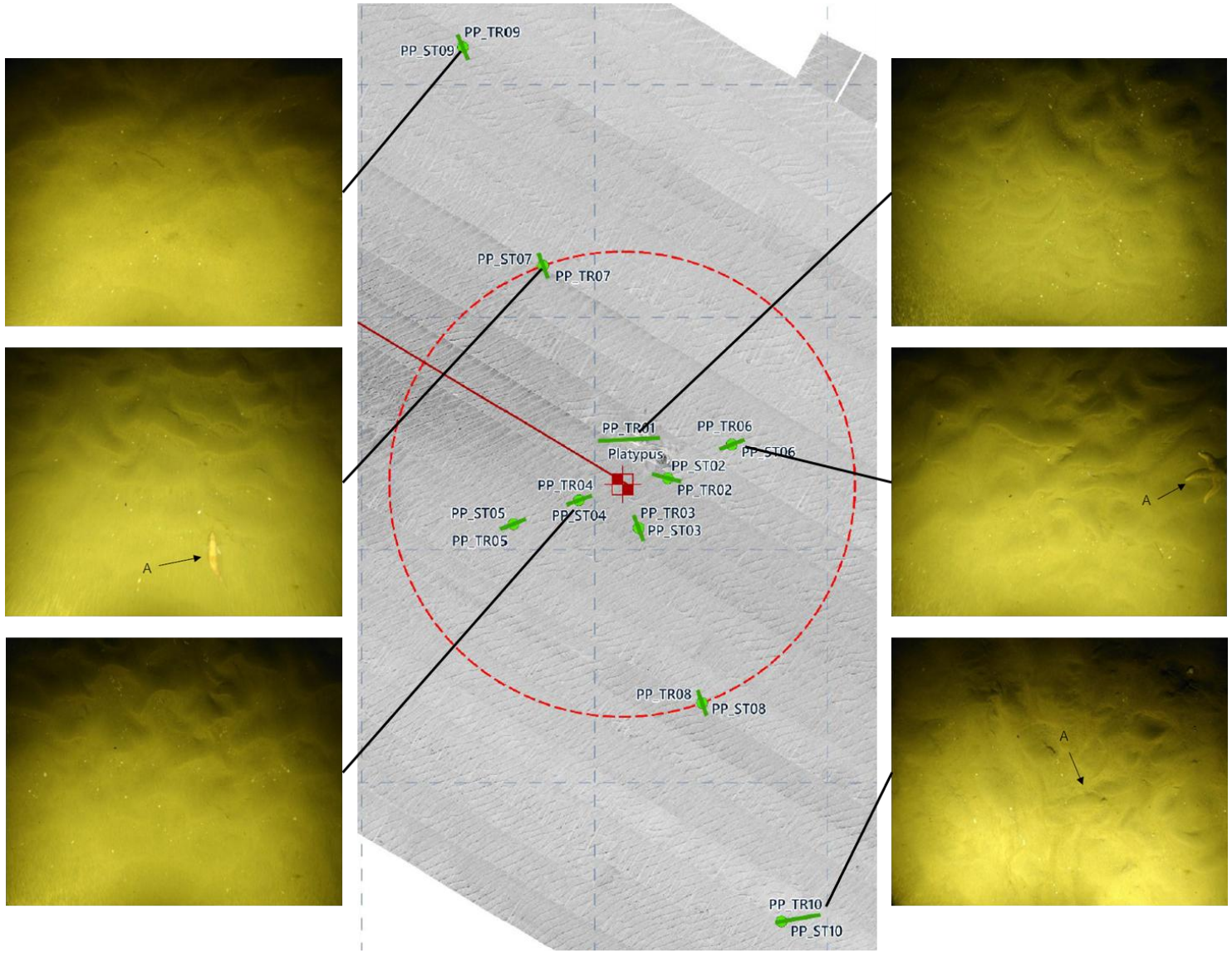


Figure 5-8: Seabed photographs within Platypus MFP survey area (Fugro, 2026a).

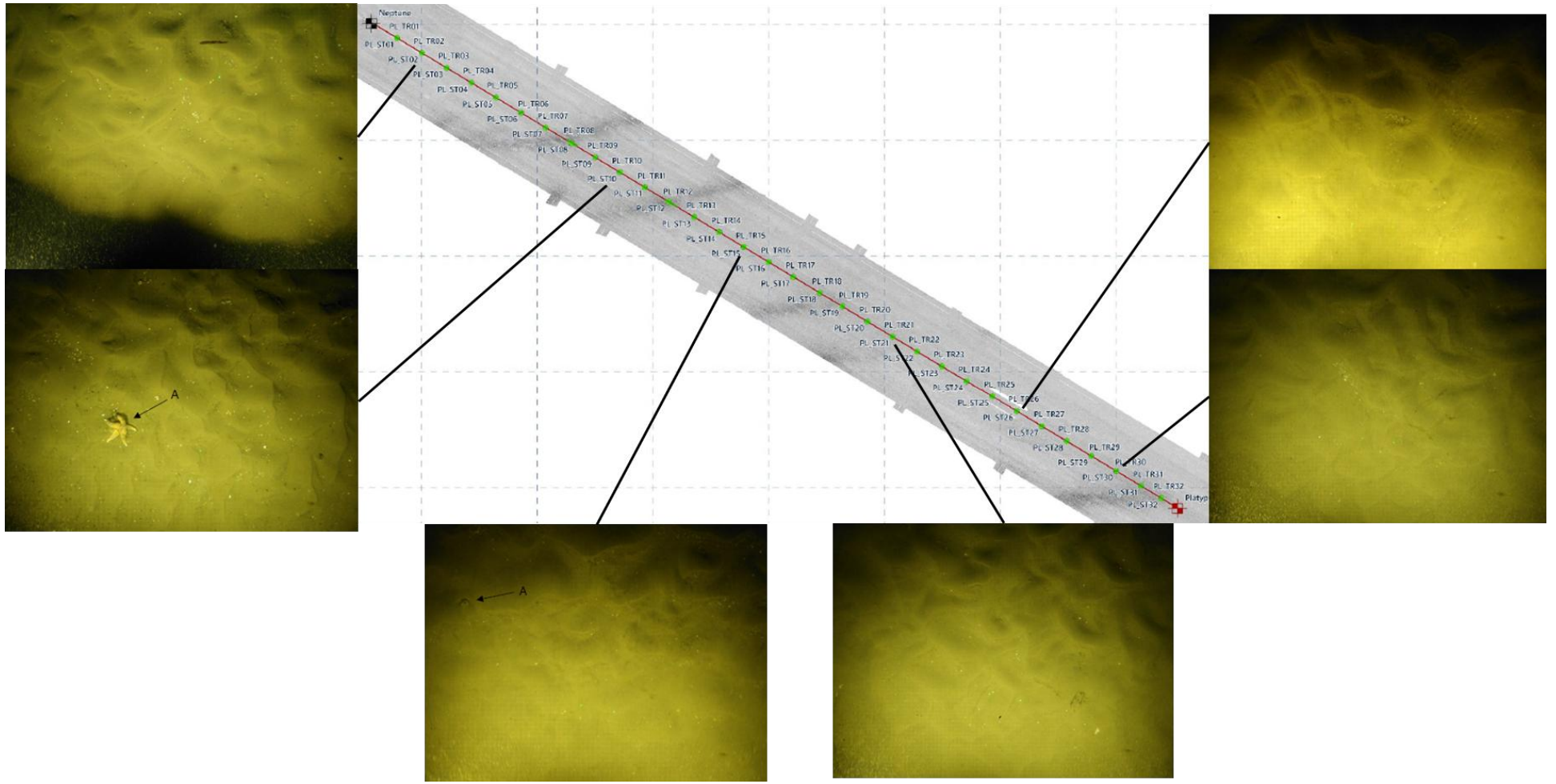


Figure 5-9: Seabed photographs within Platypus pipeline route survey area (Fugro, 2026b).

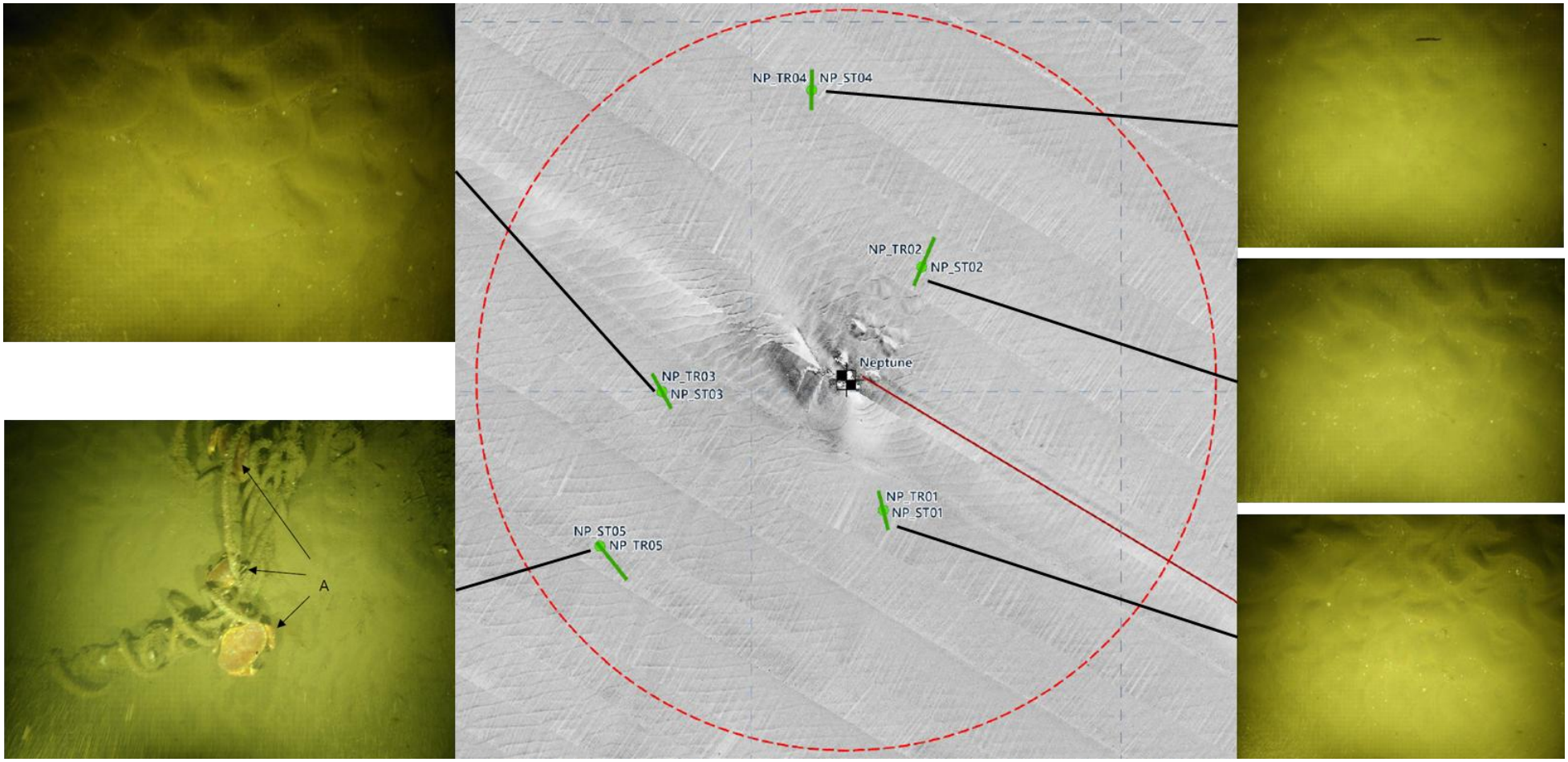


Figure 5-10: Seabed photographs within Neptune survey area (Fugro, 2026c).

5.3.2.2 Benthic Communities

Bacteria, plants and animals living on or within the seabed sediments are collectively referred to as benthos. Species living on top of the sea floor may be sessile (e.g. seaweeds) or freely moving (e.g. starfish) and collectively are referred to as epibenthic or epifaunal organisms. Animals living within the sediment are termed infaunal species (e.g. tubeworms and burrowing crabs). Semi-infaunal animals, including sea pens and some bivalves, lie partially buried in the seabed. Furthermore, there are mobile species, such as sand eels, which utilise the seabed for shelter.

Fugro (2026a) found that the benthic community across the proposed Platypus MFP location was dominated by annelids and that annelids comprised the most diverse and abundant portion of the community. Annelids comprised 36.7% of species and 40.5% of individuals, Arthropoda 25% of species and 32.4% of individuals, Mollusca 23.3% of species and 21.2% of individuals, and Echinodermata 6.7% of species and 3.6% of individuals (Fugro, 2026a). The remaining portion was contributed by 'other phyla' comprising 8.3% of species and 2.3% of individuals (Fugro, 2026a). Community composition by species and individuals varied slightly across the survey area (Fugro, 2026a). Community diversity was measured using the Shannon-Wiener diversity index and Brillouin's index. The two diversity indexes showed similar patterns with diversity ranging from good to high along the proposed route. The Shannon-Wiener diversity index ranged from 3.42 to 4.27, with a mean of 3.89, and the Brillouin's index ranged from 2.06 to 2.60, with a mean of 2.37 (Fugro, 2026a). Variability for each index was low (RSD 8%).

Fugro (2026b) found that the benthic community along the proposed pipeline route was dominated by annelids, comprising the most diverse and abundant portion of the community. Annelids comprised 36.0% of species and 43.3% of individuals. Unlike the proposed Platypus MFP location, Arthropoda only contributed more species than Mollusca (26.8% and 19.6%), Mollusca contributed more individuals than Arthropoda (32.8% and 18.2% respectively) (Fugro, 2026b). Echinodermata contributed 5.2% of species and 9.6% of individuals (Fugro, 2026b). The remaining portion was contributed by 'other phyla' comprising 5.2% of species and 3.3% of individuals (Fugro, 2026b). Community composition by species and individuals varied slightly across the survey area (Fugro, 2026b). Community diversity ranged from good to high along the proposed route. The Shannon-Wiener diversity index ranged from 3.19 to 4.60, with a mean of 4.02, and the Brillouin's index ranged from 1.96 to 2.74, with a mean of 2.47 (Fugro, 2026b). Variability for each index was low (RSD 7%). Along the pipeline route, a single ross worm (*Sabellaria spinulosa*) individual was recorded at PL_ST09. Under specific conditions ross worms may coalesce in colonies and form biogenic reefs, which are an Annex I habitat, this habitat was not recorded along the pipeline route, nor in any other survey area (Fugro, 2026a, b&c).

Fugro (2026c) found that the benthic community across the Neptune survey area was dominated by annelids, comprising the most diverse and abundant portion of the community. Annelids comprised 37.5% of species and 37.3% of individuals. Similar to the proposed pipeline route, Arthropoda only contributed more species than Mollusca (25.0% and 23.2%), Mollusca contributed more individuals than Arthropoda (16.5% and 32.1% respectively) (Fugro, 2026c). Echinodermata contributed 5.4% of species and 10.3% of individuals (Fugro, 2026c). The remaining portion was contributed by 'other phyla' comprising 8.9% of species and 3.7% of individuals (Fugro, 2026c). Community composition by species and individuals varied slightly across the survey area (Fugro, 2026c). Community diversity ranged from good to high along across the survey area. The Shannon-Wiener diversity index ranged from 3.91 to 4.33, with a mean of 4.13, and the Brillouin's index ranged from 2.47 to 2.63, with a mean of 2.56 (Fugro, 2026c). Variability for the Shannon-Wiener and Brillouin's indexes was low (RSD 4% and 2% respectively) (Fugro, 2026c).

5.3.3 Fish and Shellfish

More than 330 fish species are thought to inhabit the shelf seas of the UKCS (Pinnegar *et al.*, 2010). Pelagic species (e.g., herring, mackerel, blue whiting, and sprat (*Sprattus sprattus*) are found in mid-water and typically make extensive seasonal movements or migrations. Demersal species (e.g., cod, haddock (*Melanogrammus aeglefinus*), sandeels (*Ammodytes tobianus*), sole (*Solea solea*) and whiting live on or near

the seabed and, similar to pelagic species, many are known to passively move (e.g., drifting eggs and larvae) and / or actively migrate (e.g., juveniles and adults) between areas during their lifecycle.

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

Table 5-2 shows the approximate spawning and nursery times of some of the fish species known to occur in the vicinity of the proposed Platypus Development area, while Figure 5-11 show the location of these areas (Coull *et al*., 1998; Ellis *et al*., 2012; Aires *et al*., 2014). The proposed redevelopment area is situated within International Council for the Exploration of the Sea (ICES) rectangles 36F0 and 36F1. It should be noted that spawning and nursery areas tend to be transient and therefore cannot be defined with absolute accuracy (Coull *et al*., 1998; Ellis *et al*., 2012).

Of the fish species identified in the proposed Platypus Development area anglerfish (*Lophius piscatorius*), blue whiting (*Micromesistius poutassou*), cod (*Gadus morhua*), herring (*Clupea harengus*), horse mackerel (*Trachurus trachurus*), lesser sandeel (*Ammodytes marinus*), mackerel (*Scomber scombrus*), and plaice (*Pleuronectes platessa*) and have been identified as Species of Principal Important in England (SPI) species (DEFRA, 2022).

Of the fish species identified cod, herring, sandeels, sprat, and whiting, constituted a significant proportion of harbour porpoise diet (Santos *et al*., 2003; Ransijn *et al*., 2019; & Booth *et al*., 2019). As such, these species are considered contributing features of the SNS SAC, under the conservation objective: “The condition of supporting habitats and processes, and the availability of prey is maintained”. Furthermore, sandeels and herrings utilise specific sediments as part of their ecology.

Sandeels are shoaling fish which hunt during daylight hours, but which shelter within the seabed during the night (DECC, 2016). Sandeels are of key ecological significance as they are a vital prey source for seabirds, marine mammals (e.g. harbour porpoises), and other fish species. Sandeels have also historically represented an important fishery in the UK, however in recent years the fishery has been closed to protect declining stocks. In the UK there are five species of sandeel, Raitt's sandeel (*Ammodytes tobianus*), lesser sandeel, greater sandeel (*Hyperoplus lanceolatus*), Corbin’s sandeel (*Hyperoplus immaculatus*), and smooth sandeel (*Gymnammodytes semisquamatus*). The two most common are the Raitt’s sandeel and the lesser sandeel, with the lesser sandeel being the most abundant. Sandeels exhibit a strong habitat preference skewed towards low slit, low gravel sands in shallow water (20 – 70m) and are generally considered restricted to these habitats (Holland et. al., 2005; Jensen et. al., 2011; DECC, 2016). The sediments of the SNS are broadly suitable for sandeels, with large areas of sand with low silt and gravel content. Langton et. al. 2021 provides a predictive model for sandeel presence and density across the UKCS (Figure 5-12). This model suggests that sandeels are likely to present within the project area, with greater probability and densities at the Platypus MFP than at Neptune. This predication aligns with observations during the 2025 survey (Fugro, 2026a, b,c), where sandeels were observed at the Platypus MFP but not at Neptune (Section 5.3.2.2).

Herring are a small pelagic shoaling fish which undertake seasonal migrations. Herring are unique amongst small pelagic fish species as they undertake demersal spawning adhering eggs to the seabed (Frost & Diele, 2022). Spawning for herring usually takes place in shallow areas (Anner, 1989). Female herring lay eggs once a year in a single batch, with inter-stock variations on number, size and weights of the eggs (Cefas, 2001). Herring exhibit strong sediment preferences for spawning, requiring coarse well-oxygenated substrates, which provide hard clean surfaces for eggs to adhere to and allow for high water flow around eggs (Frost & Diele, 2022). Where available herring will preferentially utilise macroalgae for spawning, as it is theorised that the high structural complexity increases egg oxygen supply significantly improving development rates and success (Hempel 1971; Woods and Podolsky 2007; Phillips and Moran 2015; von Nordheim *et al*. 2018). However, given the requirement for clean hard sediments, with good oxygenation, sediments with high fines

content such as muddy sediments are deemed unsuitable for herring spawning as fine particles adhere to the eggs leading to asphyxiation (Frost & Diele, 2022).

Table 5-2 Summary of spawning and nursery activity for species known to occur in the vicinity of the proposed project area (Coull et al.,1998; Ellis et al., 2012; Aires et al., 2014).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish	N	N	N	N	N	N	N	N	N	N	N	N
Blue Whiting	N	N	N	N	N	N	N	N	N	N	N	N
Cod	SNJ	S*NJ	S*NJ	SNJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Haddock	J	J	J	J	J	J	J	J	J	J	J	J
Herring	NJ	NJ	NJ	NJ	NJ	NJ	NJ	SNJ	SNJ	SNJ	NJ	NJ
Horse Mackerel	J	J	J	J	J	J	J	J	J	J	J	J
Lemon sole	N	N	N	SN	SN	SN	SN	SN	SN	N	N	N
Mackerel	NJ	NJ	NJ	NJ	S*NJ	S*NJ	S*NJ	SNJ	NJ	NJ	NJ	NJ
Plaice	S*NJ	S*NJ	SNJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	SNJ
Sandeel	SN	SN	N	N	N	N	N	N	N	N	SN	SN
Sole	N	N	SN	S*N	SN	N	N	N	N	N	N	N
Sprat	NJ	NJ	NJ	NJ	S*NJ	S*NJ	SNJ	SNJ	NJ	NJ	NJ	NJ
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	NJ	SNJ	SNJ	SNJ	SNJ	SNJ	NJ	NJ	NJ	NJ	NJ	NJ

Key: S = Spawning; S* = Peak Spawning; N = Nursery; J = Juveniles (i.e., 0 group fish)
Green highlight indicates high intensity nursery.
Source : Coull *et al.* (1998); Ellis *et al.* (2012); Aires *et al.* (2014).

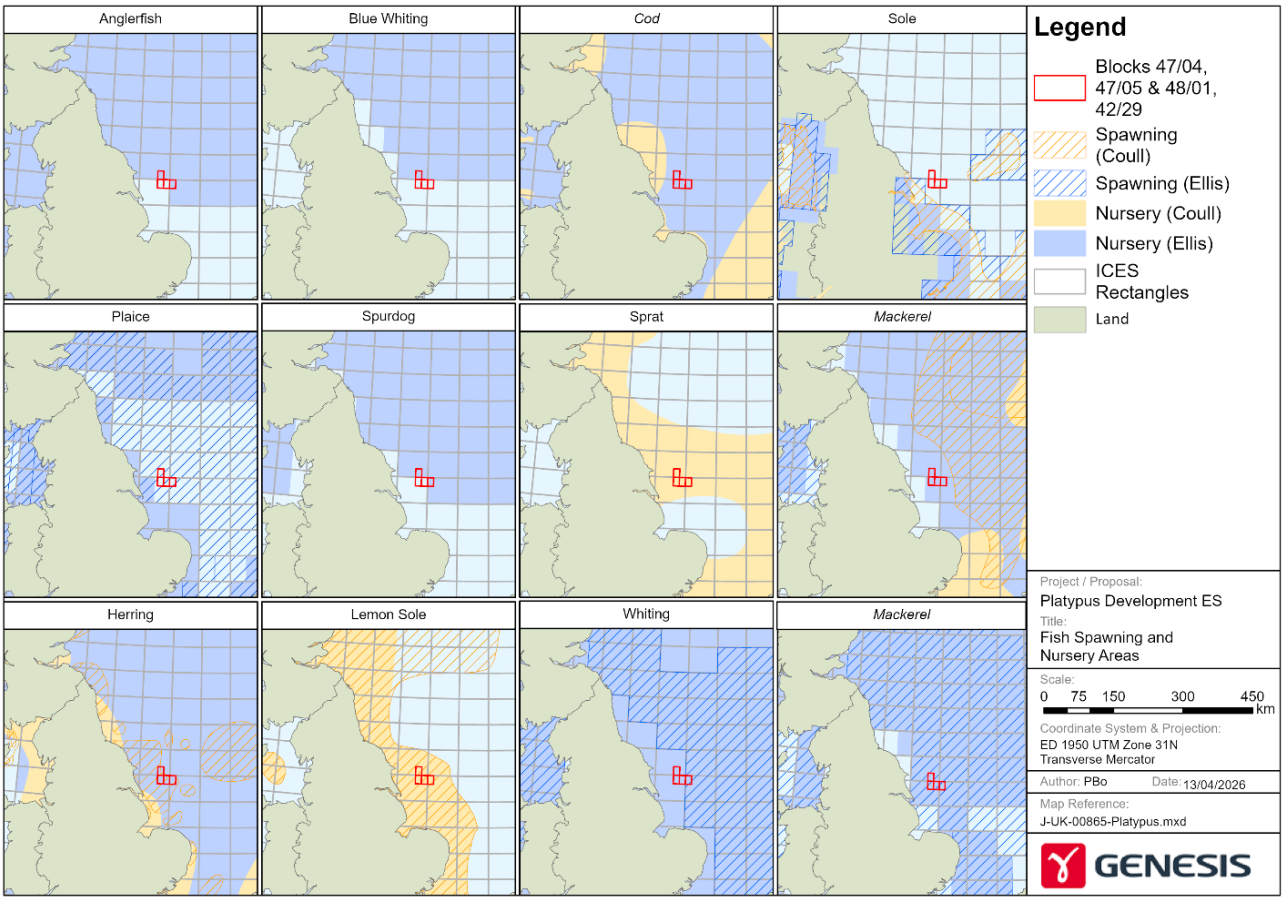


Figure 5-11: Spawning and nursery grounds for species known to occur in the vicinity of the proposed project area (Coull et al.,1998; Ellis et al., 2012).

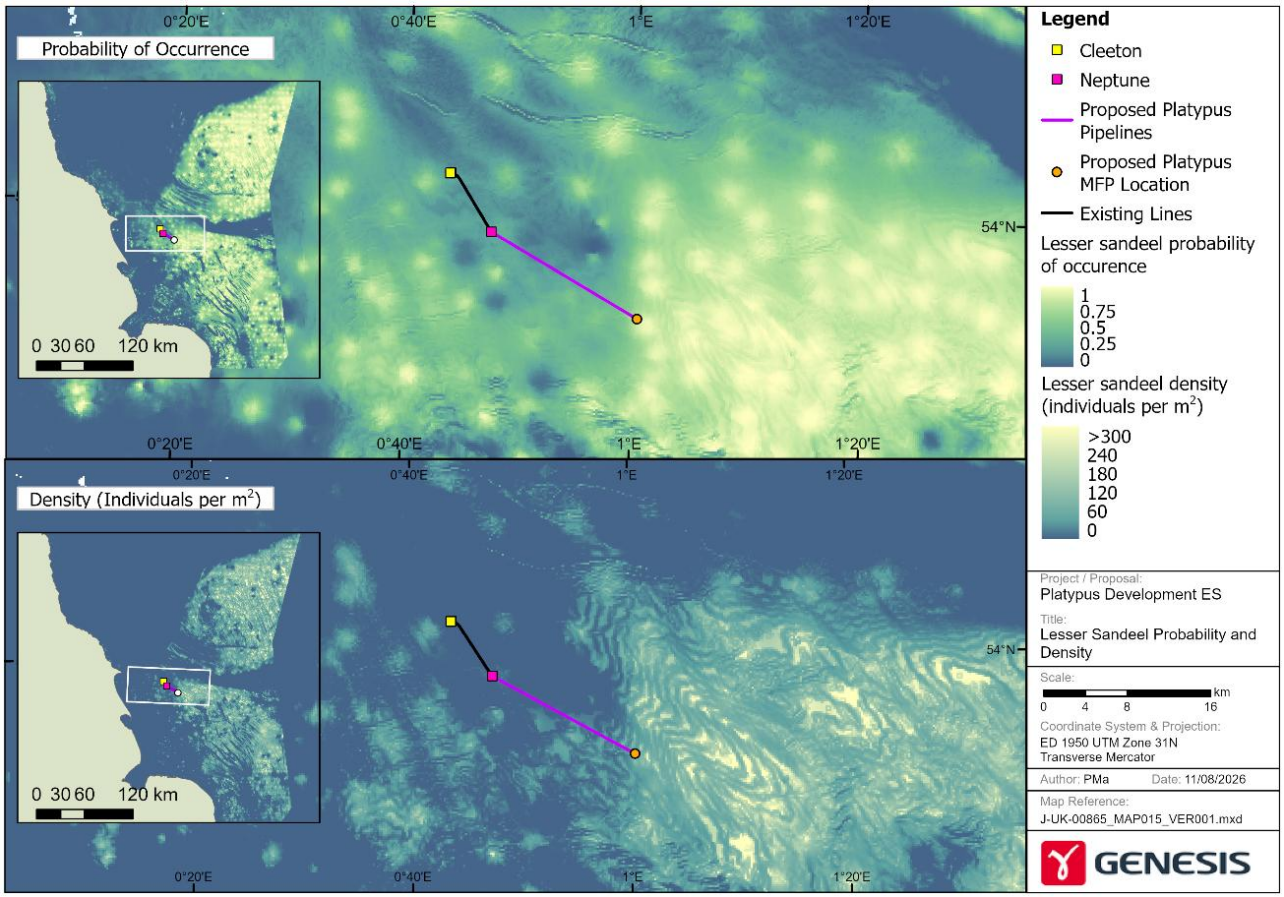


Figure 5-12: Probability of Lesser Sandeel Occurrence and Predicted Lesser Sandeel Density (Langton et. al., 2021).

5.3.4 Sharks, Skates and Rays

Sharks, skates and rays (elasmobranchs) have a cartilage, rather than a bony, skeleton and occur globally. Over 30 species have been recorded in Scottish waters.

Larger species such as the common skate take 15 years to reach maturity, while smaller species may mature in around six years. They are vulnerable to overfishing due to this slow growth rate combined with a slow breeding rate which mean that depleted populations take a long time to recover. Elasmobranchs reproduce by laying eggs or bearing live young which are fully developed prior to birth or hatching. This means they are large enough to be trapped in trawl nets or dredge gear and can often be caught as bycatch before they have chance to reproduce and consequently relatively few individuals reach breeding age. They are also vulnerable to habitat disturbance (Scottish Government, 2019b).

There are thought to be 27 species of skate in the north-east Atlantic (Ellis *et al*. 2015), of which many are present in UK waters. Among the most widespread are the thornback ray (*Raja clavata*) and the cuckoo ray (*Raja naevus*). The common skate (*Leucoraja batis*) is listed as "critically endangered" on the IUCN Red list.

The distribution of elasmobranchs in the UKCS is not extensively documented. According to Department for Business, Energy & Industrial Strategy (BEIS) (2022) the most common species recorded in UK waters are:

Sharks

- Lesser spotted dogfish (*Scyliorhinus canicular*);
- Greater spotted dogfish (*Scyliorhinus stellaris*);
- Spurdog (*Squalus acanthias*);
- Tope shark (*Galeorhinus galeus*);

Skates and rays

- Thornback Ray (*Raja clavata*);
- Cuckoo ray (*Raja naevus*);
- Starry ray (*Amblyraja radiata*);
- Blonde ray (*Raja brachyura*);
- Small-eyed ray (*Raja microocellata*);
- Undulate ray (*Raja undulata*);
- Spotted ray (*Raja montagui*).

Sightings of common skate (*Leucoraja batis*), porbeagle (*Lamna nasus*) and basking shark (*Cetorhinus maximus*) are rare (BEIS, 2022). The common skate is generally thought to be limited to the northwest of Scotland and basking sharks are primarily sighted on the west coast of the UK, with limited sightings reported on the east coast (BEIS, 2022).

5.3.5 Seabirds

The UK is important for a range of internationally important seabird species due to its extensive network of cliffs, sheltered bays, coastal wetlands, estuaries and surrounding seas (DESNZ, 2022). Seabird distribution and abundance in the offshore areas, in general, peaks following the breeding season and throughout the winter. Seabirds are distributed closer inshore during the breeding season, foraging closer to coastal breeding colonies in spring and early summer.

Predicted maximum monthly abundance of seabirds in the area is based on an analysis of the European Seabirds at Sea data collected over 30 years (Kober *et al*., 2010). Continuous seabird density surface maps were generated using the spatial interpolation technique 'Poisson kriging' and fifty-seven seabird density surface maps were created to show particular species distribution in specific areas. Data from the relevant maps has been summarised for the area of interest (Table 5-3).

Distribution and abundance of these bird species vary seasonally and annually. The majority of species present exist at low densities of <1 – 5 individuals per km^2 throughout both winter and breeding seasons.

The Black-legged kittiwake, common guillemot, and northern fulmar are the species with the greatest predicted densities within the project area. Black-legged kittiwake and common guillemot had the highest predicted winter density with 48 individuals per kilometres squared (km^2), and the highest predicted breeding density with 35 and 13 individuals per km^2 respectively.

Total predicted seabird density peaks in September with 116 individuals per km^2. Total predicted seabird density exceeds 100 individuals per km^2 from September to February, with predicted densities, ranging from 40 – 90 during the period of March to July.

Table 5-3: Predicted monthly seabird surface density (maximum number of individuals/km2) at the Project area (Kober et al., 2010).

Species	Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern Fulmar	Breeding												
	Winter												
Sooty Shearwater	Summer												
Manx Shearwater	Breeding												
European Storm Petrel	Breeding												
Leach's Storm-Petrel	Breeding												
Northern Gannet	Breeding												
	Winter												
Pormarine Skua	Additional (1)												
	Additional (2)												
Arctic Skua	Breeding												
	Additional												
Great Skua	Breeding												
	Winter												
Black-legged Kittiwake	Breeding												
	Winter												
Black-headed gull	Breeding												
Little gull	Additional												
Great Black-backed Gull	Breeding												
	Winter												
Common Gull	Breeding												
	Winter												
Lesser Black-backed Gull	Breeding												
	Winter												
Herring Gull	Winter												
Common Tern	Breeding												
Arctic Tern	Breeding												
Common Gulliemot	Breeding												
	Winter												
	Additional												
Razorbill	Breeding												
	Winter												
	Additional												
Little Auk	Winter												
Atlantic puffin	Breeding												
	Winter												
Total breeding													
Total winter													
Total additional													
Total summer													
Total seabirds													

Key	0.001 - 1	1 - 5	5 - 20	20 - 50	50 - 85	85 - 100	100 – 117

Seabirds are generally not at risk from routine offshore oil and gas production operations. However, they may be vulnerable to pollution from less regular offshore activities such as accidental hydrocarbon discharges. Oily surface pollution can cause direct toxicity to birds through ingestion and / or hypothermia as a result of the birds' inability to waterproof their feathers.

Seabirds will generally be most vulnerable to the impacts of an oil spill during the post-breeding season (July to September) when breeding birds disperse away from their breeding colonies into the North Sea. Some species, (e.g., guillemots and razorbills), rapidly moult their wing feathers and become flightless for approximately six weeks and consequently spend large amounts of time on the water surface. This significantly increases their vulnerability to the impacts of oil between July and September.

Fulmars (*Fulmarus*. *glacialis*) and auks (*Alcidae* spp.) may be particularly vulnerable to surface pollutants as they spend the majority of their time on the surface of the water. Gulls and terns are less vulnerable as they spend a larger proportion of their time flying and therefore less time on the sea surface (Stone *et al*., 1994).

Using survey data from 1995 – 2015, a Seabird Oil Sensitivity Index (SOSI) has been published (JNCC, 2017). The purpose of the index is to identify areas where seabirds are likely to be most sensitive to oil pollution by considering factors that make a species more or less sensitive to oil-related impacts. Data were collected from a wide survey area extending beyond the UK Continental Shelf using boat-based, visual aerial, and digital video aerial survey techniques.

This seabird data was combined with individual seabird species sensitivity index values. These index values are based on a number of factors which are considered to contribute towards the sensitivity of seabirds to oil pollution. Factors such as:

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

The combined seabird data and species sensitivity index values are subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution. This is presented as a series of fine scale density maps for each month that show the median, minimum, and maximum seabird sensitivity to oil pollution, and an indication of data confidence. The index is independent of where oil pollution is most likely to occur; rather, it indicates where the highest seabird sensitivities might lie if there were to be a pollution incident.

The mean sensitivity SOSI data for the proposed Platypus Development area is shown in Table 5-4. For blocks with 'no data', an indirect assessment has been made based upon guidance from JNCC (JNCC, 2017) where possible.

As can be seen from the data available and the indirect assessment, the sensitivity of seabirds to surface pollution within and adjacent to the proposed Platypus Development varies throughout the year. For the majority of Blocks sensitivity ranges from low to extremely high throughout the year. In Block 47/04 sensitivity is extremely high in January. In Block 47/05 sensitivity is extremely high in January, February, October, November, and December. In Block 48/01 sensitivity is extremely high in January, June, September, October, November, and December.

Table 5-4: SOSI Indirect Assessment for the proposed Platypus Development area Blocks (JNCC, 2017).

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
47/04	5	1	2	2*	5	2	4	3	3	3*	4	4
47/05	1*	1	2	2*	5	2	3	2	3	1*	1	1
47/09	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
48/01	1*	2	2	2*	5	1	3	2	1	1*	1*	1
48/02	1*	2	1	1*	2	2	2	3	1	1*	1*	1
48/06	2	2	2	2*	5	5	3	3	2	2	2	1
48/07	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

** Data gap filled using data from the same block in adjacent months.*

Red box highlights the project area blocks

5.3.6 Marine Mammals

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

5.3.6.1 Pinnipeds

Two species of seal are resident in British waters: the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Although both species are Annex II species, they are not listed on Annex IV of the EU Habitats Directive, and as such are not classified as EPS. Seals are protected in the UK under the Conservation of Seals Act 1970, and the harbour seal is classed as a Feature of Conservation Interest (FOCI).

Both grey seals and harbour (also called common) seals tend to frequent inshore waters but have been seen offshore from a number of platforms in the North Sea (Cosgrove, 1996).

During a study by Carter *et al* (2022) grey (n = 114: 45 male, 69 female) and harbour seals (n = 239: 107 male, 132 female) were tagged at 26 sites in the UK and Ireland between (2005 – 2019). Haul-out counts were scaled to total population size for UK and Ireland using the mean estimated proportion of the population hauled-out during the survey window (and thus available to count). Total population size was then scaled to at-sea population size using the mean estimated proportion of time seals spend at-sea based off the telemetry data gathered during the study period.

Telemetry data were analysed at a 5 km^2 cell resolution, enabling the percentage of the at-sea population for the UK and Ireland (i.e. excluding hauled-out animals) present in each cell at any one time to be estimated. The resulting distribution maps indicate that harbour seals may occur in low numbers, and grey seals are likely to occur in the areas of operation (Carter *et al*., 2022; Figure 5-13).

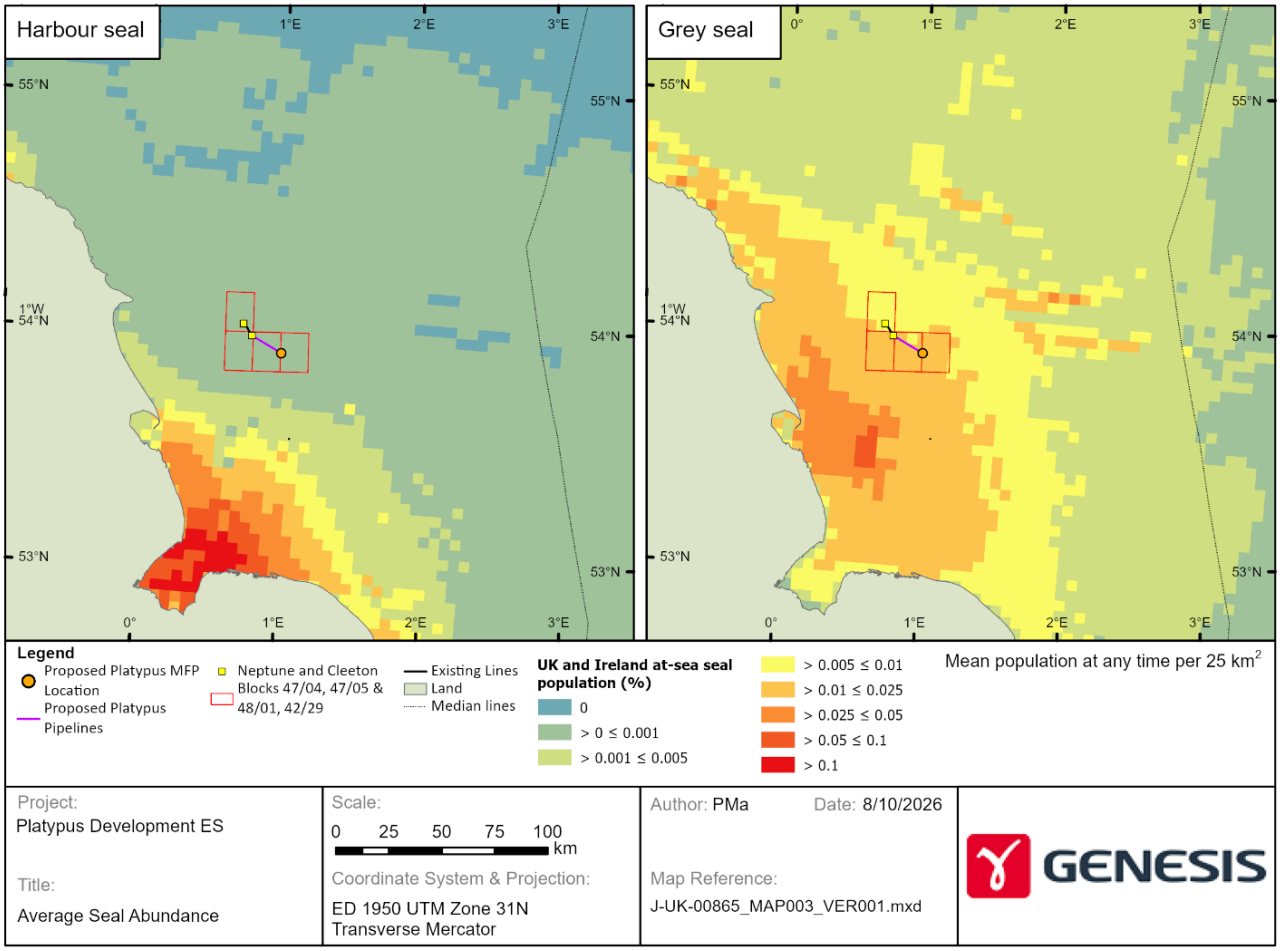


Figure 5-13 Mean UK and Ireland at-sea seal population distribution in the vicinity of the proposed Pegasus West Development (Carter et al., 2022).

5.3.6.2 Cetaceans

Many activities associated with the offshore oil and gas industry have the potential to impact on cetaceans by causing physical injury, disturbance, or changes in behaviour (JNCC, 2008).

A series of Small Cetacean Abundance in the North Sea (SCANS) surveys have been conducted to obtain an estimate of cetacean abundance in the North Sea and adjacent waters, the most recent of which is SCANS-IV (Gilles *et al*., 2023). Aerial and shipboard surveys were carried out during the summer of 2022. The report summarises design-based estimates of abundance for those cetacean species for which sufficient data were obtained during SCANS-IV: harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncates*), Risso's dolphin (Grampus griseus), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), short-beaked common dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*), long-finned pilot whale (*Globicephala melas*), beaked whales (all species combined; Cuvier's beaked whale (*Ziphius cavirostris*), Sowerby's beaked whale (*Mesoplodon bidens*) and unidentified beaked whale, fin whale (*Balaenoptera physalus*) and minke whale (*Balaenoptera acutorostrata*).

The Platypus Development is located within SCANS-IV survey area "NS-C". Aerial survey estimates of animal abundance and densities (animals per km^2) within this area are provided in Table 5-5 (Gilles *et al*., 2023). The data suggest that harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin and minke whale may occur in the area

Table 5-5: Cetacean Abundance in SCANS-IV Survey Block NS-C (Gilles et al., 2023).

Species	Block NS-C	
	Animal Abundance	Density (animals/km^2)
Harbour Porpoise	36,286	0.6027
Bottlenose Dolphin	2,520	0.0419
White-beaked Dolphin	894	0.0149
Short-beaked Common Dolphin	192	0.0032
Minke Whale	412	0.0068

The JNCC has compiled an Atlas of Cetacean Distribution in Northwest European Waters (Reid *et al.*, 2003) which gives an indication of the seasonal distribution and abundance of cetacean species in the North Sea. The Reid *et al.* (2003) data broadly aligned with the SCANS-IV data, showing that harbour porpoise, bottlenose dolphin, white-beaked dolphin, Atlantic white-sided dolphin, and minke whale have been observed in the area of the proposed Platypus Development (Table 5-6). All cetaceans are EPS and are listed under Annex IV of the EU Habitats Directive. Harbour porpoises are granted further protection under Annex II of the EU Habitats Directive.

Table 5-6 Seasonal cetacean sightings within the proposed Platypus Development area.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harbour porpoise		2	2	1	1	2	3	3	2	1	1	1
Bottlenose dolphin							2	2				
White-beaked dolphin	1		1	2		2	1	1	1		1	1
Atlantic white-sided dolphin								1				
Minke whale								1	2			
Key: 1 = Low; 2 = Moderate; 3 = High.												

5.4 Protected Areas

A network of Marine Protected Areas (MPAs) is in place to aid the protection of vulnerable and endangered species and habitats through structured legislation and policies. These sites include SAC and SPA, which were designated in the UK under the EU Nature Directives (prior to January 2021) and are now maintained and designated under the Habitats Regulations for England and Wales, Scotland, and Northern Ireland.

Amendments to the Habitats Regulations mean that the requirements of the EU Nature Directives continue to apply to how European sites (SACs and SPAs) are designated and protected. The Habitats Regulations also provide a legal framework for species requiring strict protection, e.g., EPS. Rare, special or threatened European species are protected within SACs, and important bird species are protected within SPAs. Marine Conservation Zones (MCZ) are designated to protect national features and habitats including wildlife, geology and geomorphology. The conservation objectives of these areas are for them to be of a 'favourable condition' whether this be a state maintained or a condition for the area to improve and reach.

The protected areas in vicinity of the proposed Platypus pipeline are shown in Figure 5-14.

Southern North Sea SAC area is designated for the protection of Annex II species, harbour porpoises, encompassing their summer and winter habitats. The sites integrity is maintained through there being no

significant disturbance to the species nor the conditions supporting the habitat including the availability of prey. The status of the site is favourable and is managed by JNCC and Natural England due to its position encompassing both offshore and inshore (within 12 nautical mile limit) waters. When designated in 2019, the SAC was the largest protected area in UK and European waters covering 36,951 km^2. The Southern North Sea SAC's boundaries were determined upon data modelling harbour porpoise densities over an 18-year period (JNCC, 2023d).

Holderness Offshore MCZ is 11.5 km southwest of the proposed Platypus MFP. Protected features include subtidal coarse sediment, subtidal sand, subtidal mixed sediments, ocean quahog (*A. Islandica*) and North Sea glacial tunnel valleys (JNCC, 2020d). It covers 1,176 km^2 and was first proposed for designation in 2011 to DEFRA and the Statutory Nature Conservation Bodies (SNCBs) before official designation being granted in 2019. The 2016 bottom trawl survey identified ocean quahog individuals. As the Holderness Offshore MCZ straddles each side of the 12 nautical mile zone, it is managed by the JNCC and Natural England.

The coastal SPA, Greater Wash spans *c*. 3,536 km^2 (JNCC, 2018d) and protects seabirds during their non-breeding and breeding season. The SPA supports the largest breeding populations of little terns (*Sternula albifrons*) in the UK SPA network and also supports populations of red-throated diver (*Gavia stellata*) (*c.* 1,407 individuals) and little gull (*Hydrocoloeus minutus*) (*c*. 1,255 individuals). As the Greater Wash area straddles each side of the 12 nautical mile zone, it is managed by both regulatory bodies, JNCC and Natural England.

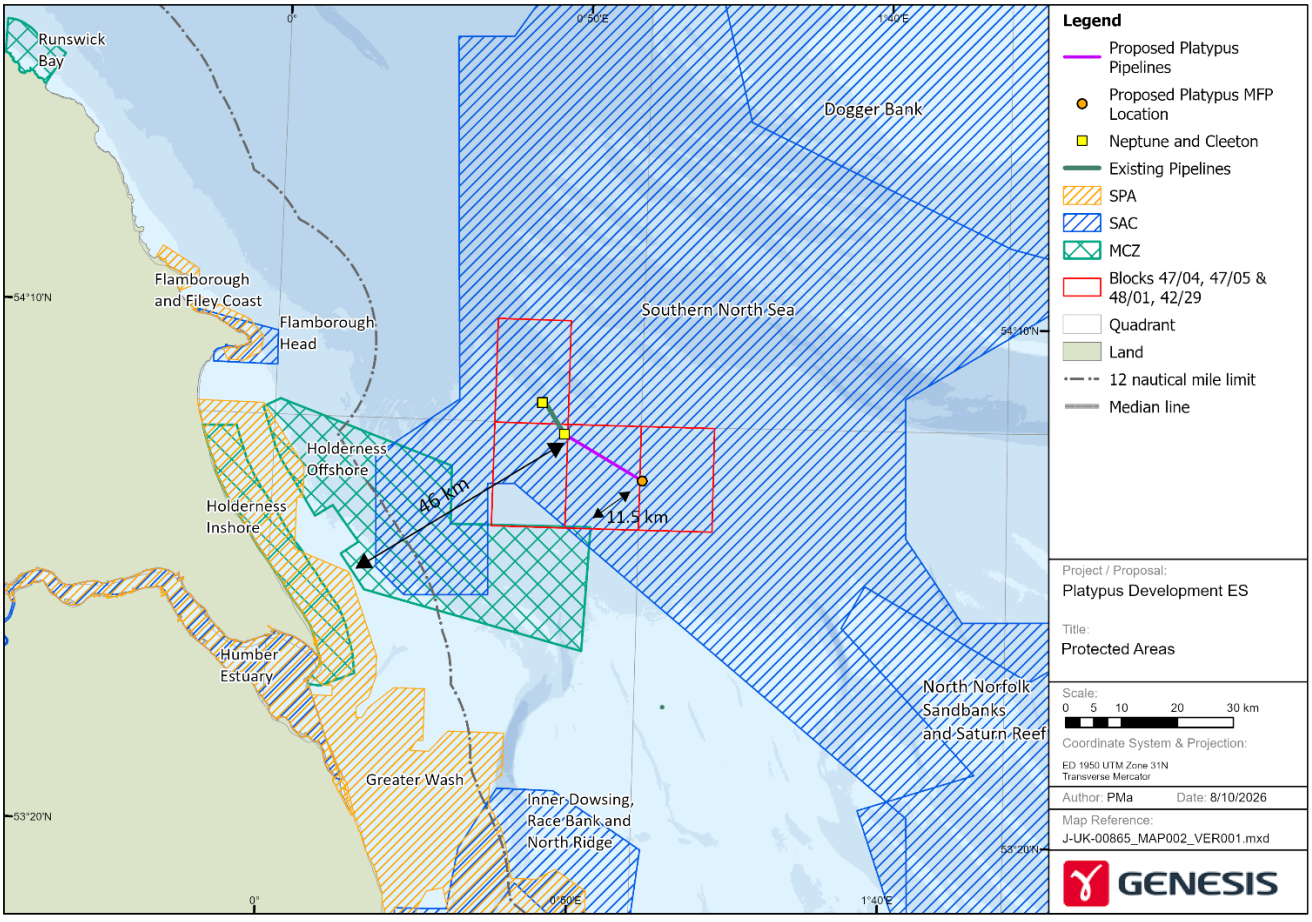


Figure 5-14: Protected Areas in vicinity of project area.

5.5 Potentially Sensitive Habitats and Species

Sensitivity is the intolerance of a species or habitat to damage from a pressure, and it incorporates the time taken for the species/habitat subsequent recovery (Laffoley *et al.,* 2000; Tyler-Walters and Hiscock 2005)

Numerous sensitive habitats and species occur in the proposed project area, defined under various legislative and other mechanisms:

- Annex I habitats (listed in Annex I of the Habitats Directive);
- Annex II species (listed in Annex II of the Habitats Directive);
- Annex I bird species (listed in Annex I of the Birds Directive);
- EPS (listed in Schedule II of the Habitats Regulations);
- FOCI (JNCC, 2016); FOCIs include species and habitats of conservation interest;
- OSPAR list of threatened and/or declining habitats and species (OSPAR, 2023);
- Species and Habitats of Principal Important in England (DEFRA, 2022); listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006, the species and habitats listed are of principal importance for conserving biodiversity in England.
- International Union for Conservation of Nature (IUCN) Red List of Threatened Species. The Red List divides species into categories: Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinct in the Wild (EW), Extinct (EX) (IUCN, 2023).

5.5.1 Sensitive Habitats

As described in Section 5.3.2, the seabed across the Platypus survey areas conformed to the 'Faunal communities in the Atlantic offshore circalittoral sand' (MD521) habitat. This habitat is an illustrative biotope of the HPI habitat 'subtidal sands and gravels' (DEFRA, 2022). This habitat is the most common subtidal habitat in the UKCS; however, it faces several existing and potential threats. These threats include pollutants in riverine discharge, trawling and dredging, aggregate extraction, pollutants from aquaculture, and oil exploration (JNCC, 2008).

No other sensitive habitats were identified in the Platypus area.

5.5.2 Sensitive and Protected Species

Table 5-7 lists the main sensitive and protected species that may be present within the proposed Project area, their conservation status and protected status.

Table 5-7: Sensitive and protected species potentially within the proposed Platypus Development area.

Species		Trend[1]	IUCN[2]	Habitats Directive (Annex II species)	Birds Directive (Annex I species)	EPS	OSPAR [3]	SPI	FOCI
Fish									
Anglerfish	*Lophius piscatorius*	Unknown	LC	No	-	No	No	Yes	No
Blue whiting	*Micromesistius poutassou*	Unknown	LC	No	-	No	No	Yes	No
Cod	*Gadus morhua*	Unspecified	VU	No	-	No	II & III	Yes	No
Haddock	*Melanogrammus aeglefinus*	Unspecified	VU	No	-	No	No	No	No
Herring	*Clupea harengus*	Increasing	LC	No	-	No	No	Yes	No
Horse mackerel	*Trachurus trachurus*	Decreasing	VU	No	-	No	No	Yes	No
Lemon sole	*Microstomus kitt*	Stable	LC	No	-	No	No		No

Species		Trend[1]	IUCN[2]	Habitats Directive (Annex II species)	Birds Directive (Annex I species)	EPS	OSPAR [3]	SPI	FOCI
Mackerel	*Scomber scombrus*	Decreasing	LC	No	-	No	No	Yes	No
Plaice	*Pleuronectes platessa*	Increasing	LC	No	-	No	No	Yes	No
Sandeels	*Ammodytes marinus*	Unknown	LC	No	-	No	No	Yes	No
Spotted ray	*Raja montagui (Dipturus montagui)*	Stable	LC	No	-	No	II & III	No	No
Spurdog (spiny dogfish)	*Squalus acanthias*	Decreasing	EN	No	-	No	II & III	Yes	No
Whiting	*Merlangius merlangus*	Unknown	LC	No	-	No	No	Yes	No
Seabirds									
Arctic skua	*Stercorarius parasiticus*	Decreasing	LC	-	No	No	No	No	No
Arctic tern	*Sterna paradisaea*	Decreasing	LC	-	Yes	No	No	No	No
Atlantic puffin	*Fratercula sterna*	Decreasing	VU	-	No	No	No	No	No
Black-headed gull	*Larus ridibundus*	Unknown	LC	-	No	No	No	No	No
Black-legged kittiwake	*Rissa tridactyla*	Decreasing	VU	-	No	No	I, II & III	No	No
Common gull	*Larus canus*	Unknown	LC	-	No	No	No	No	No
Common guillemot	*Uria aalge*	Increasing	LC	-	No	No	No	No	No
Common tern	*Sterna hirundo*	Unknown	LC	-	Yes	No	No	No	No
European storm-petrel	*Hydrobates pelagicus*	Unknown	LC	-	Yes	No	No	No	No
Great black-backed gull	*Larus marinus*	Stable	LC	-	No	No	No	No	No
Great skua	*Stercorarius skua*	Increasing	LC	-	No	No	No	No	No
Herring gull	*Larus argentatus*	Decreasing	LC	-	No	No	No	No	No
Leach's storm-petrel	*Oceanodroma leucorhoa*	Decreasing	VU	-	Yes	No	No	No	No
Lesser Black-backed gull	*Larus fuscus*	Increasing	LC	-	No	No	I	No	No
Little auk	*Alle alle*	Decreasing	LC	-	No	No	No	No	No
Manx shearwater	*Puffinus puffinus*	Unknown	LC	-	Yes	No	No	No	No
Northern fulmar	*Fulmarus glacialis*	Decreasing	LC	-	No	No	No	No	No
Northern gannet	*Morus bassanus*	Increasing	LC	-	No	No	No	No	No
Pomarine skua	*Stercorarius pomarinus*	Unknown	LC	-	No	No	No	No	No

Species		Trend[1]	IUCN[2]	Habitats Directive (Annex II species)	Birds Directive (Annex I species)	EPS	OSPAR [3]	SPI	FOCI
Razorbill (lesser auk)	*Alca torda*	Increasing	LC	-	No	No	No	No	No
Sooty Shearwater	*Puffinus griseus*	Decreasing	NT	-	No	No	No	No	No
Marine Mammals									
Minke whale	*Balaenoptera acutorostrata*	Unknown	LC	No	-	Yes	No	Yes	No
Bottlenose dolphin	*Tursiops truncatus*	Unknown	LC	Yes	-	Yes	No	Yes	No
Short-beaked common dolphin	*Delphinus delphis*	Unknown	LC	No	-	Yes	No	Yes	No
White-beaked dolphin	*Lagenorhynchus albirostris*	Stable	LC	No	-	Yes	No	Yes	No
Harbour porpoise	*Phocoena phocoena*	Decreasing	VU	Yes	-	Yes	II & III	Yes	No
Harbour seal	*Phoca vitulina*	Unknown	LC	Yes	-	No	No	Yes	No

IUCN Key				
	DD - Data Deficient	LC - Least Concern	NT - Near Threatened	VU - Vulnerable
	EN - Endangered	CR - Critically Endangered	EW - Extinct in the Wild	EX - Extinct

[1] Population trend (IUCN Red List). Where available, the geographic area shown is 'Europe', otherwise it is 'Global' (IUCN, 2023)
[2] IUCN category (IUCN, 2023)
[3] OSPAR list of threatened and/or declining species (Regions II & III) (OSPAR, 2023)

5.5.3 MarSEA

The Marine Evidence-based Sensitivity Assessment (MarESA) approach replaced the 1999-2010 Marine Life Information Network (MarLIN) assessment approach. These assessments incorporate the intolerance and recoverability features have to physical, chemical and biological pressures. The combination of intolerance and recoverability indicates the features sensitivity to pressures including physiological pressures such as desiccation and increase in temperature.

The MarESA and MarLIN sensitivity assessments are generic as there are not absolute values; they are based on the magnitude of a pressure without accounting for spatial or temporal scale. The resilience of features is location dependent, due to the environmental factors of size of local population, isolation level, sea temperature, and oceanic currents. This creates a highly conservative guidance on sensitive features and their limitations, which does help in situations with multi-stressor environmental conditions.

Upon review of the MarSEA catalogue no assessed features were found to be within the project blocks.

5.5.4 FeAST

The associated Feature Activity Sensitivity Tool (FeAST) pressures resulting from the activity of oil and gas infrastructure development are listed in Table 5-8. FeAST builds upon MarLIN to be a tool with an updated evidence base. Details as to the benchmarks for each pressure can be found on the JNCC website. Features include both habitats and species wherein their loss of population may result in changes in habitat classification. In Table 5-8, the potential presence of features in project blocks are assessed according to UK biotopes map and known records of presence locally (JNCC, 2025).

The potential of a feature being present does not represent the confirmation of the feature being present. A feature being 'not sensitive' to a pressure indicates it has a high resistance and is likely to recover quickly; conversely a high sensitivity, occurs when the resistance and resilience of a feature to a pressure is low. 'Sensitive' was listed where there was not enough information available to assign the feature a final sensitivity score, and concern for the species is still highlighted. Pressures of which features have a high sensitivity to are listed in the following subsections.

Table 5-8: FeAST Assessment.

Feature	Pressures														Potential presence in Project Blocks[2,3]
	Hydrocarbon & PAH contamination	Organic Enrichment	Physical change	Physical Removal	Removal of Target Species (including lethal)	Siltation Rate Changes (Heavy)	Siltation Rate Changes (Light)	Sub-surface abrasion / penetration	Surface Abrasion	Synthetic compound contamination	Transition elements & organo-metal contamination	Water clarity changes	Water flow changes	Wave exposure changes	
Fish															
Sandeels	L	M	H	H	H	H	M	H	M	S	S	-	L	NS	Y
Geomorphological Feature															
Sediment Waves (Shelf)	-	-	M	M	-	NS	-	L	NS	-	-	M	H	L	Y

Sensitivity index													
-	Not assessed / relevant	NS	Not Sensitive	S	Sensitive	L	Low	M	Medium	H	High

Note: No inshore, coastal or shelf subtidal features are included in this table. 'Y' highlights feature present in Project Blocks according to UK biotopes map and records of presence.

Sources: [1]JNCC, EMODnet UK biotopes (2023), [2]MarLIN (2025), [3]Ocean Biodiveristy Information System (OBIS) (2025)

5.6 Socio-Economic Environment

This section describes the socio-economic activities and potential receptors in the vicinity of the proposed Platypus Development.

5.6.1 Commercial Fisheries

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

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

5.6.1.1 Fishing Effort

Fishing effort statistical data, of UK vessels over 10 m in length, between 2020 and 2024 for ICES rectangle 36F0 and 36F1 is provided in Table 5-9 (Scottish Government Marine Directorate [SGMD], 2025). There is an increase in fishing effort in the summer months compared to winter months, with activity peaking in July and August. Fishing effort in ICES 36F0 comprised an average of 3.2% (2.4% - 3.7%) of UK total fishing effort between 2020 and 2024. Fishing effort is lower in ICES 36F1 comprised an average of 0.9% (0.6% - 1.1%) of UK total fishing effort between 2019 and 2023.

Table 5-9 Summary of fishing effort in ICES rectangle 36F0 and 36F1 (SGMD, 2025).

Year	Monthly Fishing Effort [1]												Total	UK total	% of UK
	J	F	M	A	M	J	J	A	S	O	N	D			
ICES Rectangle 36F0															
2020	134	101	130	75	221	218	307	309	352	287	242	188	2,563	104,678	2.4%
2021	292	126	209	235	281	230	345	373	343	319	276	229	3,258	105,977	3.1%
2022	209	112	249	259	343	275	353	370	294	316	275	178	3,232	95,516	3.4%
2023	175	165	219	199	307	344	436	388	314	384	218	214	3,365	96,131	3.5%
2024	138	226	248	273	332	351	446	399	292	320	229	145	3,398	92,322	3.7%
Mean	190	146	211	208	297	284	377	368	319	325	248	191	3,163	98,925	3.2%
ICES Rectangle 36F1															
2020	72	48	44	29	77	69	130	202	89	92	82	46	981	104,677.9	0.9%
2021	48	31	46	29	15	29	49	75	69	82	65	47	584	105,976.5	0.6%
2022	53	15	56	47	68	49	31	67	84	78	69	61	679	95,516.1	0.7%
2023	52	68	56	60	94	78	117	145	113	97	134	78	1,091	96,130.9	1.1%
2024	86	63	76	64	84	112	95	89	86	104	112	82	1,054	92,322.0	1.1%
Mean	62	45	56	46	68	67	84	116	88	91	92	63	878	98,925	0.9%

[1] Monthly effort data are shown for ICES rectangles where five or more UK vessels over 10 m undertook fishing activity on a given year. Rectangles in which fewer than five over 10 m vessels undertook fishing activity are identified but as the data is disclosive they are not shown.

5.6.1.2 Fishing Landings

The annual weight (te) and value (Great British Pound [GBP]) of landings from UK vessels into the UK and abroad, and foreign vessels into the UK for demersal, pelagic and shellfish species across 2020-2024 from ICES rectangles 36F0 and 36F1 are shown in Table 5-10.

Data shows that in both ICES rectangles, shellfish species dominated landings in both value and weight for the period of 2020 to 2024, followed by demersal species with pelagic species contributing the least landings in terms of both value and weight (SGMD, 2025). Of the two ICES rectangles, 36F0 contributed more, with an average contribution to UK shellfish landings of 6.01% in value and 4.6% by weight across the last five years. While 36F1 had an average contribution to UK shellfish landings of 1.3% in value and 1.99% by weight.

Table 5-10 Summary of fishery landings in ICES rectangle 36F0 and 36F1 (SGMD, 2025).

Year	Species	Variable	ICES rectangle total	UK total	% of UK total
ICES Rectangle 36F0					
2020	**Demersal**	Value (GBP)	22,276.62	177,603,349.49	0.01
		Weight (te)	20.5	116,517.2	0.02
	Pelagic	Value (GBP)	4,629.73	291,139,518.10	0.002
		Weight (te)	2.9	339,441.3	0.001
	Shellfish	Value (GBP)	9,067,977.29	179,360,854.10	5.1
		Weight (te)	3,170.2	73,727.0	4.3
2021	**Demersal**	Value (GBP)	27,828.45	173,292,073.13	0.02
		Weight (te)	31.0	99,316.3	0.03
	Pelagic	Value (GBP)	4,526.80	284,429,672.66	0.002
		Weight (te)	5.2	367,339.4	0.001
	Shellfish	Value (GBP)	15,908,932.44	214,218,804.00	7.4
		Weight (te)	4,022.5	74,801.7	5.4
2022	**Demersal**	Value (GBP)	19,179.85	167,087,022.58	0.01
		Weight (te)	11.3	95,049.5	0.01
	Pelagic	Value (GBP)	6,111.54	291,902,064.74	0.002
		Weight (te)	5.3	321,096.1	0.002
	Shellfish	Value (GBP)	14,491,016.90	228,733,494.42	6.3
		Weight (te)	3,434.8	68,439.9	5.0
2023	**Demersal**	Value (GBP)	32,753.02	180,002,198.13	0.02
		Weight (te)	17.4	101,918.7	0.02
	Pelagic	Value (GBP)	1,365.69	365,580,597.23	0.0004
		Weight (te)	1.3	374,852.4	0.0003
	Shellfish	Value (GBP)	15,850,502.84	256,538,149.28	6.2
		Weight (te)	2,977.8	71,885.8	4.1
2024	**Demersal**	Value (GBP)	17,674	188,523,050.34	0.01
		Weight (te)	6	99,562.7	0.01
	Pelagic	Value (GBP)	7,950	480,014,497.63	0.002
		Weight (te)	5	427,082.7	0.001
	Shellfish	Value (GBP)	10,778,438	213,716,112.46	5.04
		Weight (te)	2,964	67,835.9	4.37
ICES Rectangle 36F1					
2020	**Demersal**	Value (GBP)	-	177,603,349.49	0.0
		Weight (te)	0.0	116,517.2	0.0
	Pelagic	Value (GBP)	-	291,139,518.10	0.0

Year	Species	Variable	ICES rectangle total	UK total	% of UK total
		Weight (te)	0.0	339,441.3	0.0
	Shellfish	Value (GBP)	2,871,860.07	179,360,854.10	1.60
		Weight (te)	1,688.9	73,727.0	2.29
2021	**Demersal**	Value (GBP)	6,500.75	173,292,073.13	0.004
		Weight (te)	6.5	99,316.3	0.01
	Pelagic	Value (GBP)	973.70	284,429,672.66	0.0003
		Weight (te)	1.0	367,339.4	0.0003
	Shellfish	Value (GBP)	2,402,831.70	214,218,804.00	1.12
		Weight (te)	1,143.6	74,801.7	1.53
2022	**Demersal**	Value (GBP)	-	167,087,022.58	0.0
		Weight (te)	0.0	95,049.5	0.0
	Pelagic	Value (GBP)	-	291,902,064.74	0.0
		Weight (te)	0.0	321,096.1	0.0
	Shellfish	Value (GBP)	2,351,106.39	228,733,494.42	1.03
		Weight (te)	1,246.2	68,439.9	1.82
2023	**Demersal**	Value (GBP)	61,566.28	180,002,198.13	0.03
		Weight (te)	15.6	101,918.7	0.02
	Pelagic	Value (GBP)	-	365,580,597.23	0.0
		Weight (te)	0.0	374,852.4	0.0
	Shellfish	Value (GBP)	3,472,000.40	256,538,149.28	1.35
		Weight (te)	1,749.8	71,885.8	2.43
2024	**Demersal**	Value (GBP)	34,384	188,523,050.34	0.02
		Weight (te)	4	99,562.7	0.004
	Pelagic	Value (GBP)	-	480,014,497.63	0.0
		Weight (te)	0.0	427,082.7	0.0
	Shellfish	Value (GBP)	2,625,889	213,716,112.46	1.23
		Weight (te)	1,295	67,835.9	1.91

Data revealed that between 2020-2024 traps were the dominant gear type used in ICES rectangle 36F0 amounting to a cumulative total of 14,999 days of fishing effort. Other gear types used were dredges, seine nets, and trawls, amounting to a cumulative total of 731, 32, and 44 days respectively. ICES rectangle 36F1's dominant gear type was also traps, with a cumulative total of 4,250 days across the 2020-2024 period. Other gear types used were dredges, seine nets, and trawls. The total cumulative days for these gear types is unavailable as most of if not all years are recorded as disclosive data.

5.6.1.3 Fisheries Sensitivity Mapping and Displacement Modelling (FiSMaDiM)

Prompted by this growth in offshore renewables the Fisheries Sensitivity Mapping and Displacement Modelling (FiSMaDiM) project was undertaken between September 2022–August 2024, with the aim to improve understanding of how offshore windfarm development affects commercial fishing on the UKCS (Muench *et al.*, 2024). It combined detailed spatial mapping of UK fishing activity with agent-based modelling to assess how the fishing industry may adapt or be displaced by offshore wind developments. The project utilised economic indicators, to develop two fisheries Sensitivity Indices (1 and 2) which can help identify areas where fishing activity may be most affected should access be restricted or displaced.

- Index 1 is unweighted and measures the average economic importance of an area to the fishing industry. This index is used for baseline screening, highlighting areas where exclusion is likely to have the largest impact.

- Index 2 is weighted and identifies fishing areas that are both economically valuable and consistently valuable over many years. This index is used for assessing the potential long-term effects of permanent offshore developments.

The Indices are built on 10 years of data from 2012-2021, with data split out by gear type. Furthermore the project provided an average fishing activity from 2012 – 2021 by gear type.

Figure 5-15 and Figure 5-16 Indices 1 and 2 by gear type in the area around the proposed Platypus Development. As can be seen (Figure 5-15) the surrounding area is of low to moderate economic importance for fishers utilising demersal trawls, pelagic/midwater trawls, and Pots and traps. This economic importance is also shown to be consistent over time (Figure 5-16). This data suggest that fisheries industry in the area may be susceptible to displacement.

The 10-year average fishing activity by gear type (Figure 5-17) indicates that on average the area surrounding the proposed project is an area of low fishing activity for all gear types except Pots and Traps. This aligns with the most recent five years of landings data presented in Section 5.6.1.2, where shellfish dominate landings.

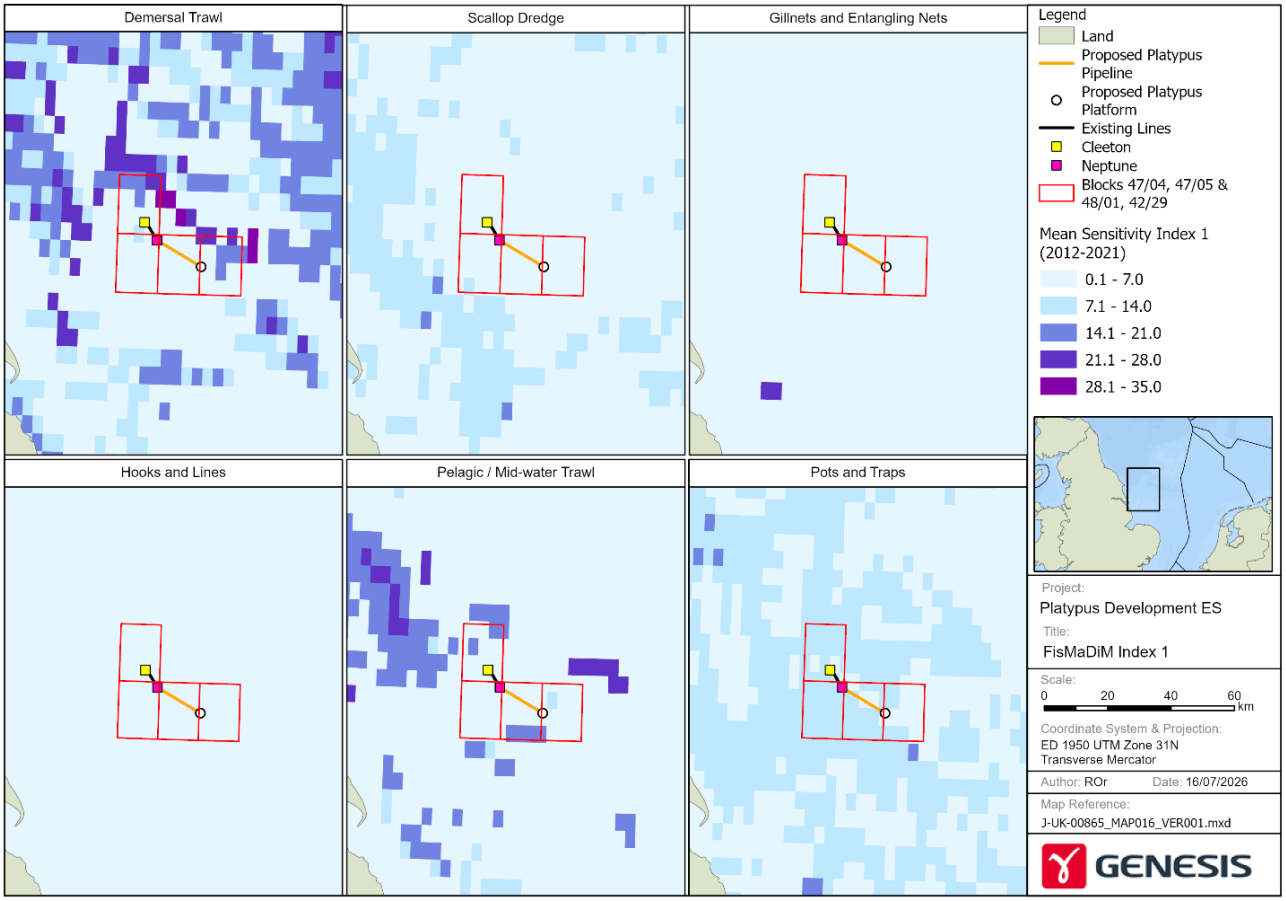


Figure 5-15: FiSMaDiM Index 1 (2012 – 2021) (Muench et al. 2024).

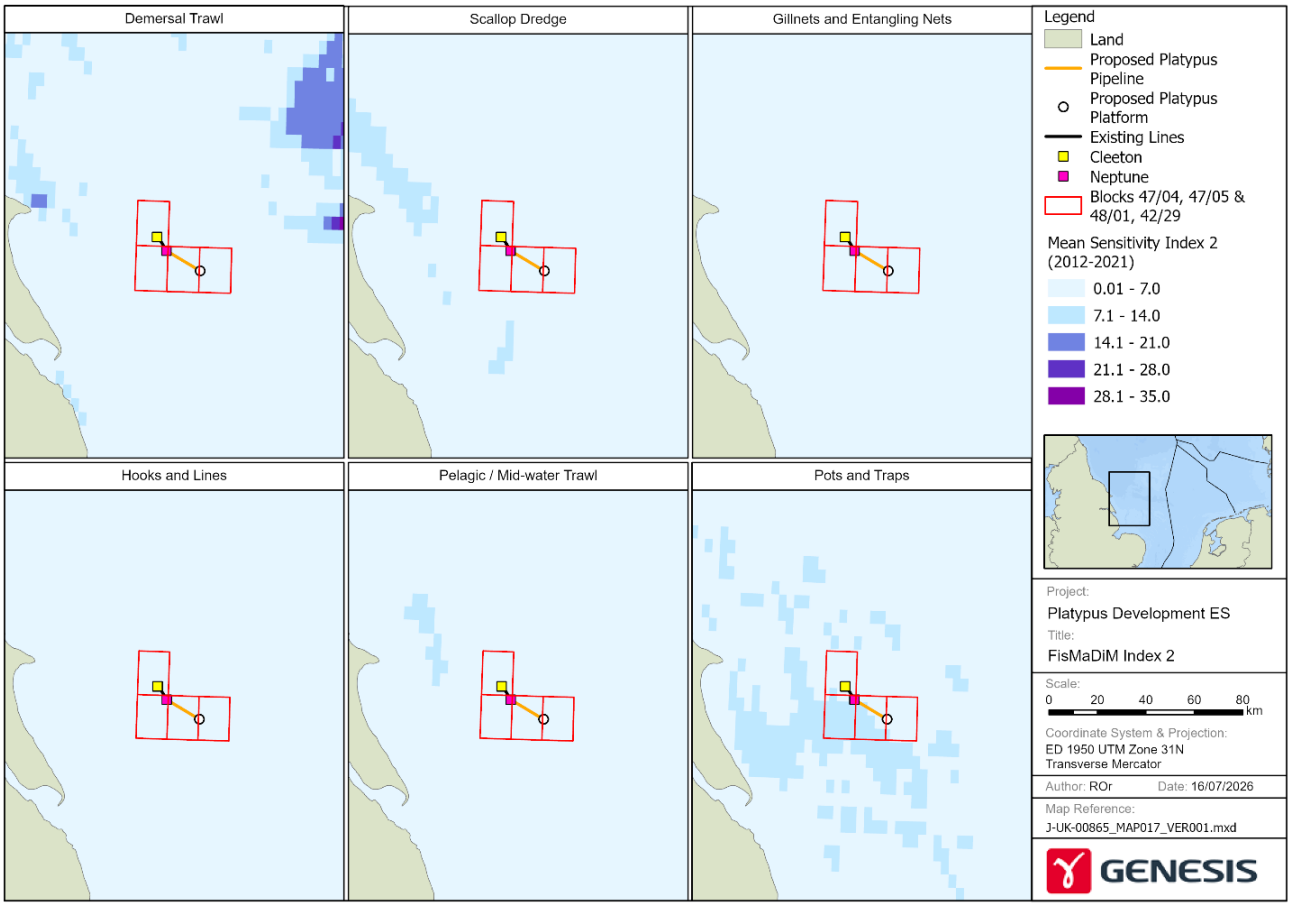


Figure 5-16: FisMaDiM Index 2 (2012 - 2021) (Muench et al., 2024).

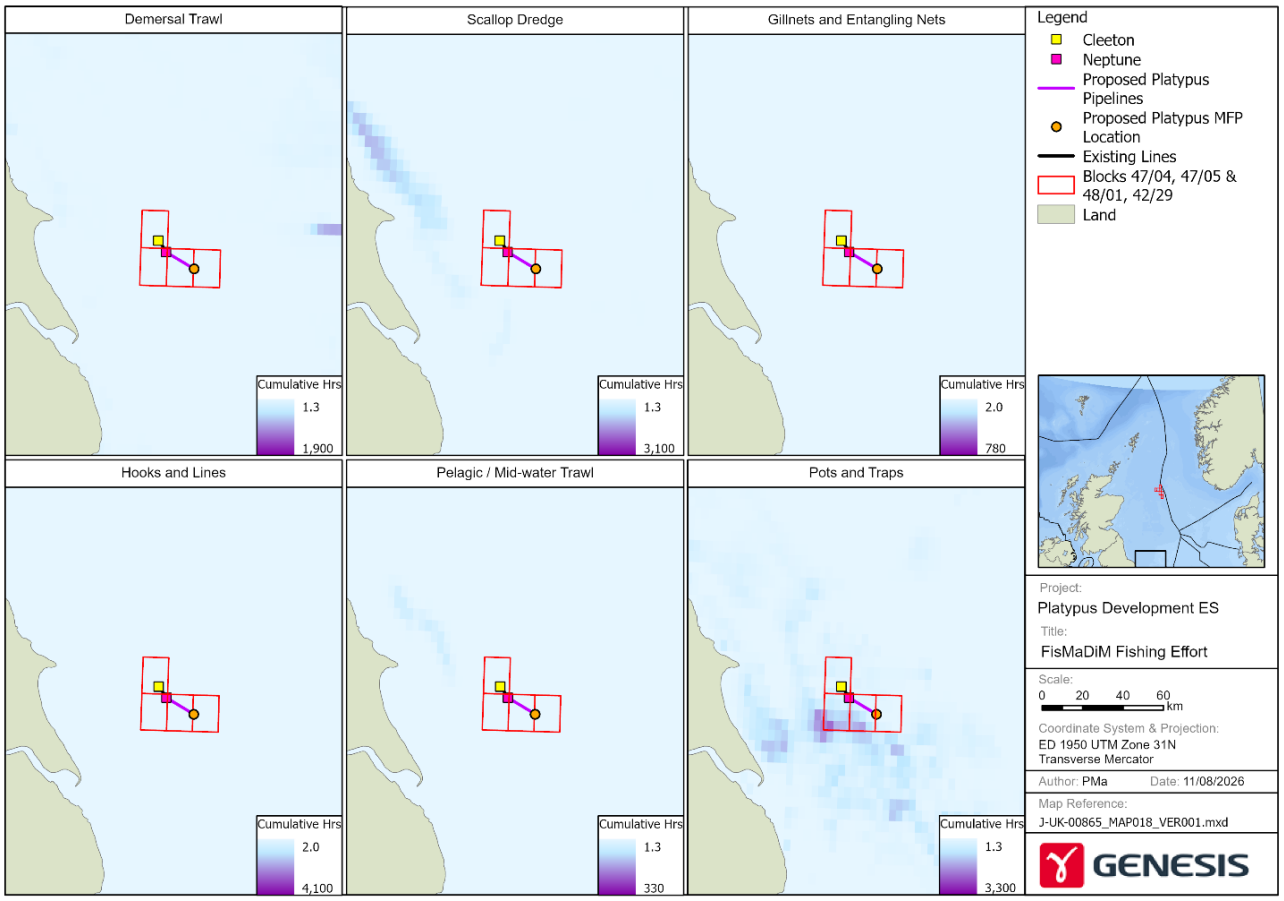


Figure 5-17: Average Fishing Activity by Gear Type 2012 - 2021 (Muench et al., 2024).

5.6.2 Vessel Density

The 2023 vessel densities in the North Sea have been presented by EMODnet (2024) as hours per km^2 per month. The vessel density in the vicinity of the proposed Platypus Development ranges from 0 to 20 hrs per km^2 per month (Figure 5-18). When compared to shipping levels throughout the North Sea, this can be considered relatively Low with the majority of the Project area within a vessel density of less than 10 vessel hours per km^2 per month.

Perenco contracted Anatec Limited to undertake a VTS and CRA (Anatec, 2026) for the Proposed Platypus MFP. The VTS determined that there are 56 identified shipping routes within 10 nm of the proposed platypus MFP location (Anatec, 2026). The routes are traversed by 4,595 vessels per year, approximately 13 vessels per day (Anatec, 2026). The ten closest (<2 nm) shipping route accounted for 17.3% of vessel traffic within 10 nm. Fishing activity was low, with an average of one fishing vessel passing within 10 nm of the proposed location every 2 days (Anatec, 2026).

CRA analysis determined the most likely collision scenario is contact between attendant vessels and the MFP, however the frequency of such a collision is low, approximately once every 390 years. This frequency decreases substantially when considering powered passing vessels, with an estimated frequency of once in 4,150 years (Anatec, 2026).

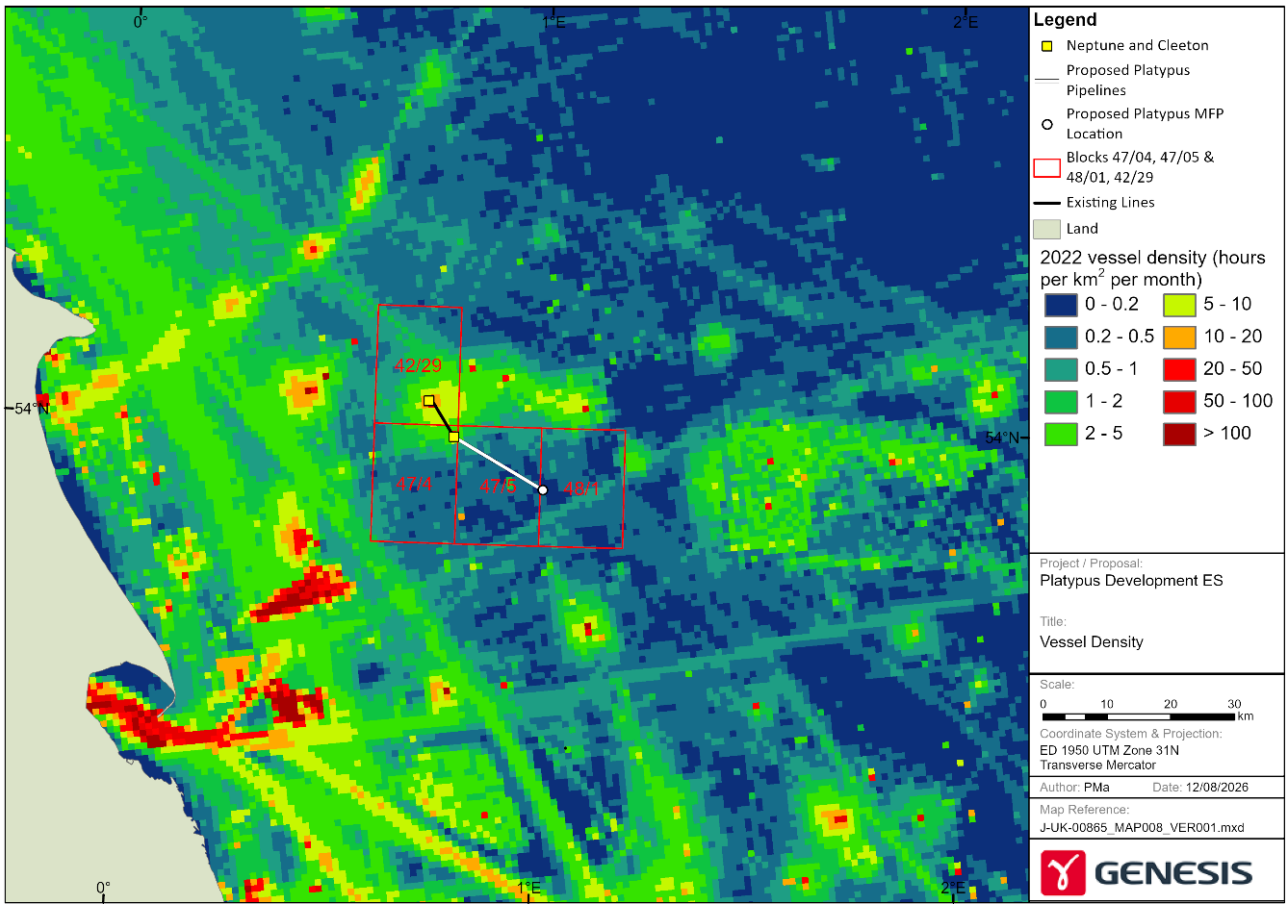


Figure 5-18: Vessel density in vicinity of the proposed Platypus Development (EMODnet, 2024).

5.6.3 Foul Ground and Wrecks

Across UK waters, there are a large number of ship and aircraft wrecks. While the location of many wrecks is known, there is a large proportion of lost vessels and aircraft whose location is not unknown. As such there is the potential for substantial unidentified aircraft remains (primarily WWII) to be found on the seabed (DESNZ, 2022). There are no protected wrecks or sites in the vicinity of the proposed Platypus Development.

From available data there are three non-dangerous wrecks within close proximity of proposed pipeline route (Figure 5-19). Additionally, there is an area of foul ground located 1.3 km southwest of Cleeton. Foul ground is an area of seabed which is considered unsuitable or hazardous to anchoring or the installation of offshore infrastructure.

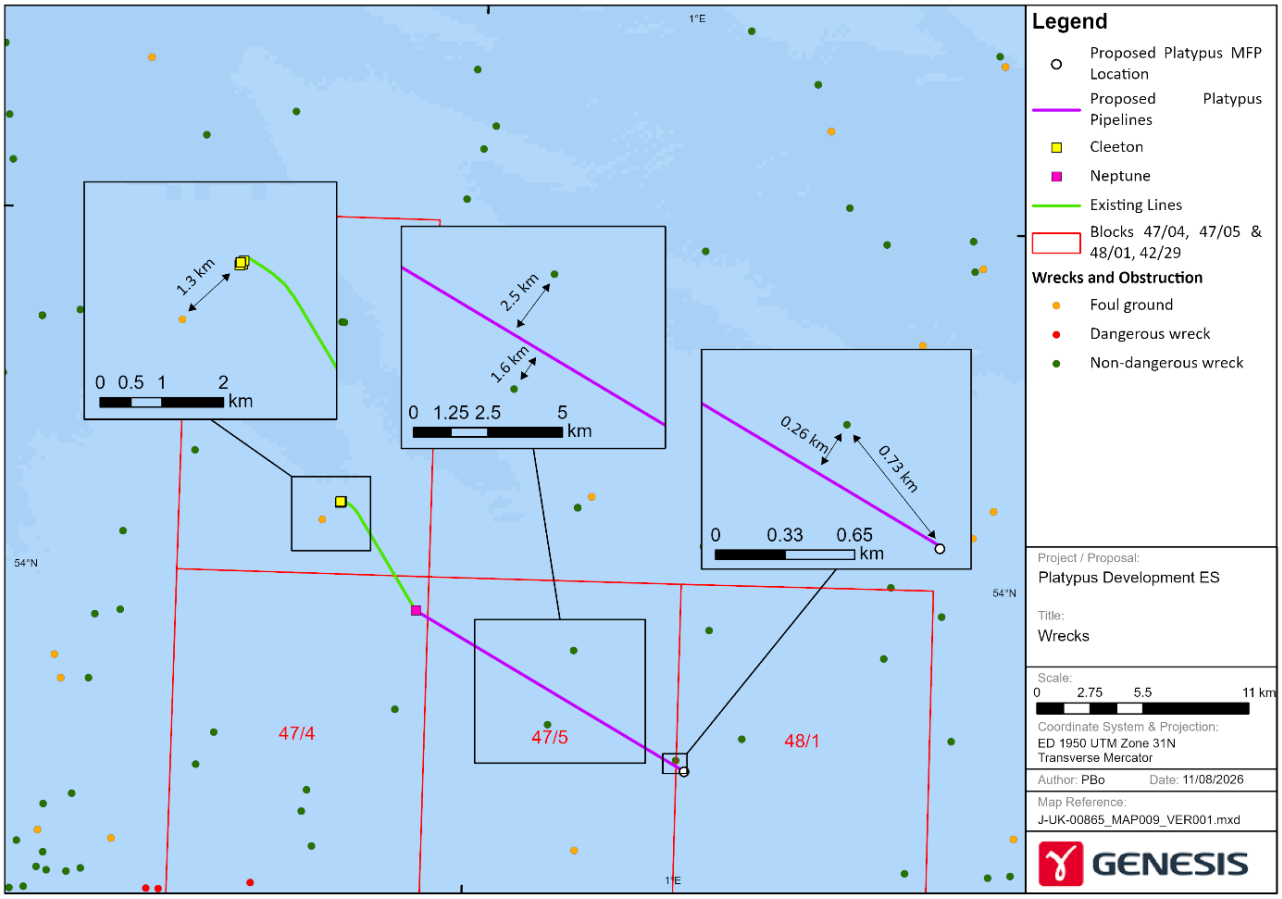


Figure 5-19: Platypus in relation to foul ground and wrecks.

5.6.4 Offshore Renewable Energy, Wind and INTOG

The proposed Platypus Development is located within vicinity of awarded Innovation and Targeted Oil & Gas (INTOG) sites and planned windfarms. The closest planned windfarm to the proposed Platypus MFP is the planned Hornsea Project 4 at 13.4 km east.

The operator Ørsted have three active and operational offshore wind farm turbine areas near the project area; Westermost Rough, Hornsea Project 1 and Hornsea Project 2. Westermost Rough is an active windfarm side since 2015 and sits 8 km out from the coastline of England. Project One became fully operational in 2019 with a coverage area of 407 km^2; followed by Project Two (Breesea, Soundmark, Sonningmay) which has been operational since 2022 at 462 km^2 (Ørsted, 2019; 2022). Hornsea Project Three (HOW03) is in development planning stage (Ørsted, 2023). The Hornsea Project initially comprised four sub-projects, however planning and preparation on the fourth part "Hornsea Project Four" has been put on indefinite hold. The proposed Platypus pipeline route does not intersect with any windfarm cable agreements. The closest CCUS agreement is 25 km to the north of the proposed Platypus MFP location.

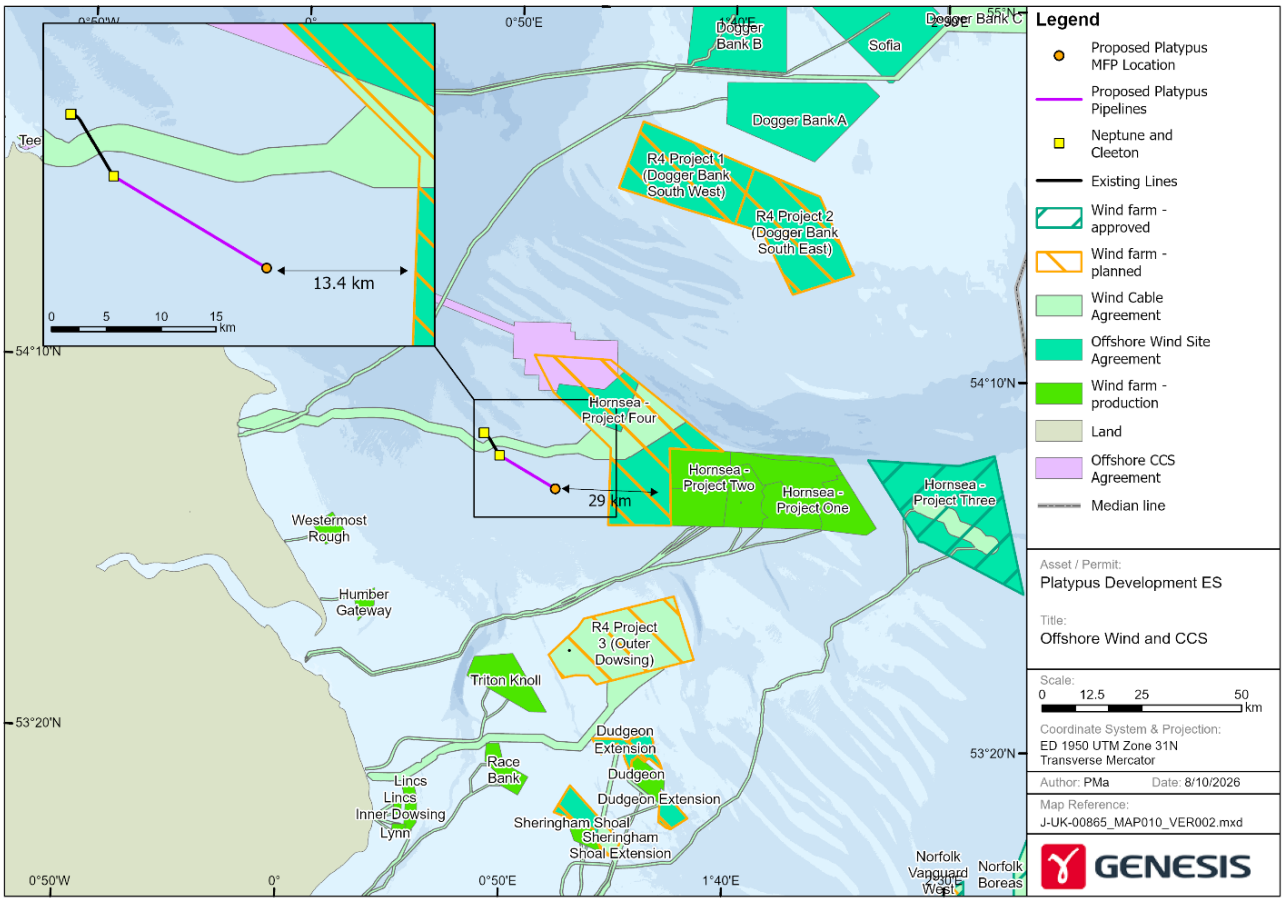


Figure 5-20: Proposed Platypus MFP location in relation to wind farms and INTOG areas.

5.6.5 Oil and Gas Activities

The proposed project is located within proximity of well-developed brownfield oil and gas production areas, with many installations, pipelines and umbilicals within the vicinity. Installations within 40 km of the proposed Platypus MFP location are detailed in Table 5-11 and presented in Figure 5-21.

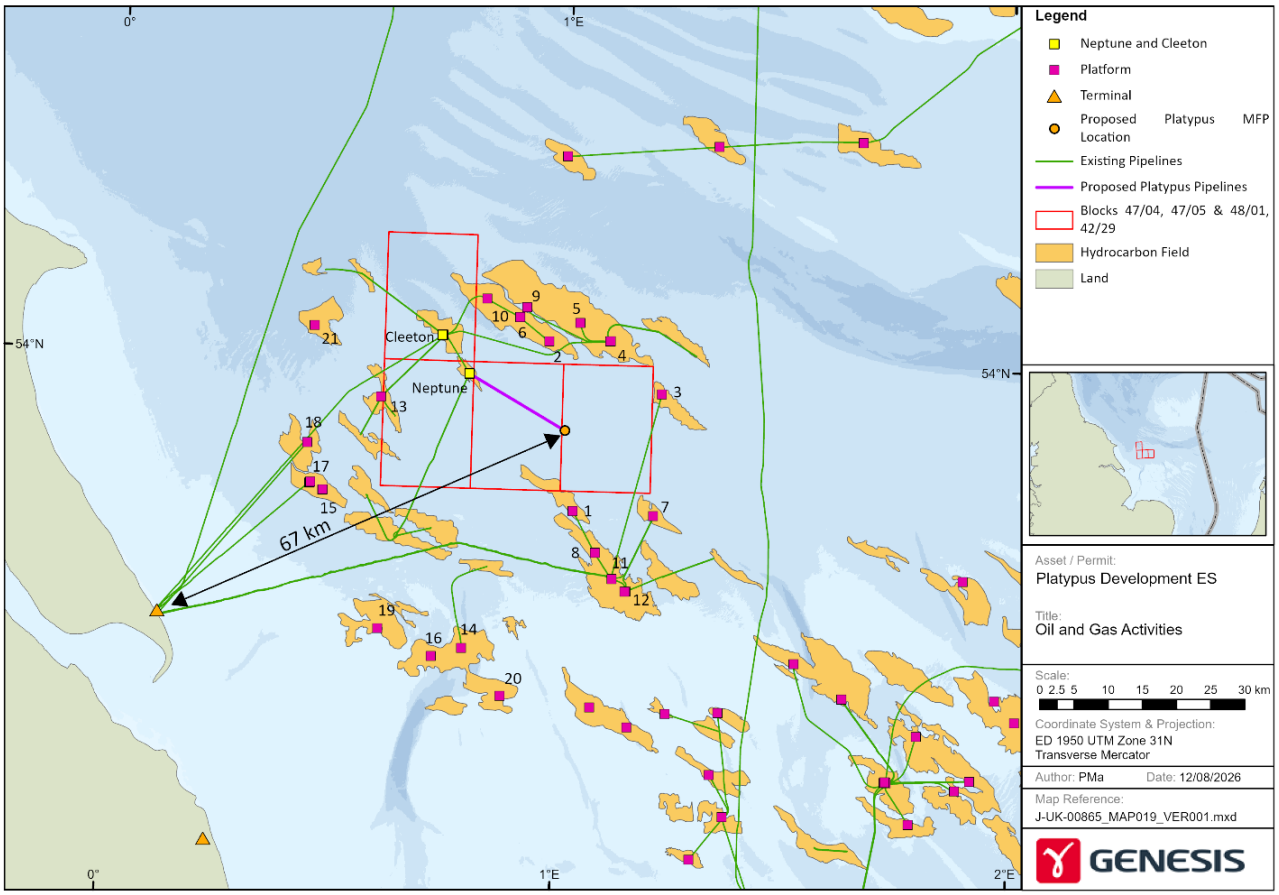


Figure 5-21: Proposed Platypus MFP location in relation to other oil and gas activities in the area.

Table 5-11 Oil and Gas Infrastructure within 40 km of the Platypus Development.

Number	Installation	Distance to Proposed Platform (km)	Status
1	Hyde	12	Producing
2	Ravenspurn South A	13	Producing
3	Babbage	15	Producing
4	Ravenspurn North CC	15	Producing
5	Ravenspurn North ST2	16	Producing
6	Ravenspurn South B	18	Producing
7	Hoton	18	Producing
8	West Sole C	18	Producing
9	Ravenspurn North ST3	19	Producing
10	Ravenspurn South C	23	Producing
11	West Sole B	23	Producing
12	West Sole A	25	Producing
13	Minerva	27	Producing
14	Amethyst 2AD	35	To be decommissioned
15	Rough AD & AP	36	Producing
16	Amethyst A1D	38	To be decommissioned
17	Rough BD, BP, & CD	38	Producing
18	York	38	To be decommissioned
19	Amethyst C1D	40	To be decommissioned
20	Amethyst B1D	40	To be decommissioned
21	Tolmount	40	Producing

5.6.6 Other Activities

There are no known military activities, telecommunication/power cables, or offshore aggregate extraction in the vicinity of the proposed project. The closest offshore mining is 57 km northeast, and the closest mineral aggregate site is 41 km southeast. As shown in Figure 5-22, the closest aquaculture sites of mussel and pacific oyster cultivation are 105 km south.

The potential expansion of aquaculture into deeper waters is acknowledged following the UK governments commitment to investment into aquaculture in the South and East Marine Plan Areas through the MMO. The Optimum Sites of Aquaculture potential (AQ1) is a model utilising information on species present (bivalve classification) and production values to identify areas in East Coast Inshore and Offshore Marine Plan Areas favourable for macroalgae culture, Bivalve Bottom Culture, Finfish Cage, Lobster Restocking, Rope Cultured Bivalve Shellfish or Trestle/Bag Culture of Bivalves. This AQ1 dataset is part of a wider study which assess potential offshore expansion; project MMO1040. (ABPmer, Centre for Environment, Fisheries and Aquaculture [CEFAS], DEFRA). The closest assessed site to the Platypus Development is 34km southwest of the proposed Platypus MFP. The AQ1 site described is positioned in the deeper waters close to the SPA Greater Wash and SAC Inner Dowsing, Race Bank and North Ridge.

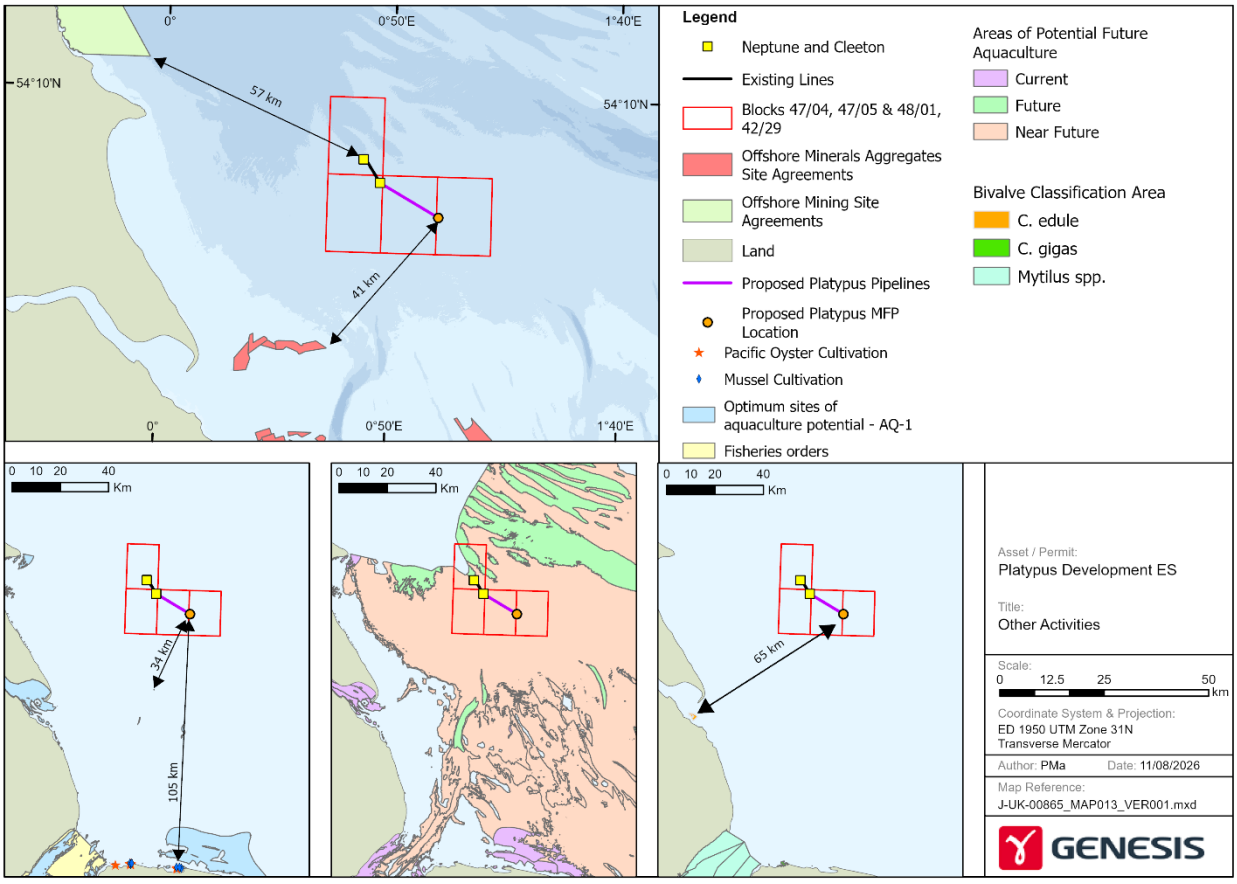


Figure 5-22: Proposed Platypus MFP location in relation to potential future aquaculture.

5.7 Climate Change

This section provides a baseline against which the effects of GHG emissions from the Platypus Development will be assessed.

The information collated to inform the baseline has been influenced by OPRED's Guide to EIA (BEIS, 2021), DESNZ Supplementary Guidance for the assessment of downstream Scope 3 GHG emissions (OPRED, 2025), and the Institute of Environmental Management and Assessment (IEMA) Guide to assessing GHG emissions and evaluating their significance (IEMA, 2022).

DESNZ Supplementary Guidance states "it is accepted that GHGs have a global effect on climate. Therefore, when determining the baseline scenario for scope 3 emissions, the location of the emissions is not relevant and a global baseline scenario of GHGs must be considered in the ES". In addition, the IEMA guidance defines the baseline for GHG assessments as a "reference point against which the impact of a new project can be compared against". This assessment will therefore be evaluated in the context of a global baseline scenario of GHGs.

The DESNZ Supplementary Guidance further states both "A realistic and reasonable description of the current state of the environment (baseline scenario) should be presented in the ES" and "a reasonable future estimate of global GHGs affecting climate over the lifetime of a project needs to be considered as part of the baseline scenario". Consequently, the baseline considered includes both a current state of the environment and a future estimate of global GHGs.

The current state of GHG emissions, atmospheric concentrations and impacts on multiple receptors are described in Section 5.7.1 and Section 5.7.2. A reasonable future estimate for global GHG emissions and concentrations are explored in Section 5.7.3 and Section 5.7.3.4 and impact scenarios for the identified future baseline are given in Section 5.1.1.

A large part of the baseline description draws on the best current evidence provided in publications of the IPCC and supplemented with additional sources. The IPCC is an organisation of governments that are members of the United Nations or World Meteorological Organisation (WMO). Its primary objective is to provide governments with climate change related scientific information necessary to develop climate policies. It provides policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

The IPCC's assessments present a consolidated understanding of historic and present atmospheric concentrations and emissions of GHGs and their impacts. They also provide projections of impacts from future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options.

5.7.1 Atmospheric GHGs Current Baseline

The IPCC Sixth Assessment Report (AR6) (IPCC, 2023) Working Group I states that it is "unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred."

Human activities have contributed to significant changes in the environment over the past century. One of the most notable indicators is the rising concentration of GHGs, particularly carbon dioxide (CO_2), in the atmosphere. Several global monitoring stations continuously track CO_2, methane (CH_4) and nitrous oxide (N_2O) concentrations to assess trends and guide efforts to reduce GHG emissions. The World Data Centre for GHGs (WDCGG) compiles data from various sources to estimate global GHG levels (Met Office, 2026).

Since 1750 (representative of the pre-industrial period), global concentrations of CO_2, CH_4 and N_2O have increased by approximately 47%, 156% and 23%, respectively (IPCC, 2023).

While a range of GHGs are present in the atmosphere, which have varying Global Warming Potential (GWP), this section focuses on GHGs that are relevant to the Platypus Development. Specifically, it considers the GHGs generated during hydrocarbon production activities and during the end-use combustion of the hydrocarbons forecast to be produced from the Platypus Development. Therefore, on this basis, the assessment focuses on CO_2, together with associated emissions of CH_4 and N_2O, which are the primary GHGs attributable to these lifecycle stages.

5.7.1.1 Carbon Dioxide (CO_2) Concentrations

Recent measurements indicate that atmospheric CO_2 has surpassed 420 parts per million (ppm) (Lan *et al*., 2026). This represents approximately a 47-50% increase since pre-industrial times, primarily driven by fossil fuel combustion, deforestation, and industrial processes (IPCC, 2023; Lindsey, 2025). Emissions from fossil fuel combustion are largely attributable to economically developed, densely populated regions, with around 82% of these emissions attributed to the industrialised northern extratropics (Jacobsen et al., 2023).

Seasonal variations are also observed: CO_2 levels tend to rise during winter and spring in the Northern Hemisphere and decrease in summer and early autumn due to increased plant photosynthesis. Despite these seasonal fluctuations, the overall trend is a consistent increase in atmospheric CO_2 over time (Met Office, 2026a). Figure 5-23 presents monthly atmospheric CO_2 concentrations from four datasets: Mauna Loa, NOAA marine global, the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), and WDCGG, and shows an upwards trend in concentration since the 1950s (Met Office, 2026).

During the 1960s, atmospheric CO_2 increased at an average rate of approximately 0.8 ppm per year. This rate rose to about 1.6 ppm per year in the 1980s and remained elevated at around 1.5 ppm per year through the 1990s. In the most recent decade (2015-2024), the annual increase has further accelerated to approximately 2.6 ppm per year. Consequently, the annual rate of increase in atmospheric CO_2 over the last 60 years is estimated to be 100-200 times faster than the natural increases observed at the end of the last ice age, between 11,000 and 17,000 years ago (Lindsey, 2025).

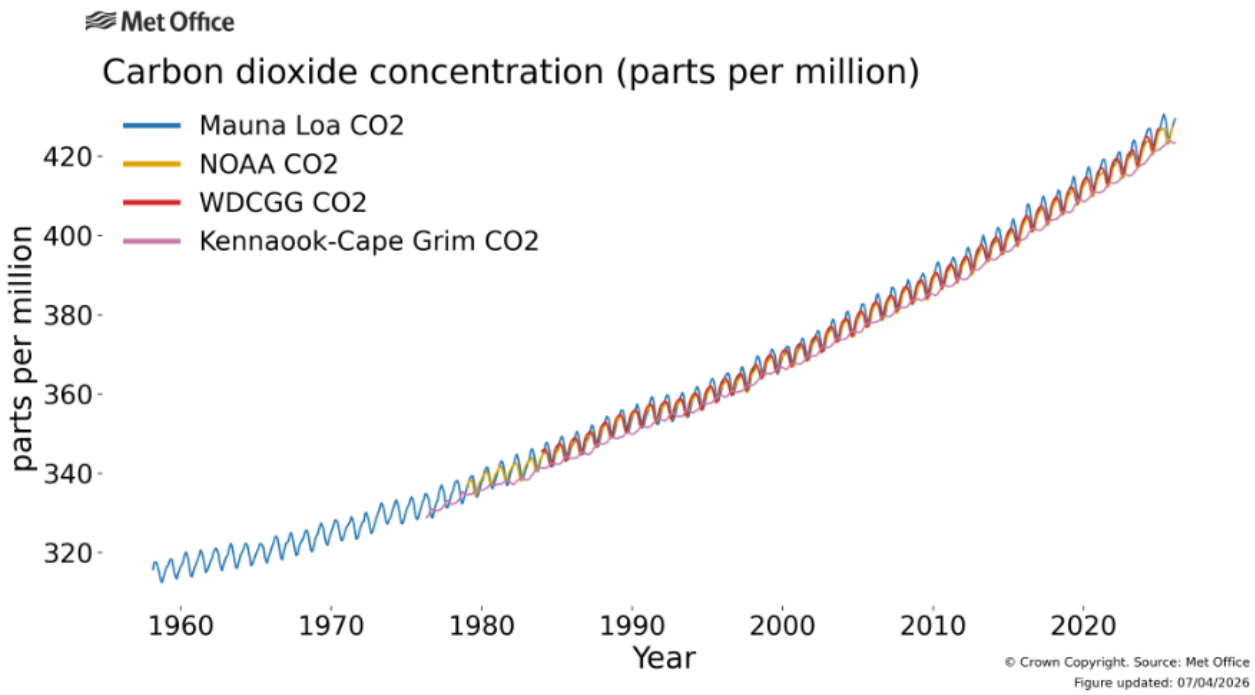


Figure 5-23: Monthly carbon dioxide concentration in the atmosphere. Four data sets are shown: Mauna Loa, NOAA marine global, CSIRO at Kennaook Cape Grim, and WDCGG (Met Office, 2026).

5.7.1.2 *Methane (CH_4) Concentrations*

Although CH_4 has a shorter atmospheric lifetime than CO_2 (and eventually oxidises to form CO_2), it is a considerably more powerful GHG due to its higher radiative efficiency, resulting in a greater warming effect per unit mass (IPCC, 2021a).

The Global Monitoring Division of the Earth System Research Laboratory at the US National Oceanic and Atmospheric Administration (NOAA) has monitored atmospheric CH_4 concentrations since 1983. Recent observations indicate a continuing increase in CH_4 concentration, which reached approximately 1,946 parts per billion (ppb) in November 2025, up from around 1,940 ppb in November 2024 (Lan *et al*., 2026).

Recent increases in atmospheric CH_4 concentrations have accelerated since 2006, increasing by an average of about 7.6 ppb per year between 2010 and 2019, with a faster rise of roughly 9.3 ppb per year from 2014 to 2019 (IPCC, 2021). Figure 5-24 presents monthly global atmospheric CH_4 concentrations from three datasets: NOAA, CSIRO, and WDCGG, all of which show a consistent overall trend, with a more rapid increase evident from around 2006 onward (Met Office, 2026).

Large uncertainties in CH_4 emission sources and sinks have made it difficult to accurately quantify global CH_4 concentrations and determine the main drivers of CH_4 increases since the 1980s. Despite these uncertainties, assessments indicate that "the multi-decadal growth trend in atmospheric CH_4 is dominated by anthropogenic activities, and the growth since 2007 is largely driven by emissions from both fossil fuels and agriculture (dominated by livestock)." (IPCC, 2021a). However, other studies suggest that recent increases in methane emissions may be driven primarily by microbial sources, with comparatively smaller contributions from other sources such as fossil fuel exploitation (Lan *et al*., 2021).

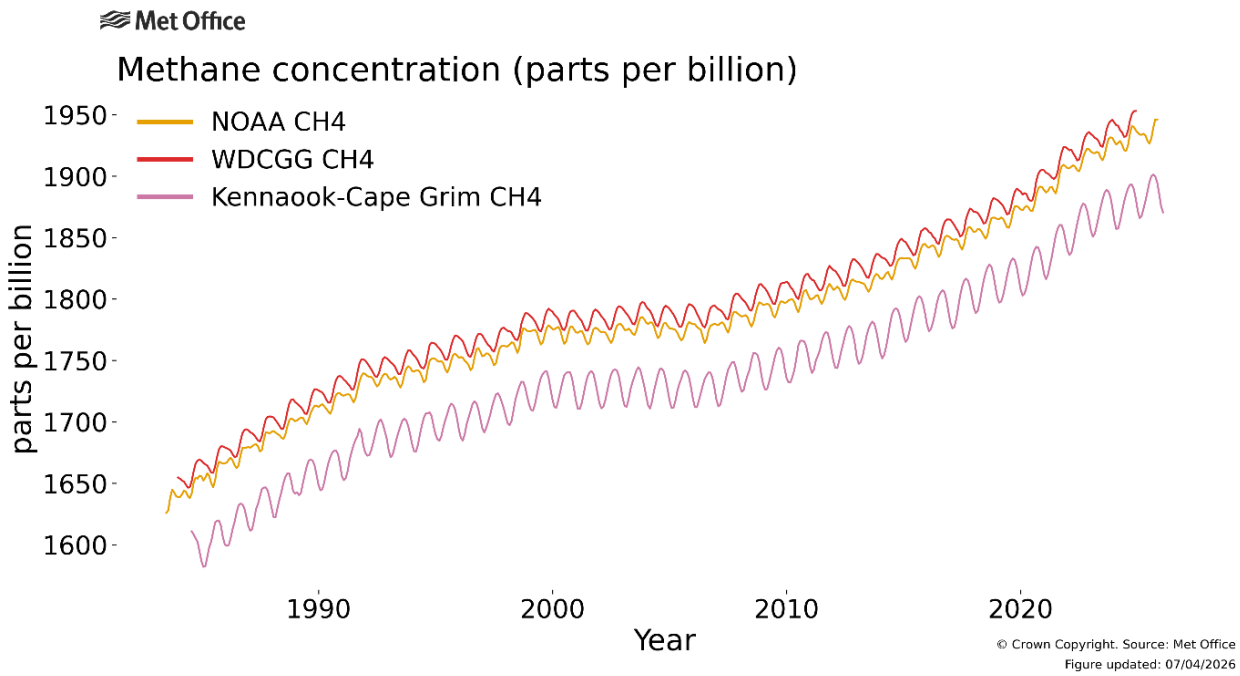


Figure 5-24: Monthly global methane concentration in the atmosphere. Three data sets are shown: NOAA, CSIRO at Kennaook Cape Grim, and WDCGG (Met Office, 2026).

5.7.1.3 *Nitrous Oxide (N_2O) Concentrations*

The NOAA Global Monitoring Laboratory has monitored N_2O concentrations since 1997, and available data shows concentrations are steadily increasing. A global average atmospheric N_2O concentration of 339.46 ppb was observed in November 2025 (an increase from 338.08 ppb in November 2024) (Lan *et al*., 2026).

Figure 5-25 presents monthly atmospheric N_2O concentrations from the CSIRO and WDCGG monitoring stations which highlights a long-term increase. Between 1995 and 2019, N_2O concentrations increased by an average of about 0.85 ppb per year, rising further to around 0.95 ppb per year during 2010 – 2019 (IPCC, 2021a). As noted by the IPCC, "This increase is dominated by anthropogenic emissions, which have increased by 30% between the 1980s and the most recent observational decade (2007–2016). Increased use of nitrogen fertilizer and manure contributed to about two-thirds of the increase during the 1980–2016 period, with the fossil fuels/industry, biomass burning, and wastewater accounting for much of the rest." (IPCC, 2021a).

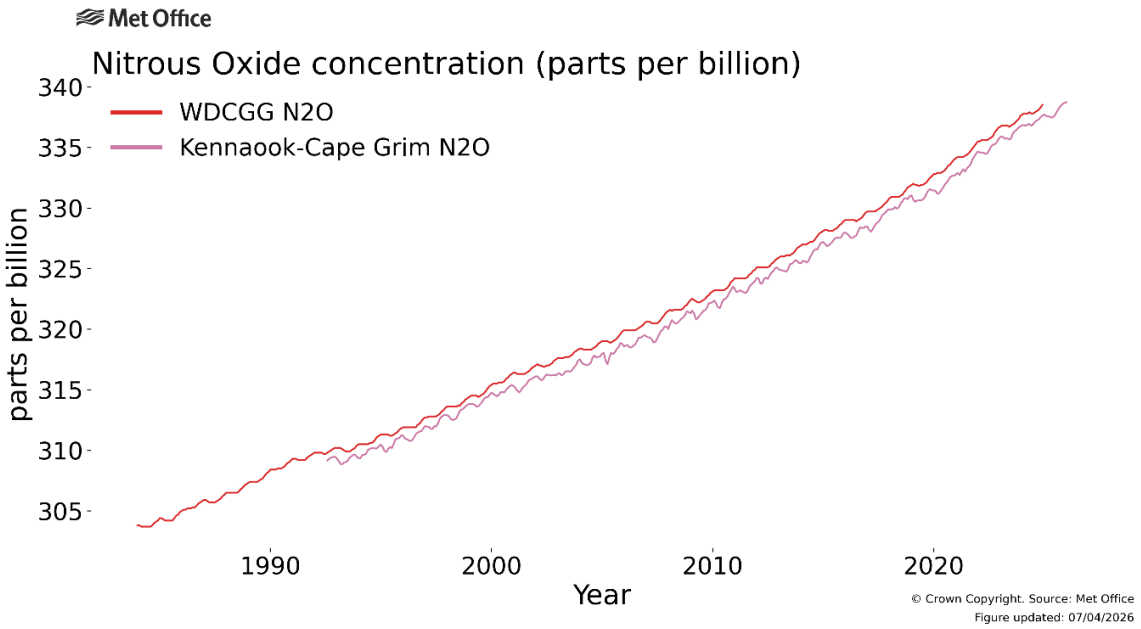


Figure 5-25: Monthly nitrous oxide concentration in the atmosphere as calculated by CSIRO and WDCGG (Met Office, 2026).

5.7.2 Baseline Environmental Indicators of Current GHG Impact

The IPCC AR6 (IPCC, 2023) Working Group I states that it is "unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred."

Climate tipping points occur when gradual climate change pushes parts of the Earth system past critical thresholds, triggering rapid and potentially irreversible changes. Once a tipping point is crossed, these changes can become self-reinforcing, even without further warming, and may lead to severe impacts such as extreme temperatures, drought, wildfires, ice-sheet loss, and disruptions to major ocean circulation systems.

A summary of the current state of environmental receptors is provided in Table 5-12, focusing on key indicators linked to potential climate tipping points. These indicators span the cryosphere, biosphere, ocean, and atmosphere, highlighting recent changes and emerging signals of heightened climate risk.

The summary is intended to offer a high-level overview of observed trends rather than a comprehensive scientific assessment. Further information on each indicator, along with references, is provided in Appendix F. Further scientific context is available at authoritative sources such as the IPCC, WMO, etc.

Table 5-12: Summary of environmental indicators with reference to EIA Regulations (2020) Schedule 6 (5): current global observations.

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations
Surface Temperature *(Schedule 6(5)(a)(iii))*	Global average temperature has increased by around 1.1 °C compared with pre-industrial levels (1850-1900 baseline). Recent years have been among the warmest on record; notably, 2024 was the warmest year on record at around 1.55 °C above the 1850–1900 baseline.

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations
Extreme Weather and Climate Events *(Schedule 6(5)(a)(iii))*	Extreme weather events are rare events at a specific place and time, while extreme climate events are patterns of extreme events that persist for some time (e.g. a season). Recent decades show an increased frequency and intensity (compared to 1850-1900 baseline) in heatwaves, heavy rainfall, droughts, and tropical cyclones globally. **Temperature extremes:** Since the 1950s, hot extremes and heatwaves have become more frequent, intense, and longer-lasting worldwide, while cold extremes have declined. Land minimum temperatures have increased around three times more than global surface temperatures since the 1960s, particularly in the Arctic. **Heavy precipitation:** The frequency and intensity of heavy rainfall events have increased across most land regions, particularly in North America, Europe, and Asia, though confidence is lower for very short-duration events due to limited data. **Drought trends:** Agricultural and ecological droughts have increased globally since the 1950s, becoming more widespread, intense, and long-lasting, with particularly strong effects in mid-latitude and subtropical regions.
Sea Level Rise ***(Schedule 6(5)(a)(iii))***	Global mean sea level rose by approximately 0.16 m between 1902–2015. The rate of sea level rise has increased significantly in recent decades, with the rate accelerating from around 1.4 mm/yr (1901–1990) to around 3.6 mm/yr (2006–2015) and around 4.75 mm/yr during 2015–2025. In recent years, satellite data has shown rapid sea level rise of approximately 5 mm in 2023–2024 influenced by El Niño. By 2025, global mean sea level was around 11 cm higher than in 1993.
Cryosphere Changes ***(Schedule 6(5)(a)(iii))***	**Ice mass loss:** During 2066-2015, the Greenland Ice Sheet lost approximately 278 Gigatonne per year (Gt/yr) (equivalent to 0.77 millimetre per year (mm/yr) sea-level rise) and the Antarctica Ice Sheet lost around 155 Gt/yr (equivalent to 0.43 mm/yr), reflecting rapid cryosphere ice loss. **Permafrost thaw:** Permafrost temperatures have risen by around 0.29 °C (±0.12 °C) since the 1980s across polar and high-mountain regions, increasing ground instability and potentially affecting approximately 1,460–1,600 Gigatonne (Gt) of carbon stored in frozen soils. **Sea-ice decline:** Arctic sea ice has decreased across all months throughout the year since 1979, with September extent declining by around 12.8% per decade. In 2025, Arctic sea ice averaged around 10.10 million km² (approximately 0.9 million km² below normal) and Antarctic sea ice around 10.81 million km², the third lowest on record.
Oceanic Changes ***(Schedule 6(5)(a)(iii))***	**Rising sea surface temperatures:** Global ocean surface temperatures have increased by around 0.88 °C since pre-industrial times, with most warming occurring since 1980, indicating an acceleration of ocean warming in recent decades. **Increasing ocean heat content:** Ocean heat content has risen steadily since the 1970s, reaching record levels in 2025; the rate of warming in the upper 2,000 m has more than doubled since the mid-20th century. **Marine heatwaves and stratification:** Marine heatwaves are becoming more frequent, longer-lasting, and more intense, while surface warming and freshening have

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations
	increased upper-ocean stratification, reduced vertical mixing and affected circulation and ecosystems. **Ocean acidification:** The ocean has absorbed approximately 20–30% of anthropogenic CO_2 since the 1980s, causing surface ocean pH to decline by around 0.017–0.027 pH units per decade. Ocean acidification is widespread, exceeds natural variability, and is strongest in parts of the Indian, Southern, Pacific, and Atlantic Oceans.
Biodiversity ***(Schedule 6(5)(a)(ii))***	**Ecosystem disruption:** Widespread changes have been observed across terrestrial, freshwater, and marine ecosystems, including shifts in species ranges, altered seasonal timing, and ecosystem reorganisation. **Biodiversity decline:** Global wildlife populations show high declines, with average vertebrate abundance falling by around 73% since 1970, indicating widespread ecosystem stress and reduced resilience. **Coral reef loss:** Coral reefs are experiencing rapid degradation, with the ongoing global bleaching event (since 2023) affecting around 84% of reefs, threatening biodiversity and ecosystem functioning.
Population and Human Health ***(Schedule 6(5)(a)(i))***	**Rising health risks:** Physical health, mental well-being, nutrition, and longevity are all impacted with growing pressure on healthcare systems. **Climate-sensitive diseases:** Observed changes in temperature, rainfall, and extreme events are linked to the spread of vector- and water-borne diseases (e.g. dengue, malaria at higher altitudes, diarrhoeal diseases), and increased respiratory and mental health impacts following floods, storms, and wildfires. **Heat-related impacts:** More frequent and intense heat extremes are increasing heat-related illness, reducing safe working capacity, and negatively affecting mental health, cognitive performance, and well-being. **Food and nutrition insecurity:** Climate variability and extremes are associated with increased food insecurity and multiple forms of malnutrition, particularly in low- and middle-income regions affected by droughts, floods, and storms.
Material Assets (Schedule 6(5)(a)(iv))	There are increasing risks to buildings, infrastructure, and physical assets due to more frequent and intense flooding, heatwaves, storms, erosion, and wildfires. Many assets were designed for historic climate conditions and are increasingly vulnerable to accelerated degradation, reduced performance, and shorter lifespans. **Energy and Industrial Water Use:** Water scarcity and rising temperatures are reducing the performance and utilisation of energy infrastructure, particularly hydropower and thermoelectric power plants, with increased operational disruptions and economic losses. **Extreme events and costs:** Growing frequency and intensity of extreme weather events are driving rising economic losses through infrastructure damage, supply-chain disruption, and recovery costs, placing pressure on public finances, insurance systems, and development pathways. **Food and resource systems under stress:** Reduced crop yields, fishery productivity, and forest outputs in multiple regions have been observed, with extreme events increasingly causing large-scale food production losses and threatening food security and livelihoods.

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations
Cultural Heritage ***(Schedule 6(5) (iv))***	Cultural heritage assets, including historic buildings, archaeological sites, cultural landscapes, and traditional practices, are increasingly exposed to climate-related pressures such as erosion, flooding, wildfires, sea-level rise, and changing soil moisture. Traditional land-use and farming practices are being eroded, particularly Indigenous and small-scale systems, leading to loss of cultural knowledge and reduced resilience of cultural landscapes.
The Landscape ***(Schedule 6(5) (iv))***	Widespread change has been observed across terrestrial, freshwater, coastal, and marine landscapes through rising temperatures, altered rainfall patterns, sea-level rise, and more frequent extreme events. **River Landscapes and Connectivity:** River landscapes are being altered by changing flow regimes, with increased drying, reduced connectivity, and shifts from permanent to intermittent watercourses in many regions. **Lake Landscapes:** Lake landscapes are changing unevenly, with lake levels rising, falling, or stabilising depending on location, and growing evidence of loss of small temporary ponds, resulting in simplified freshwater landscapes. Mountain and high-altitude landscapes are being reshaped by glacier retreat, permafrost thaw, and altered runoff, leading to new lake formation, changed drainage patterns, and increased landscape instability.

5.7.3 Atmospheric GHGs Future Baseline

The future projection of GHG emissions, and hence their atmospheric concentrations, are strongly dependent on the global direction and appetite for identifying and executing emissions reductions measures to avoid the worst impacts of climate change. This direction is currently highly uncertain and, consequently, the future projection of emissions and concentrations of GHGs is also uncertain.

Following its introduction at the 1992 Earth Summit in Rio, the UN Framework Convention on Climate Change (UNFCCC) entered into force in 1994. Within the framework of the UNFCCC, contracting states meet regularly at the Conference of the Parties (COP) to discuss climate change. These COPs have resulted in subsequent international instruments including the Kyoto Protocol in 1997 and the Paris Agreement in 2015 (COP21).

The Paris Agreement states the following objective; "Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" (United Nations, 2015).

In order to meet this objective, the focus of the Paris Agreement is on the mitigation of GHG emissions, adaptation measures to address the adverse effects of climate change that cannot be avoided through mitigation, and the provision of support – in terms of finance, technology and capacity building – to enable developing states to meet their commitments. The international commitment to the objectives of the Paris Agreement, and the collective role of society in reaching those goals, was confirmed in 2021 in the Glasgow Climate Pact, which requires signatory countries to increase climate action toward reducing reliance on fossil fuels.

The Paris Agreement contains both a collective objective to be pursued by all states, and individual obligations by which each state is obliged to contribute to that collective objective. Thus, the Paris Agreement: (a) establishes a collective objective that states act to hold "the increase in global average temperature to well below 2°C above pre-industrial levels and [to pursue] efforts to limit the temperature

rise to 1.5°C"; and (b) establishes an individual obligation on each state to, among other things, submit a pathway for their own emissions reductions in the form of Nationally Determined Contributions (NDCs). It is through their NDCs that states communicate the pathway they will take to reduce their GHG emissions in pursuit of the collective objective of the Paris Agreement.

Following the adoption of the Paris Agreement, international organisations such as the IPCC and the International Energy Agency (IEA) have developed various emissions reduction scenarios, based on scientific research and analysis. These scenarios translate the goals of the Paris Agreement into what is required, practically, to meet these goals and to aid government climate policy. Notably, the IPCC published (i) Special Report on Global Warming of 1.5°C (IPCC SR1.5) in October 2018, (ii) the Sixth Assessment Report (Working Group I contribution) in August 2021, and (iii) the Sixth Assessment Report (Working Group II contribution) in February 2022.

At the national level, the UK's Climate Change Act (2008) (UK Govt 2008) is the principal legislative mechanism for reducing UK GHG emissions. The Act sets the framework to address climate change mitigation and adaptation, including end user emissions. It requires the UK government to propose regular, legally binding milestones on the way to achieving Net Zero GHG emissions, known as carbon budgets.

NDCs are one of the primary instruments for countries achieving the aims of the Paris Agreement. Based on the advice from the UK Climate Change Committee (CCC), in preparation for the Seventh Carbon Budget, the UK published its NDC target to reduce all GHG emissions by at least 81% by 2035, compared to 1990 levels (excluding international aviation and shipping emissions) (UKCCC, 2024).

The UK CCC balanced pathway is the UK Carbon Budget emissions reduction pathway from 2025 to Net Zero by 2050, with each specific carbon budget spanning a 5-year period with a maximum GHG emission target. The UK CCC published its Seventh Carbon Budget in February 2025, which limits the UK's GHG emissions to 535 $MtCO_2e$ over the five-year period 2038 to 2042.

At the global level, multiple sets of possible future pathways of GHG emissions have been developed, each established from alternative standpoints and objectives. Four sets of pathways based on robust inputs and assumptions are summarised in this section along with an evaluation, of which present the most appropriate future baseline for use in this ES.

The four sets of pathways are:

- IPCC Baseline narrative Shared Socioeconomic Pathways (SSPs)
- IPCC Outcome-based scenario categories (C1 – C8)
- IPCC Illustrative Migration Pathways (IMPs)
- IEA scenarios

5.7.3.1 IPCC Baseline Narrative Scenarios

One of the ways the IPCC meets its objective is publishing SSPs, which are a set of alternative socioeconomic future projections designed to support climate change analysis. Their purpose is to provide a consistent framework for exploring how different patterns of societal development influence future GHG emissions and are used in scenario-based projections to compare how different development pathways lead to different climate outcomes and risks (IPCC, 2022a).

The SSPs are a set of five baseline narrative scenarios describing how society might evolve (economics, population, technology, governance), and how this influences emissions.

The projected CO_2 emissions from 2015 to 2100 under five IPCC SSPs are presented in Figure 5-26. The projected atmospheric CO_2 concentrations under different SSP futures is also shown in Figure 5-26.

The SSPs consider a wide range of existing and planned projects and other activities, both natural and anthropogenic. They also consider the net impact of atmospheric emissions attributed to sources and sinks and hence are inherently cumulative.

For the five different SSPs, Figure 5-26 shows:

- **SSP1-1.9 and SSP1-2.6:** Rapid CO_2 emissions cuts with Net Zero reached by mid-century**.** The CO_2 concentrations peak and then stabilise, with a slight decline by 2100. These pathways align with 1.5–2°C long-term warming limits.
- **SSP2-4.5:** CO_2 emissions decline at a slower rate compared to SSP1-1.9 and SSP1-2.6. CO_2 concentrations continue to accumulate in the atmosphere, locking in higher long-term warming.
- **SSP3-7.0 and SSP5-8.5:** CO_2 emissions continue rising with the resulting CO_2 concentrations accelerating upwards. This leads to very high warming which is largely irreversible over century-scale time horizons.

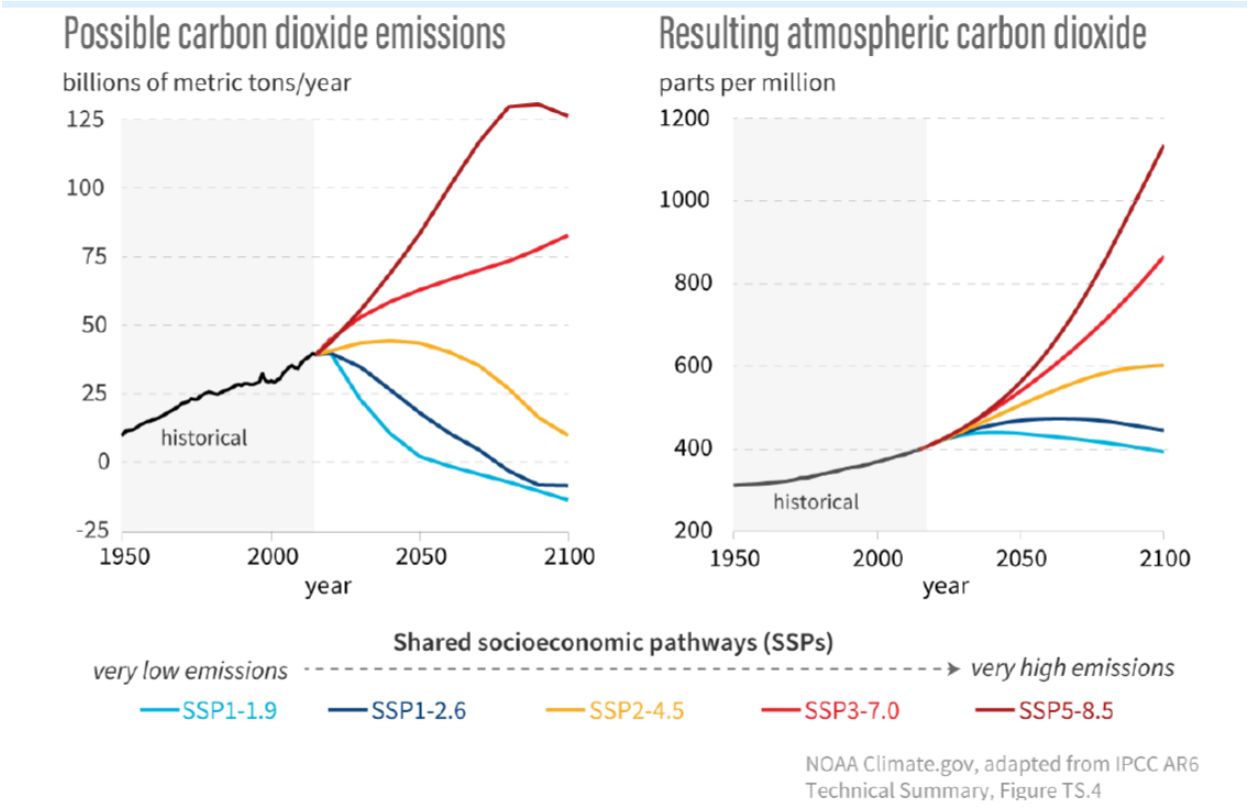


Figure 5-26: Potential future pathways for annual global CO_2 emissions (left) and the resulting atmospheric CO_2 concentrations through the end of the century (right) (Lindsey, 2025).

Figure 5-27 panel (a) again presents the projected emissions trajectories for CO_2 and additionally presents the emission pathways from 2015 to 2100 for three key non-CO_2 drivers included in the SSPs: CH_4), N_2O and sulphur dioxide (SO_2). SO_2 is a contributor to cooling aerosols. The lower-emissions pathways (SSP1-1.9, SSP1-2.6) project declining emissions of most non-CO_2 gases, in addition to CO_2, while the higher-emissions pathways (SSP3-7.0, SSP5-8.5) project sustained or increasing emissions for CO_2, CH_4 and N_2O. SO_2 emissions decline across all scenarios, reflecting improved air-quality controls.

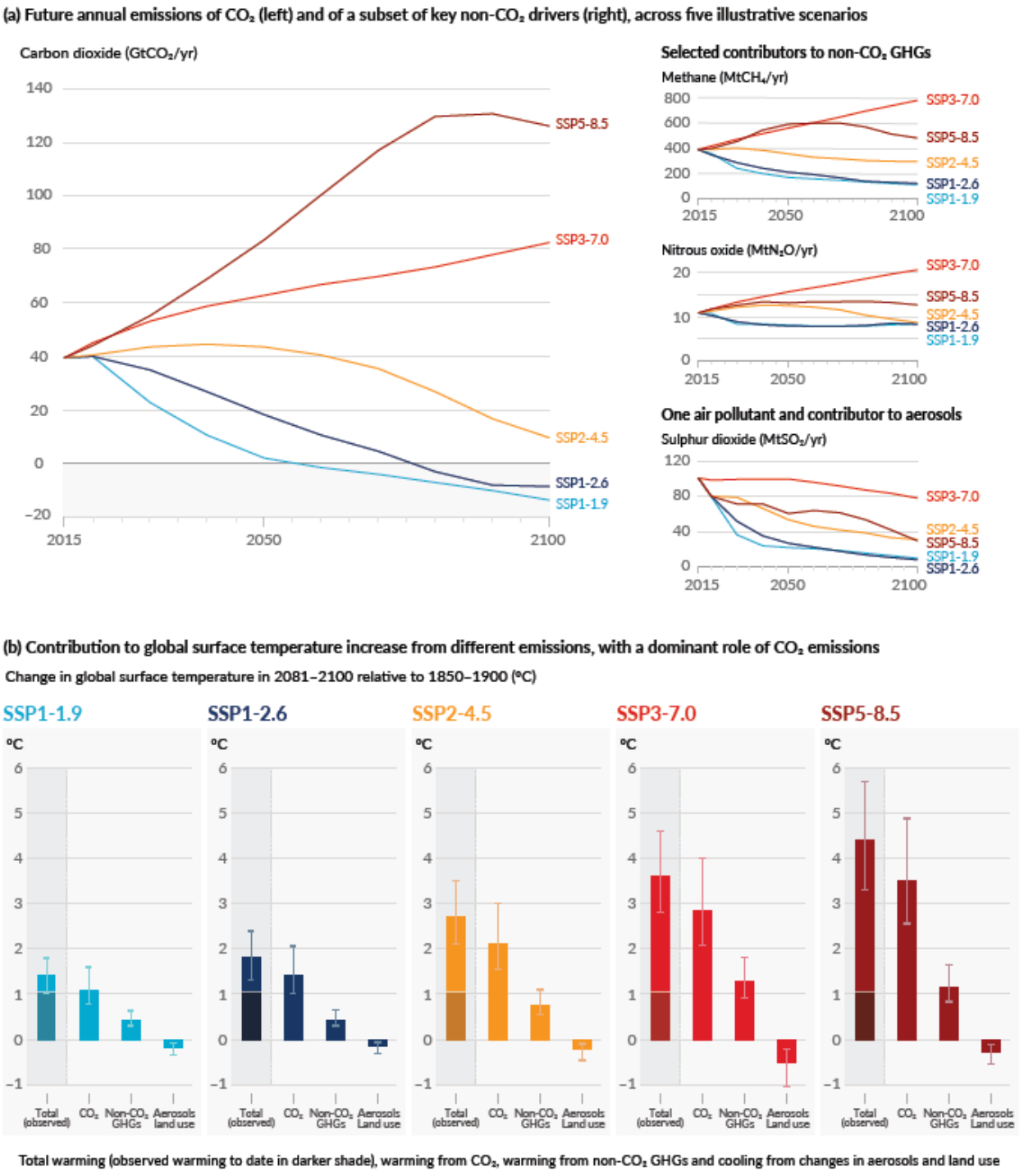


Figure 5-27: Projected emissions trajectories in panel (a) for CO_2 from all sectors, expressed in gigatonnes of CO_2 per year ($GtCO_2$/yr), shown in the left p anel. The right-hand panels show emissions pathways for a subset of three key non-CO_2 climate drivers included in the scenarios: methane (in $MtCH_4$/yr, top-right), nitrous oxide (MtN_2O/yr, middle-right), and sulphur dioxide ($MtSO_2$/yr, bottom-right). The contribution to global surface temperature in 2081-2100 shown in panel (b) across all scenarios (IPCC, 2021b).

Panel (b) in Figure 5-27 illustrates the projected contributions to global surface temperature increase from CO_2 and non-CO_2 GHGs for the five SSPs in 2081-2100 (relative to the 1850-1900 baseline). In all scenarios, CO_2 is shown as the largest contributor to total warming, with non-CO_2 GHGs contributing to additional warming. Net cooling contributions are also presented across all scenarios from other anthropogenic drivers, primarily aerosols and land-use changes, which partially offset GHG-related warming.

5.7.3.2 IPCC Outcome-based Scenarios

The SSPs are baseline narrative scenarios, describing how society might evolve (exploring different assumptions on economics, population, technology, governance), and how this influences emissions.

The IPCC has also modelled scenarios that are outcome-based classifications driven by temperature outcomes and mitigation characteristics, not on narratives. These modelled scenarios have been used to develop a range of categories (derived from multiple scenarios) that model future warming trajectories. Of these categories, C1 and C2 relate to scenarios that lead to at least a 50% chance of limiting the temperature rise to 1.5°C in 2100 and align with the Paris Agreement.

The IPCC defines a range of further categories that limit increasing temperatures where C3 limits warming to 2°C (67% likelihood) up to C8 that exceeds warming of 4°C (at least 50% likelihood). Unlike the C1 and C2 scenarios these are not aligned with the Paris Agreement goal.

The outcome-based scenarios and the SSP framework are explicitly linked because the SSP scenarios produce emissions trajectories, and these trajectories result in temperature outcomes which are then classified into categories C1 – C8.

Across every SSP assessed, global average surface temperatures are projected to keep rising until at least the middle of this century. Projected global surface temperatures for three periods (2021-2040, 2041-2060 and 2081-2100) are shown in Table 5-13 along with illustrative mapping of how the SSPs broadly relate to the C1 to C8 categories. This mapping is not a direct correlation since multiple SSPs can fall into the same category (i.e. can have the same temperature outcome, and the C1 to C8 categories include scenarios not covered by SSP narratives.

Table 5-13: Projected changes in global surface temperature relative to 1850 baseline for selected 20-year periods across the five illustrative emissions scenarios (IPCC, 2021a).

IPCC Scenario	Likely Category	Near Term (2021-2040)		Mid Term (2041-2060)		Long Term (2081-2100)	
		Best Estimate (°C)	Very Likely Range (°C)	Best Estimate (°C)	Very Likely Range (°C)	Best Estimate (°C)	Very Likely Range (°C)
SSP1-1.9	C1a	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	C3a	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	C6	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	C7	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	C8	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

5.7.3.3 IPCC Illustrative Migration Pathways

The IPCC also has a Current Policies (CurPol) scenario and a Moderate Action (ModAct) scenario which are used to benchmark against the SSPs (IPCC, 2022b). The CurPol scenario represents emissions based on global policies implemented by circa 2020 with no additional strengthening of climate policy and shows emissions continuing to rise or plateau at high levels. The ModAct scenario represents moderate strengthening of global policies, e.g. implementation of NDCs (Paris pledges) and gradual additional action resulting in emissions slowly stabilising but not declining rapidly (IPCC, 2022a). CurPol and ModAct are grounded in real-world policy decisions and commitments, in 2020, rather than being outcome driven. They are included in this baseline because they can be considered as indicative of future warming outcomes if governments take no other action than is already enacted (CurPol) or broadly follow through on stated intentions (ModAct).

5.7.3.4 International Energy Agency scenarios

The IEA is an intergovernmental organisation that research and reports on global energy markets, trends, policy recommendations and technologies to help countries meet their energy needs reliably, affordably and sustainably. Although not perfectly aligned due to differing primary objectives, the scenarios outlined by the IEA in the World Energy Outlook (IEA, 2025b; IEA, 2024) can be nominally mapped onto specific IPCC SSPs as follows, but recognising that the IEA scenarios are single pathways:

- The Net Zero Emissions (NZE) scenario is a highly ambitious normative scenario, assumes a pathway to Net Zero CO_2 emissions for the global energy system by 2050 and aligns with limiting long-term global warming to approximately 1.5°C above pre-industrial levels, closely corresponding to the SSP1-1.9 scenario.
- The Announced Pledges Scenario (APS) assumes that governments will meet their GHG and Net Zero targets on time and in full but that there will still be residual emissions in 2050 and is associated with around 1.7°C of warming, positioning it between SSP1-1.9 and SSP1-2.6. As part of the Paris Agreement's five-year update cycle, countries were formally required to submit their next round of Nationally Determined Contributions (NDCs) in 2025. However, at the time of publishing the 2025 edition of the World Energy Outlook, not all NDCs had been submitted. Since the IEA's APS depends on a complete and current set of national pledges, the IEA excluded the APS from the 2025 edition of its World Energy Outlook
- Stated Policies Scenario (STEPS) is a policy-driven scenario that includes both enacted and announced measures, showing a world where emissions peak and decline modestly, fossil fuel use stabilises, and warming reaches around 2.5°C. It indicates progress but still falls well short of climate goals and is most comparable with SSP2-4.5.
- Current Policies Scenario (CPS) is a baseline energy pathway that assumes no further policy action beyond what is already implemented. It is a policy-constrained pathway that corresponds to the high-emissions, weak-policy end of the IPCC scenario space, broadly aligning with SSP2 and SSP3 groups of pathways without strong mitigation.

The trajectories for CO_2 emissions projected by the IPCC SSPs are presented in Figure 5-28 along with historical emissions, with the lifetime of the Platypus Development shown for context. The CO_2 emissions trajectories for the IEA scenarios are also presented in Figure 5-28 to show that their respective emissions trajectories are between SSP1-1.9 and SSP2-4.5. The IPCC Illustrative Mitigation Pathways (IMPs) CurPol and ModAct are also included in Figure 5-28 and show that, over the lifetime of the Platypus Development, both scenarios are broadly aligned with SSP2-4.5. All of these scenarios are projections which have limitations, assumptions and uncertainties associated with them are summarised in Appendix H.

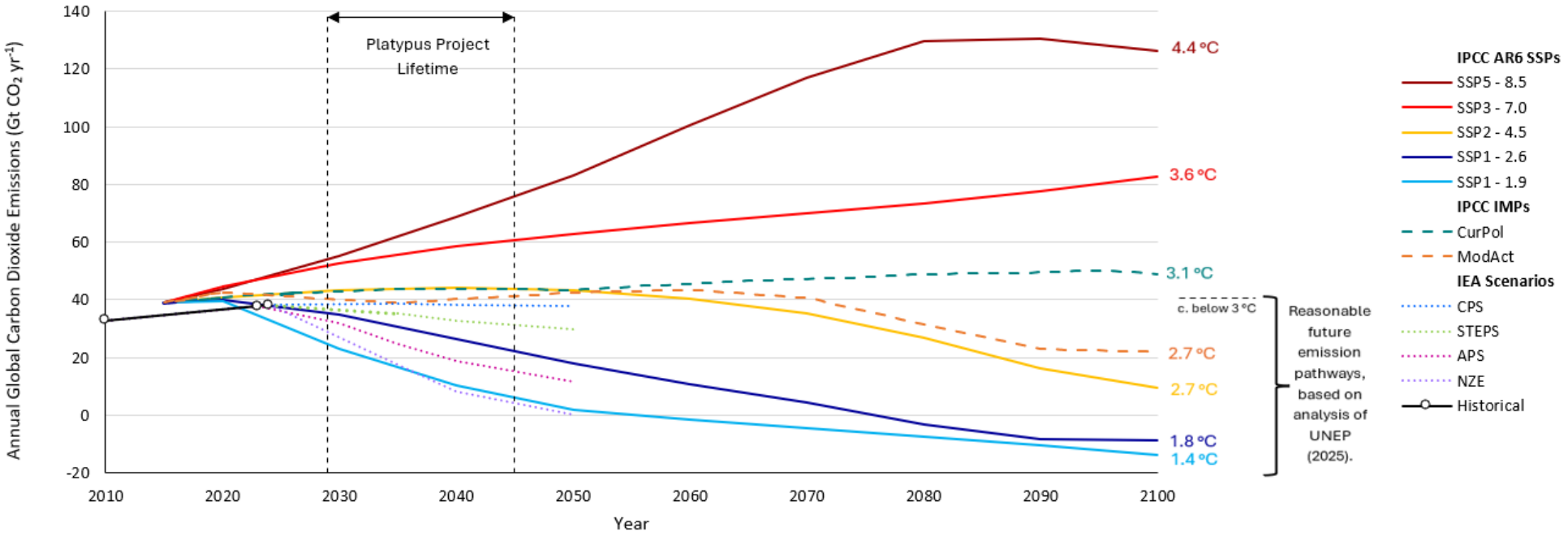


Figure 5-28: CO_2 emissions trajectories for the IPCC Pathways and IEA Scenarios, with selected reasonable future emission pathways highlighted (IEA, 2024; IEA, 2025a; IEA, 2025b; Riahi et al., 2017; IIASA, 2026; UNEP, 2025).

5.7.3.5 Likelihood

The authors of the four scenario sets described do not attribute a likelihood for any of the scenarios being the future that is followed. This section therefore considers which of the future baseline scenarios could be used as a reasonable future estimate of global GHGs over the lifetime of the Platypus Development.

The United Nations Environment Programme (UNEP) is the main environmental body of the United Nations. It plays a central role in global environmental governance by providing science, coordinating international action, and helping countries address environmental challenges. Since 2010, it has provided an annual science-based assessment of the gap between estimated future GHG emissions if countries implement their climate mitigation pledges, and where they should be to avoid the worst impacts of climate change.

In its most recent Emissions Gap Report 2025 (UNEP, 2025), UNEP concludes that global climate action is off-track, with current pledges leading to around 2.3–2.8°C warming relative to pre-industrial times and an increasing emissions gap relative to Paris targets. A temporary exceedance of 1.5°C warming is now highly likely, and avoiding dangerous levels of warming requires large emissions cuts (35–55% by 2035).

The assessment by UNEP is based on four types of scenarios, as described in Table 5-14, that provided the foundation for estimating the emissions gap and the global temperature implications of the emissions gap, as shown in Figure 5-29. In the current policies continuing scenarios there is an 80% chance of keeping warming below a 3°C increase relative to pre-industrial times over this century. This likelihood increases if unconditional NDCs are fully implemented by 2035 and similar efforts continue. The UNEP Report finds that global warming projections over this century, based on full implementation of NDCs, are now 2.3-2.5°C relative to pre-industrial times, while those based on current policies are very likely not to exceed 3°C rise. It is still possible that warming would be kept below 1.5°C.

Based on the analysis of the UNEP Emissions Gap Report (UNEP, 2025), it is reasonable to conclude that a future estimate of global GHG emissions in a do-nothing scenario will be bounded by SSPs that are aligned with keeping temperature rise between 1.5°C and 3°C relative to pre-industrial times. This aligns with IPCC Working Group I conclusions, which stated that the most fossil fuel intensive scenario (SSP5-8.5) was unlikely, that SSP5-8.5 and SSP3-7.0 should be considered counter-factual scenarios, and that current policies would lead to approximately stable GHG emissions similar to those in SSP2-4.5, i.e. temperature rise below 3°C (Gillet, 2024).

The SSPs that are considered to be a reasonable future estimate of global GHG emissions, in a do-nothing scenario, over the lifetime of the Platypus Development are shown in Figure 5-30 along with the IEA scenarios and IPCC IMP scenarios CurPol and ModAct. CurPol is included because, over the project lifetime, it is bounded by SSP2-4.5, which is aligned with keeping temperature increase relative to pre-industrial times below 3°C. Post-2050 CurPol and SSP2-4.5 deviate, as shown in Figure 5-28.

The likely evolution of climate conditions and the projected state of the environment associated with SSP1-19 to SSP2-4.5 i.e. lower to intermediate warming futures, are described in Section 5.7.4.

Table 5-14: Summary of scenarios for emissions gap assessment and global warming projections (UNEP, 2025).

UNEP Scenario	Scenario Description
Current Policies Continuing	This scenario projects global GHG emissions based only on policies adopted and implemented as of November 2024, as well as policy rollbacks in the United States of America as of September 2025.
Unconditional NDCs Continuing	This scenario projects GHG emissions assuming full implementation of the most recent NDCs and announced 2035 pledges that do not depend on explicit external support (cut-off date: 30 September 2025). For the G20 economies and major emitting countries that do not yet have a new NDC or announced pledge, it assumes a current policies scenario. For others, it assumes a continuation of efforts at a similar level of ambition to their 2030 pledge. Default projections include the NDC of the United States of America.
Conditional NDCs continuing	In addition to the unconditional NDCs and announced 2035 pledges, this scenario encompasses the most recent NDC targets for which implementation is contingent on receiving international support, such as finance, technology transfer and/or capacity-building (cut-off date: 30 September 2025). For the G20 economies and major emitting countries that do not have a new NDC or announced pledge, it assumes a current policies scenario, based on policies already adopted and/or implemented. For others, it assumes a continuation of efforts at a similar level of ambition to their 2030 pledge. Default projections include the United States of America's NDC.
Conditional NDCs plus all net-zero pledges	This is the most optimistic scenario included. It assumes the achievement of the conditional NDC scenario until 2035 and all net-zero or other long-term low emissions development strategies (LT-LEDS) pledges (cut-off date: 30 September 2025) thereafter. The United States of America's former net-zero target is excluded.

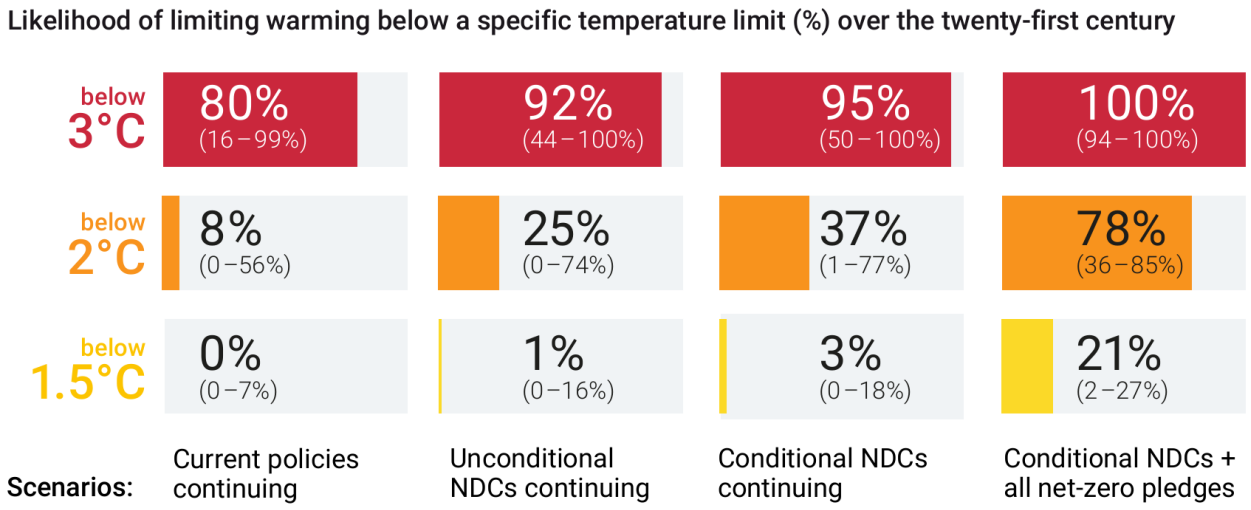


Figure 5-29: Temperature implications of the emissions gap (UNEP, 2025).

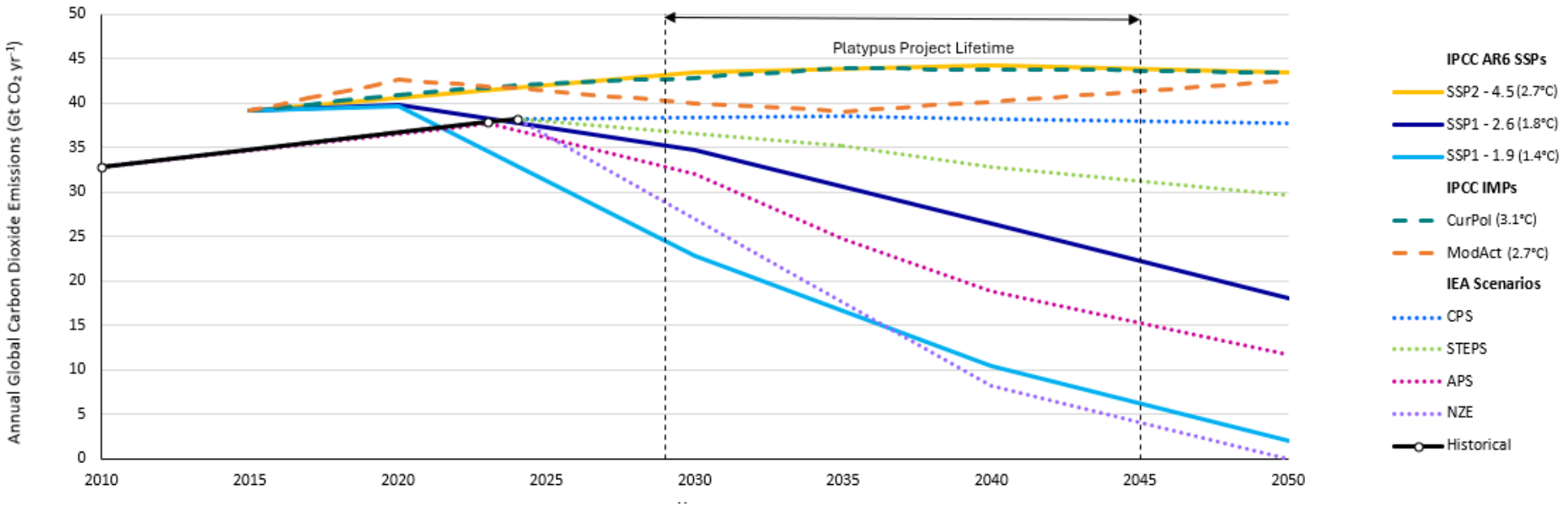


Figure 5-30: Reasonable future emissions pathways over the project lifetime, with global surface average temperature increase in 2100 of IPCC pathways given in the legend (IEA, 2024; IEA, 2025a; IEA 2025b; Riahi et al., 2017; IIASA, 2026).

5.7.4 Baseline for Impact on Environmental Receptors from Future GHG Emissions

Future predictions of how environmental receptors (such as human health, biodiversity, oceans, the cryosphere etc.) will respond in a warming world are inherently difficult to define with precision. The climate system is complex and influenced by numerous interacting physical, biological, and socio-economic processes operating across different spatial and temporal scales. While the direction of change is often well understood (for example, increasing temperatures, sea-level rise, and changes in precipitation patterns), the magnitude, timing, and regional expression of these changes remain uncertain. These uncertainties arise from limitations in observational records, natural climate variability, differences between climate models, and uncertainty around future human activities and emissions trajectories.

The IPCC has addressed these challenges through a structured and evidence-based assessment process. Working Group I (WGI) focuses on the physical science basis of climate change, using observations, paleoclimate records and climate model simulations to project future changes in temperature, precipitation, sea level, cryosphere extent and extreme weather events. These projections are not exact predictions of what will happen and instead, they describe a range of possible future outcomes and include confidence ratings that assess how strong and consistent scientific evidence is.

Working Group II (WGII) builds on the WGI climate projections to examine how climate change may affect ecosystems, biodiversity and human communities. It considers how environmental receptors may change at different levels of global warming, recognising that impacts do not increase linearly with temperature and can vary widely depending on local conditions. WGII also highlights that uncertainty increases when moving from climate changes to real-world impacts, because impacts depend not only on the climate itself but also on how exposed and sensitive systems are, how well they can adapt, and how societies develop in the future. For this reason, WGII presents its findings as ranges of risk and confidence, rather than exact predictions.

In combination, the assessments from IPCC Working Groups I and II provide a robust scientific framework for understanding likely future changes while clearly acknowledging uncertainty. A high-level summary of the assessments is presented in Table 5-15, which shows the projected state of the environment under lower-, intermediate- and higher-warming futures across key environmental receptors, drawing on information in multiple documents (IPCC, 2019a; IPCC, 2019b; IPCC, 2021; IPCC, 2021a; IPCC, 2022; IPCC, 2022a; and IPCC, 2023). A fuller summary with references is provided in Appendix G, while further detail, including underlying assumptions, confidence levels, and region-specific scientific assessments, is available from the IPCC, particularly through the assessments of Working Groups I and II.

The projections shown in Table 5-15 are mainly based on the IPCC's SSPs from the AR6. However, where appropriate, projections derived from the IPCC's Representative Concentration Pathways (RCPs), which formed the basis of climate projections in the Fifth Assessment Report (AR5), have been used where SSP-based data for certain key environmental receptors is not available.

RCPs describe trajectories of GHG concentrations and radiative forcing, while SSPs combine socio-economic development pathways with different levels of radiative forcing to explore a broader range of possible future climate outcomes.

Table 5-15: Summary of the projected state of the environment under lower-, intermediate- and higher-warming futures across key environmental receptors and by reference to 2020 Regulations Schedule 6 (5).

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C)
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	**Aligns with:** SSP2-4.5 and RCP4.5	**Aligns with:** SSP3-7.0 and SSP5-8.5 and RCP8.5
Mean Global Surface Temperature *(Schedule 6(5)(a)(iii))*	Increase by between 1.0°C to 1.8°C (relative to 1850-1900 baseline) by 2100.	Increase by between 2.1°C to 3.5°C (relative to 1850-1900 baseline) by 2100.	Increase by between 3.3°C to 5.7°C (relative to 1850-1900 baseline) by 2100.
Extreme Weather and Climate Events *(Schedule 6(5)(a)(iii))*	**Hot temperature extremes** are projected to become more frequent, intense, and longer lasting across most inhabited regions, while cold extremes are projected to become less frequent, even if warming is limited to 1.5 °C, with much larger changes at higher warming levels. **Heavy precipitation:** Under SSP1, increases in the frequency and intensity of heavy precipitation are projected to occur, but these changes are relatively moderate, with present-day one-in-10-year events becoming more frequent (around 1.3–1.5 times) at lower levels of global warming. The frequency of present day one-in-10-year events is projected to increase by around 1.5 times at lower global warming levels. **Droughts:** Frequency of present day one-in-10-year agricultural and ecological drought events is projected to double.	**Hot temperature extremes** are projected to at least double in intensity at 2 °C, alongside increases in hot days, warm nights, and heatwave duration across most land areas. **Heavy precipitation:** Increases in the frequency and intensity of heavy precipitation are projected to be more pronounced. The frequency of present-day one-in-10-year events becoming significantly more frequent (around 1.5–1.7 times) as global warming approaches ~2 °C. **Droughts:** Frequency of present day one-in-10-year agricultural and ecological drought events is projected to increase by around 2.4 times.	**Hot temperature extremes** are projected to quadruple in intensity at 3 °C, with widespread increases in hot days, warm nights, and heatwave duration. **Heavy precipitation:** Heavy precipitation events become more frequent and more intense globally, particularly for rarer events. One-in-10-year and one-in-50-year events are projected to approximately double and triple in frequency, respectively. **Droughts:** Frequency of present day one-in-10-year agricultural and ecological drought events is projected to increase by around 4.1 times.
Sea Level Rise *(Schedule 6(5)(a)(iii))*	Global mean sea level rise is projected at ~2–3 m if warming is limited to 1.5 °C over the next 2000 years.	2–6 m of sea level rise over the next 2000 years is projected if warming is limited to 2 °C.	Global mean sea level rise is projected to exceed the likely range, reaching nearly 2 meters

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C)
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	**Aligns with:** SSP2-4.5 and RCP4.5	**Aligns with:** SSP3-7.0 and SSP5-8.5 and RCP8.5
			(m) by 2100 and over 15 m by 2300.
Cryosphere Changes *(Schedule 6(5)(a)(iii))*	**Ice sheets:** projected contribution to global mean sea level rise by 2100 will be 0.01–0.10 m (from the Greenland Ice Sheet) and 0.03–0.27 m (from the Antarctic Ice Sheet). **Glaciers:** Evidence is limited and confidence is low, but projections indicate that with sustained warming of 1.5–2°C, around 50–60% of glacier mass could remain, mostly in the polar regions. **Permafrost:** For every 1°C increase in Global Average Surface Temperature (GSAT), the volume of permafrost in the top 3 metres of soil is reduced by about 25% (±5% uncertainty). **Permafrost:** By 2100, near-surface permafrost area (within 3–4 m depth) is projected to decrease by 24 ± 16%. Lower emissions substantially dampen permafrost-carbon release relative to higher-warming scenarios.	At sustained warming of 2–3 °C, the Greenland and West Antarctic ice sheets are projected to be lost almost completely and irreversibly over multiple millennia. **Ice sheets:** projected contribution to global mean sea level rise by 2100 will be 0.04–0.13 m (from the Greenland Ice Sheet) and 0.03–0.29 m (from the Antarctic Ice Sheet). **Glaciers** are projected to lose around 29,000 Gt (9,000-49,000 Gt) which represents around 18% (range of 5-31%) of their early 21st century mass. **Glaciers:** Around 50–60% of glacier mass outside Antarctica is projected to be lost. **Permafrost:** By 2100, near surface permafrost is projected to decline by 15-87%.	**Ice sheets:** projected contribution to global mean sea level rise by 2100 will be 0.03-0.34m (from the Greenland Ice Sheet) and 0.09–0.18 m (from the Antarctic Ice Sheet). **Glaciers** are projected to lose around 58,000 Gt (28,000-88,000 Gt) which represents around 36% (range of 16-56%) of their early 21st century mass. **Glaciers:** An estimated 60–75% of glacier mass outside Antarctica is projected to disappear. At this level of warming, there is medium confidence that nearly all glacier mass in low latitudes, Central Europe, the Caucasus, western Canada and the United States of America (USA), North Asia, Scandinavia, and New Zealand will be lost. **Permafrost:** By 2100, near-surface permafrost area is projected to decline by 69 ± 20%. Thawing permafrost is projected to result in the cumulative release of tens to hundreds of gigatonnes of carbon as CO_2 and CH_4 to the atmosphere by 2100, with the potential to further amplify climate change.
Oceanic Changes *(Schedule 6(5)(a)(iii))*	**Ocean surface temperature** is projected to increase by around 0.86 °C (likely range: 0.43–1.47 °C) between 2081–2100.	Specific changes under intermediate-warming futures are not directly detailed within the AR6 report as it is an intermediate scenario.	**Ocean surface temperature** is projected to increase by around 2.89 °C (likely range: 2.01–4.07 °C) between 2081-2100.

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C)
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	**Aligns with:** SSP2-4.5 and RCP4.5	**Aligns with:** SSP3-7.0 and SSP5-8.5 and RCP8.5
	Ocean heat content is projected to increase by around 2–4 times by 2100 (compared to 1971–2018 baseline). **Marine heatwaves** are projected to become around 4 times more frequent (likely range: 2–9) in 2081–2100 (compared to 1995–2014 baseline). **Ocean acidification:** It is virtually certain that surface ocean pH will decline by 0.036 to 0.042 pH units by 2081-2100 (relative to 2006-2015 baseline).	However, the following information can be derived from the IPCC Regional Fact Sheet (IPCC, 2021): - **Ocean surface temperature** is projected to increase further with a likely range of 1.5 to 2.5°C. - **Ocean heat content** will continue to increase throughout the 21st Century. - **Marine heatwaves** become more frequent and intense. - **Ocean acidification** continues steadily.	**Ocean heat content** is projected to increase by around 4–8 times by 2100 (compared to 1971–2018 baseline). **Marine heatwaves** are projected to become around 8 times more frequent (likely range: 3–15) in 2081–2100 (compared to 1995–2014 baseline). **Ocean acidification:** It is virtually certain that surface ocean pH will decline by 0.287 to 0.29 pH units by 2081-2100 (relative to 2006-2015 baseline). There are elevated risks for aragonite shell-forming species as aragonite-corrosive conditions is likely over about 16–20% of the surface ocean by 2081–2100, mainly affecting the Arctic and Southern Oceans and parts of the northern Pacific and northwestern Atlantic.
Biodiversity *(Schedule 6(5)(a)(ii))*	**Terrestrial ecosystems:** An estimated 3–14% of assessed species are projected to face a very high risk of extinction. **Ocean and coastal ecosystems:** Risks of biodiversity loss range from moderate to very high. **Biodiversity hotspots:** Very high extinction risk for endemic species is estimated at around 2%.	**Terrestrial ecosystems:** The proportion of species at very high extinction risk increases to 3–18%. **Ocean and coastal ecosystems:** Risks of biodiversity loss remain moderate to very high, with more ecosystems at high and very high risk. **Biodiversity hotspots:** Very high extinction risk for endemic species doubling to at least 4% (relative to 1.5 °C).	A very high extinction risk for endemic species (i.e. species exclusively confined to a single, specific geographic region) in biodiversity hotspots. Extinction risk is projected to increase at least tenfold as warming rises from 1.5 °C to 3 °C. **Terrestrial ecosystems:** The proportion of species at very high extinction risk increases to 3–18%. **Ocean and coastal ecosystems:** Risks of biodiversity loss increases to high to very high.

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C)
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	**Aligns with:** SSP2-4.5 and RCP4.5	**Aligns with:** SSP3-7.0 and SSP5-8.5 and RCP8.5
			Biodiversity hotspots: Very high extinction risk for endemic species is 10 times higher than at 1.5°C.
Population and Human Health *(Schedule 6(5)(a)(i))*	**Climate-sensitive diseases:** Malaria: Increased distributional range and vectorial capacity of malaria in parts of sub-Saharan Africa, Asia and South America. Aedes-borne diseases (dengue, Zika, chikungunya, yellow fever): Projected increased global abundance of Aedes mosquito. Europe largely avoids widespread exposure increases. **Food and nutrition insecurity:** Increased frequency and severity of droughts, floods and heatwaves, together with continued sea-level rise, are projected to increase risks to food security. In vulnerable regions, food security risks increase from moderate to high, assuming no or low levels of adaptation.	**Climate-sensitive diseases:** Malaria: Clear increases in malaria transmission risk in many endemic regions. Aedes-borne diseases: Around half of global population exposed to transmission risk by 2050, with most of Europe experiencing significant increases in exposure compared to pre-industrial conditions. **Food and nutrition insecurity:** Food security risks become more severe, driven by climate change. Impacts include increased malnutrition and micronutrient deficiencies. Risks are concentrated in Sub-Saharan Africa, South Asia Central and South America, and Small Island states.	**Climate-sensitive diseases:** Malaria: Severe and widespread increases in transmission risk. Aedes-borne diseases: Overall exposure to mosquito-borne disease transmission continues to increase, with Aedes aegypti (yellow fever mosquito) abundance projected to increase by around 30% by the end of the century. **Food and nutrition insecurity:** Compared with warming of 2°C or less, climate-related hazards are projected to affect much larger areas, intensifying regional inequalities in food security and disproportionately impacting vulnerable regions.
Material Assets *(Schedule 6(5)(a)(iv))*	**Impacts on energy and industrial water use:** Hydropower and thermos-electric power plants adaptations are projected to be most effective at lower levels of warming. **Increasing Adaptation Limits:** Beyond 1.5°C of global warming, limited freshwater availability may create hard limits for Small Islands and	**Impacts on energy and industrial water use:** The effectiveness of adaptation measures for hydropower and thermoelectric plants decreases at higher levels of warming. This may be due to reduced water availability for hydropower, lower cooling efficiency from higher river temperatures, and greater disruption from droughts and floods.	**Increasing Adaptation Limits:** Some water management measures are projected to become less effective across many regions, with certain areas of Europe reaching hard limits to adaptation. **Flood-related damages** are projected to rise substantially without adaptation, c. 2.5 to 3.9 times higher at 3 °C warming compared to 1.5 °C.

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C)
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	**Aligns with:** SSP2-4.5 and RCP4.5	**Aligns with:** SSP3-7.0 and SSP5-8.5 and RCP8.5
	regions that rely on glacier and snowmelt. **Productivity loss:** Estimated global GDP reduction of around 0.5% due to climate-related productivity losses. **Food production loss:** By 2100, less than 8% of current global agricultural areas are projected to become climatically unsuitable.	**Increasing Adaptation Limits:** Soft adaptation limits are expected to affect major crops in many areas, particularly in tropical regions. **Flood-related damages** are projected to rise substantially without adaptation, at around 1.4 to 2 times higher at 2 °C warming compared to 1.5 °C.	**Productivity loss:** Estimated global GDP reduction of around 2.4%, relating to greater heat exposure and productivity losses. **Food production loss:** A substantial share of current crop and livestock areas is projected to become climatically unsuitable. c. 10% of current global agricultural areas become unsuitable by 2050 and >30% become unsuitable by 2100.
Cultural Heritage *(Schedule 6(5)(a)(iv))*	Predicting impacts on cultural heritage is inherently challenging, as heritage assets are highly location-specific, and there is limited consistent data available on their condition and vulnerability. However, key projected risks include: **Coastal risks:** Sea-level rise and storm-driven coastal erosion threatening archaeological and heritage sites worldwide. Rising sea levels are projected to increase the risk of flooding and erosion, threatening World Heritage sites across regions such as Africa, the Arctic and the Mediterranean (which hosts 49 cultural World Heritage sites, including the city of Venice and the early Christian monuments of Ravenna). **Physical damage and loss:** Direct damage to cultural and natural heritage sites from flooding, erosion, and other climate hazards. **Loss of intangible heritage:** Disruption or loss of traditional cultures, ways of life, and community identities. This may include the loss traditional knowledge systems. **Arctic impacts:** Increasing permafrost thaw and flooding affecting heritage sites and altering tourism patterns linked to cultural heritage in Arctic regions.		
The Landscape *(Schedule 6(5)(a)(iv))*	More frequent and severe droughts could transform perennial rivers into intermittent ones and lead to the complete loss of already intermittent rivers (medium evidence, medium agreement). This would put freshwater fish at greater risk in environments that are already prone to heat and drought. **Loss of scenic value:** Higher temperatures, lower rainfall,	**Changes in freshwater ice:** River ice duration is projected to decrease by around 7.3 days over 2009-2029 and 2080-2100.	**Impacts on water quality and availability:** Wildfire frequency is expected to rise by c. 30%. More frequent fires, together with soil erosion linked to deforestation could negatively impact water quality and availability. **Increased areas of drier landscapes:** In ecosystems that historically experience few fires, a 4°C increase in global temperatures significantly elevates fire risk, potentially

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C)
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	**Aligns with:** SSP2-4.5 and RCP4.5	**Aligns with:** SSP3-7.0 and SSP5-8.5 and RCP8.5
	and more frequent fires are expected to reduce the scenic quality of vineyards in Central Chile, South America. Scenario analysis estimates a projected reduction in aesthetic visual experience by 18–28% by 2050.		leading to greater tree mortality and the transformation of large areas of the Amazon rainforest into drier landscapes with lower biomass. **Changes in freshwater ice:** Around 4.6% of ice-covered lakes in the Northern Hemisphere could shift to having only intermittent winter ice. Warmer lakes with less ice lose more water through evaporation. By 2100, annual global lake evaporation is expected to increase by about 16% (compared to a 2006–2015 baseline). As ice melts, more energy goes into evaporation rather than heating the air, further increasing water loss. River ice duration is also projected to decrease, by nearly 17 days during 2009-2029 and 2080-2100.

6 Environmental Impact Assessment Methodology

In order to determine the impacts that the proposed Platypus Development may have on the environment an ENVironmental and socio-economic impact IDentification (ENVID) was undertaken following a structured methodology. The purpose of the ENVID was to identify the significance of the environmental and social impacts associated with the planned activities and the significance of the environmental and social risks associated with unplanned events. Appropriate mitigation measures, controls and safeguards to minimise these impacts/risks were also identified.

This chapter presents the Environmental and Socio-Economic Impact Assessment (ESIA) and the Environmental and Socio-Economic Risk Assessment (ESRA) matrices used to determine the impact of the planned and potential unplanned activities (respectively) associated with the proposed Project.

6.1 Receptors and Aspects

6.1.1 Environmental and Socio-economic Receptors

Receptors to be considered in the ESIA and ESRA include:

- Environmental receptors:
  - Resource Availability;
  - Air Quality;
  - Water Quality;
  - Sediment Quality;
  - Plankton;
  - Benthic Communities (including flora and fauna);
  - Fish;
  - Marine Mammals;
  - Seabirds;
  - Coastline (including beaches and coastal recreational areas); and
  - Designated Areas.
- Socio-economic receptors:
  - Landfill Resources;
  - Fisheries; and
  - Shipping.

6.1.2 Aspects

Aspects considered included:

- Emissions to Air;
- Resource Use (offshore and onshore) (including energy use);
- Disturbance to the Seabed (short term and long term);
- Discharges to Sea;
- Underwater Noise;
- Physical Presence: short term (e.g. presence of vessels and drilling rig) and long term (e.g. infrastructure installed);
- Waste Generation (including transportation and final disposal); and
- Unplanned Events (e.g. loss of vessel inventory or a well blowout).

The aspects associated with each activity were assessed in terms of their impact on the receptors in the area. For example, the use of vessels will result in emissions to air, fuel use, discharges to sea, waste generation, underwater noise, physical use of space and, disturbance to the seabed (i.e. anchoring). Receptors potentially impacted by these aspects include air quality, climate, resource depletion, marine mammals, seabirds, other users of the sea, seascape and benthic communities.

6.1.3 Effects on Receptors due to Emission of GHGs

The primary source of GHG emissions from the Platypus Development are the indirect emissions that will occur at the point of use of the exported products. This will be almost exclusively somewhere in the UK, but the locations cannot be more firmly known. Furthermore, all GHG emissions add to the global atmospheric concentrations of the GHGs and consequently contribute to climate change and its repercussions on all topics in the Schedule 6(5) of the EIA Regulations, including human health, biodiversity, water, land use, air quality.

A separate and specific methodology has therefore been adopted to assess the impacts of GHG emissions and this is described in Section 6.7.

6.2 ESIA for Planned Activities

The significance of the environmental/social impact of planned activities on each of the susceptible receptors is derived by considering the 'Receptor Sensitivity' in relation to the 'Magnitude of Effect' of the aspect.

6.2.1 Receptor Sensitivity

Four categories of Receptor Sensitivity are applied ranging from 'Low' to 'Very High' as shown in Table 6-1.

Table 6-1: Receptor Sensitivity.

Category	Environmental Definition
(a) Low	**Flora/Fauna/Habitats - within the impacted area** • Population sizes are considered to be of little to no geographical importance. • Species do not have designated conservation status and are of IUCN 'Least Concern'. • No designated habitat/sites. • Impacted species are widespread in the North East Atlantic region. **Air quality:** Emissions may impact on other nearby installations. **Water quality**: Open offshore water body. **Cultural heritage sites**: Site integrity is already compromised. **Resource availability:** (e.g. landfill sites, diesel use) Renewable and/or abundant. **Third party users:** have capacity to absorb change without impact.
(b) Medium	**Flora/Fauna/Habitats – within the impacted area** • Significant numbers of at least one receptor of national importance (e.g. FOCI). • Significant numbers of a species which is listed as IUCN 'Near Threatened'. • Nationally designated habitat/sites. • Species may be of regional value. **Air quality**: Populated areas nearby. **Water quality**: Semi-enclosed water body with good flushing. **Cultural heritage sites:** Site is of local heritage importance. **Resource availability**: (e.g. landfill sites, diesel use) Renewable and/or available. **Third party users:** have capacity to absorb change without significant impact.
(c) High	**Flora/Fauna/Habitats – within the impacted area** • Significant numbers of at least one receptor of regional (European) importance (e.g. Annex II / IV species and the OSPAR designations). • Significant numbers of a species which are listed as IUCN 'Vulnerable'. • Designated habitats/sites (e.g. OSPAR designations and Annex I habitats: SACs and SPAs). • Locally distinct sub-populations of some species may occur. **Air quality:** Densely populated areas nearby. **Water quality:** Semi-enclosed water body with limited flushing. **Cultural heritage sites:** Site is of regional heritage importance. **Resource availability:** (e.g. landfill sites, diesel use) Not renewable and/or limited availability. **Third party users:** have low capacity to absorb change and significant impact is likely to occur.

(d) Very High	**Flora/Fauna/Habitat – within the impacted area** • Significant numbers of at least one receptor of international importance. • Significant numbers of a species which are listed as IUCN 'Endangered' or 'Critically Endangered'. • Designated habitats/sites (e.g. OSPAR designations and Annex I habitats, MPA Networks; SACs, SPAs, Ramsar sites etc.) (as for High (c)). • At least one receptor is endemic (unique) to the area. **Air quality:** Very densely populated area with sensitive receptors such as schools and hospitals. **Water quality:** Enclosed water body with no flushing. **Cultural heritage sites:** Site is of international heritage importance. **Resource availability:** (e.g. landfill sites, diesel use) Not renewable and/or scarce availability. **Third party users:** have no capacity to absorb change e.g. unemployment due to long term closure of fisheries.

6.2.2 Magnitude of Effect

Definitions for the Magnitude of Effect on the receptors are presented in Table 6-2. Prior to determining the Magnitude of Effect, industry recognised 'base case' mitigation measures are assumed to be applied. For example, only MARPOL compliant vessels will be used. These industry recognised mitigations are considered prior to identifying the residual impact.

Table 6-2: Magnitude of Effect.

Magnitude Level		Description	
		Environmental Impact	Social Impact
0	**Positive/No effect** *Regulatory compliance or Company goals are not a concern.*	**No environmental concerns** • Positive environmental impact e.g. retaining a 500 m zone resulting in a 'protected area'. • No significantly negative environmental effects.	**No public concerns** • Possible enhancement in the availability of a resource benefitting the persons utilising the area e.g. removal of 500 m zones results in return of access to fishing grounds. • No impacts on sites or features of cultural heritage. • No impact on resource or landfill availability.
1	**Negligible** *Regulatory compliance or Company goals are not breached.*	**Negligible environmental effects** • Any effects are unlikely to be discernible or measurable and will reverse naturally. • No beaching or transboundary impacts.	**Limited local public awareness and no concerns** • An intermittent short-term decrease in the availability of a resource which is unlikely to be noticed e.g. vessels working out-with existing 500 m exclusion zones could temporarily impact on a shipping route or fishing area. • Undiscernible changes to a site or feature of cultural heritage that do not affect key characteristics and are not above background changes. • Undiscernible use of a resource (e.g. diesel, rock cover or landfill).
2	**Minor** *Possible minor breach of regulatory compliance. .*	**Minor, localised, short term, reversible effect** • Any change to the receptor is considered low, would be barely detectable and at same scale as existing variability. • Recover naturally with no Company intervention required. • No beaching or transboundary impacts	**Some local public awareness and concern** • A temporary (<1 year) decrease in the availability or quality of a resource e.g. access to fishing grounds may temporarily be inhibited due to presence of vessels. • Minor changes to a site or feature of cultural heritage that do not affect key characteristics. • Minor use of a resource (e.g. diesel, rock cover or landfill).

3	**Serious** *Possible moderate breach of regulatory compliance.*	**Detectable environmental effect within the project area** • Medium localised changes to the receptor are possible. • Localised Company response may be required. • No beaching or transboundary impacts.	**Regional / local concerns at the community or stakeholder level which could lead to complaints** • Medium decrease in the short-term (1-2 years) availability or quality of a resource affecting usage e.g. bring a rig on site for 1-2 years. • Nuisance impacts e.g. marine growth odour coming from yards. • Partial loss of a site or feature of cultural heritage. • Moderate use of a resource (e.g. diesel, rock cover or landfill).
4	**Major effect** *Possible major breach of regulatory compliance.*	**Severe environmental damage extending beyond the project area** • High, widespread mid-term (2-5 years) degradation of the receptor. • Company response (with Corporate support) required to restore the environment. • Possible beaching and / or transboundary impacts.	**National stakeholder concerns leading to campaigns affecting the Company's reputation** • High mid-term (2-5 year) decrease in the availability or quality of a resource affecting usage e.g. closure of fishing grounds. • Substantial loss or damage to a site or feature of cultural heritage. • High use of a resource (e.g. diesel, rock cover or landfill).
5	**Critical effect** *Major breach of regulatory compliance resulting in project delays and prosecution.*	**Persistent severe environmental damage** • Very high, widespread long-term (>5 years) degradation to the receptor that cannot be readily rectified. • Major impact on the conservation objectives of internationally/nationally protected sites. • Full Corporate response required. • Major beaching and/or transboundary impacts.	**International public concern and media interest affecting the Company's reputation** • Very high decrease in availability of a resource and potentially livelihood of users for > 5 years e.g. *hydrocarbons on beaches affecting tourism or tainting of fish resulting in the long-term closure of fishing grounds.* • Total loss of a site or feature of cultural heritage. • Significant use of a resource (e.g. diesel, rock cover or landfill).

6.2.3 Environmental / Socio-Economic Impact Significance

The 'Receptor Sensitivity' (Table 6-1) and the 'Magnitude of Effect' (Table 6-2) are combined using the matrix presented in Table 6-3 to determine the Impact Significance for planned activities.

Table 6-3: ESIA Matrix for Planned Activities.

		Receptor Sensitivity			
		(a) Low	(b) Medium	(c) High	(d) Very high
Magnitude of Effect	(0) Positive/No effect				
	(1) Negligible				
	(2) Minor				
	(3) Serious				
	(4) Major				
	(5) Critical				

(i) Positive / No effect significance	• Positive or no environmental or social impact. • No public interest or positive public support.
(ii) Low significance	• No/negligible environmental and social impact. • No concerns from consultees.
(iii) Moderate significance	• Discernible environmental and social impacts. • Requirement to identify project specific mitigation measures. • Concerns by consultees which can be adequately addressed by the Company.
(iv) High significance	• Substantial environmental and social impacts. • Serious concerns by consultees requiring corporate support. • Alternative approaches should be identified.

6.3 Cumulative and Transboundary Impacts

The ESIA sets the activities and potential impacts in the context of all other activities taking place in the Platypus Development area to determine the additional cumulative effects of the new activities. The potential cumulative effects are discussed in the impact assessment chapters.

Where relevant, transboundary impacts of each aspect on the receptors is discussed in the impact assessment chapters e.g. the impact of emissions on climate change.

6.4 ESRA for Unplanned Events

To determine the environmental and social risk of an unplanned event (e.g. dropped object or a well blowout), the following approach considers firstly, the Impact Significance of the environmental impact of an event should it occur and secondly, the Likelihood of the event occurring.

6.4.1 Environmental and Social Significance of an Unplanned Event

The ESIA approach described above for determining the environmental and social impacts of planned activities is also used to determine the Impact Significance of impacts that may result from unplanned events.

6.4.2 Likelihood of an Unplanned Event

The 'Likelihood' of an unplanned event is then considered. Five categories of Likelihood, ranging from 'Extremely Remote' to 'Likely', are presented in Table 6-4.

Table 6-4: Likelihood of an Unplanned Event.

Likelihood Category	Definition
Extremely Remote	Has never occurred within industry or similar industry but theoretically possible.
Remote	Similar event has occurred elsewhere but unlikely to occur with current practices
Unlikely	Event has occurred in the industry during similar activities.
Possible	Event could occur during project activities.
Likely	Event is likely to occur more than once during the project.

6.4.3 Environmental Risk of an Unplanned Event

Combining the Impact Significance of the environmental/social impact (Table 6-3) with the Likelihood of the unplanned event occurring (Table 6-4) allows the level of Environmental Risk associated with an unplanned event to be determined using the matrix presented in Table 6-5. Note the potential for a beneficial Impact Significance has been removed as it is not expected that an unplanned event would lead to a beneficial environmental or socio-economic impact.

Table 6-5: ESRA Matrix for Unplanned Activities.

		Environmental significance of unplanned event*		
		(ii) Low	(iii) Moderate	(iv) High
Likelihood of event	**Extremely remote**	Low	Low	Low
	Remote	Low	Low	Medium
	Unlikely	Low	Medium	Medium
	Possible	Low	Medium	High
	Likely	Low	High	High

*Note the numbers associated with each significance level range from (ii) to (iv) in keeping with assignment in Table 6-3.

Low risk	• Negligible environmental and social risks. • Mitigation measures are industry standard and no project specific mitigation required. • No consultee concerns.
Medium risk	• Discernible environmental and social risks. • Consultee concerns can be adequately resolved. • Local public interest.
High risk	• Significant environmental and social risks. • Serious consultee concerns. • Media interest and reputational impacts.

6.5 Assessment of Significance of Project Environmental and Social Risks

Using the information provided in Chapter 4 (Project Description) and Chapter 5 (Environmental Baseline), and the criteria set out above, Appendix B (ENVID Results) identifies all activities associated with the proposed Platypus Development and their Impact Significance / Environmental Risk.

Appendix B is split into the following nodes:

1. Vessel use during drilling, subsea and platform installation, Neptune/Cleeton modifications and commissioning;
2. Drilling operations and flow test;
3. Platypus MFP installation;
4. Pipelines installation;
5. Neptune and Cleeton modifications and tie-in (including venting during tie-in); and

6. Commissioning and production (a) Platypus, (b) Neptune and (c) Cleeton.

The assessment showed that, with the application of industry standard mitigation measures, the majority of the planned activities are anticipated to have a Low Impact Significance. Only six of the planned activities are considered to have an Impact Significance of Moderate, whilst none are considered to be High. The Moderate activities were in relation to Seabed Disturbance (four), Discharges to Sea (one) and Underwater Noise (one). The Moderate Significance was driven primarily by the high sensitivity of receptors due to project location within the Southern North Sea SAC.

As with the planned activities, the Impact Significance associated with the majority of the unplanned events identified were found to be Low following the application of mitigation measures/safeguards, which reduced the Likelihood of the events occurring. Two unplanned events; loss of vessel fuel inventory due to collision and a well blowout during drilling activities resulting in hydrocarbon releases, were considered to pose a 'High' Impact Significance for environmental or socio-economic impacts. However, with the application of standard industry mitigation, the Likelihood of these events occurring was considered 'Remote' meaning the resulting Environmental Risk is considered 'Medium' in both cases.

Table 6-6 summarises the activities associated with the proposed Project that have been identified to have Moderate or High Impact Significance.

Table 6-6: Summary of activities identified to have Moderate or High Impact Significance.

Aspect	Source/ Activity	Impact Significance
Discharges to Sea	• Deliberate discharge to sea from drilling operations e.g. WBM cuttings, cement, drilling chemicals, production water. Disturbance to seabed impacting on benthic species.	Moderate
Seabed Disturbance	• Interaction of vessels with the seabed. Jack up vessels will be positioned using anchors. Jack up vessels will also interact with the seabed via the spud cans. • Installation of pipelines via trench and bury (production and Methanol lines. • Installation of surface laid spools, mattresses, Rock Filter Units (RFUs) grout bags within the 500 m zones. • Contingency rock may be added to pipeline if targeted depth of burial is not achieved.	Moderate
Underwater Noise	• Piling of platform jacket and driving conductors.	Moderate
Unplanned Events	• Major hydrocarbon/ chemical spillage (i.e. vessel collision and loss of containment).	High
	• Accidental Release of LTOBM / WBM, hydrocarbons / chemicals to sea.	Moderate
	• Well blowout. Uncontrolled hydrocarbon (condensate) flow to surface.	Moderate
	• Well blowout. Uncontrolled hydrocarbon (gas) flow to surface.	High
	• Dropped Object - large object, such as the MFP itself (topsides + jacket).	Moderate
	• Emergency abandonment of pipeline.	Moderate
	• Pipeline rupture - Due to pipeline corrosion, or fatigue, snagging, or dropped object.	Moderate
	• Scour protection for pipeline.	Moderate
	• Helicopter crash. Loss of Heli fuel to sea.	Moderate

Chapters 7 - 13 of this ES further assess the impacts of the aspects/activities that:

- Are subject to regulatory control;

- Were found to pose a Moderate or High Impact Significance to the environment;
- Were raised during the consultation phase; or
- Were identified as areas of public concern.

Chapter 13 (Accidental Events) presents the results of Oil Spill Modelling carried out to determine the impact of a major hydrocarbon loss.

6.6 Biodiversity Considerations

The European Environment Agency (EEA, 2010) identifies five principal pressures and drivers of biodiversity loss:

- Habitat loss and fragmentation;
- Overexploitation and unsustainable use of natural resources;
- Pollution;
- Invasive alien species; and
- Climate change.

Project activities have the potential to contribute to one or more of these pressures either directly or indirectly. Potential impacts on biodiversity may include:

- Changes in ecosystem structure and function, including impacts on ecosystem services;
- Habitat loss, degradation or modification resulting from seabed disturbance, installation activities, physical presence of infrastructure, and changes in habitat type;
- Loss of species, populations or biodiversity value through direct or indirect impacts on habitats and ecological communities;
- Direct impacts on protected or notable species, for example through interactions with vessels, infrastructure or other project activities;
- Introduction and spread of invasive non-native species; and
- Pollution or contamination affecting ecological receptors and wider ecosystem functioning.

The pressures on biodiversity have therefore been incorporated as a consideration in different chapters throughout the ES, as shown in Table 6-7.

Table 6-7: Biodiversity Pressures and Relevant ES Sections.

Biodiversity Pressure	Relevant ES Section
Changes in Ecosystem Services	All impact assessment chapters (Chapters 7 to 13)
Habitat loss and degradation	Chapter 10 – Seabed Disturbance
Loss of species / Species diversity	Chapter 10 – Seabed Disturbance Chapter 7 – Physical Presence
Direct impact on species	Chapter 7 – Physical Presence, Chapter 11 – Underwater Noise
Spread of invasive non-native species	ENVID (Appendix B); screened out from detailed assessment
Pollution / contamination	Chapter 9 – Discharges to Sea
Climate change	Chapter 8 – Emissions to Air and Climate Change

6.7 Impact Assessment Methodology Specific to Impacts from GHG Emissions

The tables in Section 6.2 and 6.4 have been developed over many years as EIA has evolved and improved. Experience from their use in multiple ESs has provided calibration of their effectiveness in deriving appropriate levels of significance for impacts and risks across a broad spectrum of activities, impact magnitudes, receptor types and sensitivities. As the consideration of indirect GHG emissions in impact assessments is a recent introduction, there is not the same degree of calibration through experience of those tables to GHG emissions impacts.

Following the Finch Ruling (Finch v Surrey County Council, 2024), OPRED has stated that it: 'expects that ESs will consider how the GHG emissions associated with a proposed project impact climate at a global level and a national level.'

The impact assessment for GHG emissions therefore adopts a separate methodology, as described here, recognising that "*Climate change is a global problem precisely because there is no correlation between where GHGs are released and where climate change is felt. Wherever GHG emissions occur, they contribute to global warming*." (Finch v Surrey County Council, 2024, p.28).

The methodology adopted for assessing the impact on climate change of GHG emissions resulting from the Platypus Development follows the guidance published by the Institute of Sustainability and Environmental Professionals (ISEP), formerly IEMA, for the assessment of GHG emissions and evaluating their significance (IEMA, 2022).

The methodology has also been shaped to align with DESNZ Supplementary Guidance for assessment the effects of downstream Scope 3 emissions on climate from offshore oil and gas projects (DESNZ, 2025).

The assessment method includes the following steps:

1. Setting of the scope and boundaries of the GHG assessment;
2. Establishing the baseline;
3. Stipulating the emissions calculation methodology;
4. Calculating the GHG emissions inventory;
5. Identifying the Sensitivity of the impacted receptor;
6. Evaluating the Magnitude of the impact of project emissions on the receptor; and
7. Concluding the significance level of the impact.

Ways to minimise or mitigate GHG emissions have been considered throughout the project design and development to date and those that have been adopted are incorporated into the project description. However, having completed the impact assessment, it can be valuable to re-examine whether further opportunities for mitigation may be available and, if appropriate, review steps 4 – 7 in light of any changes.

6.7.1 Scope and Boundaries

6.7.1.1 System boundaries

All material GHG emissions, direct or indirect, during the whole life of the proposed project will be included in the scope. Activities which would not significantly change the result of the assessment, and for which estimating emissions would be complex, may be excluded. The ISEP guidance suggests that an emission source or activity may not be material where the expected emissions are less than 1% of total emissions, and where all such exclusions total a maximum of 5% of total emissions.

Platypus fluids will be exported via the Platypus MFP and Neptune and will be received at Cleeton for processing from which they are then export.

Emissions at Neptune and, particularly, at Cleeton serve production from several existing fields in addition to Platypus. The assessment of Platypus production GHG emissions is therefore set within the boundary of the baseline for all fields for which processing occurs at Cleeton up to the point of export.

6.7.1.2 Temporal boundaries

Emissions of GHGs from pre-production activities are assumed to occur in 2028 and 2029.

Emissions of GHGs from all other sources related to the Platypus Development are detailed annually between the scheduled date for first gas (September 2029) and Cessation of Production (December 2045).

The effects of GHGs in the atmosphere are long term and are assessed in the context of global surface temperature increases from cumulative global GHG emissions over the project lifetime and to the end of the current century.

6.7.2 GHG Emissions Baseline

The baseline for GHG emissions, atmospheric concentrations and their resulting impacts have been documented in Section 5.7. This includes the current baseline and multiple possible future baselines and includes justification of the adopted future baseline for the impact assessment.

The baseline description fulfilled the requirements of Schedule 6 of the EIA Regulations (DESNZ, 2020). The baseline in Section 5.7 provides:

"A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of its likely evolution without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge."

As suggested by DESNZ and ISEP guidance (DESNZ, 2025; IEMA, 2022) a reasonable future estimate of the baseline has been based on up to date available environmental information and scientific knowledge on global GHGs and their effect on the environment.

6.7.3 Emissions Calculation Methodology

Quantification of GHG emissions for each source at each phase of the Platypus Development will use the following general calculation form:

GHG emission = Activity data x GHG emission factor

All calculations shall use EFs from well-established and up to date sources which will be referenced at each step.

Activity data will be established from a combination of recorded historical data and projections from Platypus engineering data. The derivation of each activity data used in the emissions quantifications will be explained and justified. Assumptions, limitations and uncertainties will be identified, explained and their significance considered.

Emissions will be calculated for activities associated with the:

- Installation of the Platypus Development infrastructure;
- Production of Platypus hydrocarbons;
- Downstream transportation and processing of Platypus hydrocarbons and delivery to end-users; and
- End use of processed hydrocarbon products.

Quantification will assume that all exported hydrocarbons from Platypus will be combusted by end-users.

Quantification of emissions from all sources will be based on the project achieving the High case production profile, wherever this influences the emissions.

Where quantified emissions are normalised to production rates (e.g. to establish GHG intensity), the Mid case production profiles will be assumed.

6.7.4 Calculate Emissions Inventory

An inventory of project GHG emissions will be generated through the implementation of the methodology in Section 6.7.3.

6.7.5 Receptor Sensitivity

The primary receptor for GHG emissions is the atmospheric concentration of GHGs, which then results in changes to the climate, which causes effects on multiple environmental and social receptors, as detailed in Section 5.7.

The assessment methodology therefore adopts the guidance of ISEP (IEMA, 2022) that the sensitivity of the receptor to GHG emissions is 'high' given the severe consequences of global climate change and that all global cumulative GHG sources are relevant to the effect on climate change.

6.7.6 Magnitude and Significance of Impact

The assessment of the magnitude of the effect of the project's GHG emissions will be based on recognised criteria proposed by ISEP and set out in Table 6-8. The ISEP criteria have been developed in recognition that a 'key goal of EIA is to inform the decision maker about the relative severity of environmental effects such that they can be weighed in a planning balance. Therefore, it is essential to provide context for the magnitude of GHG emissions reported in the EIA in a way that aids evaluation of these effects by the decision maker.' (IEMA, 2022).

Since there is only one category of sensitivity of the receptor to these effects ('High'), the ISEP guidance establishes a direct correlation from Magnitude to Significance which is also shown in Table 6-8.

Table 6-8: Magnitude and Significance of effects of project GHG emissions.

Magnitude of Effect	Definition	Significance of Effect
Major Adverse	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.	**Significant Adverse**
Moderate Adverse	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.	**Significant Adverse**
Minor Adverse	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.	**Not Significant**
Negligible	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.	**Not Significant**
Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.	**Significant Beneficial**

ISEP emphasises the position that: "For the avoidance of doubt, a 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change, aligning project emissions with a science-based 1.5°C compatible trajectory, and [in the UK context] achieving net zero by 2050."

The focus of the ISEP guidance on the UK Net Zero objectives is appropriate to the Platypus Development because 98% of the Platypus product is natural gas which will flow into the UK natural gas transmission system from where it will be received and combusted by end-users in the UK. All emissions from the Platypus Development will therefore form part of the UK reported emissions.

To enable the application of Table 6-8 to the Platypus Development, the impact assessment will consider a quantitative contextualisation of the Platypus Development GHG emissions against UK national and sectoral emissions reduction targets and a qualitative contextualisation of how the project is compatible with the UK emissions reduction trajectory and environmental protection objectives. This will include evaluation of how the project complies with up to date policy and good practice emissions reduction measures.

ISEP provides examples of the types of contextual information against which a project can be evaluated to determine if the project is contributing to or jeopardising achieving Paris aligned targets.

Those that are applicable to the Platypus Development are:

- National Carbon Budgets;
- Sectoral budgets and reduction strategies;
- Current and future GHG emissions intensity of an activity;
- Existing and emerging national or local policy or regulation;
- Expert advice of guidance bodies.

Global Cumulative Impacts

The assessment will also consider the cumulative effects of the project GHG emissions in combination with other existing and planned future projects at a global level.

The ISEP guidance (ISEP, 2026) states:

- "The atmospheric concentration of GHGs and resulting effect on climate change is affected by all sources and sinks globally, anthropogenic and otherwise. As GHG emission impacts and resulting effects are global rather than affecting one localised area, the approach to cumulative effects assessment for GHGs differs from that for many EIA topics where only projects within a geographically bounded study area of, for example, 10 km would be included." (pp.17-18)
- "All global cumulative GHG sources are relevant to the effect on climate change, and this should be taken into account in defining the receptor (the atmospheric concentration of GHGs) as being of 'high' sensitivity to further emissions." (pp.17-18)
- "Effects of GHG emissions from specific cumulative projects therefore in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other." (pp.17-18)

This will instead be achieved through assessment of the Platypus Development GHG emissions in the context of the future baseline scenario. Global emissions reductions pathways form the basis of the future baseline scenario described in Section 5.7. These pathways consider a wide range of existing and planned projects and other activities, both natural and anthropogenic. They also consider the net impact of atmospheric emissions attributed to sources and sinks and hence are inherently cumulative. Therefore, the cumulative effects of the GHG emissions from the project are considered within the context of the future baseline.

6.7.7 Further Mitigation

Following assessment of the significance of the impact of Platypus full lifecycle GHG emissions, consideration will be given to whether the introduction of any additional mitigation measures are appropriate.

7 Physical Presence

This chapter discusses the potential impacts associated with the physical presence of the following:

- The vessels and the drilling rig associated with the proposed Platypus Development;
- The proposed Platypus MFP; and
- All subsea infrastructure.

Potential impacts on other sea users, fish, marine mammals and seabirds are discussed, with reference to the impact assessment methodology presented in Chapter 6. The impacts on the seabed and the local benthic communities are discussed in Chapter 10 (Seabed Disturbance).

As described in Sections 4.6 and 4.7, relatively minor topside modifications will be required at Neptune and Cleeton. Neptune modifications include the addition of one hydrocarbon riser and one methanol riser. Cleeton modifications are minor and mainly involve equipment installation. It is therefore considered that the alterations to Neptune and Cleeton are not expected to have any additional physical presence impacts and therefore are not considered further in this chapter.

7.1 Presence of Vessels, Drilling Rig, and MFP

The vessels required for the drilling, installation and commissioning activities associated with the proposed Platypus Development are summarised in Table 4-13 and may include (but are not limited to), a drilling rig, a HLJUV, tug vessels, JUB, pipelay vessel, DSV, standby vessels such as ERRVs, supply vessels and environmental survey vessels. During routine production operations (after drilling, installation and commissioning activities), vessel use will be limited to a W2W vessel (maximum 8 weeks per year) and therefore the number of vessels usually present in the area will not significantly increase as a result of the proposed Platypus Development.

As a worst-case scenario, four anchors may be used to assist with the positioning of the drilling rig over the location of the wells. It is anticipated the drilling rig will be on location for *c*. 161 days as the base case (excluding mobilisation and demobilisation) with a contingency of a further 30 days use of a JUB to complete and tie the wells into the MFP if the wells are drilled prior to the MFP installation, or in the contingency scenario should tie-in and completion not be possible with the drill rig due to vessel availability, scheduling delays etc. Eight anchors will be used to position the HLJUV during the MFP installation and four anchors will be used to position the JUB at Neptune to undertake the modifications to the platform. All anchors will be recovered at the end of the installation and drilling campaigns.

As described in Section 4.5, the refurbishment and upgrade of the Platypus MFP will be carried out onshore, involving the re-purposing of a decommissioned offshore asset and then the jacket and topsides will be installed offshore.

The physical presence of the installation vessels, support vessels, drilling rig and MFP could potentially result in navigational hazards, a restriction of fishing operations, and disturbance to fish, marine mammals and seabirds.

7.1.1 Impact of Vessels, Drilling Rig and MFP on Other Sea Users

When compared to shipping levels throughout the North Sea, the shipping levels in the Platypus area can be considered relatively low with much of the Project within an area with a vessel density of less than 10 vessel hours per km^2 per month (EMODnet, 2024; Section 5.6.2).

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

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

All vessels will be equipped with marine navigational aids and an aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations (HSE, 2011), to warn ships and aircraft of their position.

The systems comprise:

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

As required by HSEx Operations Notice 6 (HSE, 2022), a vessel warning communication will be issued at least 48 hours before any vessel movement. The vessel routes will be selected with the aim of minimising interference to other vessels and the risk of collision. All drilling activities will occur within a 500 m exclusion zone. In addition, a CtL permit application will be submitted to OPRED which will be supported with a traffic (shipping and navigation) survey and, a collision risk management assessment if required. An ERRV will also provide support during installation and drilling operations.

The proposed Platypus Development will be located within ICES rectangle 36F0 and 36F1. The information presented in Section 5.6.1 suggests that fishing effort to date within this rectangle is Moderate.

As detailed in Section 4.8.1, a drilling rig will be used to drill the wells. The drilling rig has allowed for the deployment of four anchors as a worst-case to assist with the placement of the rig. The drilling rig and associated anchors will be located wholly within a 500 m exclusion zone.

Using the impact assessment methodology presented in Chapter 6; UK fishing industry and vessels in the area have the capacity to absorb change without a significant impact, however acknowledging the spatial squeeze on fishermen from other users of the sea (i.e. wind farms), their Receptor Sensitivity is considered to be **Medium (b)**. Given the use of navigational aids; the 500 m safety zone at the drilling location; the submission of a CtL, and Perenco commitment to submitting statutory notifications of any drilling rig movements and potential schedule changes and only using vessels adhering to the COLREGS, the Magnitude of Effect of the physical presence of the drilling rig and vessels on other sea users is considered **Minor (2)**. Given the Medium Receptor Sensitivity and the Minor Magnitude of Effect, the Impact Significance is considered **Low** such that any social impacts of the physical presence of vessels and drilling rig are considered to be negligible.

7.1.2 Impact of Vessels, Drilling Rig and MFP on Marine Mammals

Note the potential impact of underwater noise associated with vessels and drilling activities are discussed in Chapter 11. This chapter discusses the physical presence of the vessels and the drilling rig. From Section 5.3.6, it is evident that a number of marine mammals occur in the area which could be disturbed by the increase in vessel traffic. In addition, there could be an increased risk of injury to marine mammals through vessel strikes. Given that the Project is located within the SNS SAC designated for harbour porpoise and that Annex II species occur in the area (grey seal, harbour seal, harbour porpoise, bottlenose dolphin, white-beaked dolphin, short-beaked common dolphin, minke whale; Section 5.3.6.2) and all cetaceans are EPS, Receptor Sensitivity is considered **High (c)**.

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

Marine mammals may be attracted to installations due to increased prey abundance (Todd *et al.,* 2009); however, no evidence of impacts of installations on marine mammals on the UKCS have been reported. Cetaceans are therefore anticipated to quickly adapt to the presence of the drilling rig and vessels, which will occupy a very small proportion of their overall available habitat such that the Magnitude of Effect of the presence of the drilling rig and vessels is considered to be **Negligible (1)**. Given the High Receptor Sensitivity and the Negligible Magnitude of Effect, the Impact Significance is considered **Low** such that any impacts of the vessels and drilling rig on marine mammals is considered to be negligible.

7.1.3 Impact of Vessels, Drilling Rig, and MFP on Seabirds

As described in Section 5.3.5, a number of seabird species are found in the Platypus area and given that birds of conservation importance from the coastal SPAs will disperse into the project area following the breeding season and will feed in the Project area, Sensitivity of birds as a receptor is considered **Medium (b)**. As described in Section 5.4, the coastal SPA, Greater Wash protects seabirds during their non-breeding and breeding season (JNCC, 2018d). It should be noted that no nesting birds were identified in the most recent Neptune bird survey (May 2025).

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

Though evidence suggests that the presence of vessels and the drilling rig could cause some bird species to be displaced from their foraging area, the very small proportion of their overall available habitat that will be occupied by the vessels and drilling rig means the impact is not considered to be noticeable. In addition, given the existing oil and gas vessel activity in the area, it is expected that the impact of the vessels and drilling rig on bird migration routes is not expected to be significant. Therefore, the Magnitude of Effect of the physical presence of the vessels and drilling rig on seabirds is considered **Negligible (1)**. Given the Medium Receptor Sensitivity and the Negligible Magnitude of Effect, the Impact Significance is considered **Low** such that any impacts of the vessels and drilling rig on seabirds are considered to be negligible.

7.1.3.1 Impact of MFP Wind Turbine on Seabirds

As there will be two wind turbines on the proposed Platypus MFP and as collision with moving turbines can result in injury or death to seabirds (Maxwell *et al.,* 2022) further analysis on the risk of bird strike is considered here.

The extent of collision risk posed by wind farms to seabirds is dependent on several factors including: the flight heights exhibited by birds in relation to the rotor swept area of a turbines, their flight speeds, and avoidance behaviour undertaken in relation to individual turbines, or entire wind farms (Johnston *et al.,* 2023).

Given the height of the proposed Platypus MFP wind turbines above sea level (35 m), the height range of concern for potential bird strike (including a conservative buffer) has been considered to be 25 to 50 m. Table 7-1 uses the ESAS data collected over 30 years (Kober *et al.,* 2010) to indicate seabird species likely to occur in the area. For those species likely to occur in the Platypus area, Table 7-1 summarises seabird foraging range (km from shore) and indicates those species of birds with modelled flying heights within the range of concern. Despite the Platypus field being located *c*. 67 km from the English coastline, species with foraging

distances less than this are still considered being conservative of potential 'island hopping' behaviours and were noted in ESAS data as being a potential species present within their density surface map. Flight activity of seabirds has been found to vary across the 24-hour diel cycle with some species flying more frequently at night as well as varying their flight style depending on diel period (e.g. dynamic soaring or pull up heights). For this reason, the upper extremity of flight height distribution is used to fully characterise risk.

Those species of bird with modelled flying heights within the range of concern, as well as low or medium avoidance rate, are considered at risk for potential collision with the Platypus MFP wind turbines. This includes six bird species in total; Northern Fulmar, Northern Gannet, Black-legged Kittiwake, Little gull, Common tern, and Razorbill.

Table 7-1: Summary of seabird flight behaviour including foraging distances, flight heights and avoidance rates for species within the Platypus area.

Species	Mean maximum foraging range (km from shore) [a] (± 1 SD)	Flight height within range of concern (25-50 m above sea level)[e]	JNCC Avoidance Rate Basic Band (2012) Model AR [f]	Potential for bird strike with Platypus MFP wind turbines*4
Northern Fulmar	542.3 ± 657.9	Yes	L*3	Yes
Sooty Shearwater	56.6 ± 45.3 (393.0 ±22.1 [b])	No	L*3	No
Manx Shearwater	1,346.0 ± 1,018.7	No	L*3	No
European storm Petrel	336.0 *1	No	L*3	No
Leach's Storm-Petrel	657*2	No	L*3	No
Northern Gannet	315.2 ± 194.2	Yes	M	Yes
Pomarine Skua	-	No	M	No
Arctic Skua	2 ± 0.7 *2[c]	No	M	No
Great Skua	443.3 ± 487.9	No	M	No
Black legged Kittiwake	156.1 ± 144.5	Yes	M	Yes
Black-headed gull	18.5*1	Yes	VH	No
Little gull	-	Yes	M	Yes
Great Black-backed gull	73.0 *1	Yes	H	No
Common Gull	50.0 *1	Yes	VH	No
Lesser Black-backed gull	127.0 ± 109.0	Yes	H	No
Herring gull	58.8 ± 26.8	Yes	H	No
Common tern	17.6 ± 9.1	Yes	L	Yes
Arctic Tern	25.7 ± 14.8	No	L	No
Common gulliemot	443.3 ± 487.9	No	L*3	No
Razorbill	88.7 ± 75.9	Yes	L*3	Yes
Little Auk	-	No	L*3	No
Atlantic puffin	137.1	No	L*3	No
Avoidance rate key (JNCC, 2024)	L = 0.9902 (± 0.0001)	M = 0.9923 (± 0.0001)	H = 0.9936 (± 0.0001)	VH = 0.9947 (± 0.0001)

*1 No Standard Deviation (SD) available for mean maximum value *2 Mean value with SD – no mean maximum value available *3 default of L 0.9902 (± 0.0001), *4 species that fly within range of concern without a High (H) or Very High (VH) avoidance rate.
[a] Woodward *et al.,* 2019; [b]Bonnet-Lebrun *et al*., 2020 ; [c] Schoombie *et al.,* 2018; [d] Johnston *et al.,* 2016; [e] Johnston *et al.,*2014 ; [f] JNCC, 2024

Although six species of seabird have modelled flying heights within the range of concern, studies have found that most seabird species spend the majority of their time flying less than 25 m above sea level. Therefore, although the bird species are capable of flying heights within 25 - 50 m, they do not spend the majority of time doing so. Therefore, given that the Platypus MFP will have two relatively small wind turbines, bird strike is expected to be very unlikely.

APEM-Marine Scotland (2022) used novel LiDAR technology to assess the flight heights of some of the most common seabird species found along the UK coastline. Results found that flight heights of fulmar (*c.* < 5 - 50 m), gannet (*c.* < 5 – 26 m) and kittiwake (*c.* < 5 - > 150 m) were generally below 25 m above sea surface level. The flight heights recorded in the study were in line with previous research of those seabird species, confirming that they are most commonly found in flight just above the sea surface (Johnston*, et al.,* 2014).

Johnston *et al* (2014) used pre-construction monitoring data from offshore wind farm sites across Europe to estimate continuous flight height distributions for 25 seabird species (species relevant to this project are shown Table 7-1). The findings from this study were found to be consistent with that of others (e.g., Krijgs-veld *et al.,* 2011), stating that the majority of flights were within 20 m of the sea surface for all bird species considered.

There are many studies and research examples which have found that the occurrence of bird collision with offshore wind turbines is low, both via collision risk modelling and collection of seabird flight data.

A study was commissioned by Vattenfall to investigate bird collision and avoidance at the European Offshore Wind Deployment Centre (EOWDC), an offshore wind test site with 11 fixed-foundation turbines located off the coast of Aberdeen. Seabirds were tracked inside the array and bird meso-avoidance (a significant change in altitude or direction before arrival) and micro-avoidance (a sudden change of flight when passing a turbine at close range) was measured. Seabird species included herring gull (*Larus argentatus*), black-legged kittiwake (*Rissa tridactyla*), Northern gannets (*Morus bassanus*), great black-backed gulls (*Larus marinus*) and many others. All of these seabird species are potentially present within the vicinity of the Platypus MFP. The study found that no collisions or even narrow escapes were recorded in over 10,000 bird videos during the two years of monitoring covering the April 2020 – October 2021 period (Vattenfall, 2023).

During two years of fieldwork at the Thanet Offshore Wind Farm (comprising 100 turbines with a rotor radius of 90 m and sea surface clearance of 25 m), bird activity was observed in 12,131 out of 600,000 videos. Six collisions in total were recorded. The analysis revealed that the collision risk of seabirds was less than half of what was expected. Seabirds were also observed to exhibit avoidance behaviour and change their flight path to avoid the turbines. The vast majority (96.8%) of recorded seabirds in this study avoided the turbines by flying between the turbine rows, while 3.2%, displayed meso-avoidance by adjusting flight height to fly below the rotor-swept zone (Skoy *et al.,* 2018). The seabird species monitored were northern gannet, herring gull, Lesser black-backed gull, great black-backed gull, and black-legged kittiwake. All of these seabird species are potentially present within the vicinity of the Platypus MFP (Skoy *et al.,* 2018).

The Offshore Renewables Joint Industry Programme carried out a comprehensive investigation into seabird behaviour and collision risk around offshore wind farms, which revealed that seabirds avoid offshore wind turbines much more than previously predicted. The study combined human observer-based tracking with a system that automatically records seabird movements, at Vattenfall's fixed foundation Thanet Offshore Wind Farm in the English Channel between July 2014 and June 2016 (Skoy *et al.,* 2018).

Given that all of these studies relate to wind farms where several wind turbines are present, the risk of bird collision with the Platypus MFP wind turbines would be far lower and therefore there is not expected to be a significant impact of the physical presence of the Platypus MFP wind turbines on seabirds.

7.2 Presence of Subsea Infrastructure

The subsea infrastructure, including associated stabilisation and protection materials, have the potential to impact on other sea users, as well as marine mammals and fish as a result of their physical presence. Section 4.9 summarises the types of subsea infrastructure to be installed as part of the proposed Platypus

Development. As noted previously, impacts on the seabed and the local benthic communities are discussed in Chapter 10 (Seabed Disturbance).

7.2.1 Impact of Subsea Infrastructure on Other Sea Users

At the time of writing the ES, the majority of the fish caught in ICES rectangles 36F0 and 36F1 were shellfish (Section 5.5.1). Traps were the most dominant gear type in the area and given they are stationary in the water or on the seabed these are unlikely to interact with subsea structures. Dredges are also an important gear type used in the area and given these are towed along the seabed, they may become entangled with or impact on any subsea structures that they come into contact with.

Prior to installing the subsea infrastructure, the Project will apply for a PWA, including a Deposit Consent to deposit materials, and a PLA application with CtL for the pipeline; and the development will comply with any notification requirements associated with the PWA and PLA approval. This will include the positions of any pipelines. The location of all infrastructure to be installed will be submitted to UKHO for inclusion on the admiralty charts, and to the sea users, such as National Federation of Fishermen's Organisations (NFFO) and Scottish Fishermen's Federation (SFF).

Landings and fishing effort data suggests that the proposed Project occurs in an area that is relatively important to the UK fishing industry, however the UK fishing industry and vessels in the area have the capacity to absorb change without noticeable impact therefore their Receptor Sensitivity is considered to be **Medium (b)**.

The long-term permanent presence of the new infrastructure out with the 500 m safety zones may cause a nuisance to commercial fisheries if they become unburied.

Access to fishing grounds will be temporarily inhibited from the installation activities but this will be short term, the Magnitude of Effect on fisheries is considered therefore **Negligible (1)** such that the overall Impact Significance is considered **Low** such that any social impacts of the physical presence of subsea infrastructure are considered to be negligible.

7.2.2 Impact of Subsea Infrastructure on Marine Mammals and Fish

With respect to the impact of pipelines and subsea structure installation on marine mammals and fish, as marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), and given presence of FOCIs and high density of sand eels (prey species for harbour porpoise as feature of SNS SAC), Receptor Sensitivity is considered to be **High (c)**.

Given that marine mammals and fish in the area are anticipated to adapt to the presence of the subsea infrastructure, which will occupy a very small proportion of their overall available habitat, the Magnitude of Effect is considered to be **Negligible (1)** and therefore the Impact Significance is considered **Low** such that any impacts from the physical presence of subsea infrastructure on marine mammals and fish is considered negligible.

7.3 Impacts of Physical Presence on the SNS SAC

To assess the potential impacts of physical presence of the proposed Project vessels, drilling rig, and infrastructure on protected features and conservation objectives of the SNS SAC, a summary of the relevant pressures 'Entanglement' and 'Collision with vessels or installations' with respect to harbour porpoise in the SNS SAC is provided in Table 7-2 (JNCC, 2023). These pressures are not considered relevant to Harbour porpoise supporting habitats and availability of prey and therefore this feature has been marked N/A.

An assessment of potential impact from seabed disturbance to Harbour porpoise supporting habitats and prey species has been provided in Section 10.5.4.

Table 7-2: Harbour Porpoise Species Sensitivity to Physical Presence (FeAST, AOps; JNCC (2023)).

Relevant Pressures	SNS SAC Features of Interest		Project Source	Potential Impact	Relative Risk of Impact	Advice on Operations and Relevance to Proposed Project
	Harbour porpoise species	*Harbour porpoise supporting habitats, processes, and availability of prey*				
Entanglement	R	N/A	Subsea infrastructure	Mortality Injury	High	Pipelines will be trenched and buried and therefore there is no subsea infrastructure being installed as part of the proposed Project that would present a risk of entanglement for harbour porpoise.
Collision with Vessels or Installations	R	N/A	Vessels, drilling rig, MFP	Mortality Injury	Medium/ Low	As described in Section 7.1.2, the evidence for lethal injury from boat collisions with marine mammals suggests that collisions with vessels are very rare (Cetacean Stranding Investigation Programme, 2011).
Key: **R - Relevant** **N/A - Not Applicable**						

7.4 Decommissioning Phase

At end of field life, the Platypus Development will be decommissioned as part of a Decommissioning Programme. Perenco will assess suitable options at the time of decommissioning and gain approval / agreement with the relevant authority.

7.5 Cumulative and Transboundary Effects

The proposed activities will result in a modest increase in vessel activity as a result of additional vessel movements. It is noted that the proposed Platypus Development is located within vicinity of awarded and planned windfarms, as described in Section 5.6.4.

Given that these activities will occur within a well-established area for oil and gas activity and the majority of vessel movements associated with the project will be short-term in nature, significant cumulative impacts are not expected.

The proposed Platypus Development is located *c*. 121 km from the UK/Netherlands median line and therefore no transboundary impacts associated with the physical presence of the additional subsea infrastructure, MFP, drilling rig or vessels are expected.

7.6 Mitigation Measures

The following industry standard mitigation measures will be undertaken to minimise the impacts from the physical presence of the vessels, drilling rig, MFP, subsea infrastructure and associated stabilisation and protection materials on other sea users, marine mammals, fish and birds.

Proposed Mitigation Measures
• Optimise vessel use; • Consultation with National Federation of Fishermen's Organisations (NFFO) for all operations; • Notice to mariners prior to operations starting; • A vessel traffic survey/ navigational risk assessment will be undertaken (as required); • Key environmental sensitives (i.e. SNS SAC Summer Area) will be considered during the planning of project timing. • Perenco will submit required notifications to the Hydrographic Office, Kingfisher and Ministry of Defence (MoD) such that all other users of the area will be notified; • Platypus MFP and all vessels will have marking and lighting as per the Standard Marking Schedule for Offshore Installations; • Notice will be sent to the Trinity house of MFP installation, any vessel movements and vessel mobilisation associated with the mobilisation and demobilisation of the rig; • Drilling rig and MFP will have a 500 m exclusion zone to mitigate any collision risk; • A guard vessel will be on location from when trenching activities commence until back-fill activities have been completed; • Lighting will be minimised as far as practicable; • The MCA will be notified of all offshore activities that could impact navigation i.e. presence of vessels, platform and pipeline installation; • A CtL will be obtained prior to installation of seabed infrastructure.

Applying the impact assessment methodology described in Chapter 6 and taking account of the mitigation measures listed above, the physical presence of the vessels, drilling rig, proposed Platypus MFP and subsea infrastructure associated with the proposed Platypus Development is considered to be of a **Low** socio-economic Impact Significance overall. In addition, the environmental Impact Significance in relation to marine mammals, birds and fish is considered **Low** overall. As mentioned previously, the environmental Impact Significance in relation to benthic species is considered separately in Chapter 10 (Seabed Disturbance). The environmental and socio-economic impacts are therefore considered acceptable when managed within the controls and mitigation measures described. The proposed Project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix A.

8 Emissions to Air

The proposed Platypus Development will result in emissions of pollutants to air, with associated local impacts on air quality, and global impacts through climate change. Different pollutant gases may contribute to one or both processes.

This chapter first presents the sources of emissions from all aspects of the project, then quantifies the magnitude of the emissions of pollutants attributed to those sources and then assesses their impacts.

The assessment considers the local/regional impact on air quality of the following air pollutants: carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), methane (CH_4), and non-methane Volatile Organic Compounds (VOC).

While a range of greenhouse gases (GHGs) are present in the atmosphere, which have varying Global Warming Potential (GWP), this assessment focuses on GHGs that are relevant to the Platypus Development. Specifically, it considers the GHGs generated during hydrocarbon production activities and during the end-use combustion of the hydrocarbons forecast to be produced from the Platypus Development. Therefore, on this basis, the assessment focuses on CO_2, together with associated emissions of CH_4 and N_2O, which are the primary GHGs attributable to these lifecycle stages.

First gas is currently anticipated to be in Q3 of 2029. The production profiles detailed in Chapter 4, as well as the emissions estimates within this chapter, are based on this target date.

Residual impacts that may be experienced by the receiving environment after the adoption of appropriate mitigation measures, are assessed with consideration to the sensitivity and dispersive capacity of the receiving environment.

8.1 Sources of Emissions

Three categories of project emissions sources have been identified:

- **Pre-Production**: Direct emissions from vessels and helicopters commissioned by Perenco for the installation of offshore facilities and infrastructure and for the drilling, commissioning and startup of the two Platypus wells. This includes:
  - Combustion of diesel/Marine Gas Oil by vessels;
  - Combustion of aviation fuel by helicopters; and
  - Flaring of reservoir fluids for well clean-up (while no flaring is intended during well clean-up, the emissions assessment includes contingency flaring to cover the worst, realistic case);
- **Production**: Direct emissions during the operational phase from:
  - Increased use of fuel gas/diesel for power generation at Cleeton;
  - Increased occasional venting at Neptune due to the increased inventory of topsides equipment, such as Platypus fluids reception vessels;
  - Venting at Platypus due to the occasional need for partial depressurisation of the Platypus to Neptune pipeline when shut in for long duration; and
  - Maintenance vessels attending the Platypus MFP.
- **Production**: Indirect emissions of GHGs associated with downstream processing and the end-use of exported hydrocarbon product.

8.1.1 Categorisation of GHG emissions

Classifying emissions by scopes (either Scope 1, 2, or 3) as detailed in the GHG Protocol (World Resources Institute (WRI, n.d.) was developed to enable companies to assess emissions for reporting of corporate emissions. Whilst not strictly developed for project reporting, the notion of Scopes is useful for contextualising project emissions. Similarly, the Corporate Value Chain (Scope 3) Accounting and Reporting Standard (WRI and World Business Council for Sustainable Development [WBCSD], 2011) describes sub-categories of Scope 3 emissions that provides a useful reference for typical GHG emissions sources upstream and downstream of a project.

These can be summarised in the context of the proposed Platypus Development as follows:

- Scope 1 GHG emissions are those arising directly from activities of the Project (e.g. combustion of fuel at a Perenco facility) related to the Platypus Development;
- Scope 2 GHG emissions are indirect emissions from the activities of third-party organisations in their provision of energy sources (power, electricity and heat) purchased by Perenco (there are no Scope 2 emissions identified for the proposed Platypus Development); and
- Scope 3 GHG emissions include all other indirect emissions from activities that occur either upstream or downstream of production in the full value chain. Downstream activities for the proposed Platypus Development include the use of produced hydrocarbons by others following their export from Cleeton.

Please see WRI (n. d.) for further definition.

The onward transportation of exported hydrocarbons, their subsequent refinement into marketed products, the distribution of these products and their ultimate use by end users are considered to be an inevitable consequence of production. Whereas these processes and emissions are out with the control of Perenco, they result in emissions of GHGs, and the impact of these emissions also requires assessment.

Products exported from the site of production (in this case the Platypus products exported from Cleeton) are sometimes referred to as 'sold products', while products in their final form, that are used by consumers ('end-users'), are termed 'end-use' products.

GHG emissions associated with activities between sold products leaving Cleeton and end-use products arriving, in refined form, at the ultimate end user are sometimes referred to as Scope 3 Category 9 and Category 10, in accordance with the breakdown of downstream emissions classes within the GHG Protocol company reporting guidance (WRI, n. d.).

In the same vein, GHG emissions from the use of end-use products are referred to as Scope 3 Category 11 emissions. For the purposes of this assessment it has been assumed that all end-use products derived from Platypus sold products will be combusted in some form as fuel. This is in line with OPRED's Supplementary Guidance '*Environmental Impact Assessment (EIA) – Assessing effects of downstream scope 3 emissions on climate*' (OPRED, 2025).

Other Scope 3 categories of the GHG Protocol Guidance (WRI, n. d.) are not of relevance (or are of *de minimis* scale) to the Project GHG emissions.

Section 8.2.3 describes how the Scope 3 downstream Category 9, 10 and 11 GHG emissions have been estimated and presents the results of the calculations. For this assessment the emissions from the activities downstream of Cleeton are separated into two categories:

- The transportation of Platypus sold products, their processing and refining into end-use products and the distribution of these end-use products to end-users are aggregated into one set of emissions (Categories 9 and 10); and
- The combustion of end-use products by end-users is the second (Category 11).

8.2 Emissions Quantification

Emissions of GHGs and other pollutants from the proposed Platypus Development are derived based on applying standard emissions factors (EF) to the quantity of hydrocarbons used in a particular activity (e.g. combusted in turbines or engines, or emitted in venting) as follows (see Chapter 6 for further details):

$$'M(is) = A(s) \times EF\ (is)'$$

where:

M(is) is the emitted mass of a particular emission gas (i) for a given source (s);

A(s) is the source (s) activity factor (typically based on engineering estimates);

EF (is) is the emission factor for the emission gas (i) relevant to the emission source.

Different GHGs have different warming effects on the atmosphere. This effect can be expressed in terms of the global warming potential (GWP), measured over a defined length of time (e.g. 100 years), relative to the warming effect of carbon dioxide. It follows that the GWP for cardon dioxide is 1. GWP are then used as multipliers to allow masses of GHGs to be expressed in terms of tonnes of carbon dioxide equivalent (te CO_2e). Emission quantities of CO_2, CH_4 and N_2O are converted to CO_2 equivalents using the Global Warming Potential (GWP) factors published in the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (IPCC, 2014) for the 100 year horizon which is consistent with current national and international reporting requirements, and are as follows:

Table 8-1: Global Warming Potential over 100 years of GHGs that are relevant to the Platypus Development (IPCC, 2014).

Direct GHGs	GWP_{100}
CO_2	1
N_2O	265
CH_4	28

8.2.1 Direct GHG Emissions: Pre-production

Emissions from activities prior to first gas have been estimated for three sources according to the method described in the following paragraphs and the results are presented in Table 8-2 by source type and in aggregate.

A baseline scenario without the Platypus Development would not result in any of these pre-production emissions.

8.2.1.1 Vessel fuel combustion

Vessel emissions have been calculated by applying Environmental and Emissions Monitoring System (EEMS) EFs for diesel engines (EEMS, 2025; EEMS, 2008[1]) to the aggregated estimate for fuel use by all vessels that is presented in Table 4-13.

The majority of these emissions will be on location at the Platypus MFP site, although a small proportion will be emitted along the transit route from ports. For assessment of impacts to air quality, it is conservatively assumed that all pre-production emissions from vessels are at the Platypus MFP site and therefore provides an overestimate of the actual impact of air quality on receptors.

GHG emissions are not geographically limited. They have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The receptor for GHG emissions is the global atmosphere (ISEP,2026).

8.2.1.2 Aviation fuel combustion

Emissions from helicopters will be along the transit route, with only a minor proportion adding cumulatively to emissions from other sources at the Platypus MFP site. Emissions of GHGs have been calculated from the

[1] The 2025 Draft EEMS guide does not provide a default EF for CO_2 from diesel combustion in engines, instead referring to the UK GHG Inventory (DESNZ, 2026d) to encourage consistency with GHG emissions reporting under the UK ETS. Since the UK ETS does not cover shipping there is no relevant EF for vessel diesel combustion in the GHG Inventory. The calculations for this ES have therefore reverted to the default EF for CO_2 provided in the EEMS 2008 guide. This approach is more conservative than using the slightly lower Conversion Factors for diesel fuel combustion published by DESNZ in its GHG Conversion Factors for GHG Reporting (DESNZ, 2026c). It is also consistent with the 2025 Draft guide default EF for diesel combustion during drilling.

total quantity of aviation fuel use estimated for the pre-production phase (as detailed in Table 4-13) using GHG EFs for CO_2, CH_4 and N_2O published by DESNZ (DESNZ, 2026c).

Since there are no published EFs for non-GHG emissions from the use of aviation fuel, no calculation has been undertaken for NO_x, SO_2, CO and VOCs. This omission results in a small underestimation of these pollutant gases at the Platypus MFP. However, this would be more than compensated for by the conservative assumption adopted in Section 8.2.1.1 wherein emissions from transiting vessels were treated as if emitted at the Platypus MFP location.

8.2.1.3 Well clean-up flaring

Well clean-up is not currently considered to be necessary for the two wells, and flaring will be minimised and avoided wherever possible. Reservoir fluids will be brought directly on-stream into the processing systems. However, should a need for clean-up be identified during drilling of the wells, a worst-case contingency has been included in the emissions estimates for flaring of up to 57 Million Standard Cubic Feet (mmscf) of gas (1,178 te) and 171 Stock Tank Barrel (stb) of condensate (21.7 te) for each well. Should any flaring be required this will be through the drill rig flare. Emissions from contingency flaring have been calculated using EFs for well test flaring provided in the revised EEMS draft guidance (EEMS, 2025).

Table 8-2: pre-production phase emissions

Combustion Emission Source	Quantity used (te)	CO_2 (te)	NO_x (te)	N_2O (te)	SO_2 (te)	CO (te)	CH_4 (te)	VOC (te)	CO_2e (te)
Drilling and Construction vessels (diesel)	10,039	32,124	596	2.2	20	158	2	20	32,760
Aviation	274	864	0.0	0.03	0	0	0.02	0	872
Well test and clean up (gas flared)	2,357	6,598	2.8	0.2	0.03	16	106	12	9,618
Well test and clean up (condensate flared)	43	139	0.2	0.004	0.001	0.8	1.1	1.1	170
Total Pre-Production	-	**39,725**	**599**	**2.4**	**20**	**174**	**109**	**33**	**43,420**

8.2.2 Direct GHG Emissions: Production phase

Cleeton processes fluids from the Cleeton Attic reservoir, Ravenspurn South and fields in the Easington Catchment Area (ECA) which includes Whittle and Wollaston, Apollo and Minerva and Eris, Ceres, Mercury and Neptune.

Platypus fluids will flow to Neptune where they will be commingled with fluids from Eris, Ceres and Mercury for export and subsequent processing on Cleeton.

The reference unit for the assessment of the Platypus Development's production phase emissions is therefore the Cleeton Hub; the group name given to the production infrastructure for Cleeton and the fields listed above.

For the avoidance of doubt, the term Cleeton Hub specifically excludes Ravenspurn North. Fluids from Ravenspurn North do not interface with the Cleeton Hub, other than that they are exported via the same Main Gas Line (MGL) to the onshore DGT. Emissions associated with the production from Ravenspurn North are also completely segregated from emissions for the Cleeton Hub. Consequently, neither hydrocarbon production nor emissions at Ravenspurn North are included in the baseline for the Cleeton Hub presented in this section of the ES.

Hydrocarbon production forecasts for the Cleeton Hub are presented in Table 4-10 and Table 4-11 in Chapter 4 and in Appendix I, both with and without the proposed Platypus development.

Emissions resulting from the production of Cleeton Hub fluids derive from:

- Two Rushton TB-5000 dual fuel gas turbine generators on Cleeton CC which operate one on and one standby;
- Diesel use in minor consumers on Cleeton such as cranes, firewater pumps and an emergency diesel generator if activated;
- Diesel use at NUIs within the Cleeton Hub;
- Occasional venting at Cleeton and at satellite platforms required for maintenance or emergency depressurisation; and
- Fuel consumed by operations support vessels and helicopters.

Production emissions data recorded and reported by Perenco for the past 5 years are presented in this section along with projected baseline emissions in the absence of the Platypus Development.

Revised projected production emissions for the baseline with the Platypus Development are presented and the incremental increase in emissions are determined by difference.

8.2.2.1 Fuel Gas Use

Historically, the Rushton TB-5000 turbines have used fuel gas other than at start up, during which use of diesel is necessary. In 2024 some disruption was experienced which led to increased downtime and increased use of diesel for power generation, issues continued to occur in 2025. For the purposes of the emissions calculations a conservative assumption has been made that diesel will remain a component of the fuel used for power generation, and so the projected baseline annual fuel gas use is commensurately lower than pre-2024 (offset by an increase in diesel use – see Section 8.2.2.2).

Quantities of fuel gas used annually from 2020 to 2025 are presented in Table 8-3 along with projected annual fuel gas use for 2026 and beyond. Low fuel gas use recorded for 2024 reflects the disruption to production that was experienced due to the issues with power generation.

The projected fuel gas use is assumed to be the same whether the Platypus Development goes ahead or not. Processing of the Platypus fluids on Cleeton will not lead to any additional power demand other than to support chemical pumps which have a combined demand of <3 kV. Since both fuel gas and diesel are currently used by the Rushton TB-5000 turbines, and emissions are higher for diesel use, it has been conservatively assumed that the additional power demand required for the Platypus Development will be met by an increase in diesel use rather than fuel gas. Increased diesel use is accounted for in Section 8.2.2.2.

Emissions from fuel gas combustion presented in Table 8-3 are derived from the default EFs provided for fuel gas combustion in turbines in the draft revised guidelines for EEMS reporting (EEMS, 2025). Where default EFs are not provided in the revised draft guideline, EFs from the 2008 EEMS guideline (EEMS, 2008) have been used. A site-specific EF for CO_2 emissions has been calculated as 2.837 tonnes of CO_2 per tonne teCO_2/te which is within 1% of the default value of 2.86. The default value has historically been used for EEMS reporting for Cleeton and is currently adopted in this ES. A site-specific EF for NO_x emissions from the Rushton TB-5000 turbine has not been derived as there is no requirement for stack sampling at Cleeton. Neither have type-specific turbine NO_x EF polynomial coefficients been suggested for the Rushton TB-5000 in the draft revised guidelines for EEMS reporting (EEMS, 2025).

It is to be noted that some minor differences may exist between the estimated emissions presented in this ES for past years and those reported under EEMS or the UK Emissions Trading Scheme (ETS). This may result from differences in reporting boundaries or in EF adopted. For example, the CO_2 EF for fuel gas combustion used for UK ETS reporting is calculated monthly based on fuel gas composition whereas the estimate presented here uses a fixed EF which thereby ensures consistency with calculations for future years.

Table 8-3: Annual emissions from fuel gas combustion at Cleeton.

Fuel Gas Use	Quantity used (te/y)	CO_2 (te/y)	NO_X (te/y)	N_2O (te/y)	SO_2 (te/y)	CO (te/y)	CH_4 (te/y)	VOC (te/y)	CO_2e (te/y)
2021	4,117	11,776	25.1	0.91	0.05	24.7	3.79	0.15	12,122
2022	3,768	10,777	23.0	0.83	0.05	22.6	3.47	0.14	11,094
2023	2,446	6,997	14.9	0.54	0.03	14.7	2.25	0.09	7,203
2024	3	8	0.0	0.00	0.00	0.0	0.00	0.00	9
2025	1,549	4,429	9.4	0.34	0.02	9.3	1.42	0.06	4,559
Projected 2026 - 2045	**1,965**	**5,621**	**12.0**	**0.43**	**0.03**	**11.8**	**1.81**	**0.07**	**5,786**

8.2.2.2 Diesel Use

Diesel is used on Cleeton, with smaller quantities also used on satellite NUIs within the Cleeton Hub. Emissions calculated for the aggregated diesel use recorded for the Cleeton Hub from 2020 to 2025 are presented in Table 8-4. Table 8-4 also presents emissions calculated for the projected baseline annual diesel use for 2026 and beyond, both in the absence of the Platypus Development and with the Platypus Development. The incremental additional emissions due to the Platypus Development are shown in Table 8-4, which derive from up to 6.6 tonnes per year (te/yr) estimated for the Platypus chemical pumps.

Emissions from diesel combustion have been calculated using the default EFs for diesel use in engines in the draft revised guidelines for EEMS reporting (EEMS, 2025). The EF for CO_2 in the 2008 EEMS reporting guide (EEMS, 2008) has been adopted in the absence of a specific default value in the 2005 draft guide. Whereas some of the anticipated diesel use will be for the Rushton TB-5000 turbines, the exact proportion has not been estimated and the EFs for diesel in engines are higher than the default EFs for combustion of diesel in turbines and consequently give a worst-case estimate.

Table 8-4: Annual emissions from diesel combustion within the Cleeton Hub.

Diesel Use	Quantity used (te/y)	CO_2 (te/y)	NO_X (te/y)	N_2O (te/y)	SO_2 (te/y)	CO (te/y)	CH_4 (te/y)	VOC (te/y)	CO_2e (te/y)
2021	611	1,957	36.3	0.13	1.22	9.6	0.11	1.22	1,995
2022	738	2,362	43.8	0.16	1.48	11.6	0.13	1.48	2,409
2023	675	2,161	40.1	0.15	1.35	10.6	0.12	1.35	2,204
2024	1,353	4,329	80.4	0.30	2.71	21.2	0.24	2.71	4,415
2025	945	3,025	56.1	0.21	1.89	14.8	0.17	1.89	3,085
Projected Future Baseline	**913**	**2,923**	**54.3**	**0.20**	**1.83**	**14.3**	**0.16**	**1.83**	**2,981**
Baseline Plus Platypus	**920**	**2,944**	**54.6**	**0.20**	**1.84**	**14.4**	**0.17**	**1.84**	**3,002**
Platypus Incremental	**6.6**	**21.1**	**0.3920**	**0.0015**	**0.0132**	**0.1036**	**0.0012**	**0.0132**	**21.5**

8.2.2.3 Venting

Venting at Cleeton and Ravenspurn South are reported annually through EEMS. Reporting of venting at Neptune and Minerva are optional returns which historically were reported separately, though reporting has ceased more recently. Aggregated quantities of gas vented at Cleeton, Ravenspurn South, Neptune and Minerva are shown in Table 8-5 for 2020 to 2025. Vented gas at each location is predominantly methane (c. 93 mole percent [mol%]) with small quantities of CO_2. The vent gas composition for each vent source has been used to determine the quantities of methane and CO_2 vented and the aggregated values are shown in Table 8-5.

Total venting in 2024 was lower than previous years due to disruptions to production and was higher in 2025 due to a higher number of unexpected shutdowns. The projected future baseline annual venting is conservatively assumed to be higher than the years 2020 – 2023 to accommodate the potential for some recurrence of issues encountered in 2025.

The quantity of gas vented during any particular upset event is dependent on the gas inventory in the vented system, not on the throughput flow rate. The inventory is dependent on the volume of the system and the pressure at which it operates. The introduction of Platypus fluids at Cleeton will not cause a change in either system volume or system pressure at Cleeton. Nor will Platypus result in an increase in the likelihood of an upset event occurring that would increase the frequency of venting. Consequently, the introduction of Platypus will not result in an increase in venting at Cleeton. Neither will the introduction of Platypus cause a change to venting at Ravenspurn South or Minerva as these are unconnected with Platypus until arrival at Cleeton. Conversely, there will be a small increase in the quantity of gas vented at Neptune on account of the additional equipment installed at Neptune for accommodating Platypus fluids. This is estimated to cause an increase of 0.09 te of gas vented at Neptune annually.

The Platypus Development will also give rise to venting at the Platypus MFP. This is estimated to total 2.45 te per year based on an assumed number of four upsets to production per year requiring blow down of Platypus topsides, plus one event every three years which would lead to depressurisation of the Platypus pipeline.

The projected future venting emissions for the baseline without Platypus, the incremental increase due to Platypus and the baseline with Platypus are presented Table 8-5.

Table 8-5: Annual emissions from venting within the Cleeton Hub.

Venting	Quantity Vented (te/y)	CO_2 (te/y)	CH_4 (te/y)	CO_2e (te/y)
2021	120	3.03	104.4	2,926
2022	116	2.94	101.1	2,834
2023	116	2.93	100.7	2,822
2024	90	2.04	77.6	2,175
2025	256	6.42	222.7	6,243
Projected Future Baseline	**167**	**4.22**	**146**	**4,079**
Baseline Plus Platypus	**170**	**4.25**	**148**	**4,146**
Platypus Incremental	**2.54**	**0.03**	**2.37**	**66.34**

8.2.2.4 Operations phase total emissions

The annual emissions for fuel gas use, diesel use and venting are aggregated in Table 8-6 for the period 2021 – 2025, for the future baseline without Platypus, the future baseline with Platypus and for the incremental addition due to Platypus.

The emissions recorded in Table 8-6 for past years do not align exactly with those reported in EEMS due to differences in the boundary of reporting for Cleeton under EEMS compared to the emissions calculated for Table 8-6 covering all activities within the Cleeton Hub.

Table 8-6: Aggregated annual operations phase emissions from all sources across the Cleeton Hub.

Aggregated Annual Production Emissions	CO_2 (te/y)	NO_X (te/y)	N_2O (te/y)	SO_2 (te/y)	CO (te/y)	CH_4 (te/y)	VOC (te/y)	CO_2e (te/y)
2021	13,736	61.4	1.04	1.28	34.3	108.3	1.37	17,043
2022	13,142	66.8	0.99	1.52	34.2	104.7	1.61	16,337
2023	9,161	55.0	0.69	1.38	25.3	103.1	1.44	12,228
2024	4,340	80.4	0.30	2.71	21.3	77.9	2.71	6,599
2025	7,460	65.6	0.55	1.91	24.1	224.3	1.95	13,887
Projected Future Baseline	**8,548**	**66.2**	**0.63**	**1.85**	**26.1**	**147.5**	**1.90**	**12,846**
Baseline Plus Platypus	**8,569**	**66.6**	**0.63**	**1.87**	**26.2**	**149.9**	**1.91**	**12,934**
Platypus Incremental	**21.1**	**0.392**	**0.0015**	**0.013**	**0.104**	**2.37**	**0.013**	**87.9**

8.2.2.4.1 Emissions benefit of renewable power generation

If a diesel generator had been included to provide power to the Platypus MFP, rather than the battery/renewables option selected, additional operational emissions would have been incurred. Whereas the base electrical load requirement for the Platypus MFP is estimated to be *c*. 3 kW for 24 hours (Section 4.5.1.1), this would increase to 18 kW to accommodate ancillary equipment required for operating a diesel generator set. Based on the use of a diesel generator with a typical efficiency of 33%, approximately 40.4 te of diesel per year would have been required on Platypus. This would have resulted in an additional 132 teCO_2e/yr, or 2,153 teCO_2e over the Platypus life of field. Selection of the renewable generation option can therefore be seen to have led to a 60% reduction in Platypus annual operational emissions.

8.2.2.5 GHG Intensity

The GHG Intensity (GHGI) of produced hydrocarbons is a measure of the GHGs emitted per unit of production. These are reported by the NSTA for each asset in the UKCS in units of kilograms CO_2 equivalent per barrel of oil equivalent (kgCO_{2e}/boe).

Total annual production phase GHG emissions from Section 8.2.2.4, combined with the production profiles in Appendix I for Cleeton Hub baseline and the Mid Case Platypus production profile, are used to derive annual GHGI values for the baseline without Platypus, for the baseline with Platypus and for the Platypus Development incremental production. These are presented in Table 8-7, with production expressed in units of million barrels of oil equivalent (mmboe). Aggregate GHGI values across the project duration (2029 – 2045) are also presented in Table 8-7. The Mid Case Platypus production profile is used in Table 8-7 as a basis for GHGI calculations since this presents a most likely value. There is minimal difference between the total production-related emissions for the High and Mid production cases. The lower production denominator of the Mid Case consequently leads to a higher GHGI estimate for the Mid Case than for the High case and consequently the Mid Case intensities are of more relevance.

Table 8-7: GHGI of produced fluids (Mid Case)

Year	GHG Emissions te CO_2e		Production mmboe		GHGI kg CO_2e/boe		
	Baseline	Platypus	Baseline	Platypus	Baseline	Baseline +Platypus	Platypus
2026	12,846	-	3.92	-	3.28	3.28	-
2027	12,846	-	3.47	-	3.70	3.70	-
2028	12,846	-	3.02	-	4.25	4.25	-
2029	12,846	29.3	2.66	0.87	4.84	3.66	0.03
2030	12,846	87.9	2.42	1.91	5.32	2.99	0.05
2031	12,846	87.9	2.21	1.31	5.82	3.68	0.07
2032	12,846	87.9	2.02	1.05	6.35	4.21	0.08
2033	12,846	87.9	1.86	0.91	6.92	4.68	0.10
2034	12,846	87.9	1.71	0.82	7.51	5.12	0.11
2035	12,846	87.9	1.58	0.75	8.15	5.55	0.12
2036	12,846	87.9	1.46	0.70	8.82	6.00	0.13
2037	12,846	87.9	1.35	0.65	9.54	6.48	0.14
2038	12,846	87.9	1.25	0.61	10.30	6.97	0.14
2039	12,846	87.9	1.16	0.59	11.10	7.40	0.15
2040	12,846	87.9	1.07	0.58	11.96	7.80	0.15
2041	12,846	87.9	1.00	0.53	12.87	8.44	0.16
2042	12,846	87.9	0.93	0.50	13.83	9.07	0.18
2043	12,846	87.9	0.86	0.47	14.86	9.71	0.19
2044	12,846	87.9	0.81	0.44	15.95	10.38	0.20
2045	12,846	87.9	0.75	0.42	17.10	11.09	0.21
2029 - 2045	**218,390**	**1,435**	**25.08**	**13.09**	**8.71**	**5.76**	**0.11**

8.2.2.6 Venting Intensity

The Venting Intensity of produced hydrocarbons expresses the quantity of gas vented per unit of production. These are reported by the NSTA for each asset in the UKCS in units of standard cubic feet (scf) of vent gas per barrel of oil equivalent (scf/boe).

Total annual production phase vent gas emissions from Section 8.2.2.4 expressed in mmscf, combined with the production profiles in Appendix I for the Mid Case production profile are used to derive annual Vent Intensity values for the baseline without Platypus, for the baseline with Platypus and for the Platypus Development incremental production. These are presented in Table 8-8, with production expressed in mmboe. Aggregate Venting Intensity values across the project duration (2029 – 2045) are also presented in Table 8-8.

As with GHGI calculations, the Mid Case Platypus production profile is used in Table 8-8 as a basis for Venting Intensity calculations since this avoids under-estimation of the most likely case.

Table 8-8: Vent Intensity of produced fluids

Year	Gas Vented mmscf		Production mmboe		Venting Intensity scf/boe		
	Baseline	Platypus	Baseline	Platypus	Baseline	Baseline +Platypus	Platypus
2026	7.91	0.00	3.92	0	2.02	2.02	0
2027	7.91	0.00	3.47	0	2.28	2.28	0
2028	7.91	0.00	3.02	0	2.62	2.62	0
2029	7.91	0.04	2.66	0.87	2.98	2.26	0.05
2030	7.91	0.12	2.42	1.91	3.27	1.86	0.06
2031	7.91	0.12	2.21	1.31	3.59	2.29	0.09
2032	7.91	0.12	2.02	1.05	3.91	2.62	0.12
2033	7.91	0.12	1.86	0.91	4.26	2.91	0.14
2034	7.91	0.12	1.71	0.82	4.63	3.18	0.15
2035	7.91	0.12	1.58	0.75	5.02	3.45	0.16
2036	7.91	0.12	1.46	0.70	5.44	3.73	0.18
2037	7.91	0.12	1.35	0.65	5.88	4.03	0.19
2038	7.91	0.12	1.25	0.61	6.34	4.33	0.20
2039	7.91	0.12	1.16	0.59	6.84	4.60	0.21
2040	7.91	0.12	1.07	0.58	7.37	4.85	0.21
2041	7.91	0.12	1.00	0.53	7.93	5.25	0.23
2042	7.91	0.12	0.93	0.50	8.52	5.64	0.25
2043	7.91	0.12	0.86	0.47	9.15	6.04	0.26
2044	7.91	0.12	0.81	0.44	9.82	6.45	0.28
2045	7.91	0.12	0.75	0.42	10.54	6.89	0.30
2029 - 2045	**134.54**	**2.00**	**25.08**	**13.09**	**5.37**	**3.58**	**0.15**

8.2.2.7 Logistics

In addition to emissions from static sources, vessels and helicopters supplying the platforms of the Cleeton Hub cause emissions in transit to/from their onshore bases. Supply vessels and ERRVs supporting the Cleeton Hub use 2,005 te fuel per year and helicopters servicing Cleeton Hub platforms use 182 te aviation fuel per year.

The Platypus Development will not lead to an increase in the frequency of supply vessels or helicopter flights to Cleeton, Neptune or any other existing installation. However, supply vessels will be required to support maintenance activities on the proposed new Platypus MFP. There will be no routine helicopter flights to the Platypus MFP during production, and as such the Aviation Fuel emissions shown in Table 8-9 correspond to the current baseline for the Cleeton Hub.

Perenco anticipates that four maintenance campaigns will be required per year at the Platypus MFP, each of up to two weeks' duration. A walk to work vessel will be used for the duration of each campaign and the total vessel days per year, and the total diesel use by the vessel, are shown in Table 4-13.

Annual GHG emissions relating to these logistics activities have been calculated using the EFs for diesel combustion in engines in the guidelines for EEMS reporting (EEMS, 2025; EEMS, 2008) for vessel diesel use, and GHG Conversion Factor (CF) published by DESNZ (DESNZ, 2026c) for use of aviation fuel. The GHG emissions are presented in Table 8-9.

Whereas these emissions are excluded from the assessment of impacts on air quality, and from the calculation of GHGI of the Platypus hydrocarbon product, they have been included in the total life-cycle GHG emissions for Platypus.

Table 8-9: GHG emissions from logistics support vessels at and in transit to the Cleeton Hub during operations phase.

Logistics GHG Emissions	Quantity used (te/y)	CO_2 (te/y)	N_2O (te/y)	CH_4 (te/y)	CO_2e (te/y)
Baseline Diesel	2,005	6,416	0.44	0.36	6,543
Baseline Aviation Fuel	182	573	0.018	0.014	578
Total Baseline	**2,187**	**6,989**	**0.46**	**0.38**	**7,121**
Platypus Incremental Diesel	**84**	**269**	**0.018**	**0.015**	**274**

8.2.3 Indirect GHG Emissions Downstream of Production

Following export from Cleeton via the MGL, Platypus gas and condensate arrive at the DGT, along with fluids from other fields in the SNS, where they are processed to meet the entry specifications of the UK National gas Transmission System (NTS). The small proportion of condensate that drops out of the processing at DGT are blended with other hydrocarbons and sold as liquefied petroleum gas (LPG) or high volatility products such as petrol/kerosene.

To determine the indirect emissions, two sets of EFs are required. The first estimates the emissions attributed to extracting hydrocarbon products, e.g. gas and condensate, and getting them to their point of use and are termed 'Well to Tank' (WtT) factors. The second estimates the emissions attributed to the combustion of the hydrocarbon products, e.g. gas and condensate, by end-users. The UK government publishes these CFs annually (DESNZ, 2026c) and they have been used to estimate the indirect emissions attributed to the gas and condensate that is expected to be produced by the Platypus Development.

Gas in the NTS serves the UK domestic demand for natural gas and will be burned as an energy source by end-users. Emissions from the end use of Platypus gas by users in the UK have been calculated using GHG EFs published by DESNZ (DESNZ, 2026c) for company reporting of Natural Gas fuel use (100% mineral blend). For this assessment, it is conservatively assumed that condensate will be consumed as petrol. The fuel end-use CF for petrol (100% mineral petrol) has been used.

Whereas end-use CFs are provided for CO_2, N_2O, CH_4 and the aggregate global warming potential of the emissions, WtT CFs are only given for the aggregate global warming potential of all emissions within this part of the value chain. These include combustion sources and non-combustion sources such as venting and fugitive losses.

The Platypus GHG emissions assessment simplistically adopts the WtT CFs to estimate the Scope 3 Category 9 and Category 10 emissions for Platypus products – even though this results in double counting of production emissions, it is expected to be insignificant (see Table 8-11). Furthermore, since Platypus production emissions are far below average for natural gas in the UK NTS, the component of the WtT CF that

covers production emissions will be considerably exaggerated and lead to a highly conservative estimate for this category of emissions.

Application of the end-use CF and WtT CF to the annual production estimates for Platypus gas and condensate result in the GHG emissions values presented in Table 8-10. The calculation uses the High Case production profiles to provide a realistic worst case emissions estimate.

Table 8-10: Downstream indirect GHG emissions of Platypus production (High Case)

Emission Category	Product type	Quantity Produced	Conversion Factor	GHG Emissions
		te	te CO_2e/te	te CO_2e
Transportation, Refining and Delivery (Scope 3 Category 9 & 10)	Gas	2,051,533	0.423	868,134
	Condensate	39,034	0.816	31,849
	Total	**2,090,567**	**-**	**899,983**
End Use Combustion (Scope 3 Category 11)	Gas	2,051,533	2.54	5,204,440
	Condensate	39,034	3.15	123,117
	Total	**2,090,567**	**-**	**5,327,557**

8.2.4 Breakdown of total GHG emissions from the full life-cycle value chain

GHG emissions estimated for the pre-production phase of the Platypus Development, during production of sold products, for the subsequent transportation, further processing and distribution of end-use products and for the ultimate combustion of end-use products is summarised in Table 8-11 for the High Case production scenario.

Table 8-11: Total GHG emissions for the Platypus Development (High Case)

Project Phase	Category	GHG Emissions	Proportion of Total
		te CO_2e	%
Pre-Production	Direct	43,420	0.69%
Production (incl. logistics)	Direct	5,913	0.09%
Downstream Transport, Processing & Delivery	Indirect	899,983	14.34%
End-use Combustion	Indirect	5,327,557	84.88%
Total	**-**	**6,276,873**	**100.00%**

Total life-of-field production under the Mid Case profiles is 77.72% of the High Case total, as derived from the production profiles in Appendix I for the Mid Case and in the High case production profiles presented in the Project Description in Chapter 4. All downstream indirect GHG emissions are directly related to the production quantities and so the GHG emissions for the downstream value chain processes for the Mid Case would also be 77.72% of the High Case emissions (4,840,061 te CO_2e). Total life-of-field GHG emissions for the Mid Case would therefore be 4,889,393 te CO_2e.

8.2.5 Uncertainties in emissions estimates

Uncertainty reflects the extent to which the data, assumptions or analytical outcomes of a study may differ from the true value. Several factors can contribute to uncertainty including the quality and availability of underlying data, the boundaries and scope defined for the study, and the timescale over which the assessment is conducted, all of which can limit the ability to predict outcomes with complete accuracy. It is important to acknowledge that complete elimination of uncertainty within a study is not feasible (ISEP, 2026).

However, by identifying and outlining the uncertainties in an assessment, the results can be interpreted in an informed and transparent manner.

The Project GHG emissions associated with the Platypus development have been calculated and evaluated based on a number of assumptions, uncertainties and limitations of available data. Causes of uncertainty are explained in Table 8-12. These uncertainties are separate from uncertainties regarding future environmental baseline projections that are discussed in Chapter 5 of the ES.

An indication of the level of uncertainty in input data is provided in the third column of Table 8-12. Where data uncertainties exist, the emissions calculations have generally adopted realistic, worst case values. The final column in Table 8-12 provides an indication of the risk that emissions estimates have been under-represented due to the uncertainties in the input data.

For local impacts to air quality, the pre-production phase direct emissions are of most significance.

For global impacts via climate change, the downstream indirect emissions are of most significance, particularly those from end-use combustion of fuels. The main source of uncertainty in these emissions estimates is the quantity of hydrocarbons that will be produced from the Platypus development over its life of field. Use of emissions estimates for the High case production profiles in the subsequent impact assessment minimises the potential for impacts to be under-represented.

Table 8-12 Uncertainties, assumptions and limitations with input data for Platypus emissions estimates.

Parameter	Uncertainties, Assumptions and Limitations	Data Uncertainty Rating	Risk of Under-Estimation
Pre-Production Direct Emissions	Combustion of diesel in vessels (including drilling rig) is the largest source of emissions in the pre-production phase. There are three key components to the vessels emissions estimate: duration of each vessel's activity; fuel usage rate for each activity; and diesel combustion emissions factors. Duration of activities is based on abundant data for development activities in the SNS, to which contingencies have been added for disruptions such as due to waiting on weather. Fuel usage values or different vessel types, whether for transiting, working in field, in port are derived from industry norms that have been established over many years. EFs are default values from the EEMS reporting guidance which are representative of the worst reasonable case. The second largest source of emissions estimated for this phase relates to the contingency included should well clean up require flaring. The quantity of hydrocarbons that may be flared under this scenario is based on reservoir conditions and the typical duration of clean up. The intention is for no flaring. Should it be required, the total quantity flared, and consequently emissions, will only be knowable at the time. The likelihood of pre-production phase direct emissions being materially more than the estimate presented is low and it is not expected to affect the conclusions of the impact assessments.	Low	Low
Production Phase Direct Emissions	Direct emissions across the Cleeton Hub have been monitored and reported for many years. Variations from one year to another occur due to a combination of planned and unplanned interruptions to production. Annual forecasts are based on projections made from previously reported data set within the plans for future production, including emissions reduction plans. Whereas individual years may see higher of lower than the forecast average, over the field life the annual values used are considered to be a reasonable worst case. Incremental additional emissions due to development of Platypus are small. Additional power demand is very low and well understood. When infrequently, venting will be required, the volumes concerned are understood, although the number of occasions each year is estimated from experience in the area. The actual number of events is liable to vary between years but, when averaged over the life of field, the value used for emissions estimates is a reasonable worst case. The majority of direct emissions during the production phase are due to combustion of diesel in maintenance support vessels. The frequency and duration of maintenance campaigns have been carefully planned and the quantity of diesel assumed to be combusted is based on robust data. The likelihood of production phase direct emissions being materially more than the estimate presented is low and it is not expected to affect the conclusions of the impact assessments.	Low	Low

Production Profiles	The production profiles are fundamental to estimating the lifecycle GHG emissions as they form the basis of the calculations. The Mid case profile represents the most likely production scenario, with a 50% probability that the actual output will be either higher or lower than forecasted. The High case profile reflects a more optimistic projection, with only a 10% likelihood that real production will meet or exceed this level and a 90% likelihood that it will fall below it. The production forecasts guide decisions on the economic viability of the project and have therefore been generated using advanced modelling techniques and provide the best possible understanding of anticipated production. Over life of field the High case profile would result in approximately 30% more production than the Mid case. Where conservative estimates of total emissions are required the High case is used, and where conservative estimates of emissions intensities are required the Mid case is used to capture the worst-likely case.	Medium	Low
Downstream Indirect Emissions	Indirect GHG emissions from the downstream processing, transportation and use of exported Platypus hydrocarbons are estimated assuming the High case production profiles. It has been assumed that all of the Platypus products will be combusted as their end-use and that all of the combustion products will be released to the atmosphere. This does not take account of the potential for a proportion of natural gas to be converted into non-combusted end products (such as ethylene derivative plastics) nor does it take account of the increasing deployment of carbon capture and sequestration that is planned as part of the UK Net Zero strategy. For these combined reasons the quantity of products assumed to be processed and combusted are most likely over-estimated. The majority of downstream emissions come from the processing, distribution and use of natural gas, with only c. 2% deriving from liquid products. Well to Tank CFs for natural gas published by DESNZ are based on best available UK data and reviewed annually. Adjustments to published WtT CFs for natural gas over the past years have been minor, implying a high degree of confidence in them. The published WtT CFs include an element for upstream production which is based on data from across the UKCS. Inclusion of production emissions in the downstream emissions estimate has therefore double accounted these. The more so since average production emissions for the UKCS are higher than for the Cleeton Hub and for Platypus. The use of WtT EFs has likely resulted in an overestimate of these emissions for Platypus. GHG emissions from the end-use combustion of fuels have been calculated using widely accepted UK Government CFs designed for company reporting (DESNZ, 2026). These publicly available datasets are updated annually to reflect changes in product demand and variations in the composition of fuels and related products. As with the WtT CFs, the combustion CFs may vary slightly from year to year though such changes are typically minor and would not materially influence the calculated lifecycle emissions or alter the conclusions of their impact assessment. Liquid hydrocarbon products from Platypus may end up as components in various fuel types. WtT and combustion CFs are published for the main fuel types consumed in the UK. For Platypus indirect emissions estimates CFs for 100% mineral petrol were used as a reasonable proxy for refined liquid fuel products since they are higher than for alternative realistic fuel types such as Liquefied Petroleum Gas. Given the small proportion of condensate relative to gas produced from Platypus selection of another fuel type as proxy would make negligible difference to the total downstream GHG emissions estimate.	Medium	Low

8.3 Local Impacts and Receptors

Increased concentrations of NO_2, SO_2, CO and VOCs in the atmosphere can result in the formation of photochemical pollution in the presence of sunlight, comprising mainly low-level ozone, but by-products may include nitric acid, sulphuric acid and nitrate-based particulate. The formation of acid and particulates contributes to acid rainfall and the dry deposition of particulates. If such deposition occurs at sea, it is possible that the substances will dissolve in seawater. The ultimate fate of emitted pollutants can often be difficult to predict owing to the dependence on metocean conditions (especially wind), which may be highly variable and lead to wide variations in pollutant fate over short timescales.

Receptors identified for assessment of impacts are workforce at neighbouring offshore installations and onshore residents within the UK. Using the descriptions for receptor sensitivity given in Table 6-1, the receptor sensitivity for local impacts on air quality is Low.

8.3.1 Direct Emissions: Pre-production Phase

Emissions of NO_2, SO_2, CO and VOCs at the Platypus MFP site during the drilling and installation phase of the project are around one order of magnitude higher than the baseline operations emissions at Cleeton. The Pre-production phase emissions will be 15 km from the nearest normally attended offshore installation (Ravenspurn North Central Complex), 67 km from the nearest landfall in the UK and 121 km from the UK-Netherlands Median line.

The emissions occur over a fixed and relatively short duration, such that there would be no potential for long-term air quality impacts.

Application of the ESIA ratings provide a qualitative assessment of negligible impact magnitude for a low sensitivity receptor, concluding the impact of pre-production phase emissions on air quality to be of Low significance.

If the receptor sensitivity and impact magnitude ratings were both considered to be a level higher, the impact would still be Low significance. The assessment of impact from the Platypus Development pre-production phase emissions on local air quality can therefore be concluded with a high degree of confidence.

8.3.2 Direct emissions: Production Phase

The current level of impact from current production emissions for the Cleeton Hub is low, such that the risk posed has not warranted a regulatory requirement for detailed impact assessment against long term air quality objectives using air dispersion modelling. The Platypus Development will result in an increase in production phase emissions of pollutant gases of less than 1% of the baseline emissions (see Table 8-6) and will be well within the variability evident over the past five years. Using the descriptions for impact magnitude in Table 6-2, the most appropriate magnitude level for impact from the Platypus Development is negligible.

In accordance with the ESIA matrix for planned activities presented in Table 6-3, a negligible effect on receptors of low sensitivity accords with an impact rating of Low significance.

If the receptor sensitivity and impact magnitude ratings were both considered to be a level higher, the impact would still be Low significance. The assessment of impact from the Platypus Development operation emissions on local air quality can therefore be concluded with a high degree of confidence.

8.4 Global Impact of GHG Emissions

8.4.1 Scope and Boundaries

All material GHG emissions, direct or indirect, during the whole life of the proposed project will be included in the scope. Activities which would not significantly change the result of the assessment, and for which estimating emissions would be complex, may be excluded. The ISEP guidance suggests that an emission source or activity may not be material where the expected emissions are less than 1% of total emissions, and where all such exclusions total a maximum of 5% of total emissions.

Emissions sources during the decommissioning phase of the project have not been included in the emissions inventory. Decommissioning will be undertaken in accordance with legislation and guidance at the time.

Decommissioning is likely to include the plug and abandonment of wells, removal of the Platypus MFP and may include removal of the subsea pipeline and other associated subsea structures. This is projected to be in 2045 when the propulsion of vessels may be decarbonised and opportunities for re-use of waste materials may be high. The uncertainty in predicting emissions for decommissioning would therefore be very high but would almost certainly be lower than emissions during the pre-production drilling and installation campaign. Pre-production emissions for Platypus account for 0.69% of total GHG emissions (High case; 0.81% for Mid case), which is below the materiality threshold of 1% recommended by ISEP (2026).

8.4.1.1 System boundaries

Sources of GHG emissions have been identified for the pre-production phase and the production phase, and for downstream processing and use of Platypus exported hydrocarbons.

The system boundary for the determination of pre-production GHG emissions includes drilling of the Platypus wells and installation of the Platypus MFP and the Platypus to Neptune pipeline. It also includes pre-start up cleaning of wells should this found to be required.

The production phase system boundary for Platypus GHG emissions includes the Platypus wells, the Platypus MFP, the Platypus to Neptune pipeline, Neptune, the Neptune to Cleeton pipeline and Cleeton.

However, Cleeton processes fluids from the Cleeton Attic reservoir, Ravenspurn South and fields in the ECA which includes Whittle and Wollaston, Apollo and Minerva and Eris, Ceres, Mercury and Neptune. Emissions are generated at Cleeton in the service of all of these fields and cannot be disaggregated into smaller units. The boundary for the Platypus GHG emissions assessment has therefore been expanded to incorporate these fields in setting the baseline for emissions, production and benchmarking production efficiency. These fields are also included in the assessment of the change that the Platypus Development will have on the baseline and, therefore, for the determination of the direct and indirect GHG emissions attributable to Platypus, as well as the GHGI and methane venting intensity of Platypus production.

The system boundary for the assessment of direct and indirect downstream GHG emissions is the UK emissions reporting boundary, as set within the global GHG emissions and global environmental impacts from climate change.

8.4.1.2 Temporal boundaries

Emissions of GHGs from pre-production activities are assumed to occur in 2028 and 2029.

Emissions of GHGs from all other sources related to the Platypus Development are detailed annually between the scheduled date for first gas (September 2029) and Cessation of Production (December 2045).

The effects of GHGs in the atmosphere are long term and are assessed in the context of global surface temperature increases from cumulative global GHG emissions over the project lifetime and to the end of the current century.

8.4.2 Baseline

The current and future baseline predictions for global GHG emissions and their impacts are covered in detail in Section 5.7 of this ES.

The baseline production emissions for the Cleeton Hub in the absence of the Platypus Development are estimated by emission source within section 8.2.2.

8.4.3 Emissions Calculation Methodology

Quantification of GHG emissions for each source at each phase of the Platypus Development has used the following general calculation form:

GHG emission = Activity data x GHG emission factor

The activity data and GHG emission factors used for each source are explained throughout Section 8.2.

8.4.4 Emissions Inventory

The project emissions inventory is summarised in Section 8.2.4, with more detailed breakdown of the inputs to the inventory given throughout Section 8.2.

8.4.5 Receptor Sensitivity

As described in Section 6.6.5, the receptor for GHG emissions impacts is High sensitivity.

8.4.6 Impact Magnitude and Significance

In accordance with both the Institute of Sustainability and Environmental Professionals (ISEP) and DESNZ guidance the determination of significance is based on a determination of whether the project supports or undermines a trajectory towards Net Zero. Therefore, it is necessary to contextualise the GHG emissions of the Platypus Development against pre-determined carbon budgets and emerging policy and performance standards, drawing on as many sources of evidence as possible (ISEP, 2026). The primary focus is on the UK's path to Net Zero since the vast majority (if not all) GHG emissions from the project will be within the UK, and because the UK has a clear strategy for aligning all domestic activity to achieving global climate goals. This section therefore considers the magnitude of the project's GHG emissions in the context of the following fields (ISEP, 2026), which is summarised in Table 8-13:

- National Carbon Budgets and Nationally Determined Contributions;
- Sectoral budgets and reduction strategies;
- The current and future GHG emissions intensity of production and of delivering hydrocarbon products to end-users;
- Existing and emerging national policy or regulation; and
- Expert advice of guidance bodies.

The Platypus Development emissions are also assessed within the context of future baseline scenarios for global emissions reductions.

The contextualisation is provided from Section 8.4.6.1 to Section 8.4.6.6. This enables the significance of the impact of the project's GHG emissions to be concluded, in Section 8.4.6.7, using the methodology of the ISEP (2026) guidance that is set out in Section 6.7.6 of this ES.

Table 8-13: Summary of contextual information used to determine significance.

Context from ISEP (ISEP, 2026)	Applicability to Platypus	Outcome of assessment
National carbon budget and NDCs	**YES**: As most, if not all, of the Platypus products will be consumed in the UK, e.g. gas in power stations generating electricity or providing heat to homes or fuel consumed whilst driving cars, the emissions are directly related to the UK carbon budget and NDCs.	The UK has a carbon budget that is aligned to the Paris Agreement and is legally binding. Hydrocarbon use, reducing over time, is included in the carbon budget out to 2050. Projected production and emissions from Platypus are not a material proportion of the carbon budgets or NDC targets.
Local or regional carbon budgets developed by local authorities and researchers	**NO**: There are no local or regional budgets that have been identified as being relevant.	Not Applicable.
Sectoral budgets or reduction strategies	**YES**: The UK offshore industry is subject to the NSTD. The OGA expects the upstream Oil and Gas industry to reduce GHG emissions from all aspects of their upstream operations.	The OGA strategy requires industry to take steps to reduce as far as reasonable in the circumstances greenhouse gas emissions. The UK offshore Oil and Gas industry is taking action in line with the NSTD. Perenco complies with the requirements of its permits and consents, providing status on Net Zero related activities to regulators as required. Projected emissions from the Platypus Development are not a material proportion of the annual targets set for decarbonising offshore production.
Current and future GHG emissions intensity of an activity	**YES**: GHG emissions intensity data is available and can be used to benchmark the Platypus Development's emissions.	The NSTA average GHG emissions intensity of producing and processing UK domestic gas in 2024 was 28 $kgCO_2e$/boe which was comprised of an emissions intensity of 18 $kgCO_2e$/boe for upstream operations and 10 $kgCO_2e$/boe for transport and processing. The estimated upstream operations GHG emissions intensity of the Platypus Development over its operational life is 0.11 $kgCO_2e$/boe which compares highly favourably with the UK average of 18 $kgCO_2e$/boe. Assuming the average 10 $kgCO_2e$/boe for transport and processing is added to the Platypus upstream operations GHG emissions intensity of 0.11 $kgCO_2e$/boe, the Platypus Development's estimated overall GHG emissions intensity would be 10.11 $kgCO_2e$/boe, which is below the UK average intensity of 28 $kgCO_2e$/boe. UK imported LNG has an average GHG emissions intensity of 85 $kgCO_2e$/boe which includes production, processing, liquefaction, shipping and regasification. According to the NSTA, in 2024 imported LNG accounted for only 15% of total UK gas supply but contributed the largest share of associated GHG emissions at 46% (NSTA, 2025).

Context from ISEP (ISEP, 2026)	Applicability to Platypus	Outcome of assessment
		Based on import data (NSTA, 2025), replacing the expected production of gas from Platypus with imported LNG (as Norwegian pipeline gas is at capacity) could result in approximately 1 $MtCO_2e$ of additional emissions. Hence, importing LNG could result in around 23% more full life cycle CO_2e emissions than producing the same gas domestically from Platypus.
Existing and emerging national and local policy or regulation	**YES**: The UK is a signatory to the Global Methane Pledge and must align with the EU Methane Emissions Regulation (EU MER) which, by 2030, will need to demonstrate that methane intensity is below EU-established thresholds.	The UK oil and gas industry is also aligned to the OGCI 2025 methane intensity commitment (also reflected in the NSTD Supply Decarbonisation commitments) which stipulates a methane intensity target for the sector of "well below" 0.2% by 2025. Methane intensity is calculated by dividing the total methane emissions for each year as reported by natural gas production to give a percentage of methane emitted per cubic meter. UK oil and gas methane intensity in 2023 was circa 0.13% and was on target for 0.12% in 2024 (NSTA, 2025a) which is below the OGCI commitment. Alternatively, methane intensity can be reported on a production basis. The latest data for 2024, compiled by the NSTA indicates the UK's methane emissions intensity is 1.5 $kgCO_2e$/boe, compared to a global methane intensity average of 15 $kgCO_2e$/boe. The UK's relatively favourable methane emissions intensity performance is supported by its progress in reducing absolute methane emissions by more than 50% since 2018 according to NSTA data (NSTA, 2025a). The estimated average methane intensity for Platypus over its production life is 0.15 $kgCO_2e$/boe which is significantly below the UK average of 1.5 $kgCO_2e$/boe. This supports the case that domestic production can reduce overall supply-chain emissions when meeting UK demand.
Expert advice of guidance bodies	**YES**: UNEP indicates that reducing losses in the value chain can reduce impact of fuel use on climate. IPCC and WMO supports prioritising methane reductions as a pragmatic near-term complement to the essential long-term task of reaching net-zero CO_2.	Importing gas as LNG is not an efficient use of global reserves when lower intensity domestic reserves are available because of the “losses” along the value chain from fuel gas use, flaring, venting, liquefaction, regasification etc. Domestic UK production also has losses, but these are significantly lower than LNG imports. Reducing losses in the fuel value chain can reduce impact of fuel use on climate, which is consistent with analysis from UNEP.
Company-specific TCFD reporting	**NO**: Perenco has yet to make any financial disclosures.	Not Applicable.

8.4.6.1 Global setting for the UK's environmental protection objectives for climate change

Schedule 6(5)(d) of the Regulations requires the assessment of likely significant effects of a project to '*take into account environmental protection objectives established in retained EU law or at national level*'. As stated in the Supplementary Guidance, "*Environmental effects from scope 3 emissions from downstream activities largely relate to the impacts on climate from the release of GHGs.*" The key environmental protection objectives relevant to GHG emissions, at both an international and national level, are set out below.

Following its introduction at the 1992 Earth Summit in Rio, the UN Framework Convention on Climate Change ("UNFCCC") (UNFCCC, 1992) entered into force in 1994. Within the framework of the UNFCCC, contracting states meet regularly at the Conference of the Parties ("COP") to discuss climate change. These COPs have resulted in subsequent international instruments including the Kyoto Protocol in 1997 and the Paris Agreement in 2015 (COP21).

In the Paris Agreement, states agreed to "*Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change"* (UNFCCC, 2015, Art. 2.1(a), p. 4).

In order to meet this objective, the focus of the Paris Agreement is on the mitigation of GHG emissions, adaptation measures to address the adverse effects of climate change that cannot be avoided through mitigation, and the provision of support – in terms of finance, technology and capacity building – to enable developing states to meet their commitments. The international commitment to the objectives of the Paris Agreement, and the collective role of society in reaching those goals, was confirmed in 2021 in the Glasgow Climate Pact, which requires signatory countries to increase climate action toward reducing reliance on fossil fuels.

The Paris Agreement contains both a collective objective to be pursued by all states, and individual obligations by which each state is obliged to contribute to that collective objective. Thus, the Paris Agreement: (a) establishes a collective objective that states act to hold "the increase in global average temperature to well below 2°C above pre-industrial levels and [to pursue] efforts to limit the temperature rise to 1.5°C"; and (b) establishes an individual obligation on each state to, among other things, submit a pathway for their own emissions reductions in the form of Nationally Determined Contributions (NDCs). It is through their NDCs that states communicate the pathway they will take to reduce their GHG emissions in pursuit of the collective objective of the Paris Agreement.

Carbon budgets are widely used by governments and regulators to support effective GHG emissions management. For governments, carbon budgets form the basis of national climate policy and help track progress toward legally binding targets. Regulators use them to monitor sector performance and ensure alignment with broader climate objectives. For example, the UK reduced its territorial GHG emissions to 423 $MtCO_2e$ by 2023 (CCC, 2025), representing a decrease by almost 50% compared with 1990 levels, demonstrating how structured, long-term approaches such as the use of carbon budgets, can drive significant GHG reductions.

Since carbon budgets typically become more stringent over time, they encourage ongoing GHG emissions reductions rather than relying on one-off improvements. This approach has been shown to work more broadly, with 36 countries reporting sustained GHG emissions reductions for more than 10 years as of 2022 (CCC, 2025). The use of carbon budgets demonstrates their effectiveness as a policy tool for driving sustained GHG emissions reductions and supporting the achievement of long-term climate goals, such as those outlined in the Paris Agreement.

The starting point for the impact assessment is therefore putting the percentage contribution of the project's GHG emissions to the national UK carbon budgets into the context of UK gas demand trajectories of the UK Net Zero strategy.

8.4.6.2 National Carbon Budgets and NDCs

8.4.6.2.1 UK emissions targets

In the UK, the Climate Change Act (2008) (UK Government, 2008) is the principal legislative mechanism for reducing UK GHG emissions and expediting its NDCs. The Act sets the framework to address climate change mitigation and adaptation, including end user emissions. It requires the UK government to propose regular, legally binding milestones on the way to achieving Net Zero GHG emissions by 2050. This is achieved by setting carbon budgets with a breakdown by sector for where emissions reductions will be required, which is then used to shape policies that will result in the respective reductions being realised. These budgets are primarily based on GHG emissions arising from the combustion and consumption of fuels and products within the UK economy, including energy used for electricity generation, heating, transport, and industrial processes. Emissions reductions targets for the first three carbon budget periods (covering 2008 – 2022) were met or exceeded and projections indicate the UK is also on course to meet the 4th Carbon Budget (UK Parliament, 2024).

Based on the advice from the CCC, the UK published its NDC target to reduce all GHG emissions by at least 81% by 2035, compared to 1990 levels (excluding international aviation and shipping emissions), with an interim target of 68% by 2030 (CCC, 2024).

The UK CCC balanced pathway is the UK Carbon Budget emissions reduction pathway from 2025 to Net Zero by 2050, with specific carbon budgets spanning successive 5-year periods with a maximum GHG emission target for each. The UK CCC published its seventh Carbon Budget in February 2025, which limits the UK's GHG emissions to 535 MtCO2e over the five-year period 2038 – 2042 (CCC, 2025).

For quantitative context, the contribution of GHG emissions from the Platypus Development to each carbon budget are presented in Table 8-14 along with Platypus contribution to the annual targets for 2030 and 2035 committed to within the UK NDC.

Table 8-14: Quantitative context for Platypus High Case Scope 3 GHG emissions relative to NDC commitments and Carbon Budgets (CCC, 2025)

Target Framework Target Date	NDC 2030	NDC 2035	5th Carbon Budget 2028-2032	6th Carbon Budget 2033-2037	7th Carbon Budget 2038-2042	Residual Emissions 2043-2045
Total UK emissions for period (MtCO2e)	259.8	154.9	1,752	965	535	Not yet set
Platypus High Case Scope 3 emissions (MtCO2e)	1.06	0.35	2.79	1.80	1.14	0.50
Platypus proportion	0.41%	0.22%	0.16%	0.19%	0.21%	N/A

8.4.6.2.2 UK emissions from use of oil and gas products

The UK's balanced pathway to Net Zero emissions sets out a trajectory for oil and gas demand to 2050. Although there is a strong drive towards transitioning to renewable energy use, fossil fuels still play a critical role in meeting the UK's energy needs. In 2023, the UK's total GHG emissions was 423.3 $MtCO_2e$ (CCC, 2025) with contributions from the following sources:

- Surface transport (i.e. cars, heavy goods vehicles (HGVs), vans, etc.) which has been the greatest source of GHG emissions in the UK since 2015 with 102.8 $MtCO_2e$ emitted in 2023.
- Residential buildings' total GHG emissions were around 52.2 $MtCO_2e$. Gas usage for space heating and hot water accounted for 80% of these GHG emissions.
- Electricity supply accounted for approximately 37.8 $MtCO_2e$ of GHG emissions, with 30% resulting from unabated gas use for power generation.

To achieve UK Net Zero targets by 2050, electricity demand is anticipated to rise significantly with the shift towards large-scale electrification. Electricity usage is projected to increase by approximately 50% by 2040 compared to 2023 levels and will be driven by, for example, the uptake of electric vehicles (EVs), heat pumps and industrial electrification (CCC, 2025) – all of which are necessary measures to reduce emissions from the three significant sources bulleted above.

At the same time, unabated gas-fired power generation is expected to decline to 7% by 2030, 3% by 2035, and 2% by 2040, with a complete phase-out expected by 2050 (CCC, 2025). Low carbon alternative sources of electricity generation will be required to meet the increased demand, and are anticipated to include renewables, nuclear and abated gas-fired generation with CCUS. Development of CCUS infrastructure will also facilitate capturing emissions from industrial processes that will be necessary to achieve Net Zero (CCC, 2025). Despite these mitigation measures, there is still an expected demand for oil and gas out to 2050 and, indeed, beyond.

GHG emissions from the use of oil and gas products in the UK in 2030, 2035 and 2050 are estimated in the CCC in the 7th Carbon Budget report (CCC, 2025) and are reproduced in Table 8-15 along with the contribution that use of Platypus products would make for context.

Table 8-15: Quantitative context for Platypus High Case Scope 3 GHG emissions relative to NDC commitments and Carbon Budgets (CCC, 2025)

Target Date	2030	2035	2050
Total UK emissions from use of Oil and Gas products (MtCO2e)	117.35	79.65	27.29
Platypus High Case Scope 3 emissions (MtCO2e)	1.06	0.35	0
Platypus proportion	0.90%	0.43%	N/A

8.4.6.2.3 UK Gas Demand

The UK is a net importer of gas and, according to the NSTA, gas imports accounted for 61% of the UK's total gas supply in 2024 (NSTA, 2025). Figure 8-1 plots UK gross gas demand as forecast by the CCC in its 7th Carbon Budget report (CCC, 2025). The NSTA has provided an illustrative baseline projection for domestic gas production, without development of any new fields, for the DESNZ Net Zero Strategy (NSTA, 2026) and this is overlaid in Figure 8-1, along with the same forecast were it to be supplemented by gas from Platypus (assuming the High case production profile). Net imported gas quantities, as projected by the CCC for the 7th Carbon Budget report (CCC, 2025), are also presented in Figure 8-1.

These projections show that:

- A continued need for gas is required to implement the transition to Net Zero and that demand will continue beyond 2050 for abated power generation and some residual industrial uses with CCUS;
- UK gas production follows a declining trend, consistent with historical patterns and field maturity in the UKCS basin; and
- The UK will continue to need to import gas in order to meet demand. The import rate will be approximately 25 million tonnes oil equivalent (mtoe) at the time of Platypus first gas, falling to approximately 11 mtoe at the end of Platypus production. The Platypus Development, which will feed into the UK gas transmission network, would increase domestic production and thereby offset a portion of the demand gap.
- While Platypus gas will help to bridge the gap between domestic gas production and demand, it is not of a scale that might jeopardise the phase down of hydrocarbon usage planned for in the UK's Net Zero transition strategy, nor undermine the effectiveness of policies introduced to achieve this. Furthermore, development of Platypus would not materially affect the compatibility with Net Zero objectives of other gas production developments in the UKCS over this period.

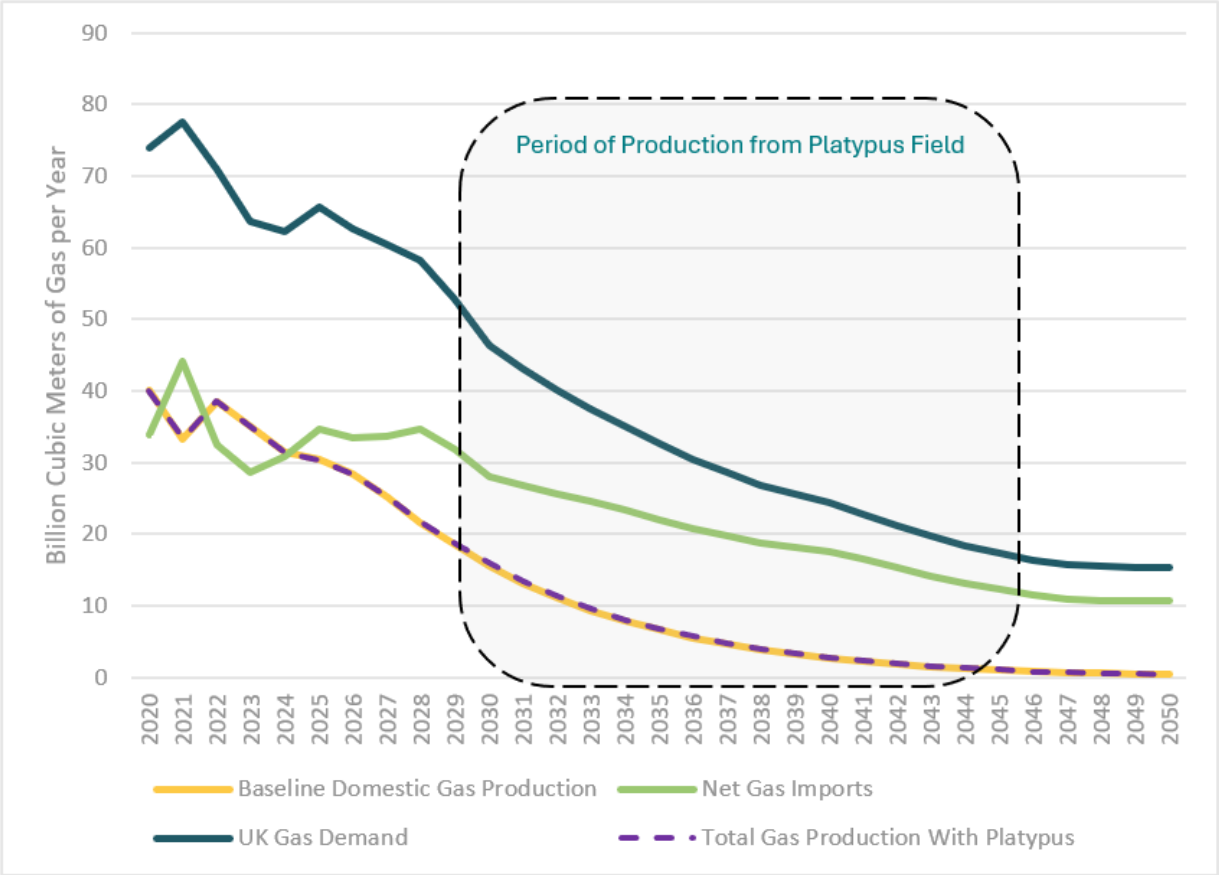


Figure 8-1: UK Gross Gas: DESNZ Net Zero Strategy and CCC 7th Carbon Budget & Demand and NSTA Production Predictions with and without addition of Platypus. All non-project data obtained from NSTA (2025).

8.4.6.3 Sectoral Budgets and Emissions Reductions Strategies

This section assesses the Platypus GHG emissions and operational management in the quantitative context of sectoral emissions reductions targets and in the qualitative context of the UK Government's stated objectives for the sector. The Government's objectives are implemented through the OGA Strategy (OGA, 2021) of the NSTA (the business name of the OGA) and, most recently, the North Sea Future Plan (NSFP) (DESNZ, 2025a).

The offshore oil and gas industry operates within a well-established framework of sector-specific GHG emissions reduction targets, decarbonisation strategies and regulatory mechanisms. These are implemented through the NSTD and the OGA Strategy, including measures within the NSTA Stewardship Expectation 11 and Emission Reduction Action Plans (ERAPs).

8.4.6.3.1 North Sea Transition Deal

The NSTD is a UK government–industry agreement designed to help the offshore oil and gas sector move towards a low-carbon, net-zero future while still supporting jobs and energy security (BEIS and DESNZ, 2021).

The NSTD aims to achieve a 60 Mt reduction in operational GHG emissions by 2030, including 15 Mt from the progressive decarbonisation of UK Continental Shelf (UKCS) production, with the overall total also incorporating GHG emissions savings from CCUS and hydrogen initiatives (BEIS and DESNZ, 2021).

The NSTD is built on five key outcomes:

1. Supply Decarbonisation
2. CCUS
3. Hydrogen
4. Supply Chain Transformation

5. People & Skills

The first objective is of particular relevance for the Platypus Development and to address this the offshore oil and gas sector has committed to the following actions to support the energy transition:

- **Emission reduction targets**: The oil and gas sector aims to cut production GHG emissions by 10% by 2025, 25% by 2027, and 50% by 2030 (against a 2018 baseline), as part of its pathway towards achieving Net Zero by 2050 (BEIS and DESNZ, 2021);
- **Improved emissions stewardship**: Companies will follow the NSTA's Stewardship Expectation 11, to actively reduce GHG emissions from both new and existing assets;
- **Streamlined emissions monitoring and reporting**: Industry, regulators and UK Government will develop standardised monitoring and reporting systems to make tracking GHG emissions easier and more consistent;
- **Reduced emissions and flaring through a MAP**: The sector will create and commit to a MAP, outlining measures to enhance the monitoring and reporting of GHG emissions, alongside setting a specific methane reduction target. Specifically, the sector is committed to:
    - Aligning with the World Bank 'Zero Routine Flaring' Initiative by ending routine flaring ahead of 2030.
    - Meeting methane intensity targets set by the Oil and Gas Climate Initiative (OGCI) of 0.25% (with a more ambitious target of 0.20%) (BEIS and DESNZ, 2021); and
- **Electrification investment**: The sector will invest £2–3 billion to power offshore operations with electricity (including renewables), helping to reduce GHG emissions (BEIS and DESNZ, 2021).

8.4.6.3.2 North Sea Transition Authority Stewardship Expectation 11

Stewardship Expectation 11 was introduced in 2021 (NSTA, 2021) and defines the NSTA's expectations on the upstream oil and gas industry to minimise GHG emissions, as far as reasonably practicable, to support delivery of the UK's Net Zero GHG emissions targets.

The Expectations focus on three main areas:

- Creation of a culture of GHG emissions reduction within the UKCS that embeds GHG reduction into decision-making across the UKCS.
- Consideration of GHG emissions across the full lifecycle from exploration and development through production to decommissioning, including by improving energy efficiency, reducing flaring/venting, and maintaining high production efficiency.
- Collaboration on Net Zero solutions by working with industry and other sectors (e.g. renewables) to support and enable potential energy integration developments such as electrification, CCUS and hydrogen developments.

Stewardship Expectation 11 was introduced to align the upstream oil and gas industry with UK and Scottish Net Zero legislation, ensuring that operators both maximise economic recovery and actively reduce GHG emissions.

8.4.6.3.3 Oil and Gas Authority Plan

The NSTA issued their revised OGA Strategy (OGA, 2021), which came into force on 11th February 2021. The revised OGA Strategy introduced a Central Obligation requiring the upstream oil and gas industry to:

1. *Secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters; and, in doing so,*
2. *Take appropriate steps to assist the Secretary of State in meeting the Net Zero target, including by reducing as far as reasonable in the circumstances greenhouse gas emissions from sources such as flaring and venting and power generation, and supporting carbon capture and storage projects.*

Both the NSTA and industry are legally required to comply with the OGA Strategy which is the key legal driver behind GHG emissions reduction requirements.

In March 2024, the NSTA issued an OGA Plan (OGA, 2024) on GHG emissions reductions from oil and gas extraction to support delivery of the Central Obligation set out in the OGA Strategy. As part of the OGA Plan,

the NSTA sets an expectation that operators will invest in reducing GHG emissions across their oil and gas activities, including the deployment of technologies to improve power generation efficiency, optimisation of processes to reduce GHG emissions from existing assets, and the incorporation of GHG emissions reduction technologies and monitoring in new and planned developments.

The development and implementation of Emissions Reduction Action Plans (ERAPs) are identified by the NSTA as necessary requirements to meet the Central Obligation in relation to investment and efficiency. Specifically, operators are required to (OGA, 2024):

1. *Produce an Emissions Reduction Action Plan ('ERAP') for each asset which, among other things, summarises and assesses applicability of available emissions abatement and emissions monitoring opportunities and technologies, and sets out planned emissions reduction initiatives, including for logistics emissions.*
2. *Implement and execute in a timely manner the ERAP produced in accordance with Requirement 1.*

These requirements in the OGA Plan build on and are consistent with the NSTA's existing Net Zero Stewardship Expectation 11.

8.4.6.3.4 North Sea Future Plan

In November 2025, the UK Government published the North Sea Future Plan (DESNZ, 2025a) ('the NSFP') which updates its objectives for the UKCS, including the following:

- ***Overarching objective:*** *to foster an internationally-leading offshore clean energy industry, which ensures good, long-term jobs, growth and investment in communities across the North Sea, in tandem with a sustainable transition in oil and gas – boosting the country's economy and energy security, in line with our climate obligations.*
- ***Supporting objective 1:*** *to ensure our oil and gas workers and supply chain can take advantage of the opportunities of our clean energy transition, creating a global blueprint for a transition which supports prosperity, jobs, growth, communities and energy security.*
- ***Supporting objective 2****: to take a globally standard-setting, 1.5°C and climate science aligned approach to future oil and gas production."*

8.4.6.3.5 Platypus Development alignment with sectoral policy

The upstream emissions target for 2030 is 9.05 $MtCO_2e$, which is a 50% reduction on 2018 emissions of 18.1 $MtCO_2e$ (NSTA, 2025). All fields within the Cleeton Hub produce gas with low GHGI and production from Cleeton Hub is estimated to result in GHG emissions totalling 0.012 $MtCO_2e$ in 2030. This is equivalent to 0.13% of the upstream UKCS 2030 target. Platypus itself is anticipated to cause just 0.00009 $MtCO_2e$ production emissions in 2030. The very low emissions values for both Platypus and the Cleeton Hub, relative to the quantity of hydrocarbons produced, will help to ensure the 2030 sectoral target for emissions reduction is achieved. It is also evident that, since Cleeton is a low emissions hub, development of Platypus will not 'lock in' protracted operations that could jeopardise achievement of emissions reductions targets or policy goals.

Perenco has developed and is implementing an ERAP for Perenco UK SNS assets, which includes the Cleeton Hub. The design decisions for the Platypus development have been driven by the ethos of the OGA Plan and the Stewardship Expectation 11. Consequently, the MFP will reuse an existing jacket and will be powered by renewable electricity. The production philosophy to use reservoir pressure to flow fluids to Neptune and onward to Cleeton, drive processing at Cleeton and onward export, has avoided almost all sources of additional GHG emissions.

The NSFP states that '*continued oil and gas production from existing fields will support a smoother transition and retain the skilled workforce we need in the UK as we ramp up cleaner technologies*'.

The (then) Secretary of State gave further clarity of the Government's future focus for the North Sea in a speech on 21 April 2026 (DESNZ, 2026a) in which he reiterated the Government's aim to decarbonise the UK's energy sector through a managed transition. He recognised oil and gas production in the North Sea as

an important and valuable resource and confirmed that domestic supply should be harnessed by keeping existing fields open for their lifetime and enabling tie backs for these fields.

The development of the Platypus field via Neptune and onward to Cleeton would clearly support these NSFP objectives and would thereby contribute to the planned transition to Net Zero in line with the UK NDC.

8.4.6.4 Activity benchmarks

As outlined by ISEP (ISEP, 2026), industry good practice can include the use of GHGI metrics to help place a project's emissions into context. This is particularly relevant where a project is meeting an established demand, as such metrics enable comparison of emissions performance against existing alternatives. For example, renewable electricity generation may reduce GHG emissions by displacing a legacy source (e.g. more carbon-intensive gas-fired baseload generation (ISEP, 2026).

Platypus gas feeds into the UK National gas Transmission System (NTS) which meets the demand for gas within the UK, the established future trajectory for which is shown in Figure 8-1. The use of gas from domestic production will reduce the level of dependence on imported LNG to the UK.

The use of GHGIs for hydrocarbon production acts as an effective benchmark, allowing for comparisons between different sources of supply, regardless of their overall total GHG emissions. By expressing GHG production emissions per unit of output (e.g. per unit of gas produced), intensities allow for an assessment of how efficiently a project delivered energy relative to alternatives and whether it represents a lower carbon option within an existing system of demand.

The lower the GHGI of a product, the more carbon-efficient the product is, and therefore the more favourable it is from a climate perspective. GHGIs should be reduced as far as practicable, driving continuous improvement across the value chain.

It is therefore paramount that any fuels consumed as nations transition to Net Zero have the lowest value chain GHG emissions which can be assessed by considering the GHGI of the fuels. This helps to mitigate the overall warming attributed to getting fuels to their point of end use (i.e. extracting, processing and delivering fuels) which ensures that hydrocarbon demand is met by the lowest-emitting and most efficient sources available.

Activity metrics of relevance to the assessment of Platypus Development GHG emissions include the GHG Intensity (GHGI), Venting Intensity and Methane Intensity of production and the GHGI for the subsequent delivery of refined end-use products to the location of its end-use.

8.4.6.4.1 GHG Intensity of Platypus Gas Versus the Baseline Case

The annual GHGI of Platypus gas assuming the Mid case production profile are shown in Table 8-7. Since GHG emissions for production activity at a facility do not vary with production output by a simple linear multiplier, the GHGI of production changes significantly over the life of a field. Table 8-7 also provides the estimated life of field GHGI for Platypus gas, between 2029 and 2045, as being 0.11 $kgCO_2e$/boe based on the aggregated life of field production phase GHG emissions and the total life of field production. Annual GHGIs for the High case profile (0.09 $kgCO_2e$/boe) would be lower than the Mid case values since the total production phase GHG emissions are ostensibly the same for both cases but these are divided by a larger production quantity for the High case. The GHGI for the Mid case is therefore a more appropriate estimate to use for benchmarking.

The GHGI figures for Platypus compare with a GHGI of 2.84 $kgCO_2e$/boe as an average for gas from the Cleeton Hub across the period 2022 - 2025, and an average value of 8.71 $kgCO_2e$/boe estimated for Cleeton Hub gas under the future baseline case between 2029 and 2045 (See Table 8-7) in the absence of the Platypus development.

Note, that GHGI values published by the NSTA (NSTA, 2025b) are for the 'Cleeton – Ravenspurn Cluster' which includes combined emissions and production for the Cleeton Hub plus Ravenspurn North. They are consequently not directly related to the figures quoted here for the Cleeton Hub (See Section 8.2.2 for further clarification on the boundary for the Cleeton Hub).

8.4.6.4.2 Platypus GHG Intensity Versus UK Domestic Gas Benchmark

The NSTA average GHG emissions intensity of producing and processing UK domestic gas in 2024 was 28 $kgCO_2e$/boe (NSTA, 2025) which was comprised of an emissions intensity of 18 $kgCO_2e$/boe for upstream operations and 10 $kgCO_2e$/boe for transport and processing (NSTA, 2025c).

In the context of UK domestic gas production, the life-of field GHGI of Platypus gas is extremely low and would deliver gas from the reservoir to the end user at a total intensity of 10.11 $kgCO_2e$/boe if the production intensity of 0.11 $kgCO_2e$/boe is added to the transportation and processing intensity of 10 $kgCO_2e$/boe.

Development of the Platypus Development would therefore contribute to reducing the carbon intensity of UKCS gas production, in alignment with sectoral objectives and contributing to the UK's Net Zero trajectory.

8.4.6.4.3 Platypus GHG Intensity Versus Imported Gas Benchmarks

The UK is a net importer of gas and, according to the NSTA, gas imports accounted for 61% of the UK's total gas supply in 2024 (NSTA, 2025) in order to meet UK gas demand requirements.

The use of imported products can impact the overall GHG emissions of those products because carbon intensity of oil and gas production can vary significantly depending on where production occurs. For example, in 2020, the carbon intensity of imported crude oil ranged from around 10 $kgCO_2e$ per barrel (bbl) to 70 $kgCO_2e$/bbl (NOIA, 2023), demonstrating that the GHG emissions associated with refined products, which are eventually consumed by end users, can have a significant range of impact depending on where the crude oil used to produce those products was sourced. Similarly, gas sourced from UK waters or from Norwegian waters (transported via pipelines), is typically around 4 to 8 times less carbon intensive than imported LNG from outside those waters (BCC, 2025; OEUK, 2023; Rystad Energy, 2024).

While GHG emissions from gas combustion are broadly consistent, at around 350 $kgCO_2e$/boe, emissions associated with upstream operations, transportation and processing can vary significantly depending on the source and supply chain.

Gas imported to the UK by pipeline from Norway has a lower GHGI than domestically produced gas. The average GHGI for imported LNG however is 85 $kgCO_2e$/boe (NSTA, 2025). As such, imported LNG can result in an additional 57 $kgCO_2e$/boe (i.e., 85 kg CO_2e/boe minus 28 $kgCO_2e$/boe) being emitted compared to domestically produced UK gas due to the additional processes of liquefaction, long-distance transportation and regasification. This is illustrated by Figure 8-2, reproduced from NSTA (NSTA, 2025).

These differences indicate that domestic production offers an opportunity to influence the overall carbon intensity of gas supply. By sourcing fuels with lower upstream GHG emissions, it is possible to achieve a degree of GHG emissions reduction associated with their use, even where end-use combustion emissions remain unchanged.

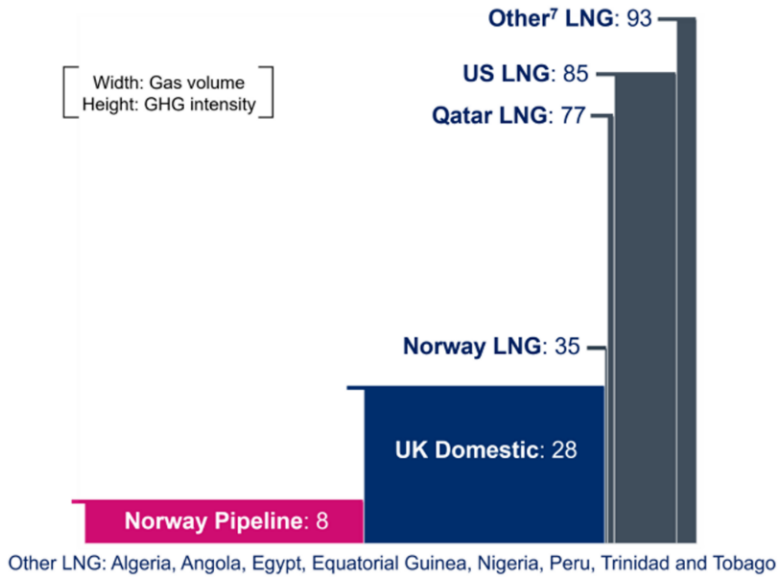


Figure 8-2: 2024 GHG Intensity ($kgCO_2e/boe$) and gas volume of UK imported gas by origin

GHG emissions for the component parts of the value chain for getting LNG from various countries into the UK NTS are shown in Figure 8-3 along with the average domestically produced gas. According to the NSTA, in 2024 imported LNG accounted for only 15% of total UK gas supply but contributed the largest share of associated GHG emissions at 46% (NSTA, 2025). This is illustrated in Figure 8-4. This figure excludes emissions for 0.5 mmboe (0.5%) of the UK's gross natural gas supply sourced from Belgium and the Netherlands, which do not have associated value chain intensity data available.

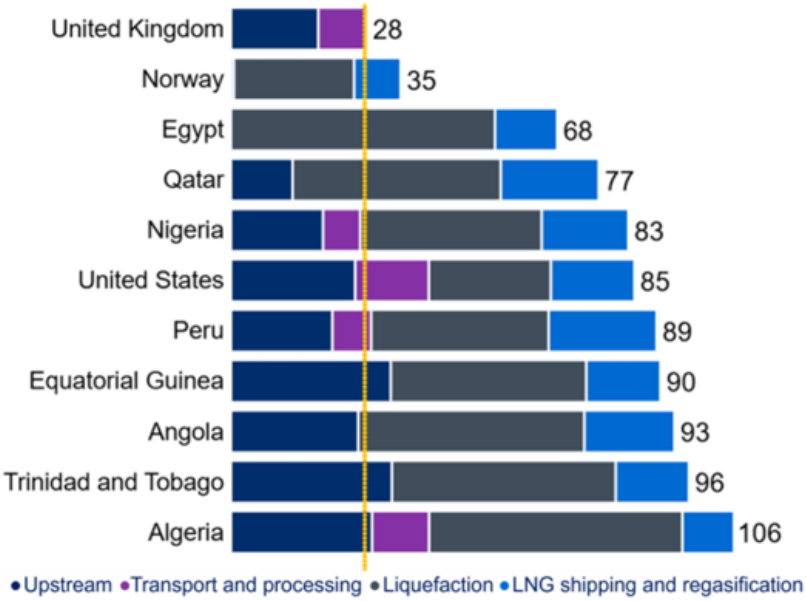


Figure 8-3: UK LNG import GHG Intensities in $kgCO_2e/boe$ in 2024 by country (NSTA, 2025a)

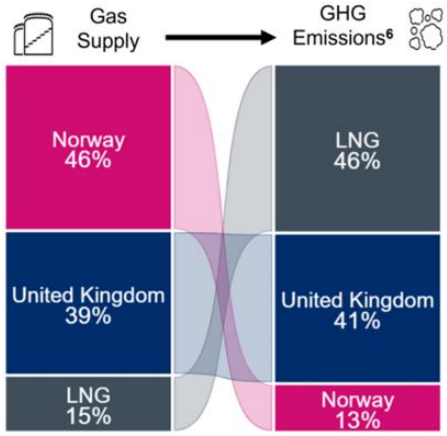


Figure 8-4: UK gas supply and associated emissions (NSTA, 2025a)

Replacement of imported LNG by domestically produced gas serves to reduce the GHGI of the UK gas supply and this would contribute to achieving the UK's emission reduction targets, even though the majority of the additional emissions associated with imported LNG occur outside the boundary for UK reporting. This reduction in the GHGI of the UK gas supply would result in lower WtT CFs for natural gas in the NTS, which would feed into company GHG reporting and national estimates for domestic residential gas use.

The scale of the potential emissions savings that the Platypus Development could make to the UK gas supply is illustrated through the following counter-factual case where Platypus production was instead supplied by imported LNG. Table 8-16 provides emissions estimates for:

- Transportation and processing of Platypus gas from the point of export to the end-user if the average UKCS GHGI for this part of the value chain (10 $kgCO_2e$/boe) is used;
- Production of Platypus fluids as determined in Section 8.2.2.5, using the life-of-field average GHGI of 0.11 $kgCO_2e$/boe derived in Table 8-7;
- The sum of the two previous items, to enable comparison with figures for imported LNG; and
- Production, transportation, processing, liquefaction, delivery to the UK and re-gasification of imported LNG using the average GHGI of 85 $kgCO_2e$/boe reported by NSTA (NSTA, 2025).

Values are provided for the supply of the life-of-field total gas estimated for the Platypus development under the Mid case profile and show emissions savings of approximately 1 $MtCO_2e$.

GHG emissions from the end-use of this gas would be 4.04 $MtCO_2e$ (Mid Case). Delivering this gas through imports of LNG rather than from the Platypus Development would add approximately 23% emissions to the full life-cycle GHG emissions of Platypus gas.

Table 8-16: Difference in overall CO_2e emissions between imported gas and Platypus gas, based on total Platypus life time production of 12,855,599 boe (Mid Case).

Mid Case Gas production (12,855,599 boe)	Platypus		Imported LNG		Difference
	EF ($kgCO_2e$/boe)	$teCO_2e$	EF ($kgCO_2e$/boe)	$teCO_2e$	$teCO_2e$
Production Direct Emissions	0.11	1,409	85	1,092,726	962,761
Downstream processing and delivery	10	128,556			
Downstream end use	315	4,044,892	315	4,044,892	0
Full Value Chain	-	4,174,857	-	5,137,618	23%

8.4.6.4.4 Platypus Venting intensity Versus UKCS Benchmark

Although baseline venting at Cleeton is predicted to remain constant up to cessation of production, the venting intensity for the Cleeton Hub is projected to increase from 3.0 scf/boe in 2029 to 10.5 scf/boe in 2045 (see Table 8-8). This is based on a constant annual venting rate and decreasing production. The production weighted average value for the Baseline over the Platypus Development timeframe (2029 – 2045) would be 5.4 scf/boe.

The baseline venting intensity would decrease with the introduction of Platypus. With the Platypus Development included, the venting intensity for the Cleeton Hub is estimated to increase from 2.3 scf/boe in 2029 to 6.9 scf/boe in 2045 and a life of field average of 3.6 (see Table 8-8).

The incremental increase in venting of 2.54 te/y due to the Platypus Development equates to 66.34 teCO_2e/y based on the composition of Platypus gas (see Table 8-5). The venting intensity for the production of the Platypus hydrocarbons alone would be 0.05 scf/boe in 2029, increasing annually to 0.30 scf/boe in 2045, and with a life of field average of 0.15 scf/boe.

The NSTA publishes venting intensity data for all oil and gas production operations in the UKCS. The average value across the sector for 2024 was 1.00 scf/boe. This value is likely to change significantly over the next decades, partly due to increased activity to reduce venting wherever possible and more significantly due to declining production across the basin. The UKCS benchmark venting intensity is therefore likely to increase over time even though the total quantity of annually vented gas will likely decrease.

Perenco seeks to minimise the need for any venting across its SNS asset portfolio. There is no routine venting within the Cleeton Hub, though venting is required for managing upsets and shutdowns and this will also apply at the new Platypus MFP.

Whereas this flareless operation is seen for some other gas production facilities in the SNS, it is unusual across the UKCS as a whole and does not occur for oil producing facilities. Because there is no option to flare vented gas within the Cleeton Hub, the overall venting intensity is not surprisingly at the higher end of the UKCS range. Due to the relatively small quantities vented, total GHG emissions for the Cleeton Hub remain low, as is seen in the GHGI values which are well below UKCS benchmarks.

8.4.6.4.5 Methane Emissions Reduction

Methane emissions management is an increasingly important focus within the UK offshore oil and gas sector, reflecting its significant role in near-term climate change.

Recent increases in atmospheric methane concentrations have accelerated since 2006 (IPCC, 2021) and methane possesses a much higher degree of radiative forcing than CO_2. Radiative forcing is a measure of how strongly a substance affects Earth's energy balance and describes how much additional heat is trapped in the atmosphere when the concentration of a gas increases. An increase in radiative forcing results in an increase in surface temperature.

Methane accounts for about 16% of radiative forcing from long-lived greenhouse gases and is therefore a material driver of present warming alongside CO_2 and nitrous oxide (N_2O) (WMO, 2025). Methane's atmospheric lifetime is approximately nine years due to its removal mainly via chemical oxidation, making it far less persistent in the climate system than CO_2 (WMO, 2025). Therefore, reducing methane emissions can deliver relatively rapid climate benefits compared to CO_2 reduction, with the rate of warming slowing within decades rather than centuries.

As a result, methane is no longer treated as a secondary consideration relative to CO_2 emissions, but as a key component of overall GHG management. When methane reductions are strong, rapid and sustained, they can rapidly slow the rate of warming. Mitigating methane emissions is therefore a credible priority for immediate action across energy, waste and agriculture systems (IPCC, 2021; WMO, 2025).

The UK oil and gas industry is also aligned to the OGCI 2025 methane intensity commitment (also reflected in the NSTD Supply Decarbonisation commitments) which stipulates a methane intensity target for the sector of "well below" 0.2% by 2025. Methane intensity is calculated by dividing the total methane emissions for each year by natural gas production to give a percentage of methane emitted per cubic metre. UK oil and gas

methane intensity in 2023 was circa 0.13% and was on target for 0.12% in 2024 (NSTA, 2025) which is below the OGCI commitment.

Alternatively, methane intensity can be reported on a production basis. The latest data for 2024, compiled by the NSTA indicates the UK's methane emissions intensity is 1.5 $kgCO_2e$/boe, compared to a global methane intensity average of 15 $kgCO_2e$/boe (NSTA, 2025). The UK's relatively favourable methane emissions intensity performance is supported by its progress in reducing absolute methane emissions by more than 50% since 2018 according to NSTA data (NSTA, 2025).

The benchmark methane intensity performance for the UKCS oil and gas (O&G) industry, and NSTA target, are shown in both units in Table 8-17. The performance for Cleeton Hub over the past four years and the projected methane intensity for the baseline, baseline plus Platypus Development and for the Platypus increment are also included in Table 8-17.

Table 8-17 Baseline and Platypus Development methane intensity relative to UKCS sector-wide performance and NSTA target.

Methane Intensity	%	kgCO2e/boe
UKCS O&G Target 2025	<0.20	N/A
UKCS O&G Performance 2024	0.120	1.5
Cleeton Hub 2022 - 2025	0.026	0.8
Baseline 2029 - 2045	0.062	2.8
Baseline + Platypus 2029 - 2045	0.046	1.9
Platypus 2029 - 2045	0.003	0.1

The data shows that the Cleeton Hub has historically had a methane intensity that is approximately half of the UKCS average. This is despite the requirement for venting of unburned methane for safety purposes in the absence of a flare. As production at the Cleeton Hub reduces in the future, the baseline projection would see the methane intensity increasing, as is also to be expected for the UKCS average. The development of the Platypus Development, with very low methane intensity, would partially offset the increase for the Cleeton Hub. The estimated methane intensity for all scenarios remain well below that of the global average for oil and gas production and this supports the case that domestic production can reduce overall supply-chain emissions when meeting UK demand.

8.4.6.5 Existing and future policy

The analysis presented here demonstrates that closing the demand gap with domestic production is the least emissions intensive option for the UK as well as being the most economically beneficial. The NSFP indicates that the UK Government intends to utilise existing fields in the UKCS to help meet this demand, alongside international suppliers, and support the transition. The NSFP states:

"*Continued oil and gas production from existing fields will support a smoother transition and retain the skilled workforce we need in the UK as we ramp up cleaner technologies*."

The Platypus Development is designed to operate as a tieback to Cleeton via Neptune which appears to Perenco to be consistent with the intent of the soon to be introduced Transitional Energy Certificates (TECs) (DESNZ, 2026b). As such, the Platypus Development would sit within the existing and future policy framework.

Platypus gas could provide domestic supply to meet residual demand and form part of the critical pathway for a managed decline of the UKCS.

Further to the energy policy objectives set out in the NSFP, the UK Government's Autumn 2024 Budget set fiscal policy relevant to North Sea developments. In the 2024 Budget the Government increased the Energy

Profits Levy (EPL) from 35% to 38%, bringing the headline tax rate up to 78%. The Chancellor of the Exchequer also extended the EPL sunset clause to 31 March 2030 and removed the 29% investment allowance. However, by maintaining the first year 100% allowance and the decarbonisation allowance (reduced to 66%), this provided an indication to the market that further investment was desirable.

In confirming the changes during her 2024 Budget speech, the Chancellor of the Exchequer stated

> [The levy] will now expire in March 2030…
>
> and we will remove the 29% investment allowance.
>
> To ensure that the oil and gas industry can protect jobs and support our energy security…
>
> …we will maintain the 100% first-year allowances, and the decarbonisation allowances, too.
>
> (HM Treasury and The RT Hon Rachel Reeves MP, 2024).

The Platypus Development would contribute to meeting this policy objective to attract investment, jobs and energy security, delivering lower emissions than the UK production average (see following section) and subsequently returning significant revenue to the UK Government under the current fiscal regime and subsequent Oil and Gas Price Mechanism (OGPM).

8.4.6.6 Cumulative Assessment against Global emissions trajectories

There is no single dataset that can be used to predict future global GHG emissions associated with existing and planned projects, therefore modelled scenarios and pathways are used to explore future emission projections in assessing the impact of emissions from the Platypus Development. Section 5.7 concluded that a reasonable future baseline for global GHG emissions would sit within the envelope bounded by IPCC SSP1-1.9 and SSP2-4.5 scenarios. The IPCC Current Policies (CurPol) and Moderate Action (ModAct) IMPs, and the IEA NZE and APS scenarios also fall within this envelope. In Table 8-18, emissions from the Platypus Development are set within the context of global emissions associated with each of the future baseline scenarios (where available) for 2030, 2035, 2040 and 2050.

Appendix H provides a description of the assumptions and limitations associated with the Intergovernmental Panel on Climate Change (IPCC) Shared Socioeconomic Pathways (SSPs), Current Policies (CurPol) and Moderate Action (ModAct) model scenarios as well as the IEA Global Energy and Climate Change (GEC) model used to derive Current Policies Scenario (CPS), Stated Policies Scenario (STEPS), Announced Pledges Scenario (APS) and Net Zero Emissions (NZE) model scenarios used in this assessment.

Across all emission pathways considered in the assessment, there are key limitations:

- The pathways represent alternative futures, rather than predictions. Emissions projections are typically based on Integrated Assessment Models (IAMs), which are simplified representations of complex systems;
- IMPs and other similar pathways (e.g. NZE scenario from IEA) are normative (i.e. designed to achieve a specified outcome) and/or illustrative rather than predictive. These pathways are designed to demonstrate how temperature or emissions targets can be achieved under defined assumptions, and therefore represent ambitious (yet pragmatic), policy-driven futures;
- The pathways are based on assumptions regarding policy, technology deployment, behaviour change, and economic conditions;
- No specific likelihoods are assigned to individual pathways;
- Emission pathways are not representative of up-to-date global oil and gas production (historic and forecast); and
- The outcomes vary significantly depending on the extent and timing of global mitigation action.

To address the assumptions and limitations, a range of plausible scenarios is considered, including high-ambition mitigation scenarios (e.g. NZE/IMPs) and less stringent policy environments (e.g. STEPS/CurPol). In Paris-aligned scenarios and pathways, fossil fuel use is more constrained, which provides a more stringent benchmark against which Platypus emissions were assessed. On the other hand, pathways consistent with current policies (e.g. STEPS) are consistent with higher levels of fossil fuel demand and use but are

increasingly misaligned with the goals of the Paris Agreement. The evolution of the baseline takes into account uncertainty across the spectrum of pathways considered, rather than assuming that any one pathway will be realised. While uncertainties remain, the consideration of multiple pathways ensures that the assessment is not dependent on any single set of assumptions and provides a transparent and robust basis for assessing the impact of emissions from the Platypus Development.

There is no scientifically robust or non-arbitrary basis for selecting a discrete subset of individual projects for separate cumulative assessment with respect to GHG emissions (ISEP, 2026), so contextualisation using emissions reduction pathways represents an appropriate and inherently cumulative assessment approach. Pathways, such as SSP1-1.9, SSP 1-2.6, etc., incorporate assumptions relating to existing, approved and future emissions sources, thereby providing a scientifically grounded means of assessing cumulative impact without requiring an exhaustive or selective project list.

The Supplementary Guidance further states that "*an assessment of scope 3 emissions in relation to the current state of climate and global emission-reduction pathways is more likely to support a reasoned conclusion on significance*" and that if "*global reduction pathways are used to contextualise magnitude of emissions as above, this approach should be inherently cumulative as these pathways take into account a wide range of existing and planned projects and other activities*" (DESNZ, 2025).

The SSPs consider a wide range of GHG sources from both natural and anthropogenic activities. They also consider the net impact of atmospheric emissions attributed to sources and sinks and hence are inherently cumulative. Therefore, the cumulative effects of the emissions from the Platypus Development have been considered within the context of the SSPs.

Table 8-18: Quantitative context of Platypus Scope 3 emissions relative to global emissions for future baseline scenarios

Emissions Pathway	Temperature Increase by 2100 relative to pre-industrial times	Parameter	Reference Year			
			2030	2035	2040	2050
IPCC SSP1-1.9	Limit warming to 1.5°C	Median Global GHG Emissions ($GtCO_2e/yr$)	33	No data	18	8
	Likelihood >50%	Platypus Developmented Proportion	0.0032%	-	0.0013%	N/A
IEA Net Zero Emissions Scenario (NZE)*	Warming consistent with 1.5°C	Annual Global Emissions ($GtCO_2/yr$)	25.1	17.6	8.14	No data
		Platypus Developmented Proportion	0.0042%	0.0020%	0.0029%	N/A
IEA Announced Pledges Scenario (APS)**	Warming consistent with 1.7°C	Annual Global Emissions ($GtCO_2/yr$)	32.1	24.7	18.8	11.7
		Platypus Developmented Proportion	0.0033%	0.0014%	0.0013%	N/A
IPCC SSP1-2.6	Limit warming to 2°C	Median Global GHG Emissions ($GtCO_2e/yr$)	40	No data	29	20
	Likelihood >67%	Platypus Developmented Proportion	0.0026%	-	0.0008%	N/A
IEA Stated Policies Scenario (STEPS)*	Warming consistent with 2.5°C	Annual Global Emissions ($GtCO_2/yr$)	36.2	35.2	32.8	29.6
		Platypus Developmented Proportion	0.0029%	0.0010%	0.0007%	N/A
IEA Current Policies Scenario (CPS)	Warming consistent with 2.9°C	Annual Global Emissions ($GtCO_2/yr$)	No data	38.5	38.1	37.8
		Platypus Developmented Proportion	-	0.0009%	0.0006%	N/A
IPCC SSP 2-4.5 (Moderate Action)***	Limit warming to 3°C	Median Global GHG Emissions ($GtCO_2e/yr$)	54	No data	53	52
	Likelihood >50%	Platypus Developmented Proportion	0.0020%	-	0.0005%	N/A

* 2030 values taken from IEA, 2024 and other years taken from IEA, 2025b.
** All values taken from IEA, 2024.
*** IPCC links WGIII Illustrative Pathways Moderate Action and Curpol to WGI SSPs SSP2 -4.5 and SSP3-7.0 respectively. Moderate Action and Current Policies pathways are also linked to the climate categories C6 and C7. However, both ModAct and CurPol are defined as potential overshoot scenarios, meaning that temperature stabilisation may not be achieved.
"no data" represents entries for which data has not been published. The IPCC has not published data for the Median Global GHG Emissions ($GtCO_2e/yr$) of SSPs in 2035. Similarly, the IEA has not published data for the Annual Global Emissions ($GtCO_2/yr$) of the NZE scenario in 2050.
"N/A" represents data entries for which the reference year is beyond the Platypus anticipated cessation of production in 2045.

The UK's share of global CO_2 emissions has fallen from 2.3% since 1990 and now accounts for 1% (CCC, 2025). Therefore, comparing any UK project in isolation to global CO_2 emissions will always result in the individual project being a small proportion of those emissions. What can be drawn from Table 8-18 is that there is a large variation in global emissions within the set of likely future baseline scenarios and that Platypus GHG emissions will not alter the significance of climate change impact of the baseline cases.

The global baseline scenarios consider a wide range of GHG emissions sources from both natural and anthropogenic activities. They also consider the net impact of atmospheric emissions attributed to sources and sinks and hence are inherently cumulative. Therefore, the cumulative effects of the GHG emissions from the Platypus Development have been considered within the context of these baseline scenarios.

The global carbon budget is an estimate of the total cumulative net amount of CO_2 that can be released while limiting global warming to a specified temperature above pre-industrial levels with a given probability. To further contextualise the estimated GHG emissions from the Platypus Development, they can be compared with the remaining carbon budgets that are aligned with limiting to 1.5°C warming (C1-C2) and to 2°C warming (C3-C4), which are nominally aligned with SSP1-1.9 to SSP2-4.5 pathways. The estimated remaining carbon budgets from the beginning of 2025 that give a 50% chance of limiting warming to 1.5°C and 2°C are 130 $GtCO_2$ and 1050 $GtCO_2$, respectively (Forster *et al.*, 2025). These figures are considerably higher than the estimated 0.00627 $GtCO_2e$, GHG emissions from the Platypus Development (High case), demonstrating that the Platypus Development will not materially influence global carbon budgets.

Platypus GHG emissions represent a very small proportion of those pathways and scenarios that are considered to be a reasonable future estimate of global GHG emissions. Whilst the project emissions contribute to the global carbon budget, the effect of the cumulative emissions depends on the complex interactions between the sources and sinks, both natural and anthropogenic. These will be defined by actions of the international community, wider society and governments.

8.4.6.7 Conclusion of significance

In conclusion, the Platypus Development proportion of global emissions is <0.005% in any reference year during the lifetime of the Platypus Development for all the seven future emissions pathways in Table 8-18.

As such, the Platypus Development will not materially influence global carbon budgets.

The crux of significance is whether a project contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards Net Zero by 2050. This has been evaluated in the context of the UK's trajectory, since this is where the emissions will take place, and this is summarised in Table 8-13. The UK's strategy for delivering its NDC is consistent with the global objective for climate change.

The assessment demonstrates that the Platypus Development will be operating in a highly regulated sector that has initiatives and commitments that are aligned to the UK Net Zero targets, which are enshrined in UK law. Benchmarking against global oil and gas production demonstrates that hydrocarbons are produced in the UK sector with lower GHGIs than the global average. This shows that meeting the hydrocarbon demand in the UK's Net Zero pathway using domestic production results in lower emissions globally than meeting that demand with imported LNG. Perenco complies with sector initiatives and commitments and anticipates that the intensity of the gas produced from the Platypus Development will be significantly better than the sector average.

The Platypus Development is considered to be fully in line with measures necessary to achieve a trajectory towards Net Zero and therefore Platypus GHG emissions are aligned with the 'Minor adverse' impact magnitude criteria, defined in the ISEP guidance (ISEP, 2026) as:

- The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type.
- A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards Net Zero.
- A project that is compatible with the budgeted, science based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve that.

- It may have residual emissions but is doing enough to align with and contribute to the relevant transition scenario, keeping the UK on track towards Net Zero by 2050 with at least a 78% reduction by 2035 and thereby potentially avoiding significant adverse effects.

Minor adverse impacts are deemed by ISEP to be not significant and the impacts from of the Platypus Development on climate change are consequently concluded to be not significant.

8.5 Mitigation Measures

Perenco has taken a suite of measures to reduce direct emissions resulting from the pre-production and production phases of the Platypus development. These have been described within this and other chapters of the ES and include specific design considerations for Platypus as well as wider operational emissions reductions initiatives across the Cleeton Hub or the whole of Perenco's North Sea asset base. Some of these are reiterated in the following table.

Proposed Pre-Production Mitigation Measures
• Well clean-up is not currently considered to be necessary for the two wells and no flaring is planned during initial start-up of production. The emissions assessment includes contingency flaring to cover the worst, realistic case. • Efficient use of vessels through journey planning, and ensuring that all contracted vessels are MARPOL compliant and from countries adhering to the IMO convention, will minimise emissions from vessel usage. • To reduce support vessel fuel use and emissions from drilling-related flaring, the wells will, if practicable, be drilled within a single campaign. • Modifications at the Cleeton Hub can be managed using the existing capacity of the platform accommodation and will not require additional support or supply vessels or flights, which will minimise pre-production emissions. • Re-use of an existing jacket structure for the MFP, avoiding emissions that would otherwise arise from the fabrication and installation of new infrastructure.
Proposed Production Mitigation Measures
Consistent with the North Sea Future Plan, revised NSTA Strategy, Stewardship Expectation 11, and the industry commitments contained within the NSTD, Perenco will incorporate the following: • Development and implementation of an ERAP for Perenco UK SNS Assets including the Cleeton Hub and the Platypus facility. • Zero routine flaring and venting at the Platypus MFP, or incremental flaring at the host facilities, will occur as a result of the project. • Use of renewable electricity to power the MFP during production. • Production philosophy will use reservoir pressure to flow fluids to Neptune and then on to Cleeton, and to drive processing at Cleeton and onward export, to avoid almost all sources of additional energy requirements and associated production emissions. • No additional combustion equipment, only minimal incremental increase in diesel and/or fuel gas usage on Cleeton. • Whilst some supply vessels will be required for the MFP during production, the project will not lead to any increase in supply vessels or helicopter flights to Cleeton, and as such logistics emissions during production will be minimised.

9 Discharges to Sea

This Chapter assesses the planned and permitted marine discharges from the proposed Platypus Development (using the impact assessment methodology presented in Chapter 6 and discusses the management and mitigation measures employed in order to adhere to legislation and to minimise environmental impact. All phases will involve the discharge of sewage and food waste from vessels; however, these discharges will be in line with MARPOL requirements such that the environmental Impact Significance of these discharges is considered Low. Note that this Chapter covers the impacts of the discharges on the water column and Chapter 10 (Seabed Disturbance) covers impacts to the seabed.

9.1 Drilling Phase

Planned and permitted discharges to sea during drilling operations include drill cuttings and associated fluids, as well as cement and associated chemicals. As described in Section 4.8.5, WBM cuttings from the top-hole sections will be discharged straight to the seabed and LTOBM cuttings will be skipped and shipped to shore for treatment prior to disposal.

During cementing operations, a quantity of cement may be discharged onto the seabed around each well, as well as other cementing chemicals such as cement mix water and spacers. The following subsections consider each of these discharges to sea resulting from the drilling phase.

9.1.1 Discharge of Drilling Fluids and Drill Cuttings

The proposed Project involves the drilling of two wells. Section 4.8.5 estimates the maximum quantities of drill cuttings that will be produced at each well as a result of the proposed drilling operations (Table 4-6).

As described in Section 4.8.5, it has been assumed that the first two well sections (36" and 17.5") will be drilled using WBM with the cuttings discharged straight to the seabed for the 36” section and from the platform for the 17.5" section. LTOBM will be used for the lower sections of the well, and the resulting cuttings will be shipped to shore for treatment prior to disposal**.**

Drill Cuttings Discharge Modelling (Appendix C) has been carried out to determine the environmental impact to the water column and the seabed from the discharge of the drill cuttings. As noted above, the impacts on the seabed are discussed in Chapter 10 (Seabed Disturbance) whilst this Chapter focuses on the impacts to the water column.

Dose-related Risk and Effect Assessment Model (DREAM) modelling was used to assess the risk to the water column associated with drill cuttings toxicity and particle suspension and to assess the recovery of the water column over time. The model, risk assessment method and results are provided in Appendix C. Note that following advice from OPRED a worst-case scenario was modelled whereby it was assumed that both of the wells would be drilled twice (i.e. due to technical challenges at each well, a re-spud of the first two sections would be required). Therefore, as shown in Table 4-6, the total volume of discharged cuttings considered in the modelling is 2,326.5 te of WBM contaminated cuttings. LTOMB contaminated cuttings have not been included in the modelling given that they will be skipped and shipped to shore.

In reality, the requirement for re-spudding both wells is extremely unlikely such that the total volume of cuttings is more likely to be 582 te of WBM contaminated cuttings. [1]

9.1.1.1 Impacts to the Water Column

Whilst the deposition of drill cuttings on the seabed is a more localised event, water column dispersion of dissolved and suspended particles occurs over a wide area. The majority of the cuttings will settle out of the water column in the immediate vicinity of the wells, with some expected to disperse further afield having been carried in the water column.

[1]The modelled contingencies were requested by OPRED and are considered to represent a highly unlikely scenario of multiple re-spuds such that it is expected that the mass discharge of drill cuttings will be lower than that modelled.

Even with the overly conservative contingency included, the modelling indicated that the discharge of drill cuttings at the Platypus wells will result in a very localised reduction in water quality, primarily due to an increase in suspended solids. The primary contributor to the water column risk is from barite (65.73%). The reduction in water quality mostly occurs in the lower water column where the cuttings from the tophole sections are discharged.

A risk of less than 5 % to the most sensitive species is considered to be tolerable (details of how this level of risk has been derived are presented in Section 2.2 of the Drill Cuttings Dispersion Modelling Report (attached as Appendix C to this ES)). The modelling results indicate that the volume of water where there is a risk to more than 5 % of sensitive species is 0.26 km^3 (Figure 9-1).

It should be noted that this plot shows the swept path (that is all areas where risk is greater than 5 % at any point in time during the entire model run). In practice, the volume where risk exceeds 5 % at any instance in time would be smaller (*c*. 0.074 km^3 for the modelled scenario, and even less given the level of contingency allowed for in the modelling) than that shown in Figure 9-1.

The modelling predicts that the area of water column where there is a risk to over 5 % of sensitive species varies over time. The volume at risk reduces to zero and disappears completely within 24 hours of the end of drilling.

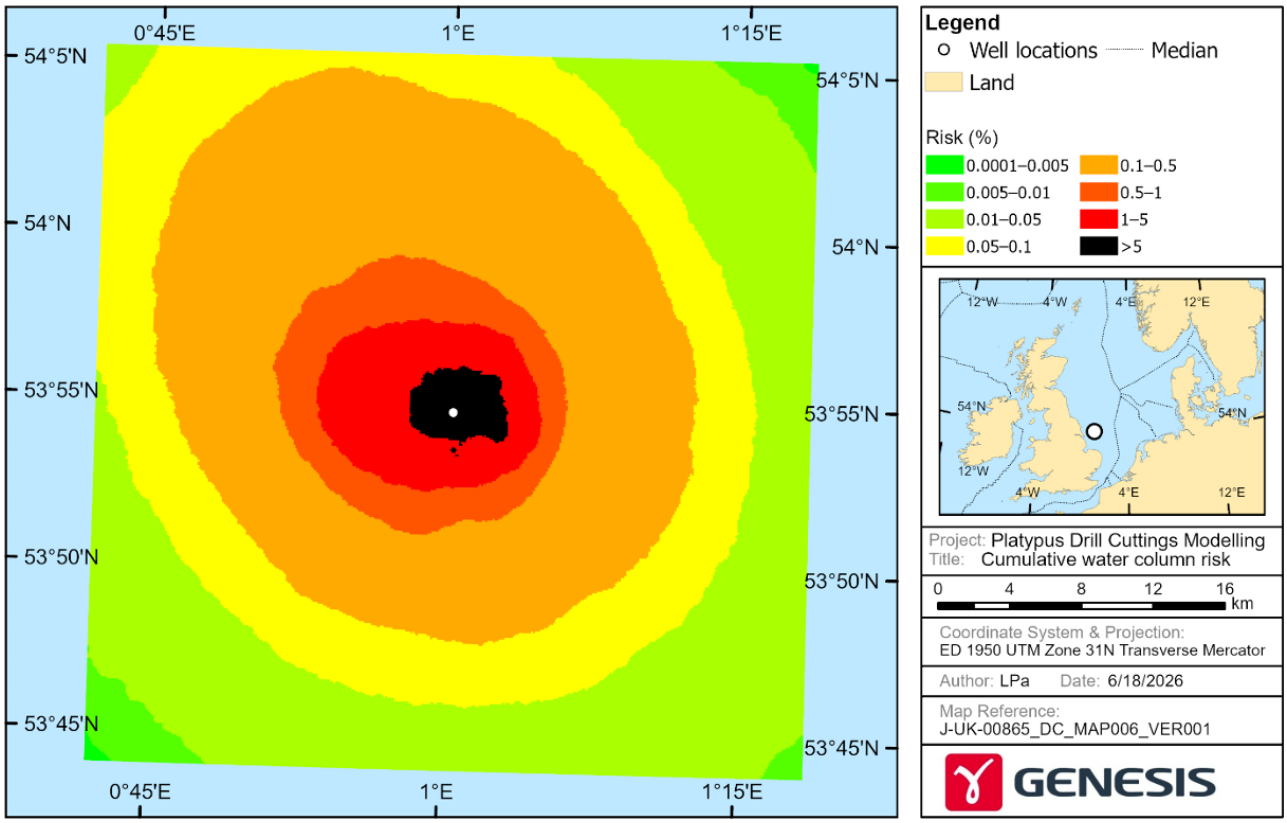


Figure 9-1: Total risk to the water column (swept path).

All chemicals discharged from the drilling and installation activities associated with the proposed Platypus Development will be compliant with the OCR and selected to minimise environmental impact. As such, all chemicals selected will have gone through rigorous testing with regards to their biodegradability, toxicity and persistence and PLONOR chemicals or Gold and Silver OCNS graded chemicals will be prioritised where possible. With careful selection of chemicals known to have minimal environmental effect, any potential impact may be limited to acute effects. While there is the possibility for acute effects, it is expected that concentrations of these chemicals upon discharge will be rapidly diluted by currents such that no chronic impact is anticipated (Vik *et al.,* 2014).

On commencement of drilling, it is expected that fish will temporarily avoid the area, which will minimise the number of fish exposed to the sediment plume. Where avoidance by fish is not possible, the sensitivity to suspended sediments varies greatly between species and their life history stages and depends on sediment composition (particle size and angularity), concentration and the duration of exposure (Newcombe and Jensen, 1996). Being the major organ for respiration and osmoregulation, gills are directly exposed to, and affected by, suspended solids in the water. If sediment particles are caught in or on the gills, gas exchange with the water may be reduced leading to oxygen deprivation (Essink 1999; Clarke and Wilber 2000). This effect is greatest for juvenile fish as they have a higher oxygen demand and small gills at higher risk of clogging (FeBEC, 2010). Spawning species within the vicinity include cod, herring, lemon sole, mackerel, *Nephrops*, sole, sprat, whiting, plaice and sandeels (Section 5.3.3).

As some fish species in the area are classified as SPI (Section 5.5.2) (e.g. Sandeel, herring, cod, whiting, plaice, mackerel, and spur dog), Receptor Sensitivity is considered **High (c)**. Given the relatively small volume of water expected to be impacted by suspended particles and sediments, and the relatively short time period that the sediments will be in the water column, any effects will reverse naturally such that the Magnitude of Effect is considered **Negligible (1)**. The overall Impact Significance of the discharged drill cuttings on the water column is therefore considered **Low** such that any impacts of the suspended drill cuttings on the water column and associated fish species are considered negligible.

9.1.2 Cement and Cementing Chemicals

As described in Section 4.8.6, when drilling a well, cement is used to secure the steel conductor and casings in the well bore, whilst cementing chemicals are used to modify the technical properties of the cement slurry. The discharges associated with these cementing operations are described briefly here and will be detailed in the drilling permit applications submitted to OPRED prior to commencement of drilling. These include:

- Discharge of residual mixed cement from the drilling rig following a cementing operation;
- Discharge of cement as a result of an aborted cementing job;
- Discharge onto the seabed of excess cement pumped down the well; and
- Discharge of cement spacers, mix-waters and cement unit washings.

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

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

The cementing chemicals to be used have not yet been determined but will be detailed in subsequent drilling permit applications. Typical cementing chemicals include:

- Anti-settling agents used to stabilise mixed cement;
- Wetting agents used to ensure an improved cement bond;
- Cement slurry dispersants used to reduce the viscosity of the slurry and aid displacement;
- Fluid loss reducers used to control water loss from cement slurries;
- Cement slurry spacer viscosifier used to build weighted fluid spacers to separate cement slurry from drilling muds during slurry displacement; and
- Cement accelerants used to reduce the time taken for cement to set.

Over a period of hours, it is expected that the cement discharged following the washing of the cement unit or as a result of an aborted cement job will be indistinguishable from background suspended solids concentrations.

The Receptor Sensitivity of the fauna in the water column that could be impacted by these discharges ranges from **Low (a)** (e.g. plankton) to **High (c)** (e.g. fish species classified as SPI), however given the temporary nature of the impact on the water column (prior to the discharged suspended solids settling to the seabed), the Magnitude of Effect is considered **Negligible (1)**. The overall Impact Significance is therefore considered **Low** such that any impacts of the suspended cement discharges are considered negligible.

9.1.3 Well Clean-up

Upon completion of the production wells, they will be cleaned up which will potentially require flaring of some gas from the drilling rig as a worst-case. Flaring will be avoided wherever possible. Perenco intend to direct all gas to process and zero flaring is the preferred option, however, an option to flare has been included within the ES as a worst-case scenario. It has been assumed that the flaring volume will be an estimated 57 MMscf (1,200 te) per well over a 48-hour period.

During well clean-up to the rig, the well completion fluids will be separated, filtered and sampled, and those which meet the oil in water discharge criteria of 30 mg/l will be discharged to sea. The well bore clean-up process will typically result in a volume of approximately 142.5 bbls (*c*. 22.7 m^3) of visibly oil-free displaced fluids per well being discharged offshore. The LTOBM chemical additives selected will be subject to the OCR requirements and the potential traces contained in the cleaned wellbore fluid discharge will be risk assessed as part of the drilling application for chemical use/ discharge. It will occur in discrete volumes at the end of each well, allowing time between the discharges for the water to disperse. This will apply to reservoir oil content in discharged fluids resulting both from wellbore clean-up process and well testing. Fluids which do not meet the discharge criteria will be returned to shore for processing.

The Receptor Sensitivity of the fauna in the water column that could be impacted by these discharges ranges from **Low (a)** (e.g. plankton) to **High (c)** (e.g. fish species classified as SPI), however given the relatively small volume of water impacted the Magnitude of Effect is considered **Negligible (1).** The overall Impact Significance is therefore considered **Low** such that any impacts of the wellbore clean-up discharges are considered negligible.

9.2 Subsea Installation and Commissioning Phase

9.2.1 Leak Testing and Commissioning

There is potential for discharge of chemicals during leak testing and commissioning of the pipelines. Pipelines will be laid empty and then filled with leak testing and commissioning chemicals post hook-up to spools.

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

All chemicals used during pipeline testing and commissioning will be risk assessed within the relevant Chemical Permit (CP) applications. The testing will be carried out over a short timescale and the quantity of chemicals discharged to the marine environment will be minimised.

Given the open nature of the North Sea, the Receptor Sensitivity of water quality is considered **Low (a)**. Marine flora and fauna may be affected on a localised level; however, given that priority will be given to PLONOR and Gold or Silver OCNS graded chemicals where possible, and discharges will disperse rapidly due to currents, the Magnitude of Effect of any discharges is therefore considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.

9.3 Production Phase

9.3.1 Produced Water Chemicals

In normal operations, produced water will be reinjected into the Cleeton reservoir via an existing dedicated reinjection well at Cleeton and therefore will not be discharged to sea.

Given the open nature of the North Sea, the Receptor Sensitivity of water quality as a receptor is considered **Low (a)**. Given that produced water will be re-injected as opposed to discharged to sea, Magnitude of Effect is considered **Positive / No Effect (0**) such that the overall Impact Significance is considered **No Effect**.

9.4 Decommissioning Phase

Some planned discharges to sea are likely to occur during the decommissioning of the proposed Platypus Development. These may include the following:

- Routine MARPOL compliant discharges from vessels associated with the decommissioning activities;
- Discharges associated with well abandonment; and
- Discharges resulting from the disconnection / cutting and recovery (where applicable) of the pipelines.

Discharges to sea resulting from the decommissioning activities will be described in the Environmental Appraisal submitted in support of the Decommissioning Programme. All discharges that may be contaminated with hydrocarbons will be treated to below minimum levels required at the time of decommissioning or shipped to shore for treatment and disposal. The quantity and nature of the marine discharges associated with the decommissioning activities are anticipated to be such that the potential risks associated with these discharges would not exceed those associated with the drilling, installation and production activities.

9.5 Impacts to Southern North Sea SAC

The SNS SAC is described in Section 5.4. To assess the potential impacts of Discharges to Sea resulting from the proposed Project on protected features and conservation objectives of the SNS SAC, a summary of the relevant pressure ‘Contaminants’ with respect to the conservation features of the SNS SAC is provided in Table 9-1 (JNCC, 2023).

Harbour porpoises are highly mobile species and therefore they themselves are not likely to be impacted by discharges to sea in water column, hence they have been noted as Not Applicable (N/A) in Table 9-1.

Harbour porpoises in the SNS SAC primarily prey on small shoaling fish such as herring, sprat, and sandeel. This habitat supports an abundance of these prey species, which are essential for the harbour porpoise's diet. Herring, sprat and sandeel are planktivorous fish that feed on zooplankton, which are typically found in the water column. Therefore, they may be vulnerable to impacts on the water column resulting from discharges to sea associated with the proposed Project activities (JNCC, 2023). According to FeAST and the AOps tool, harbour porpoise supporting habitats are classified as Not Sensitive (NS), however, the relative risk of impact is considered High.

Table 9-1: Harbour Porpoise Species, Supporting Habitat, Processes and Prey Availability Sensitivity to Discharges to Sea (FeAST, AOps; JNCC (2023)).

Pressure Relevant to this Section	SNS SAC Features of Interest		Project Source	Potential Impact	Relative Risk of Impact	AOps and Relevance to Proposed Project
	Harbour porpoise species	*Harbour porpoise supporting habitats, processes, and availability of prey*				
Contaminants	N/A	NS	Planned discharges to sea, accidental releases.	Effects on water and prey quality. Bio-accumulation through contaminated prey ingestion.	High	Given the open nature of the North Sea, water quality has been assessed to have a Low Receptor Sensitivity. The discharge of drill cuttings at the Platypus wells will result in a very localised reduction in water quality, primarily due to an increase in suspended solids. Produced water will be re-injected as opposed to discharged to sea.
Key: NS - Not Sensitive N/A - Not Applicable						

9.6 Cumulative and Transboundary Effects

The cumulative impact of drill cuttings and cement on the seabed are discussed in Chapter 10 (Seabed Disturbance). In relation to all other discharges, given the proposed mitigation measures no significant cumulative impacts are anticipated.

9.7 Mitigation Measures

The following mitigation measures are proposed to minimise impacts resulting from the discharges to sea associated with the proposed Platypus Development.

Proposed Mitigation Measures
• Efficient use of vessels, through journey planning; • Perenco will review vessel CMID as part of vessel assurance and all vessels will be compliant with the Company's MAS; • Vessels will be MARPOL compliant; • All contracted vessels will originate from countries adhering to the IMO convention; • Perenco's audit procedures will ensure that the contracted vessels ballasting procedures are in line with IMO Convention aimed at preventing associated harmful effects; • All discharges of ballast water will be monitored, and records maintained; • Jack up vessels routinely test deck water prior to discharge, in cases where legal limits are exceeded deck water is returned to shore and disposed of. Some vessels have Separators onboard which they can use to separate and discharge water. The jack up vessels will adhere to OPPC deck drainage regulations / requirements; • Adherence to OPPC Regulations;

Proposed Mitigation Measures
• Chemical selection process will aim to select the lowest toxicity chemicals for a given technical requirement; • Cement discharge will be minimised through seabed monitoring via ROV; • Specific muds and cement program; • Chemical Permitting process; • Discharge of fluids will follow procedures which will minimise environmental impact; • Onboard testing of all fluids prior to discharge; • Discharge process will be controlled, maximum rates set that significant changes to the ambient environment are minimised (specified in CPs); • LTOBM contaminated cuttings will be skipped and shipped for onshore disposal, no planned discharge; • All produced water will be re-injected.

Applying the impact assessment methodology described in Chapter 6 and taking account of the mitigation measures listed above, the overall Impact Significance associated with discharges to sea (other than those associated with the accumulation of drill cuttings or cement on the seabed, which are discussed in Chapter 10 (Seabed Disturbance) is considered **Low**. The impacts are therefore considered acceptable when managed within the additional controls and mitigation measures described.

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

10 Seabed Disturbance

A number of activities will be carried out during the proposed Platypus Development which have the potential to impact seabed habitats and benthic communities in the area, including the following:

- Installation of the Platypus MFP jacket;
- Anchors, anchor lines and spud cans from vessel use required for installation, modification and drilling activities;
- Discharged drill cuttings during drilling activities;
- Discharged cement deposits during drilling activities;
- Installation of a drilling template (as a worst case);
- Trenching and burying of the 12" Export Pipeline and 3" Methanol Pipeline; and
- Associated stabilisation features (mattresses, grout bags, RFUs, DMAs, contingency rock).

This Chapter considers the impact of the different sources of seabed disturbance identified, quantifies the area of potential seabed disturbance and assesses the impact of the disturbance using the impact assessment methodology presented in Chapter 6.

Seabed impacts may be characterised as either short-term (e.g. disturbance caused by anchor lines) or long-term (e.g. persistent anchor scars following recovery of anchors, or infrastructure installed on the seabed to be in place for the life of the field). The following sections identify the sources of disturbance associated with each phase of the proposed Project, quantify the worst-case impacts, and assess these in the context of seabed habitats and associated ecosystems. The assessment also considers the designated features of the SNS SAC.

10.1 Drilling Phase

10.1.1 Drilling Rig

A maximum of two wells will be drilled as part of the proposed Platypus Development. As described in Section 4.2, project base case and contingency scenarios are considered. The contingency scenario results in a greater footprint of seabed disturbance, given that in addition to the drilling rig, a JUB would also require to be mobilised (along with associated spud cans and anchors) and therefore the contingency scenario has been assessed in this Chapter. It is possible that the drilling rig and contingency JUB may require to be temporarily set down at a stand-off location before being moved into final location. Note the temporary set down at the stand-off location will not require the use of anchors, however, it would result in a total of 14 spud can depressions in the seabed (three spud cans on the drilling rig for two placements, four spud cans on the contingency JUB for two placements). In addition, support pads (rock or mud mats) may be required to support the drilling rig and contingency JUB and therefore this has been accounted for in the impact assessment.

This Chapter considers the worst-case seabed impact associated with the placements and anchoring of a drilling rig and JUB, the potential for spud can depressions remaining, and installation of a drilling template.

As described in Section 4.8.1, as a worst-case scenario, four anchors may be used to assist with the positioning of the drilling rig (per drilling rig placement) over the location of the wells. Four anchor lines with a combined length of *c.* 3,728 m will connect each anchor to the drilling rig and up to 50 % of each anchor line (1,891 m) will be in contact with the seabed (per drilling rig placement). Maximum anchor dimensions of 3 m (L) x 3 m (W) (total footprint 9 m^2 per anchor) are assumed.

The maximum anticipated area of seabed disturbance associated with the installation of the anchor system and spud can depressions is provided in Table 10-1, with the impacts on the seabed and associated ecosystem discussed in Section 10.5.

10.1.2 Drill Cuttings

Drill Cuttings Modelling (Appendix C) has been carried out using DREAM to determine the environmental impact to the seabed from drill cutting discharges from the proposed Platypus Development, based on two well locations (drilled without a template). The drill cuttings modelling also includes a large contingency[1].

The impacts to fish from dispersion of the drill cuttings in the water column has been assessed in Chapter 9 (Discharges to Sea), whilst this chapter focuses on the deposition of drill cuttings on the seabed and impacts to benthic communities.

As discussed in Section 4.7.6 and Section 9.1.1, the base case is that the conductor is driven and in this case the WBM cuttings from only one top hole section will be discharged to the water column. However, if the conductor is drilled, WBM cuttings from one top hole section (the conductor section) will be discharged straight to the seabed and the other surface section will be discharged from the drilling rig to the water column. To represent the worst-case scenario, modelling has been based upon the conductor being drilled. The LTOBM cuttings will be skipped and shipped to shore for treatment prior to disposal.

The modelling considered the fate of the discharged cuttings from the wells and calculated the risk to the seabed sediments for the duration of drilling and over a 10-year period post drilling, based on a combination of stressors including: burial thickness, change to grain size, toxicity of chemicals, and pore water oxygen depletion.

In the absence of any other stressors a risk to more than 5 % of sensitive species would occur when (Trannum, 2004; Kjeilen-Eilertsen *et al.*, 2004; and Neff, 2005 as cited in Appendix C):

- Burial thickness exceeds 6.5 millimetres (mm);
- A median grain size change greater than 52.7 micrometre (µm);
- Oxygen content depletion greater than 20 %; and
- Toxicity where chemical concentration (in this case the base oil and/or reservoir oil) exceeds the Predicted No Effect Concentration (PNEC).

A risk of less than 5 % to the most sensitive species is considered to be tolerable. The model calculates the risk to sensitive species for each of the seabed stressors individually and for all stressors combined. The main contributor to the risk as a result of drilling the proposed Platypus wells is deposition thickness (51.77 %) with grain size change making up the remaining risk (48.23 %). There is no contribution to risk from oxygen depletion or toxicity. LTOMB contaminated cuttings have not been included in the modelling given that they will be skipped and shipped to shore. Further details are provided in Appendix C.

10.1.2.1 Burial Thickness

As noted above, the main risk stressor as a result of the modelled drilling discharges is deposition thickness.

In terms of cuttings thickness, the modelling predicted a maximum estimated thickness of cuttings of 0.603 m (603 mm) in the immediate vicinity of the wells, reducing rapidly with distance (Figure 10-1). In reality, the size of the cuttings pile is expected to be smaller as the model includes the discharges from the contingency re-spuds and side-tracks.

The area where the cuttings thickness is over 6.5 mm is predicted to be *c*. 0.0204 km^2 at the end of drilling (up to approximately 100 m from the discharge locations). To put this into context, a typical exclusion zone around a platform of 500 m radius is equivalent to an area of 0.785 km^2. Over time the area where thickness is greater than 6.5 mm gradually reduces.

[1] The modelled contingencies are considered to represent a highly unlikely scenario of multiple re-spuds; it is anticipated that the mass of drill cuttings discharged will be lower than that modelled. Further details are provided in Section 9.1.1.

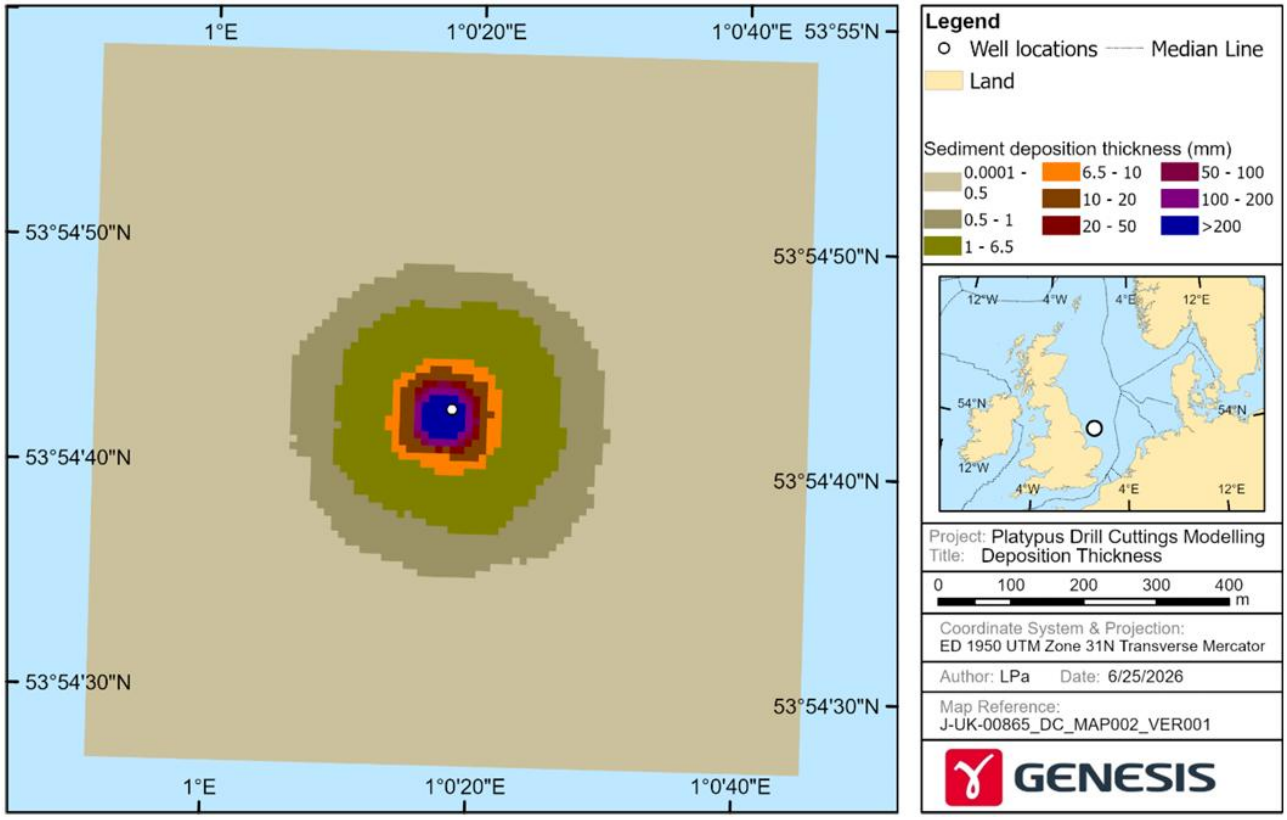


Figure 10-1: Deposition thickness around the Platypus well locations at the end of drilling.

10.1.2.2 Combined Risk

Overall, the maximum area where there is a combined risk (i.e. from all stressors) to more than 5 % sensitive species is predicted to be 0.0204 km^2, occurring at the end of drilling. The area reduces to 0.0116 km^2 after one year, to 0.0078 km^2 after three years, and to zero within four years and eight months post-drilling.

The area where there is a risk to 5 % of the most sensitive species reduces to over time due to bioturbation and re-suspension (both of which are modelled in DREAM) and re-colonisation by opportunistic species (which is not modelled in DREAM). Therefore, in practice the area of risk will reduce faster than calculated by the model.

The predicted combined risk to the sediment over time, resulting from the drilling of the proposed Platypus wells, is shown in Figure 10-2.

Note that the area of impact at four years and eight months has been used to represent the permanent area of impact for this assessment, although it is recognised that the area of impact will further reduce over time.

Table 10-1 summarises the anticipated maximum area of seabed to be impacted during the drilling phase and therefore includes areas impacted by the drill cuttings discharges. The impact of the discharged cuttings is discussed in Section 10.5. As noted above, potential impacts to the water column from the discharge of drill cuttings are discussed in Chapter 9 (Discharges to Sea).

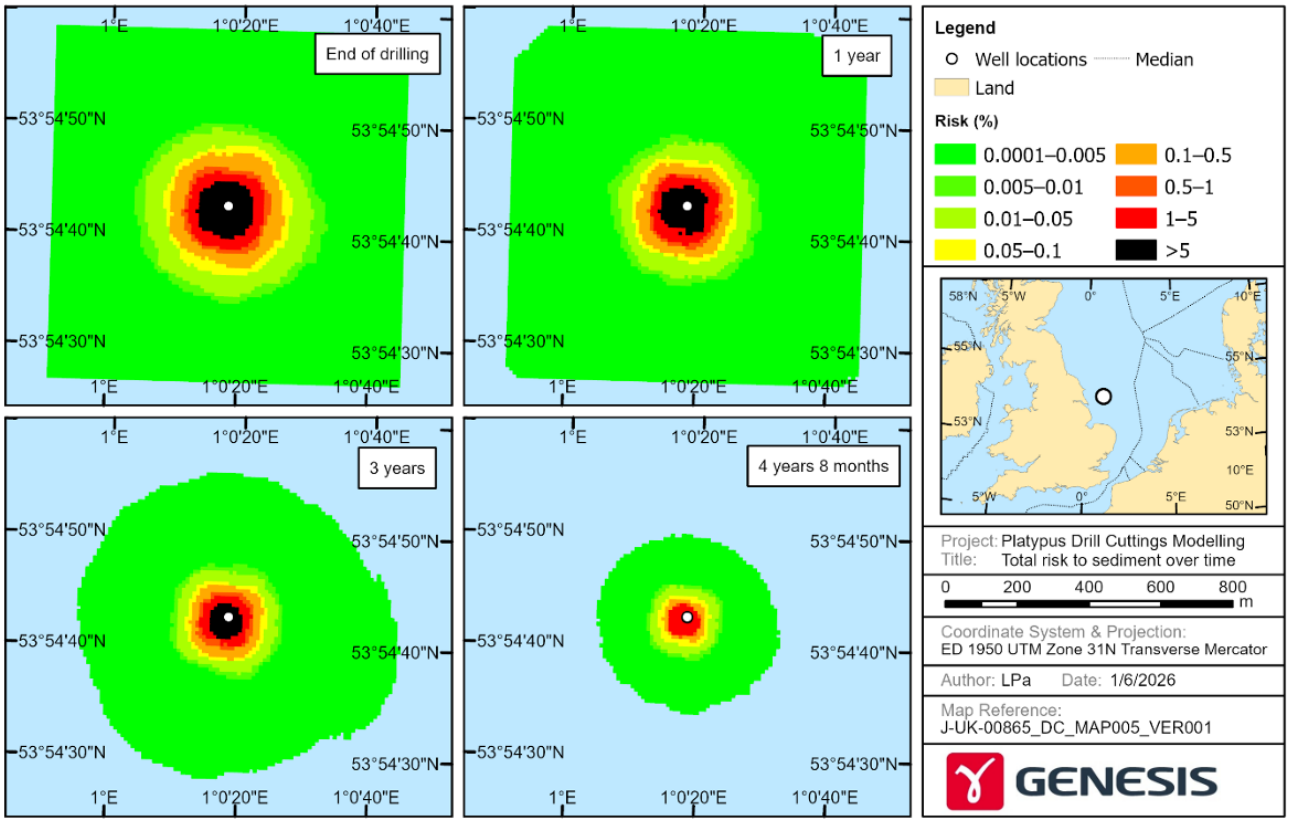


Figure 10-2: Predicted combined risk to the sediment over time, resulting from the drilling of the proposed Platypus wells.

10.1.3 Cement Deposits at the Wells

As discussed in Section 4.7.7, it is possible that solid cement deposits could occur on the seabed in the immediate vicinity of the top of each well. If they do occur, these deposits are expected to impact on an area of *c.* 0.00035 km^2 permanently, based on approximately 25 te impacting on an area extending 7.5 m around each well radius. The worst-case area assumption for cement patios has been made. The impact of these deposits on the seabed and its associated ecosystem are discussed in Section 10.5.

10.2 Installation Phase

10.2.1 Installation of Platypus MFP Jacket

As described in Section 4.5, installation of the Platypus MFP jacket will involve piling to secure it to the seabed. Disturbance to the seabed will primarily occur when the jacket is piled into the seabed and will be within close proximity to the physical footprint of the jacket (23 m by 23 m). A contingency buffer of 2 m around the jacket footprint is allowed for temporary disturbance during installation.

A HLJUV with up to eight anchors (and associated anchor lines) and six spud cans will be used to install the Platypus MFP. It is possible that the HLJUV may require to be temporarily set down at a stand-off location before being moved into its final location. Note the temporary set down of the HLJUV at the stand-off location will not require the use of anchors, however, it would result in a total of 12 spud can depressions in the seabed. In addition, support pads (rock or mud mats) may be required to support the HLJUV and therefore this has been accounted for in the impact assessment.

10.2.2 Pipelines, Drilling Template and Stabilisation and Protection Materials

Table 4-8 and Table 4-9 summarise the pipelines and associated stabilisation and protection features to be installed as part of the proposed Platypus Development. Installation of a drilling template has also been

assessed, with Table 10-1 summarising the seabed areas anticipated to be temporarily and permanently impacted.

The export pipeline and methanol line to be installed between Platypus MFP and Neptune will be trenched and mechanically buried. Trenches will be cut using a towed plough and mechanically backfilled using a separate towed backfill plough. Jet trench is the preferred installation method, however mechanical plough and backfill is assessed in this chapter of the ES as a worst-case. It is assumed as a worst-case that the two pipelines will be laid in separate trenches, however, the project is continuing to determine if the export pipeline and methanol pipeline can be laid in the same trench. A number of DMAs may be required along the pipeline route whilst laying, to provide pipeline stabilisation before the back filling of the trench.

It should be noted, the area of disturbance presented represents a worst-case, for example, much of the area impacted by the grout bags will likely also be impacted by the mattresses and infrastructure. In addition, the quantities of mattresses and grout bags allowed for include a contingency (Table 4-9).

For those structures laid on the seabed (including stabilisation features and drilling template), the impacted area beneath each item is considered to be permanently impacted, however the assessment also allows for temporary disturbance of sediments resettling on the seabed in the immediate vicinity of each item.

Based on the baseline surveys conducted by Fugro in 2025, Perenco do not currently envisage requiring rock deposits/remediation, however a contingency volume has been included should the seabed conditions change. A worst-case estimate of 5,000 te of rock (based upon 750 at each pipeline end and 3,500 along the line) has been made. The pipeline route shall be reassessed following completion of the pre-lay surveys which shall be conducted ahead of pipelay operations. The estimate has been made as a worst-case based on previous pipeline work scopes in the area.

Any rock that may be laid can be expected to follow the typical industry standards with a diameter within the range of 100 – 150 mm and for granite rock to be used. Rock grading will be developed in later design stages to ensure optimal structural stability and considerations to minimise seabed disturbance will be prioritised for example using a fall pipe to lay the rock.

The impacts of the anticipated disturbance on the seabed and its associated ecosystem resulting from subsea installation activities are discussed in Section 10.5.

10.2.3 Topside Modifications at Neptune

As described in Section 4.6, required modifications on Neptune are likely to be undertaken using a JUB with four spud cans as a worst-case. In addition, up to four anchors may be used to bring the JUB on location. It is possible that the JUB at Neptune may require to be temporarily set down at a stand-off location before being moved into its final location, which will not require the use of anchors, however, it would result in a total of eight spud can depressions in the seabed (two placements of four spud cans). In addition, support pads (rock or mud mats) may be required to support the Neptune JUB and therefore this has been accounted for in the impact assessment.

10.3 Production Phase

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

10.4 Decommissioning Phase

The decommissioning activities will result in some temporary disturbance to the seabed. Sources of disturbance are expected to include (but are not limited to):

- Seabed sampling for pre-decommissioning survey work;
- Localised dredging or jetting to allow access for cutting (piles);
- Potential temporary wet storage of items following disconnection and prior to recovery;
- Temporary positioning of baskets for recovery of tie-in spools etc.; and
- Anchoring or placement of drilling rig during well abandonment.

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

The Environmental Appraisal submitted in support of the Decommissioning Programme will capture the impacts associated with the disturbance of the seabed. The activities will be further detailed on the relevant MAT and associated SAT applications in line with advice received from OPRED at the time. It is anticipated that the area disturbed by the decommissioning activities will mostly be within the area disturbed by the installation activities. Note that estimating the area of impact associated with decommissioning is not included in the ES but will be captured in the impact assessments required prior to decommissioning activities commencing.

10.5 Seabed Disturbance Impact Assessment

10.5.1 Quantification of Impact

Table 10-1 summarises the anticipated temporary and permanent areas of seabed disturbance associated with the proposed Platypus Development.

It should be noted that these total seabed disturbance values consider the impact areas separately, whereas in reality the impacts will overlap. Therefore, the values presented are conservative and represent worst-case.

Table 10-1 divides the areas of disturbance into permanent and temporary; which are further divided into two categories.

The temporary impacts can be divided in terms of what pressure is delivered:

- Indirect resulting from settlement of suspended sediments;
- Direct cause by direct physical contact with the seabed.

Temporary impacts from sediment resuspension are associated with smothering and increased suspended sediment pressures, where fine material settles on the seabed following installation activities. These impacts are indirect and typically result in short-term burial or sediment deposition, with ecological effects dependent on deposition thickness and duration. Recovery is expected to occur relatively rapidly through natural sediment reworking and biological recolonisation.

Direct interactions with the seabed (e.g. from anchor line contact) generate abrasion and penetration pressures, resulting in the physical disturbance or removal of benthic organisms within the contact area. These effects are typically spatially discrete and occur instantaneously, with recovery dependent on sediment mobility and recolonisation processes.

The permanent seabed disturbance associated with the proposed Project can be divided into:

- Permanent habitat modification which represents a replacement or change of the existing habitat; and
- Permanent physical disturbance which represents a physical abrasion of the existing habitat.

Permanent habitat modification will result from the placement of rock, mattresses and infrastructure on the seabed that is to remain in place and therefore converting soft sandy sediment to a hard substrate. This change persists for the operational lifetime of the infrastructure and is therefore considered a permanent effect in terms of habitat character, although it is spatially limited.

Anchor scars and spud can depressions are considered a permanent physical disturbance feature as defined by JNCC due to the potential for long-term persistence of seabed morphology changes and uncertain recovery timescales. However, unlike infrastructure placement, these impacts do not introduce new material and are expected to gradually recover through natural sedimentary processes, albeit over extended periods.

Table 10-1: Anticipated area of seabed disturbance associated with the proposed Platypus Development Project.

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
Area Impacted by Platypus MFP Installation						
1.	Jacket structure	Assessment assumes: • physical footprint of the jacket is 23 m by 23 m. • a contingency buffer of 2 m around the jacket footprint is allowed for temporary disturbance during installation. *Calculation:* *Permanent impact: jacket footprint (23 m x 23 m) = 529 m^2 (0.0005 km^2).* *Temporary impact: extended jacket footprint (27 m x 27 m) – permanent impact area (0.0005 km^2) = 0.0002 km^2*	0.0002	N/A	0.0005	N/A
Area Impacted by Vessel Anchors, Anchor Lines and Spud Cans						
2.	Anchors	Assessment assumes: • **HLJUV** for MFP Installation – **8** anchors, **1** positioning. **13.5** m^2 impacted by each anchor during positioning. • **Drilling rig** – **4** anchors, **1** positionings. **9** m^2 impacted by each anchor during positioning. • **JUB** for contingency (If drilling first, would return with a JUB) - **4** anchors, **1** positioning. **9** m^2 impacted by each anchor during positioning. • **JUB** for Neptune Modifications – **4** anchors, **1** positioning. **9** m^2 impacted by each anchor during positioning. *Calculation:* *HLJUV: 8 anchors x 1 positioning x 13.5 m^2 area of disturbance each = 108 m^2 (0.000108 km^2)* *Drilling rig: 4 anchors x 1 positionings x 9 m^2 area of disturbance each = 36 m^2 (0.000036 km^2).* *JUB (Contingency): 4 anchors x 1 positioning x 9 m^2 area of disturbance each = 36 m^2 (0.000036 km^2).* *JUB (Neptune): 4 anchors x 1 positioning x 9 m^2 area of disturbance each = 36 m^2 (0.000036 km^2).* *Total for all anchors: 108 + 72 + 36 = 216 m^2 (0.000216 km^2).*	N/A	N/A	N/A	0.000216

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
		All anchors will be recovered at the end of the installation / drilling campaign; however, the impact of anchors is considered a permanent physical disturbance to account for the potential for long-term persistence of anchor scars.				
3.	Anchor Lines	Assessment assumes: • **HLJUV** for MFP Installation – **8** anchors lines, **1** positioning, **250 m** of anchor line on seabed, **30 m** corridor lateral movement. • **Drilling rig** – **4** anchor lines, **1** positionings, **1,891 m** of anchor line on seabed, **2 m** corridor lateral movement. • **JUB** for contingency (If drilling first, would return with a JUB) - **4** anchors, **1** positioning, **1,213 m** of anchor line on seabed, **2 m** corridor lateral movement. • **JUB** for Neptune Modifications – **4** anchors, **1** positioning, **1,213 m** of anchor line on seabed, **2 m** corridor lateral movement. *Calculation:* *HLJUV: 8 anchor lines x 1 positioning x 250 m length of line on seabed x 30 m corridor = 60,000 m^2 (0.06 km^2)* *Drilling rig: 4 anchor lines x 1 positionings x 1,891 m length of line on seabed x 2 m corridor = 3,782 m^2 (0.003782 km^2).* *JUB (Contingency): 4 anchor lines x 1 positioning x 1,213 m length of line on seabed x 2 m corridor = 2,426 m^2 (0.002426 km^2)* *JUB (Neptune): 4 anchor lines x 1 positioning x 1,213 m length of line on seabed x 2 m corridor = 2,426 m^2 (0.002426 km^2)* *Total for all anchor lines: 60,000 + 3,782 + 2,426 + 2,426 = 68,634 m^2 (0.0686 km^2).* As all anchors will be recovered at the end of the installation / drilling campaign, the impact of anchor lines is considered temporary. No permanent impact.	N/A	0.0686	N/A	N/A
4.	Spud Cans	Assessment assumes: • **HLJUV** for MFP Installation – **6** spud cans, **2** positionings (including set-down). **258** m^2 area of each spud can.	0.0019	N/A	N/A	0.0076

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
		• **Drilling rig** – **3** spud cans, **2** positionings (including set-down). **254.5** m^2 area of each spud can. • **JUB** for contingency (If drilling first, would return with a JUB) - **4** spud cans, **2** positionings (including set-down). **184.6** m^2 area of each spud can. • **JUB** for Neptune Modifications – **4** spud cans, **2** positionings (including set-down). **184.6** m^2 area of each spud can. Following recovery of the drilling rig and JUB(s), the impact of spud can depressions is considered a permanent physical disturbance to account for their potential for long-term persistence. An additional 25 % of each spud can footprint has been added as temporary disturbance to account for sediment suspension during placement / recovery. *Permanent Impact Calculation:* *HLJUV: 6 spud cans x 2 positionings x 258 m^2 (area of each spud can) = 3,096 m^2 (0.003096 km^2).* *Drilling rig: 3 spud cans x 2 positionings x 254.5 m^2 (area of each spud can) = 1,527 m^2 (0.001527 km^2).* *JUB (Contingency): 4 spud cans x 2 positionings x 184.6 m^2 (area of each spud) = 1,476.8 m^2 (0.001477 km^2).* *JUB (Neptune): 4 spud cans x 2 positionings x 184.6 m^2 (area of each spud) = 1,476.8 m^2 (0.001477 km^2).* *Total permanent disturbance for all spud cans: 3,096 + 1,527 + 1,476.8 + 1,476.8 = 7,576.6 m^2 (0.007577 km^2).* *Temporary Impact Calculation:* *HLJUV: 6 spud cans x 2 positionings x 64.5 m^2 (25 % of spud can area for temporary disturbance) = 774 m^2 (0.000774 km^2).* *Drilling rig: 3 spud cans x 2 positionings x 63.625 m^2 (25 % of spud can area for temporary disturbance) = 381.75 m^2 (0.000382 km^2).* *JUB (Contingency): 4 spud cans x 2 positionings x 46.15 m^2 (25 % of spud can area for temporary disturbance) = 369.2 m^2 (0.000369 km^2).*			

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
		JUB (Neptune): 4 spud cans x 2 positionings x 46.15 m^2 (25 % of spud can area for temporary disturbance) = 369.2 m^2 (0.000369 km^2). *Total temporary disturbance for all spud cans: 774 + 381.75 + 369.2 + 369.2 = 1,894.15 m^2 (0.001894 km^2).*				
Area Impacted During Drilling						
5.	Discharged drill cuttings	Assessment assumes: • temporary disturbance is considered to be the area over which there is a predicted combined risk to > 5 % of species at the end of drilling, which is estimated to be 0.0204 km^2 (Section 10.1.2); and • permanent disturbance is the area where this risk remains after four years and eight months post-drilling, which is reduced to zero and therefore there is no permanent disturbance associated with discharged drill cuttings (Section 10.1.2).	N/A	0.0204	N/A	N/A
6.	Cement deposits	Discharged cement at top of each well associated with cementing of the top-hole section. Assessment assumes: • Cement patio forms at the top of both wells. • Radius of each patio is 7.5 m (based on consultant's experience). *Calculation: 2 wells x π (7.5 m radius cement patio)^2 = 353.475 m^2 (0.00035 km^2)*	N/A	N/A	0.00035	N/A
Area Impacted by Subsea Structures						
7.	Drilling Template	Assessment assumes: 1 x drilling template: 23 m (L) x 23 m (W) To assess the temporary area of disturbance, an area of temporary impact extending 2 m on either side of the structure has been allowed for. *Permanent impact calculation: 1 drilling template x 23 m (L) x 23m (W) = 529 m^2 (0.000529 km^2)*	0.0002	N/A	0.0005	N/A

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
		Temporary impact calculation: 1 drilling template x 27 m (extended length) x 27 m (extended width) – permanent impact area (529 m^2) = 200 m^2 (0.0002 km^2)				
Area Impacted by Trenching and Burying Activities						
8.	12" Export Pipeline	A *c.* 16.5 km 12" export pipeline will be installed between Neptune and the Platypus MFP. As a contingency, 1 km has been added to the length of the line for the seabed disturbance calculation (17.5 km). • Corridor width of 20 m along full length of line temporarily impacted during trench and bury activities. *Temporary impact calculation: 17.5 km line (+ 20 m at either end, extended length 17,540 m) x 20 m corridor = 350,800 m^2 (0.3508 km^2).* Note there is no area of permanent impact as ecosystem begins to recover at end of activities.	N/A	0.3508	N/A	N/A
9.	3" Methanol/CI Pipeline	A *c.* 16.5 km 3" methanol pipeline will be installed between Neptune and the Platypus MFP. As a contingency, 1 km has been added to the length of the line for the seabed disturbance calculation (17.5 km). • Corridor width of 20 m along full length of line temporarily impacted during trench and bury activities. • Project is exploring opportunities to lay both lines in the same trench, however as a worst case the ES assumes they are laid in separate trenches. *Temporary impact calculation: 17.5 km line (+ 20 m at either end, extended length 17,540 m) x 20 m corridor = 350,800 m^2 (0.3508 km^2).* Note there is no area of permanent impact as ecosystem begins to recover at end of activities.	N/A	0.3508	N/A	N/A
Area Impacted by Associated Protection and Stabilisation Materials						
10.	Mattresses[2] 6 m (L) x 3 m (W)	50 x mattresses within Platypus 500 m zone. 50 x mattresses within Neptune 500 m zone. As detailed in Table 4-8, it is anticipated up to 100 mattresses will be required (measuring 6 m (L) x 3 m (W)).	0.0052	N/A	0.0018	N/A

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
		As a worst case it is assumed that an additional area of 2 m on each side of each mattress will be temporarily impacted during installation. *Permanent impact calculation: 100 mattresses x 6 m (L) x 3 m (W) = 1,800 m^2 (0.0018 km^2)* *Temporary impact calculation: 100 mattresses x 10 m (extended length) x 7 m (extended width) – permanent impact area (1,800 m^2) = 5,200 m^2 (0.0052 km^2)*				
11.	25 kg Grout Bags[1]	No. of 25 kg grout bags within Platypus 500 m zone: 1,250 No. of 25 kg grout bags within Neptune 500 m zone: 1,250 (Total no. of grout bags: 1,250 + 1,250 = 2,500) 62.5 te of grout bags (2,500 x 25 kg) to be used. Assessment assumes 1 te of grout bags permanently impacts on 1 m^2 of seabed and temporarily impacts on an additional 1 m^2 during installation. *Permanent impact calculation: 62.5 te of grout bags x 1 m^2 = 62.5 m^2 (0.00006 km^2)* *Temporary impact calculation: 62.5 te of grout bags x 1 m^2 = 62.5 m^2 (0.00006 km^2)*	0.00006	N/A	0.00006	N/A
12.	RFUs	Platypus 500 m zone – 50 Neptune 500 m zone – 50 Assessment assumes: 100 x 8 te RFUs with a diameter of 3,200 m (radius 1,600 m). Area doubled to account for temporary impact (- permanent impact).	0.0008	N/A	0.0008	N/A
13.	DMAs[2]	Platypus 500 m zone – 20 Neptune 500 m zone – 20 DMAs (1.7 m x 1.7 m each) are considered a temporary (direct) disturbance as they will be recovered at completion of the pipeline lay / back filing of the trench. *Direct (physical contact) temporary impact calculation: 40 DMAs x 1.7 m x 1.7 m = 115.6 m^2 (0.0001156 km^2).* As a worst case it is assumed that the DMA footprint is extended by 2 m on each side to account for suspended sediments during installation.	0.001	0.0001	N/A	N/A

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
		Indirect (suspended sediments) temporary impact calculation: 40 x 10,000 kg DMAs with a footprint of 5.7 m (extended length) x 5.7 m (extended width) each – direct temporary impact area (115.6 m^2) = 1,184 m^2 (0.001184 km^2).				
14.	Contingency Rock	<u>Along the pipeline route and at Platypus MFP/Neptune</u> Assessment assumes: A worst-case estimate of 5,000 te of rock may be required (based upon 750 te at each pipeline end and 3,500 te along the line). This equates to an area of roughly 300 m^2 of rock cover on the seabed (5 m^2 rock berm width, by 60 m length of line). *Permanent impact calculation: 60 m length of line x 5 m rock berm width = 300 m^2 (0.0003 km^2).* To assess the temporary area of sediment resuspension, the rock berm width has been extended by 1 m on either side (7 m total extended width. *Temporary impact calculation: 60 m length of line x 7 m extended berm width – permanent area of impact = 120 m^2 (0.00012 km^2).* <u>Stabilisation materials to support the HLJUV, JUB and drilling rig</u> Assessment assumes: 1000 te of rock per spud can + 100% for contingency. Each 1,000 te of rock has a seabed footprint of *c.* 300 m^2. • **HLJUV** for MFP Installation (8 legs) - 8,000 te + 100% contingency = **16,000 te** • **Drilling rig** (3 legs) - 3,000 te + 100% contingency = **6,000 te.** • **JUB** for contingency (If drilling first, would return with a JUB) - 3,000 te + 100% contingency = **6,000 te.** • **JUB** for Neptune Modifications – 3,000 te + 100% contingency = **6,000 te.** *Permanent impact calculation:(16,000 + 6,000 + 6,000 + 6,000 te of rock) / 1,000) x 300 m^2 = 10,200 m^2 (0.0102 km^2).*	0.00012	N/A	0.0105	N/A

Item number	Infrastructure	Assumptions / Comments	Area of seabed temporarily impacted (km^2)		Area of seabed permanently impacted (km^2)	
			Indirect (suspended sediments)	Direct (physical contact)	Habitat modification	Physical abrasion
Maximum area of impact			**0.0097**	**0.7907**	**0.0146**	**0.0078**

Notes:
[1] It should be noted this is considered an over-estimate as the mattresses and grout bag quantities include contingency. In addition, grout bags will in many cases impact on the same areas as accounted for by the mattresses.
[2] the DMAs will likely be within the disturbance footprint of the trenches and therefore this is a conservative estimate.

10.5.2 Impacts from Subsea Installation Activities

This Section details the impacts of the proposed subsea installation activities on habitats and associated benthic communities in the vicinity of the proposed Platypus Development Project.

10.5.2.1 Permanent Disturbance

The placement of the anchors associated with holding the HLJUV, drilling rig, and JUB(s) on location will likely cause some scars on the seabed. Anchor scars are considered a permanent physical disturbance feature as defined by JNCC due to the potential for long-term persistence of seabed morphology changes and uncertain recovery timescales. However, unlike infrastructure placement, anchors will be subsequently recovered such that the substrate in the area will not change. Therefore, anchor scars are expected to gradually recover through natural sedimentary processes, albeit over extended periods.

All spud cans will be recovered at the end of the installation / drilling campaign; however, the impact of spud can depressions is considered a permanent physical disturbance to account for their potential for long-term persistence. It is acknowledged that the drilling rig spud cans will likely leave depressions on the seabed. These are expected to backfill over time, with benthic communities recolonising the areas as soon as the items have been recovered.

Installation of infrastructure (including Platypus MFP jacket, drilling template, stabilisation and protection materials) will result in a permanent impact to the seabed as captured in Table 10-1. In addition, cement deposits may form a cement patio on the seabed around each well, which is also considered a permanent impact on the seabed. These cement deposits will be located above the discharged drill cuttings, the impacts of which are described in Section 10.5.3.

The permanent placement of these items on the seabed may cause mortality or displacement of individual benthic animals and direct mortality of sessile seabed organisms. In addition, the stabilisation features (i.e. mattresses, grout bags, RFUs, and contingency rock) can lead to a direct loss of habitat with the addition of 'hard' substrate to a sandy seabed. The Project area is of habitat type 'Offshore circalittoral sand' (Section 5.3.2) and 'subtidal sands and gravels' which was found to occur across the survey area (Fugro, 2026a,b,c).

It is acknowledged that these materials may also create habitats for benthic organisms that live on hard substrates e.g. sponges, soft corals and tubeworms, sea slugs, hermit crabs and brittle stars (Coolen *et al*., 2018). It is possible that, over time, the natural movement of sediments across the seabed will lead to the gradual burial of the hard substrate and infilling of the spaces between the mattresses and rock cover, as has been observed at other developments in the North Sea (such as the Donan field in Block 15/20).

As described in Section 5.3.2.2, a few potentially sensitive species were observed across the survey areas, including members of the Pleuronectiformes (flatfish, particularly sole and plaice), Gadidae (cods, codfishes, or true cods), Ammodytidae (*Ammodytes marinus*, Raitt's sand eel*)* and a single ross worm (*Sabellaria spinulosa*). Under specific conditions ross worms may coalesce in colonies and form biogenic reefs, which are an Annex I habitat, however this habitat was not recorded along the pipeline route, nor in any other survey area (Fugro, 2026a,b,c). No other potential sensitive habitats or species were observed. No *Arctica islandica* individuals were reported within either photographic or macrofaunal data.

Given the project location within the SNS SAC, potential impacts to the conservation objective "The condition of supporting habitats and processes, and the availability of prey is maintained", are discussed in Section 10.5.4. This focusses on potential impact to fish such as herring, sprat, and sandeel as prey for harbour porpoise.

Taking account of the FeAST (Section 5.5.4), sandeel are noted to have a high sensitivity to physical change, physical removal, removal of target species, heavy siltation rate changes, and subsurface abrasion / penetration. The action of installing subsea infrastructure and associated stabilisation and protection features on the seabed results in both permanent physical change (change in habitat type from soft to hard substratum) and abrasion, to which sandeel are particularly vulnerable.

Given the proposed Project location within the SNS SAC and likely presence of prey species for harbour porpoise and their supporting habitat, Receptor Sensitivity is considered **High (c)**. The Magnitude of Effect on benthic fauna and flora of the installation of the Platypus MFP jacket and cement discharged around the wells is considered **Negligible (1)** given the small area of impact. The Magnitude of Effect of installation of stabilisation and protection materials within 500 m safety zones is considered **Minor (2)** such that the added infrastructure and material can be considered to result in a change in habitat at a very localised scale. Given the High Receptor Sensitivity and the Minor Magnitude of Effect for stabilisation and protection features, the Impact Significance of permanent seabed disturbance on habitats and benthic communities is considered **Moderate** overall. The impacts are therefore expected to result in noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause degradation or impair the value of the receptors.

10.5.2.2 Temporary Disturbance

Temporary disturbance can be divided into categories:

- Trenching and burying activities;
- Disturbance resulting from items temporarily coming into contact with the seabed (for example drilling rig anchors and anchor lines); and,
- Disturbance resulting from suspended sediments settling out of the water column.

Each category is covered separately under the following subsections.

TRENCHING AND BURYING ACTIVITIES

As described in Section 10.2.2, it is assumed as a worst-case that the two pipelines will be laid in separate trenches and mechanically buried. The seabed will recover naturally once activities are finished and therefore no permanent impact has been accounted for.

Given the proposed Project location within the SNS SAC and likely presence of prey species for harbour porpoise and their supporting habitat, Receptor Sensitivity is considered **High (c)**. The Magnitude of Effect on benthic flora and fauna from the trenching and burying activities is considered to be **Serious (3)** given the combined length of the lines, such that the Impact Significance is considered **Moderate**.

ITEMS TEMPORARILY COMING INTO CONTACT WITH THE SEABED

As summarised in Table 10-1, the placement of the drilling rig anchors and anchor lines, as well as DMAs, will result in a temporary seabed impact given that the items will be on the seabed for a relatively short period and will be recovered following installation activities. It is acknowledged that although they will be recovered at the end of installation / drilling operations, the drilling rig anchors and spud cans will likely leave depressions on the seabed and hence have been considered as a permanent source of disturbance.

The temporary placement on the seabed of the items identified will impact on both habitats and benthic animals at a localised level. Recovery of the habitats and benthic communities is expected to commence once the items are recovered. Re-colonisation of the impacted areas can take place in a number of ways, including mobile species moving in from the edges of the area (immigration), juvenile recruitment from the plankton and burrowing species digging back to the surface. Recovery times for soft sediment faunal communities are difficult to predict, although some studies have attempted to quantify timescales. Collie *et al*. (2000) examined impacts on benthic communities from bottom towed fishing gear and concluded that, in general, sandy sediment communities were able to recover rapidly from disturbance, although this was dependent upon the spatial scale of the impact. It was estimated that recovery from a small-scale impact, such as a fishing trawl (the impact footprint of which is much greater than anchors) could occur within about 100 days. It was assumed that re-colonisation was through immigration into the disturbed area rather than from settlement or reproduction within the area.

Given the proposed Project location within the SNS SAC and likely presence of prey species for harbour porpoise and their supporting habitat, Receptor Sensitivity is considered **High (c)**. Any changes to the receptors impacted are not considered significant in that as most receptors are expected to be impacted at an individual level rather than a population level and once installation activities are completed, recovery of the ecosystem is expected to commence. The Magnitude of Effect on benthic flora and fauna from the

installation activities is therefore considered to be **Minor (2)**, such that the overall Impact Significance is considered **Moderate**. The impacts are therefore expected to result in noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause degradation or impair the value of the receptor.

SUSPENDED SEDIMENTS SETTLING OUT OF THE WATER COLUMN

In addition to physically disturbing the benthic communities and their habitat in a localised area, trenching and burying activities as well we placement of anchors, subsea infrastructure and associated stabilisation and protection materials on the seabed may also result in the creation of a temporary plume of suspended solids in the water column.

It is possible that disturbed sediment particles may be transported via tidal currents for re-settlement over adjacent seabed areas. This may have indirect negative effects on the benthic ecology in the vicinity, including smothering and scour of seabed communities causing a loss of species diversity, abundance and biomass in affected areas. Sessile epifaunal species may be particularly affected by increases in suspended sediment concentrations as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus (Nicholls *et al*., 2003). Larger, more mobile animals, such as crabs and fish, are expected to be able to avoid any adverse suspended solid concentrations and areas of deposition. Re-suspended sediments could have a negative impact on suspension feeding organisms such as sea pens and bivalves including *A. islandica,* however, neither of these have been identified within the survey area (Fugro, 2026a,b,c).

As noted above, Collie *et al.* (2000) reported recovery of benthic communities within 100 days following fish trawling. Therefore, like the effects described from items being placed on the seabed, similar recovery can be expected following settlement of suspended solids.

Where avoidance by fish is not possible, the sensitivity to suspended sediments varies greatly between species and their life history stages and depends on sediment composition (particle size and angularity), concentration and the duration of exposure (Newcombe and Jensen, 1996). Being the major organ for respiration and osmoregulation, gills are directly exposed to and affected by suspended solids in the water. If sediment particles are caught in or on the gills, gas exchange with the water may be reduced leading to oxygen deprivation (Essink 1999; Clarke and Wilber, 2000). This effect is greatest for juvenile fish as they have small easily clogged gills and higher oxygen demand (FeBEC, 2010).

The ability for organisms including fish species to detect predators may be reduced as a result of low visibility associated with suspended sediments. In instances of persistent and widespread suspended sediments there is the possibility of reduced feeding success among juvenile fish which may influence survival, year-class strength, recruitment and overall condition (Clarke and Wilber, 2000). However, as the proposed activities are relatively short-term, any impacts from low visibility are expected to be temporary and are not considered significant.

Given the proposed Project location within the SNS SAC and likely presence of prey species for harbour porpoise and their supporting habitat, as well as fish species that are considered SPIs (Section 5.3.3), Receptor Sensitivity is considered **High (c)**. However, any changes to the receptors impacted are not considered significant in that most receptors are expected to be impacted at an individual level rather than a population level and once installation activities are completed, recovery of the ecosystem is expected to commence. Therefore, the Magnitude of Effect on benthic communities and fish from suspended sediment settling out of the water column caused by the proposed installation activities is considered to be **Minor (2)** and the Impact Significance is thus considered **Moderate**. The impacts are therefore expected to result in noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause degradation or impair the value of the receptor.

10.5.3 Impacts from Drill Cuttings Discharges

The discharge of drill cuttings from the proposed Platypus wells will impact on the sediments and associated benthic communities within the Project area. As described in Section 10.1.2 and Table 10-1, following drilling, the area over which there is a predicted combined risk to > 5 % of species is estimated to be 0.0204 km^2,

reducing to zero after four years and eight months post-drilling. The main risk stressor as a result of the modelled drilling discharges is deposition thickness.

In the model, the risk reduces over time as a result of bioturbation and re-suspension. However, the model does not account for recolonisation of the sediment over time. Therefore, the area where there is a risk to over 5 % of the species is conservative.

As described above, sea pens and bivalves including *A. islandica* were not identified within the survey area (Fugro, 2026a,b,c).

The recovery of benthic communities from burial and organic enrichment occurs by recruitment of new colonists from planktonic larvae and immigration from adjacent undisturbed sediments. Ecological recovery usually begins shortly after completion of drilling and often is well advanced within a year. Full recovery may be delayed until concentration of biodegradable organic matter decrease through microbial biodegradation to the point where surface layers of sediment are oxygenated (Neff, 2005). Gates and Jones (2012) found evidence of recovery when comparing results from a pre-drill survey and one carried out three years later. The authors noted that the visible extent of the cuttings pile had decreased over time and that megafauna had returned to the area, though at a lower density to that found in the pre-drill surveys.

Studies have shown effects on benthic macrofauna, notably a decrease in diversity and abundance, are most often confined to within a 250 m radius of the cuttings pile, and are seldom detected beyond 500 m, even around the largest piles (Breuer *et al.,* 1999 and Breuer *et al.,* 2004). Contaminants within cuttings piles generally have a low solubility and are mainly bound to particulate matter (OSPAR, 2016). Therefore, most of the contaminants follow the solids to the seabed where they settle. Benthic megafauna may take longer to recover than the smaller infauna and a study undertaken at a deep-water hydrocarbon drilling site in the Faroe-Shetland Channel suggested recovery times may be more than 10 years for megafauna species (Jones *et al.,* 2012).

A study by Bakke *et al.* (1985), describes an experiment which involved trays of natural seabed sediments, devoid of flora and fauna, being covered in a 10 mm layer of WBM slurry. They were placed on the seabed and it was found that re-colonisation started immediately by the appearance of opportunistic species. Other studies into the impacts of WBM discharges have shown that after a few years, more stable communities develop (UKOOA, 1999).

Resuspension and resettlement of disturbed cuttings may also impact demersal species and/or fish eggs. However, it should be noted that monitoring studies have not found levels of trace metals in fish and shellfish collected close to offshore installations to be significantly above natural background concentrations (Bakke *et al.,* 2013). International Association of Oil & Gas Producers (IOGP) report 543 (IOGP, 2016) examines evidence relating to the effect of cuttings discharges on early-stage fish life and concludes that WBM generally has a low toxicity to pelagic invertebrates and early life stages of fish. Studies on early life stages of sea scallops, lobsters and haddock (Cranford *et al.,* 1998) showed a slight reduction in survival of haddock and fed (but not unfed) lobster after 96 hours exposure at 100 mg/l of drilling fluid suspension and no effect on fertilisation, survival or growth of sea scallops.

Given the proposed Project location within the SNS SAC and likely presence of prey species for harbour porpoise and their supporting habitat, Receptor Sensitivity is considered **High (c)**. However, the area over which 5 % of species are at risk reduces to zero after four years and eight months post-drilling and given the proposed mitigation measures, the Magnitude of Effect on benthic communities from the discharge of drill cuttings is considered **Minor (2)** such that the Impact Significance is considered **Moderate**.

10.5.4 Impacts to Southern North Sea SAC

To assess the potential impacts of Seabed Disturbance resulting from the proposed Project on protected features and conservation objectives of the SNS SAC, the only pressure that may be relevant to Seabed Disturbance is ‘Reduction in prey resource’ (Table 10-2), given that harbour porpoise are highly mobile species living within the water column and are therefore not sensitive to the impacts of seabed disturbance

themselves. The relevant conservation objective is "The condition of supporting habitats and processes, and the **availability of prey** is maintained".

As described in Section 9.5, Harbour porpoises in the SNS SAC primarily prey on small shoaling fish such as herring, sprat, and sandeel (JNCC, 2023). Although these species of fish typically feed on zooplankton found within the water column, they also have a significant presence on the seabed, where they may lay eggs and spawn. Given that herring and sandeel (both considered SPI) are found within the Platypus area and these species of fish are closely associated with seabed habitats, seabed disturbance resulting from proposed Project activities may have an impact on the availability of prey for harbour porpoise.

Section 5.3.3 describes the importance of sandeels and their preferred habitat, with a specific focus on the lesser sandeel given they are the most abundant. Figure 5-12 illustrates a predictive model of distribution of the lesser sandeel within the proposed Project area, demonstrating that they are likely to be present at the Platypus MFP and, in smaller numbers, at Neptune (Langton *et al.*, 2021). This prediction aligns with observations during the 2025 survey (Fugro, 2026a,b,c), where sandeels were observed at the Platypus MFP end but not at Neptune (Section 5.3.2.2).

Herring have a preference toward hard sediments with good oxygenation, usually in shallower areas, as this sediment type provides surfaces for eggs to adhere to and allows for high water flow around eggs. Sediments with high fines content such as muddy sediments are deemed unsuitable for herring spawning as fine particles adhere to the eggs leading to asphyxiation (Frost & Diele, 2022).

Table 10-2: Harbour Porpoise Availability of Prey Sensitivity to Seabed Disturbance (FeAST, AOps; JNCC (2023)).

Pressure Relevant	*SNS SAC Features of Interest*		Project Source	Potential Impact	Relative Risk of Impact	AOps and Relevance to Proposed Project
	Harbour porpoise species	*Harbour porpoise supporting habitats, processes, and availability of prey*				
Reduction in prey resource	N/A	R	Seabed disturbance causing disturbance / displacement of fish as prey for harbour porpoise.	Reduction in food availability, increased competition, displacement from natural range.	Medium	Permanent and/or temporary placement of items on the seabed and changes in habitat type due to addition of hard substrates may cause mortality / displacement / loss of habitat for individual benthic animals and fish closely associated with the seabed.
Key: R – Relevant N/A - Not Applicable						

10.6 Cumulative and Transboundary Effects

The impacts resulting from the seabed disturbance associated with the proposed Platypus Development Project have the potential to act cumulatively with both existing and new developments, as well as other activities ongoing within the area.

The proposed Project will be located in proximity of well-developed brownfield oil and gas production areas, with many installations, pipelines and umbilicals within the vicinity. Installations within 40 km of the proposed Platypus MFP are detailed in Table 5-11 and presented in Figure 5-21.

Having given consideration to the existing / planned infrastructure and ongoing activities within the area, it can be concluded that the seabed disturbance resulting from the proposed Platypus Development Project is not expected to contribute to any significant cumulative effects.

The footprint of permanent disturbance is relatively small, as summarised in Table 10-1.

Accounting for the future decommissioning of Platypus field and its associated infrastructure, the long-term permanent impact on the seabed is constrained to the field lifetime and the subsequent recolonisation.

It is worth noting that an ICES report on the structure and dynamics of the North Sea benthos (Rees *et al.,* 2007) concluded that the ecological effects of anthropogenic influences arising from oil and gas installations and aggregate extraction were not identifiable on a large ICES block scale. They found no evidence of impacts associated with clusters of installations, rather that variations identified were associated predominantly with natural forces.

The footprint of all subsea infrastructure will be within UK waters and the drill cuttings piles will not extend outside UK waters, therefore there will be no transboundary effects expected.

10.7 Mitigation Measures

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

Proposed Mitigation Measures
• Vessels using dynamic positioning (DP) will be prioritised where possible, given that DP thrusters are not expected to impact the seabed at water depths present in the project location. • Pre-rig site survey / deep geotechnical surveys aimed to maximise the safe installation of drilling rig / jack-up vessels and minimise potential for re-positioning. • Visual monitoring of cement operations. • ROV to minimise cement patio. • Consideration being given to piled conductors. • Platypus MFP jacket to be lifted from deck and lowered straight to final location. • Pipeline route surveys to ensure proposed route is appropriate. • Trench and bury prioritised over rock cover. • Pipelines will be laid within the same trench if technically possible. • Within the Platypus and Neptune 500 m zones; mattresses, RFUs and grout bags preferred over rock cover. Potential for addition of rock (as a contingency) where target trench depth cannot be reached. Quantity of mattresses and grout bags will be optimised.

Applying the impact assessment methodology described in Chapter 6 and taking account of the mitigation measures listed above, the environmental Impact Significance of the seabed disturbance resulting from the proposed activities overall is considered **Moderate**. The impacts are therefore expected to result in noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause degradation or impair the value of the receptor.

Perenco will take into consideration the environmental impact when selecting the drilling rig and subsea installation methods, to ensure that environmental impacts are reduced to as low as reasonably practicable.

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

11 Underwater Noise

This chapter assesses the impact of underwater noise associated with the proposed Platypus Development, using the risk assessment methodology outlined in Chapter 6.

11.1 Introduction

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

It is generally accepted that exposure to anthropogenic noise can induce a range of adverse effects on marine life (OSPAR, 2009). The type and extent of potential impact to an animal from noise depends on many factors including the level and frequency characteristics of the noise, hearing sensitivity and behaviour of the species, propagation characteristics of the operational area (e.g. sediment type, bathymetry), and whether marine species are using the spatial extent of the noise field. Potential impacts can vary from insignificant impacts, such as temporary avoidance or small changes in behaviour, to significant impacts such as auditory and physical injury (Southall *et al*., 2007; Southall *et al*., 2019; National Marine Fisheries Service (NMFS), 2024; Richardson *et al*., 1995).

The Conservation of Offshore Marine Habitats and Species Regulations 2017 make it an offence to injure or disturb EPS (including all marine mammals), where disturbance has a likelihood of impairing their ability to survive, to breed or reproduce, to rear or nurture their young, or to migrate. New projects must assess if their activity, either alone or in combination with other activities, is likely to cause an offence involving an EPS.

11.2 Noise Sources Associated with the Platypus Development

Activities associated with the proposed Platypus Development, resulting in the generation of underwater noise, include:

- Drilling activities;
- Vessel operations, including the use of dynamic positioning;
- Trenching operations; and
- Piling for the installation of the MFP jacket and conductor piping.

These underwater noise sources are discussed in more detail in the next section.

Marine mammals are receptors to underwater noise and are considered EPS. The proposed activities will also take place in the SNS SAC (designated for harbour porpoise). Therefore, marine mammal receptor sensitivity is considered **High (c)** due to a number of species being designated (e.g. as Annex II species; see Section 5.5.2). Some of the fish species around the Platypus Development are classified as FOCIs (e.g. sandeel, herring, cod, whiting, plaice, mackerel, sole, and spur dog) such that their sensitivity as a receptor would be considered **Medium (b)**.

11.3 Impacts of Noise Sources

11.3.1 Drilling Activities

Rotating equipment such as generators and pumps all result in underwater noise during drilling operations. In general, noise from drilling operations has been found to be predominantly low frequency (<1,000 Hz) with relatively low source levels (Greene, 1987; Nedwell and Edwards, 2004; McCauley, 1998, Todd *et al.*, 2020). Furthermore, a study by Greene (1987) noted that the noise generated by drilling activities from a drilling rig did not exceed local ambient levels beyond 1 km. Noise associated with the drilling activities is

therefore considered to be of a relatively low level. Sensitivity of marine mammals and fish in the area is considered **High (c)** as a worst case, whilst the magnitude of effect of drilling noise is considered **Negligible (1)**. The impact significance of underwater noise from drilling activities is therefore assessed as **Low** such that the impact of noise from drilling activities is considered negligible.

11.3.2 Vessel Operations

Within the UKCS, vessel traffic is a substantial contributor to general anthropogenic underwater noise with the primary sources of noise coming from the propellers, propulsion and other machinery (Ross, 1976; Wales and Heitmeyer, 2002). Table 4-13 summarises the total vessel requirements for each phase of the Platypus Development.

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

Anthropogenic noise has the potential to interfere with acoustic communication, predator avoidance, prey detection, reproduction and navigation in fish. The effects of “excessive” noise on fish include avoidance reactions and changes in shoaling behaviour (Slabbekoorn *et al*., 2010). Prolonged avoidance of an area may interfere with feeding or reproduction or cause stress-induced reduction in growth and reproductive output. Fish exhibit avoidance reactions to vessels and it is likely that radiated underwater noise is the cause. For example, noise from research vessels has the potential to bias fish abundance surveys by causing fish to move away. Reactions include diving, horizontal movement and changes in tilt angle (de Robertis and Handegard, 2013). Popper *et al*. (2014) reviewed the effects of vessel noise on fish, and noted that there is no direct evidence of mortality or potential mortality to fish from vessel noise or other continuous noise sources. The authors concluded that the likelihood of noise from vessels causing mortality or injury to fish was remote, even for fish in close proximity to vessels, however, it is possible noise from vessels may cause some behavioural disturbance to fish.

As receptors to underwater noise, marine mammals and fish receptor sensitivity is considered **High (c)** as a worst-case. As the marine mammals and fish in the area are accustomed to the presence of vessels, such that any impacts from vessel noise are typically behavioural impacts, the magnitude of effect of the increased vessel noise on these receptors is considered **Negligible (1)**. Given the High receptor sensitivity and the Negligible magnitude of effect, the impact significance of the increased vessel noise in the area is assessed as **Low** such that the impact of noise from vessels is considered **Negligible**.

11.3.3 Trenching Operations

Trenching will be required for the installation of the pipeline and umbilical. While jet trenching is the preferred installation method, a mechanical plough and backfill has been assessed as a worst-case. There is limited research on the impact of trenching on marine mammals. However, like dredging, the noise emitted from trenching is thought to be broadband, with most energy below 1 kHz (Culloch *et al*., 2016). Noise levels during trenching are likely to be dominated by the trenching vessel itself, and therefore the magnitude of effect is considered consistent with vessel noise as noted above. Given the worst-case **High (c)** receptor sensitivity and the **Negligible (1)** magnitude of effect, the impact significance of the trenching noise associated with the Platypus Development is assessed as Low such that the impact of noise from trenching is considered negligible.

11.3.4 Piling Activities

Piling requires a hydraulic hammer to forcibly drive tubular steel piles into the seabed, resulting in substantial levels of impulsive underwater noise being generated. The level of this noise depends on numerous factors such as the size and operating energy level of the hammer, the diameter and length of the piles, the sub-surface depth of pile, number of hammer strikes, and physical factors that influence noise propagation (such as bathymetry, type of seabed substrate, water temperature and salinity). As described in Sections 4.5 and 4.8, the MFP jacket and conductor piping will be piled.

Piling for the installation of the MFP is considered to be the loudest source of noise associated with the Platypus Development and therefore assumed to be the activity which results in the largest extent of potential injury or behavioural disturbance to marine mammals and fish. It is proposed that four piles will be installed and each pile would have a penetration depth of *c*. 62 m and measure 1.2 m in diameter. It has been estimated that it will take 75 minutes to install a single pile, with a maximum of four piles to be installed per day. The piling activities would begin with a soft start, with the energy of 78 kJ for 20 minutes. The maximum, worst case energy requirement for a single pile would be 780 kJ, which has been considered in the underwater noise modelling undertaken to estimate the potential impacts of these activities (Appendix D).

Installation of a single conductor may require up to two days to complete, with piling activities occurring for a maximum of 20 hours within any 24-hour period. Any extended interruption to piling operations significantly increases the risk of not achieving the target depth, therefore, considering this and the length of time estimated to pile one conductor, it is likely that piling at night will be required.

11.3.4.1 Impact to Marine Mammals

Section 5.3.6 describes the abundance, distribution and seasonal occurrence of marine mammals known to occur in the vicinity of the Platypus Development. Marine mammals have been grouped by the NMFS according to the hearing range for the species (Table 11-1; NMFS, 2024). In many species, sensitivity to underwater noise is related to their use of high frequency noise for echolocation.

Table 11-1: Marine mammals known to occur in the Platypus Development area and their hearing groups.

Functional hearing group (NMFS 2024)	Generalised hearing range	Species known to occur in the area[1]
Low-Frequency (LF) cetacean	7 Hz to 36 kHz	**Minke whale**
High-Frequency (HF) cetacean	150 Hz to 160 kHz	**Bottlenose dolphin**, **Common dolphin**, Killer whale, Risso's dolphin, **White-beaked dolphin**, **White-sided dolphin**
Very High-Frequency (VHF) cetacean	200 Hz to 160 kHz	**Harbour porpoise**
Phocid pinnipeds	40 to 90 kHz	**Grey seal**, Harbour seal

[1] Species listed are the most sighted marine mammal species in the North Sea (Gilles *et al*., 2023; Reid *et al*., 2003; Carter *et al*., 2022). Species highlighted in **bold** are those that are more likely to be present in the region of the Platypus Development.

Offshore piling has been recognised as an activity that could, under certain conditions, cause disturbance and/or injury to marine mammals (JNCC, 2010). The potential impact of underwater noise on the marine mammal receptors has been assessed using the recommended JNCC guidance (JNCC, 2010).

Auditory Injury

The predicted noise levels from piling have been compared with the NMFS (NMFS, 2024) thresholds for auditory injury to marine mammals. These thresholds are based on a comprehensive review of evidence for impacts of underwater noise on marine mammals and are now widely applied as appropriate precautionary criteria for assessing the impact of underwater noise on marine mammals.

As discussed in detail in Appendix D, predicted noise levels from the proposed piling of the MFP have been compared to the NMFS (2024) zero-to-peak sound pressure level (SPL) and cumulative sound exposure level (SEL) thresholds for auditory injury onset.

The predicted maximum distances where the zero-to-peak SPL thresholds for auditory injury onset are exceeded during the MFP piling are summarised in Table 11-2. It is predicted that the zero-to-peak SPL generated throughout the piling will not exceed the auditory injury thresholds for any marine mammal hearing group outside the standard 500 m mitigation zone that will be employed during the piling operations (JNCC, 2010).

Marine mammals have been modelled (see Appendix D) as swimming away from the piling location at the onset of piling, which has been observed during piling activities (Brandt *et al*., 2011, 2016, 2018; Carstensen *et al*., 2006; Dahne *et al*., 2013). The received cumulative SEL has been calculated for marine mammals swimming away from the piling location at different swim speeds. Results are presented showing the furthest distance that marine mammals must be from the piling location at the start of the piling in order to not be exposed to cumulative SEL exceeding the auditory injury threshold when they swim away.

The predicted initial distances that marine mammals must be from the piling location at the start of piling in order to not be exposed to cumulative SELs exceeding the auditory injury thresholds after they swim away are shown in

Table 11-3. The modelling predicts that auditory injury threshold ranges will not exceed the 500 m mitigation zone for HF cetaceans, VHF cetaceans and phocid pinnipeds, assuming that the mammals swim away from the piling location at a minimum speed of 1.5 m/s.

The modelling predicts that the auditory injury threshold for LF cetaceans (e.g., minke whales) may be exceeded at distances of up to 1.3 km at a swim speed of 1.5 m/s. A swim speed of 1.5 m/s is relatively conservative since marine mammals exposed to high noise levels would likely swim sway at faster speeds (Kastelein *et al*., 2018). LF cetaceans have been shown to have swim speeds of around 2.3 m/s, and faster flee speeds of 4.1 m/s (Boisseau *et al*., 2021). At a swim speed of 2.0 m/s, the cumulative SEL auditory injury threshold for LF cetaceans will not be exceeded outside the 500 m mitigation zone. A 500 m mitigation zone and associated mitigation measures e.g., Marine Mammal Observers, PAM and Marine Mammal Mitigation Protocol (MMMP) is expected to be sufficient to mitigate against auditory injury to marine mammals.

Table 11-2: Predicted distances from the piling location where the zero-to-peak SPL thresholds for auditory injury onset to marine mammals was exceeded.

Marine Mammal Hearing Group	Zero-to-peak SPL Auditory Injury Threshold (dB re 1 µPa)	Maximum Distance to Threshold Exceedance (m) [1]
LF cetacean	222	10
HF cetacean	230	10
VHF cetacean	202	80
Phocid pinnipeds	223	10

[1] Predicted distances have been rounded up to the nearest 10 m.

Table 11-3: Predicted distances that marine mammals must be from the piling location (at the start of piling) in order to not be exposed to cumulative SEL exceeding the auditory injury threshold when they swim away at different speeds.

Marine Mammal Hearing Group	Cumulative SEL Threshold for Auditory Injury (dB re 1 µPa^{2}s)	Swim Speed (m/s)	Maximum Distance to Threshold Exceedance (m) [1]
LF cetacean	183	2.0[2]	120
HF cetacean	185	1.5	0
VHF cetacean	155	1.5	10
Phocid pinnipeds	185	1.5	0

[1] Predicted distances have been rounded up to the nearest 10 m.
[2] A swim speed of 2.0 m/s has been presented for LF cetaceans. LF cetaceans have been shown to have swim speeds of around 2.3 m/s and faster flee speeds of 4.1 m/s.

Disturbance

Table 11-4 presents the results of the modelling for predicting the distance associated with marine mammal behavioural disturbance due to piling at the Platypus Development MFP location. Any piling induced disturbance experienced is considered to be temporary.

Table 11-4: Predicted distance and areas where the adopted marine mammal behavioural disturbance thresholds are exceeded.

Marine Mammal Hearing Group	SEL Behavioural Disturbance Threshold (dB re 1 µPa²s)	Maximum Distance to Threshold Exceedance (km) [1]	Area of Threshold Exceedance (km²) [2]
NMFS 'Level B Harassment' criteria for behavioural disturbance to all marine mammals	150[3]	9	230
Tougaard (2016) criteria for behavioural disturbance to all marine mammals	145	17	772
JNCC (2025) EDR for pin piling without noise abatement	N/A	20	1,257

[1] Predicted distances have been rounded to the nearest 1 km.
[2] Predicted areas have been rounded up to the nearest 1 km².
[3] The NMFS 'Level B Harassment' rms SPL threshold of 160 dB re 1 µPa has been converted to an SEL threshold of 150 dB re 1 µPa²s assuming a conservative integration time of 100 ms.

With the application of JNCC guidance, any impacts of the proposed piling activities on marine mammals are considered to be short term behavioural impacts, rather than resulting in injury, such that the magnitude of effect is considered **Minor (2)**. Given the **High (c)** receptor sensitivity and the **Minor (2)** magnitude of effect, the impact significance of piling noise on marine mammals is assessed as **Moderate**.

11.3.4.2 Impact to Fish

The fish species associated with the Platypus Development area are identified in Section 5.3.3. Fish species differ in their hearing capabilities depending on the presence of a swim bladder, which acts as a pressure receiver (McCauley, 1994). Most fish can hear within the range of 100 Hz to 1 kHz, with some able to detect lower frequencies. Within this range, the hearing threshold varies from approximately 50 dB re 1 µPa for hearing specialists to 110 dB re 1 µPa for non-specialists. Fish with a connection between the swim bladder and otolith system have more sensitive hearing and may detect frequencies up to 3 kHz (Popper *et al*., 2003). Many species of fish produce noises for communication that are typically emitted at frequencies below 1 kHz (Montgomery *et al*., 2006).

Auditory Injury

Potential impacts to fish species were assessed by comparing the underwater noise modelling results presented in Appendix D to the Popper *et al*. (2014) fish injury thresholds. The results summarised in Table 11-5 predicts that any injury to fish species, and fish eggs and larvae due to the zero-to-peak SPL will be limited to distances up to a maximum of 40 m from the location of piling activities.

In the cumulative SEL modelling, it is assumed that mobile fish will swim away from the piling location at a speed of 0.5 m/s, whilst fish eggs and larvae are assumed to remain stationary. The predicted minimum initial distances that fish must be from the pile noise source (at the start of pile driving operations), to not be exposed to cumulative SELs above the fish injury thresholds, are summarised in Table 11-6. The modelling predicts that the cumulative SEL injury thresholds will not be exceeded if fish swim away from the piling location at a speed of 0.5 m/s.

It is predicted that fish eggs and larvae that cannot move away from the piling may potentially be injured at distances of up to 240 m from the piling location. However, given the relatively small impact area compared

to the large spawning grounds in the North Sea, it is not expected that the piling operations associated with the Platypus Development will have a significant adverse effect.

Table 11-5: Predicted distances from the piling location where the zero-to-peak SPL thresholds for injury to fish, and fish eggs and larvae are exceeded.

Fish Group	Zero-to-peak SPL Injury Threshold (dB re 1 µPa)	Maximum Distance to Threshold Exceedance (m) [1]
Fishes with no swim bladder	213	20
Fishes with swim bladder involved in hearing	207	40
Fishes with swim bladder not involved in hearing	207	40
Eggs and larvae	207	40
[1] Predicted distances have been rounded up to the nearest 10 m.		

Table 11-6: Predicted distances that fish species and fish eggs and larvae must be from the piling location at the start of piling in order to not be exposed to cumulative SEL exceeding injury thresholds.

Fish Group	Cumulative SEL Threshold for Injury (dB re 1 µPa^{2}s)	Swim Speed (m/s)	Maximum Distance to Threshold Exceedance (m) [1]
Fishes with no swim bladder	219	0.5	0
Fishes with swim bladder involved in hearing	207	0.5	0
Fishes with swim bladder not involved in hearing	210	0.5	0
Eggs and larvae	210	Stationary	240
[1] Predicted distances have been rounded up to the nearest 10 m.			

Disturbance

Behavioural disturbance to fish cannot be quantitively predicted from the propagation modelling since there are no well-established disturbance thresholds for fish. The qualitative criteria established by Popper *et al.* (2014) suggest that any disturbance to fish species will likely be localised, with higher levels of disturbance only occurring in regions near to the source (e.g., within a few hundred metres). At further distances from the source (e.g., beyond one kilometre), the risk of behavioural disturbance to fish is likely to be low. Fish are mobile and would be expected to move away from a sound source that had the potential to cause them harm. If fish are disturbed by sound, evidence suggests they will return to an area once the activity generating the sound has ceased (Slabbekoorn *et al.*, 2010).

Any injury or disturbance to fish is expected to be of a short duration such that the magnitude of effect of piling noise in fish is considered **Negligible (1)**. Given the **Medium (b)** receptor sensitivity and the Negligible magnitude of effect, the impact significance of piling noise on fish is assessed as **Low** such that any environmental impacts from piling are considered **Negligible**.

11.4 Cumulative and Transboundary Effects

The additional vessels and trenching vessel associated with the Platypus Development will cause a modest increase in underwater noise in the area. However, any cumulative impacts of underwater noise due to vessels are not considered significant given the existing shipping levels. Cumulative impacts of underwater noise due to drilling are also not considered significant given the low source levels. Piling activities associated with the installation of the MFP will cause a moderate increase in underwater noise but will be relatively

short term in nature. Any cumulative impacts of underwater noise due to piling will not be significant as a result of the short duration.

The modelled piling location for the proposed Platypus Development is located *c.* 121 km from the UK/Netherlands median line and therefore no transboundary impacts associated with the underwater noise from the piling activities are expected.

11.5 Mitigation Measures

The following industry standard mitigation measures will be undertaken to minimise the impacts from the underwater noise sources associated with the Platypus Development.

Proposed Mitigation Measures
• A qualified, trained, and equipped Marine Mammal Observer will be present during piling. The Marine Mammal Observer will carry out a 1-hour pre-piling survey of a 500 m mitigation zone and, if an animal is detected, the piling will be delayed until no marine mammals have been detected in the mitigation zone for at least 20 minutes. • A soft-start/ramp-up of hammer energy will be employed where the hammer will commence at a low energy at the start of piling. The soft start will be such that maximum hammer energy will not be reached until after a period of 20 minutes; and • PAM will be employed during periods of low visibility to detect marine mammal presence.

The following mitigation measures will be undertaken to minimise the impact of underwater noise sources in the SNS SAC.

SNS SAC Mitigation Measures

• To ensure the 20% daily impact threshold is not exceeded on a given day, Perenco will liaise with the SNS SAC Development Co-ordination Forum. The group will facilitate the coordination of activities in the SNS SAC;
• Prior to operations, Perenco will liaise with operators of other activities to:
  ○ Agree activity combinations that do not exceed the SAC sound budget;
  ○ Identify operational mitigations;
  ○ If it is not possible to avoid schedule overlap, then agree time sharing principles in writing to ensure that the SNS SAC sound budget is not exceeded; and
  ○ Maintain communication in-field to ensure adherence to mitigation and time share plans.
• On days where the daily impact threshold is likely to be exceeded, Perenco will discuss mitigation and potential adaptations to the piling schedule with the Developer Communication Forum to ensure the threshold is not exceeded.

Applying the impact assessment methodology described in Chapter 6 and taking account of the mitigation measures listed above, the Impact Significance of the various underwater noise sources associated with the proposed Platypus Development is considered **Low**. The impacts are therefore considered acceptable when managed within the controls and mitigation measures identified. The proposed Platypus Development will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix A.

12 Waste

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

Perenco is committed to reducing waste generation and to managing all generated waste, by applying approved and practical methods and by adhering to a waste hierarchy (Figure 12-1). Waste will only be disposed of if it cannot be prevented/reduced, reclaimed, recovered and re-used, or recycled. All wastes will be managed in accordance with Perenco's Waste Management Procedure, within which each asset has a Waste Management Plan (WMP), and via the existing contract with licensed waste contractors. The procedure establishes the controls required to manage the hazards associated with the transportation and disposal of waste from offshore sites and the processes, and verification activities necessary to ensure legal obligations are satisfied.

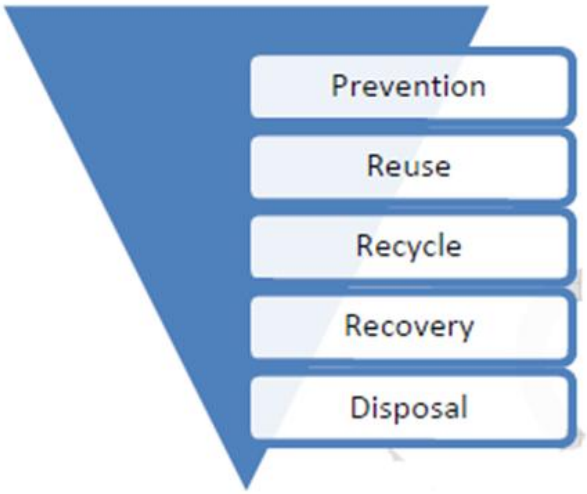


Figure 12-1: Perenco's Waste Management Hierarchy

Duty of Care (under the Environment Protection Act 1990) makes it the waste producer's responsibility to ensure that waste is only transferred to an appropriately licensed carrier who should have a Waste Carrier Registration. Transfer of Controlled Waste requires a Transfer Note to be completed (or Consignment Note in the case of Special Waste). The Transfer Note details the type and quantity of waste, from whom and to whom the waste has been transferred, the category of authorised person to whom the waste has been consigned, relevant licence numbers, time, place and date of transfer.

12.1 Vessel Waste

Waste will be generated from a number of vessels associated with the proposed activities (Table 4-12 provides a list of vessels). Waste from these vessels will be managed in line with the individual vessel WMPs in accordance with MARPOL requirements, which regulate discharges of waste to sea from ships.

12.2 Drilling Waste

Drilling rigs generate various waste products during routine operations including contaminated cuttings, waste oil, chemical and oil contaminated water and scrap metal. Wastes will be minimised by use of appropriate procurement controls, and all wastes will be properly segregated for recycling / disposal / treatment, as per the drilling rig's WMP.

The WBM contaminated drill cuttings will be discharged to sea whilst the LTOBM contaminated cuttings will be skipped and shipped to shore for treatment and management in line with the waste hierarchy.

12.3 Installation and Commissioning Phase

Installation activities will routinely generate a number of wastes including scrap metal, wooden crates, plastic wrapping etc. All wastes will be properly segregated for recycling/disposal/treatment in accordance with Perenco's Waste Management Procedure and Controlled Waste Transfer Notes will be completed.

The quantity of offshore waste will be minimised as a large percentage of construction operations will be completed onshore. As described in Section 4.4, the refurbishment and upgrade of the Platypus MFP will be carried out onshore, involving the re-use of a decommissioned offshore asset. The decision to re-use a decommissioned offshore asset reduces the overall steel requirements of the proposed Project and in doing so, reduces the production of waste associated with steel production and fabrication.

12.4 Production Phase

12.4.1 General Waste

The platform is a MFP and will be unmanned, quantities of waste produced will be minimal and managed in line with WMP and waste hierarchy. Any waste produced during routine annual maintenance vessel visits (visits are expected to total approximately eight weeks per year) will be managed in line with the individual vessel WMP in accordance with MARPOL requirements, which regulate discharges of waste to sea from ships.

During the production phase, there is not expected to be any additional waste at Neptune as a result of Platypus production.

At Cleeton the only additional waste because of the Platypus Development will be from the need for more filter changes for the produced water system. The produced water will be re-injected and thus does not form a waste stream.

Neptune and Cleeton general waste streams are segregated by personnel at the source of generation and manually handled to the appropriate labelled waste receptacle until transferred onshore for disposal. All waste is segregated in accordance with Perenco's Waste Management Procedure. Controlled waste transfer notes will continue to be completed as required and records on monthly waste disposal activities will be maintained. Waste Management Duty of Care audits will continue to be carried out.

12.4.2 Perenco Waste Management Special Waste

Cleeton and Neptune have radioactive waste permits for Naturally Occurring Radioactive Material (NORM) accumulation and disposal. The types of hazardous wastes handled will not change as a result of the proposed Platypus Development.

12.5 Decommissioning Phase

The waste generated as a part of the future CoP decommissioning activities will be a combination of both hazardous (special) and non-hazardous wastes. As operator, Perenco will have in place a WMP to identify, quantify (where possible) and discuss available disposal options for waste resulting from the decommissioning activities. Where possible, materials will be recycled or sold and reused taking into account a waste hierarchy similar to that shown in Figure 12-1.

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

12.6 Cumulative and Transboundary Effects

Waste will be managed in line with existing procedures and therefore, significant cumulative or transboundary impacts from drilling, commissioning and operational wastes are not expected.

12.7 Mitigation Measures

The following mitigation measures are proposed to minimise the waste produced from the proposed Platypus Development.

Proposed Mitigation Measures
• Perenco will apply the principles of the Waste Management Hierarchy during all activities i.e. Prevent, Reuse, Recycle; • Compliance with MARPOL requirements; • Perenco will look to vessel owner to minimise all wastes during the project (monthly reporting of waste sent to shore; Waste Management Plan and Waste Record Book; Waste Management Duty of Care audit); • Waste minimisation and supply chain management; • Perenco environmental team will undertake audits throughout the project phases; • All wastes to be properly segregated for recycling / disposal / treatment; • Waste will be dealt with in accordance with regulatory requirements (and Contractors will be audited to ensure above); • End of project reporting of waste sent to shore; • Selection of a proven and competent waste contractor for handling drill cuttings; • Only suitably permitted and licensed disposal yards / landfill sites will be used, in compliance with relevant legislation; • Offshore waste will be minimised by large percentage of construction operations being completed onshore.

Applying the impact assessment methodology presented in Chapter 6, Receptor Sensitivity of landfill sites is considered **Medium (b)** as landfill availability is considered a finite resource. Perenco recognise landfill sites as a finite resource, however, as the majority of waste will be recycled and the vessels and platforms have WMP's in place, with the application of the above control measures, the Magnitude of Effect of waste generated throughout the project is considered to be **Negligible (1)**. Given the Low Receptor Sensitivity and the Negligible Magnitude of Effect, the Impact Significance is considered **Low** such that any environmental impacts associated with waste production are considered to be negligible.

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

13 Accidental Events

This chapter assesses the impact of possible unplanned or accidental events that may arise due to the proposed Platypus Field Development project, using the risk assessment methodology outlined in Chapter 6. Worst case accidental events are considered to have releases of hazardous liquids and/or gases associated with them. This section identifies the sources of worst-case accidental events and assesses the potential impacts associated with them.

13.1 Sources of Accidental Releases

Sources of accidental releases of hazardous liquids and gases are varied and could include very large spill events such as a well blowout and relatively smaller scale releases such as a loss of small volumes of diesel.

This chapter focuses on the environmental impact associated with the two worst-case accidental hydrocarbon releases, for which modelling has been undertaken (Appendix E). The potential impacts resulting from either of these hydrocarbon releases have been evaluated taking account of the sensitivity and the assimilative capacity of the receiving environment, as well as the volume and behaviour of the release. The likelihood of the scenarios considered here is remote.

13.1.1 Small Scale Accidental Releases

Small scale unplanned or accidental releases of hazardous liquids considered of 'Medium or 'Low' risk during the ENVID workshop (Appendix B) include:

- Loss of helifuel during helicopter use;
- Accidental chemical/hydrocarbon spillage (i.e. vessel collision and loss of containment) during vessel use;
- Discharge of hazardous drainage water from the closed drain system during drilling operations;
- Accidental release of LTOBM/WBM during drilling operations;
- Unplanned hydrocarbon flow to the surface during drilling operations;
- Loss of hydraulic fluid during installations;
- Loss of hydrocarbon containment during MFP commissioning and production; and
- Loss of chemical containment during MFP commissioning and production.

13.1.2 Hydrocarbon Release from Pipeline

The likelihood of a large release of hydrocarbons from the pipeline is Remote based on the project design and implementation of standard industry mitigation. In particular, corrosion to the pipeline will be mitigated using corrosion resistant materials, cathodic protection and procedures to identify and mitigate areas at risk of corrosion. Due to the significantly lower volume of hydrocarbons released in a pipeline rupture compared to a well blowout and diesel inventory loss (hence a lower Magnitude of Effect), a pipeline rupture was not modelled.

13.2 Spill Modelling

13.2.1 Overview

Modelling has been undertaken using the Oil Spill Contingency and Response (OSCAR) model to evaluate potential spills from the Platypus Development. The primary aims of the modelling are to understand:

- How the hydrocarbons are likely to disperse over time (both on the sea surface and in the water column);
- The probability of hydrocarbons accumulating on the sea surface, in the water column, reaching the shoreline and accumulating in the sediment; and
- Where hydrocarbon concentrations could exceed thresholds identified to have a significant environmental impact on the sea surface, in the water column, at the coast and in sediments.

OSCAR supports two types of simulations: stochastic (probabilistic) and deterministic. The stochastic approach models a spill scenario multiple times over different weather conditions and aggregates results from all the runs. The stochastic modelling indicates the probability of exceeding the pre-defined assessment thresholds.

Deterministic simulations represent the results of a single spill scenario within a defined timeframe of metocean conditions. A deterministic scenario is selected based on the stochastic modelling and represents the timeframe which gives the worst-case shoreline oiling. The deterministic model results are used to predict oil thickness on the sea surface, oil concentrations in the water column, oil concentrations reaching the shoreline, and concentrations deposited in the sediment in the selected modelled worst-case scenario.

The hydrocarbon spill modelling is described in detail in Appendix E.

13.2.2 Scenarios

Two hydrocarbon release scenarios were modelled:

- Well blowout
- An instantaneous worst-case full diesel inventory loss from the Mobile Offshore Drilling Unit (MODU)

The volume of hydrocarbons released in each scenario is very similar, as such a conservative approach was taken and both scenarios were modelled. Thus, ensuring the worst-case scenario was captured and assessed.

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

Full diesel inventory loss could occur due to vessel collision.

Table 13-1: Key parameters used in the hydrocarbon spill scenarios.

Scenario	Location	Release Duration[1]	Simulation Duration (Days)[2]	Spill Volume (m^3)[3]
Well Blowout	**53° 54' 39.859" N 1° 0' 12.933" E**	**98 days**	**128**	**1,519**
Full Diesel Inventory Loss		**1 hour**	**30**	**1,050**

[1] Release duration has been determined by the time it takes to drill a relief well. 98 days is based on time estimated for similar wells in the area (Perenco, 2025).
[2]The simulation duration includes release duration plus 30 days to allow time for the hydrocarbon to disperse.
[3]Volume released estimation; Blowout - uncontrolled flow rate multiplied by time to drill relief well and diesel inventory - largest capacity of previous rigs contracted by Perenco.

13.2.3 Hydrocarbon Properties

The fate and effect of a spill is dependent on the chemical and physical properties of the hydrocarbons. OSCAR includes a database that contains various oil types. A suitable analogue (Kristin Kondensat) was selected from this database to represent the Platypus condensate for the well blowout. Although the pour point is lower in the Platypus condensate than for the “Kristin Kondensat”, the pour point temperature will not be reached in the North Sea (minimum annual average temperature is around 10°C) and therefore this will not influence the behaviour of the condensate. The Marine Diesel analogue within the OSCAR database was selected for the full diesel inventory loss.

Table 13-2: Hydrocarbon Properties.

Property	Well Blowout		Full Inventory Loss
	Platypus Condensate	OSCAR Analogue (Kristin Kondensat)	Marine Diesel
API (°)	43	45.8	-
Specific gravity	0.81	0.798	0.843
Viscosity (cP)	< 0.7 @ 30°C	4.0 (at 13°C)	3.9
Pour Point (°C)	< -48	-27	-36
Asphaltene content (% weight)	< 0.1	0.6	0.05
Wax content (% weight)	0.0	7.3	0.05

13.2.4 Summary of Modelling Results

A summary of the stochastic and deterministic modelling results for the two modelled scenarios, (well blowout and diesel inventory loss) are presented in Table 13-3.

Table 13-3: Spill modelling results summary.

Variable	Environmental Fraction		Well Blowout	Diesel Inventory Loss
Release volume over whole simulation			1,519.1 m^3	1,050 m^3
% total oil in environmental fraction; (end of deterministic simulation)	Sea surface		0%	0%
	Shoreline		0.01%	0.004%
	Water Column		0.4%	0.008%
	Seabed sediment		27.5%	32.4%
	Evaporated		57.9%	48.8%
	Biodegraded		14.2%	18.8%
Total oil (tonnes) in environmental fraction; (end of deterministic simulation)	Sea surface		0 t	0 t
	Shoreline		0.1 t	0.04 t
	Water Column		5 t	0.08 t
	Seabed sediment		338 t	295.6 t
	Evaporated		711 t	445 t
	Biodegraded		174 t	171.4 t
Extent above thresholds (deterministic simulations)	Fraction	Thresholds		
	Sea surface	0.3 µm	997 km^2	67 km^2
	Shoreline	0.1 kg/m^2 (100 g/m^2)	0 km	0 km
	Water column	10 µg/l (10 ppb)	15.5 km^3	24.4 km^3
	Seabed sediment	5 g/m^2	0 km^2	0 km^2

13.3 Impact Assessment

This section evaluates the impacts of the condensate and diesel releases by considering the predicted modelling results (Appendix E) in relation to the environmental receptors that could be impacted. The classification of environmental significance and magnitude of effect is in line with the methodology described in Chapter 6. Environmental significance and magnitude of effect are combined to give an environmental significance of impact. This is then combined with likelihood to give an environmental risk. All matrices explaining terminology are shown in Chapter 6.

Both scenarios (well blowout and diesel inventory loss) have been assessed and in both cases, it has been assumed that the likelihood of the event occurring is Remote (Table 6-5).

13.3.1 Water Quality

Accidentally released condensate and diesel will be dispersed over a wide area by wind, waves and currents. Low viscosity hydrocarbons disperse naturally through the water column, particularly in the presence of breaking waves, where they are rapidly diluted (International Tanker Owners Pollution Federation Limited (ITOPF), 2014). Oils with an asphaltene content of greater than 0.5% tend to emulsify in moderate to rough seas (ITOPF, 2014), increasing the oil's persistence in the environment. The Platypus Development condensate is unlikely to form emulsions as the asphaltene content is less than 0.5%.

Applying the assessment methodology presented in Chapter 6, the sensitivity of water quality in the area is considered to be Low (a) due to the location in open ocean conditions which by nature rapidly disperse and dilute marine discharges.

Modelling results for both deterministic scenarios suggest that the level of hydrocarbons in the water column may reach or exceed the defined NOEC of 10 µg/l (ppb) over a volume of 15.5 km^3 for the well blowout and 24.4 km^3 for the diesel inventory loss. In the case of the diesel inventory loss, the hydrocarbon is present over a larger volume in much higher concentrations (over 1,000 µg/l (ppb)) (Figure 13-2). For comparison, typical background values of THC in the North Sea range from 0.5-0.7 µg/l in pristine areas, 1 - 30 µg/l near installations, and 2 µg/l in coastal waters (DTI, 2001).

The stochastic modelling shows there is low probability of condensate or diesel in the water column resulting in transboundary impacts on water quality. Therefore, the magnitude of effect would be classed as Serious (3) (no beaching or transboundary impacts).

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	Low	Serious	Moderate	Low
Diesel Inventory Loss	Low	Serious	Moderate	Low

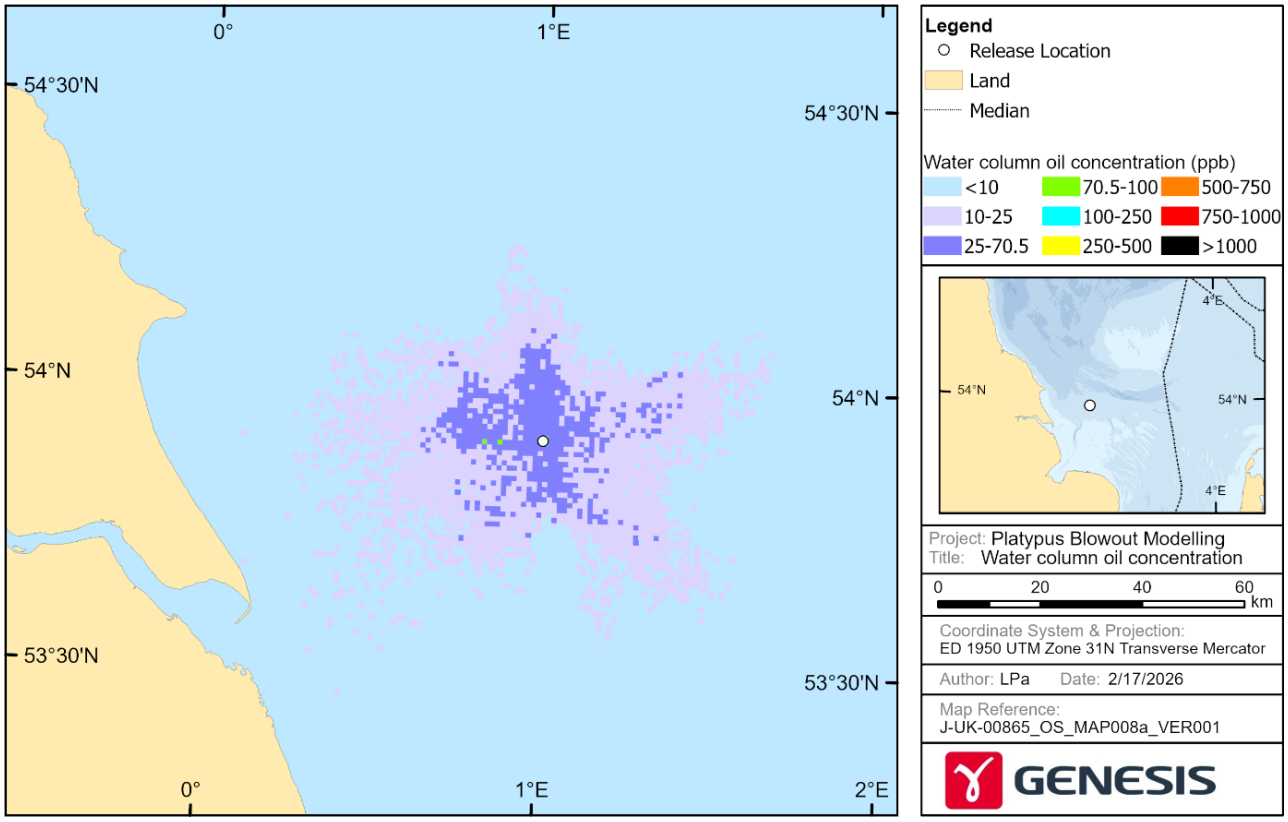


Figure 13-1: Maximum condensate concentration in the water column as a result of a well blowout (deterministic).

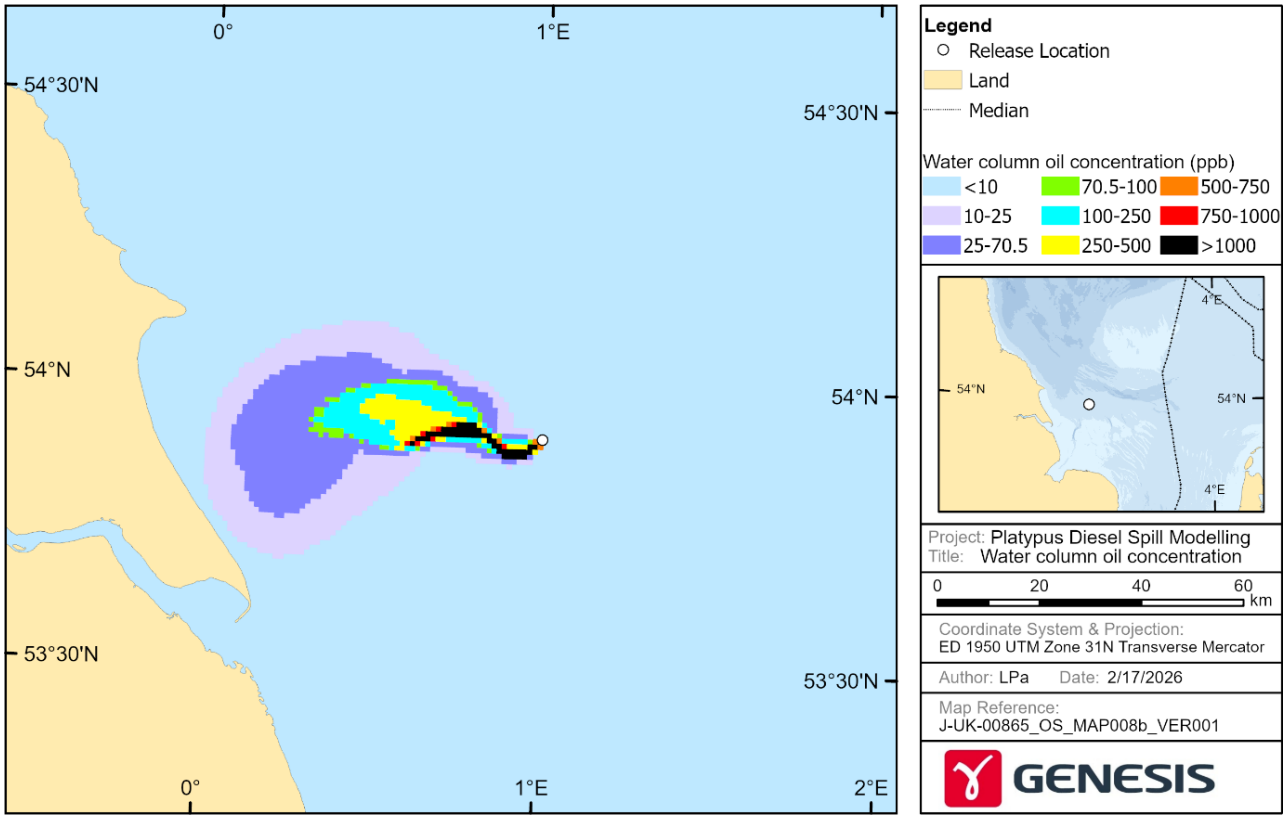


Figure 13-2: Maximum diesel concentration as a result of a full diesel inventory loss (deterministic).

13.3.2 Sediment Quality

Sediments in the Platypus Development area generally comprise of mud, sand and gravel (Section 5.2.5). The sensitivity of sediments in the area is considered to be **High (c)** in that the project area is in the SNS SAC. One of the SNS SAC conservation objectives is that the condition of supporting habitats and processes, and the availability of prey, is maintained to ensure harbour porpoises are maintained in a Favourable Conservation Status. Impacts to the seabed would impact harbour porpoise prey.

Worst-case deterministic modelling predicted that the maximum concentration of hydrocarbons on the seabed would not exceed the 5 g/m^2 threshold during the well blowout or diesel inventory loss scenarios (Figure 13-3 and Figure 13-4). Consequently, the magnitude of effect from these potential releases is considered to be **Negligible (1)** (no breaches of regulatory compliance and no transboundary impacts).

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	Low	Negligible	Low	Low
Diesel Inventory Loss	Low	Negligible	Low	Low

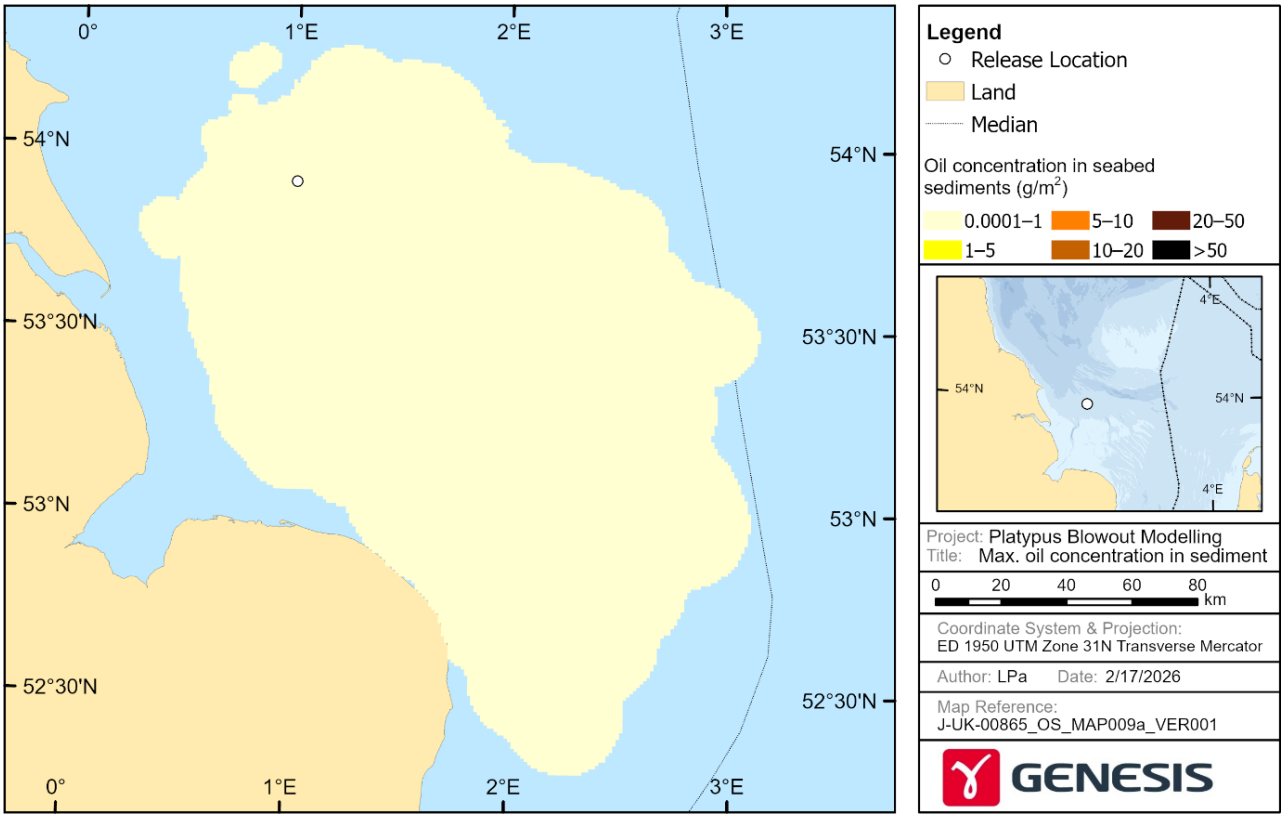


Figure 13-3: Maximum condensate concentration in sediment as a result of a well blowout (deterministic, 128 days).

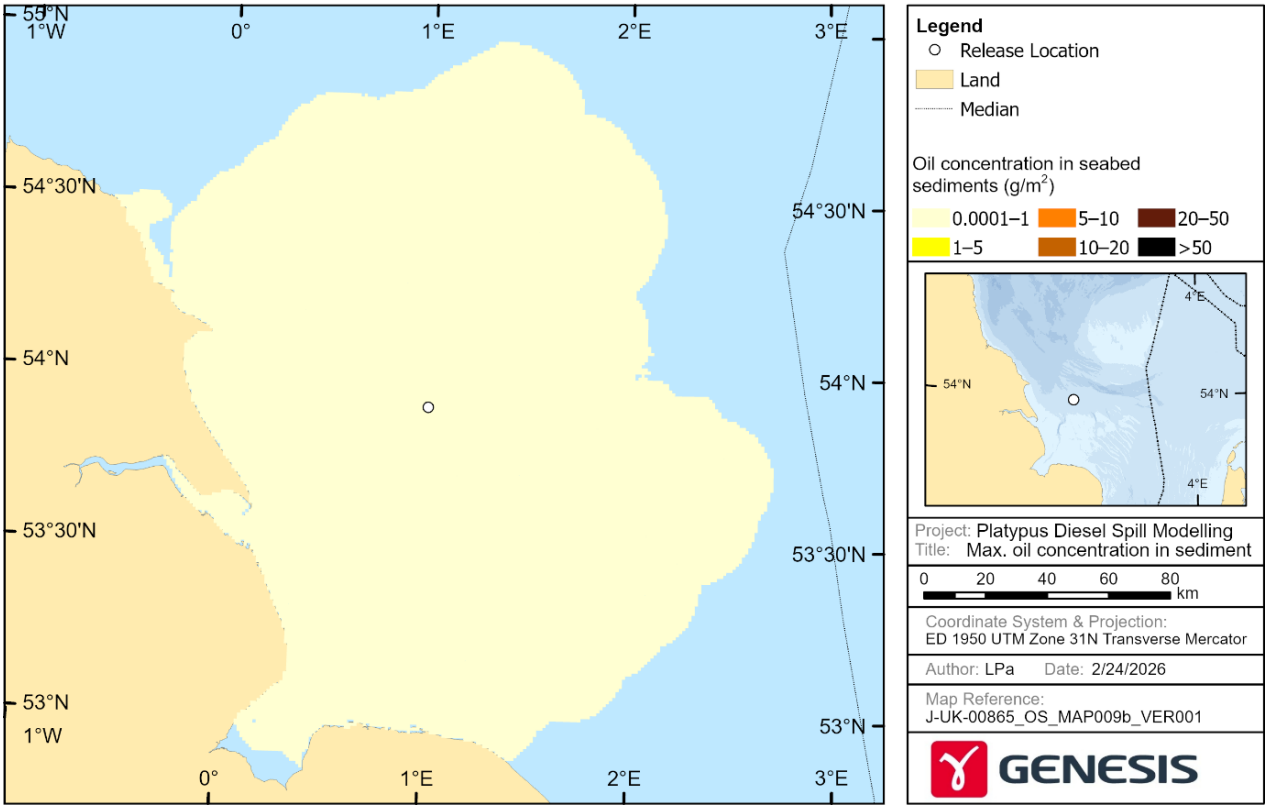


Figure 13-4: Maximum diesel concentration in sediment as a results of a full diesel inventory loss (deterministic, 30 days).

13.3.3 Plankton

The planktonic community is composed of a range of microscopic plants (phytoplankton) and animals (zooplankton) that drift with the oceanic currents. As hydrocarbons can float on the water's surface and disperse within the ocean as it weathers, plankton may be exposed to both floating hydrocarbon slicks and to small, dissolved droplets of hydrocarbon in the water column (Cormack, 1999; Almeda *et al*., 2013).

Changes in the patterns of distribution and abundance of phytoplankton can have a significant impact on entire ecosystems (Ozhan *et al*., 2014). Both oil presence and biodegradation can impact phytoplankton in the immediate vicinity of a spill. Hydrocarbon slicks can inhibit air-sea gas exchange and reduce sunlight penetration into the water, both essential to photosynthesis and phytoplankton growth (González *et al*., 2009). PAHs in the oil also affect phytoplankton growth, with responses ranging from stimulation at low concentrations (1 mg/l) to inhibition at higher concentrations (100 mg/l; Harrison *et al*., 1986).

Zooplankton at the surface are thought to be particularly sensitive to oil spills due to their proximity to high concentrations of dissolved hydrocarbon and to the additional toxicity of photo-degraded hydrocarbon products at this boundary (Bellas *et al*., 2013). Following an oil spill, zooplankton may suffer from loss of food resources in addition to the toxic effects from direct exposure, resulting in mortality or impaired feeding, growth, development, and reproduction (Blackburn *et al*., 2014 and references therein).

The limited swimming ability of the free floating early life stages (eggs and larvae) of invertebrates such as echinoderms, molluscs and crustaceans renders them unable to escape oil polluted waters. These early life stages are more sensitive to pollution than adults and their survival is critical to the long term health of the adult populations (Blackburn *et al*., 2014 and references therein).

However, impacts on plankton populations from hydrocarbon releases are typically brief and localised. Zooplankton biomass was documented in the month following the Tsesis oil spill off the coast of Sweden in 1977 (1,000 te of medium grade fuel oil) with biomass levels being re-established within five days (Johansson *et al*., 1980). Plankton populations are abundant and widespread, with high rates of reproduction. Typically, recruitment from adjacent areas not affected by the release is sufficient to replace losses (IPIECA-IOGP, 2015). Consequently, the sensitivity of plankton at the proposed Platypus Development location is **Low (a)**.

Based on the stochastic modelling results there is a low probability of transboundary deterioration in water quality which could impact the plankton. Therefore, the magnitude of effect has been classed as **Serious (3)**.

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	Low	Serious	Moderate	Low
Diesel Inventory Loss	Low	Serious	Moderate	Low

13.3.4 Benthos

Benthic fauna can either move, tolerate hydrocarbons (with associated impacts on the overall health and fitness), or die in response to exposure (Gray *et al*., 1988; Lee and Page, 1997). The response to hydrocarbon exposure by benthic species differs depending on life history, feeding behaviour and the ability to metabolise toxins, especially PAHs. However, severe oil pollution typically causes initial massive mortality and lowered community diversity, followed by extreme fluctuations in populations of opportunistic mobile and sessile fauna (Suchanek, 1993).

Generally, infaunal polychaetes are affected by oil pollution (Suchanek, 1993). However, their recolonisation of affected areas varies. Some polychaete species decrease in abundance whilst others may be the first colonisers in the aftermath of an oil spill (Blackburn *et al*., 2014 and references therein). Some polychaetes contribute to biodegradation of oil in sediments whilst some have different abilities to metabolise contaminants (Bauer *et al*., 1988; Driscoll and McElroy, 1997).

The different response of polychaetes to oil pollution is likely a consequence of their different feeding strategies and trophic relationships in benthic environments. For example, *Capitella capitata* has been found to be amongst the first colonisers in the aftermath of an oil spill. *C. capitata* thrives in the absence of

competition and is a non-selective deposit feeder consuming detritus and algae. It benefits from organic pollution. In contrast, *Heteramalla sarsi* is a predatory polychaete that feeds on benthic amphipods. *H. sarsi* abundance dropped to < 5% of pre-spill abundance following the Tsesis oil spill in the Baltic Sea (1977). This decrease in polychaete abundance was correlated with a decrease in amphipod abundance in the region (Elmgren *et al*., 1983), indicating that amphipods like *B. elegans* are sensitive to hydrocarbons. Polychaetes of the family *Spionidae*, which includes *S. bombyx*, have been observed to decrease after an oil spill, then recover quickly. However, they did not recover as quickly as *C. capitata. S. bombyx* is therefore considered to have low sensitivity to hydrocarbon contamination (Ager, 2005).

Amphipods (small crustaceans) and burrowing bivalves can be sensitive even to brief exposures of relatively low hydrocarbon concentrations (IPIECA-IOGP, 2015; Suchanek, 1993). Amphipods may be particularly sensitive to the effects of oil pollution because of their low dispersal rate and limited mobility. The Holderness Offshore MCZ southwest of the area is designated for *A. islandica* (considered under OSPAR to be a threatened and/or declining species) were recorded in the in the area (Section 5.4). As a burrowing filter feeder, it is expected that any oil in the sediment or water column would impact on the species.

Applying the assessment methodology presented in Chapter 6, the sensitivity of benthic communities in the area is considered to be **High (c)**, as some of the species present (for example *Ammondytidae*) are recognised to be of conservation significance and/or have OSPAR designations.

For both scenarios, modelling predicted that no areas of sediment would exceed the 5 g/m^2 hydrocarbon threshold. Concentrations less than 1 g/m^2 would be present over a wide area. The magnitude is classed as **Negligible (1)** (no breaches of regulatory compliance and no transboundary impacts).

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	Low	Negligible	Low	Low
Diesel Inventory Loss	Low	Negligible	Low	Low

13.3.5 Fish

Exposure of fish to hydrocarbons can occur either through uptake across the gills or skin or direct ingestion of oil or oiled prey. Pelagic species, which spend the majority of their life-cycle in the water column, are likely to receive the highest exposure to oil that remains near the surface, whereas demersal fish species, associated with the seabed, are more likely to be exposed to particle-bound contaminants.

The chemical components of light oils have a high biological availability (bioavailability) and toxicity impacts are more likely than from heavy crude. At exposure concentrations lower than those sufficient to cause mortality, contamination may lead to sub-lethal effects such as impaired feeding and reproduction (ITOPF, 2014).

The likelihood of adult fish mortality due to open water oil spills is small (IPIECA-IOGP, 2015). Significant effects on wild stocks have seldom been detected, and fish are thought to actively avoid hydrocarbons (ITOPF, 2014). However, hydrocarbons have been detected in fish bile over one year after the Deepwater Horizon oil spill (Murawski *et al*., 2014), suggesting that adult fish may accumulate hydrocarbons after a large oil pollution event.

An oil spill could have the potential to impact fish spawning success because the eggs and larvae of many species are very sensitive to oil pollution. Joye *et al*. (2016) reported an estimated 2–5 trillion fish larvae were killed as a consequence of the Deepwater Horizon oil spill (2010), and while that was a deep sea oil blowout it gives a sense of scale on the potential impacts of a blowout to fish populations.

Cod, herring, lemon sole, mackerel, plaice, sandeel, sole, sprat and whiting have spawning grounds in the Platypus Development area. The eggs and larvae of broadcast spawners, such as cod, which are widely dispersed, could be exposed to oil in the water column. Modelling shows contamination of the water column is predicted to occur over a volume of 15.5 km^3 for the well blowout scenario and 24.4 km^3 for the diesel inventory loss scenario. Demersal spawner fish, such as sandeels, could be exposed to hydrocarbons deposited on the seabed (Section 5.3.3). In general, sandeels are considered to be fairly tolerant to the

exposure to hydrocarbons, for example, studies indicated that exposure to the Braer spill did not significantly impact sandeel survival or settlement (sourced from FEAST).

Of the fish species identified in the proposed Platypus Development area; sandeel, herring, cod, whiting, plaice, mackerel, sole, and spurdog have been assessed by Joint Nature Conservation Committee (JNCC) as Features of Conservation Importance (FOCI) (JNCC, 2010). Consequently, the receptor sensitivity for fish is classified as **Medium (b)**, in that some of the species present are recognised to be of conservation significance and recovery is expected to occur within medium-term timescales (<5 years).

Given the water volumes affected in both scenarios and applying the impact assessment methodology presented in Chapter 6, the magnitude of impacts is classified as **Serious (3)** (no beaching or transboundary effects).

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	Medium	Serious	Moderate	Low
Diesel Inventory Loss	Medium	Serious	Moderate	Low

13.3.6 Seabirds

Seabirds are particularly sensitive to the effects of surface oil pollution, and some oil pollution incidents have resulted in mass mortality of seabirds (for example, Munilla *et al.,* 2011; Votier *et al.,* 2005). Mortality occurs from the ingestion of oil, which results in liver and other organ failure, as well as contamination of plumage, which destroys the insulating properties, leading to hypothermia (Alonso-Alvarez *et al*., 2007). The impact of oil pollution on seabird populations depends on the numbers of seabirds at sea around the pollution incident and on the seabird species present. Diving seabirds such as seaducks (*Anatidae*), divers (*Gaviidae*), cormorants (*Phalacracoracidae*), grebes (*Podicepididae*) and auks (*Alcidae*) are more susceptible than more aerial species such as gulls (*Laridae*) (Webb *et al.,* 2016). In the Platypus Development area, common guillemot have been identified at densities of 20–50 individuals/km^2 and have been recorded throughout the year (Section 5.3.5). They dive for food and therefore may be exposed to surface and subsurface oiling.

Susceptible species tend to spend a greater proportion of their time at sea and have limited ability to locate alternative feeding sites. At population level, species with small or geographically limited populations, a low potential reproductive rate (productivity) and low adult survival rates are particularly sensitive due to their limited ability to recover (Webb *et al.,* 2016).

There are birds of conservation importance (Section 5.3.5) at national, OSPAR, European or International Red List Levels within the area of the proposed Platypus Development. Of these species the conservation status of the Leach's Storm-Petrel, Black-legged Kittiwake and Northern Fulmar is classified as 'vulnerable' and Arctic Skua and Atlantic Puffin as 'endangered' on the IUCN Red List for Birds, due to the rapid declines recorded in their European populations. The Black-legged Kittiwake is vulnerable to oil spills from direct mortality and as a result of successive years of breeding failure due to ecosystem degradation, leading to reduced numbers of prey species (e.g. herring and sandeels) (Birdlife, 2020). Therefore, the seabird sensitivity is classed as **Medium (b)**.

There is a high probability of surface oiling over a small area following a well blowout (Figure 13-9) and a low to moderate probability of surface oil following a full diesel inventory loss (Figure 13-10). However, the predicted thickness of oil at the sea surface is higher for the diesel inventory loss scenario (0.836 mm) compared to the well blowout scenario (0.0046 mm) (Figure 13-5, Figure 13-6).

Oil spill modelling for both scenarios also indicates there is a low probability of condensate or diesel reaching the coast in areas that are internationally or nationally designated for seabirds. Shoreline oil concentrations would not exceed the threshold of 100 g/m^2 (0.1 kg/m^2) above which impacts are considered potentially significant.

The magnitude of effect is classed as **Serious (3)** as the impacts from a large spill could potentially affect the ability of regional populations to propagate and recover. This could have adverse effects on the already declining seabird populations to reach favourable conservation status.

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	Medium	Serious	Moderate	Low
Diesel Inventory Loss	Medium	Serious	Moderate	Low

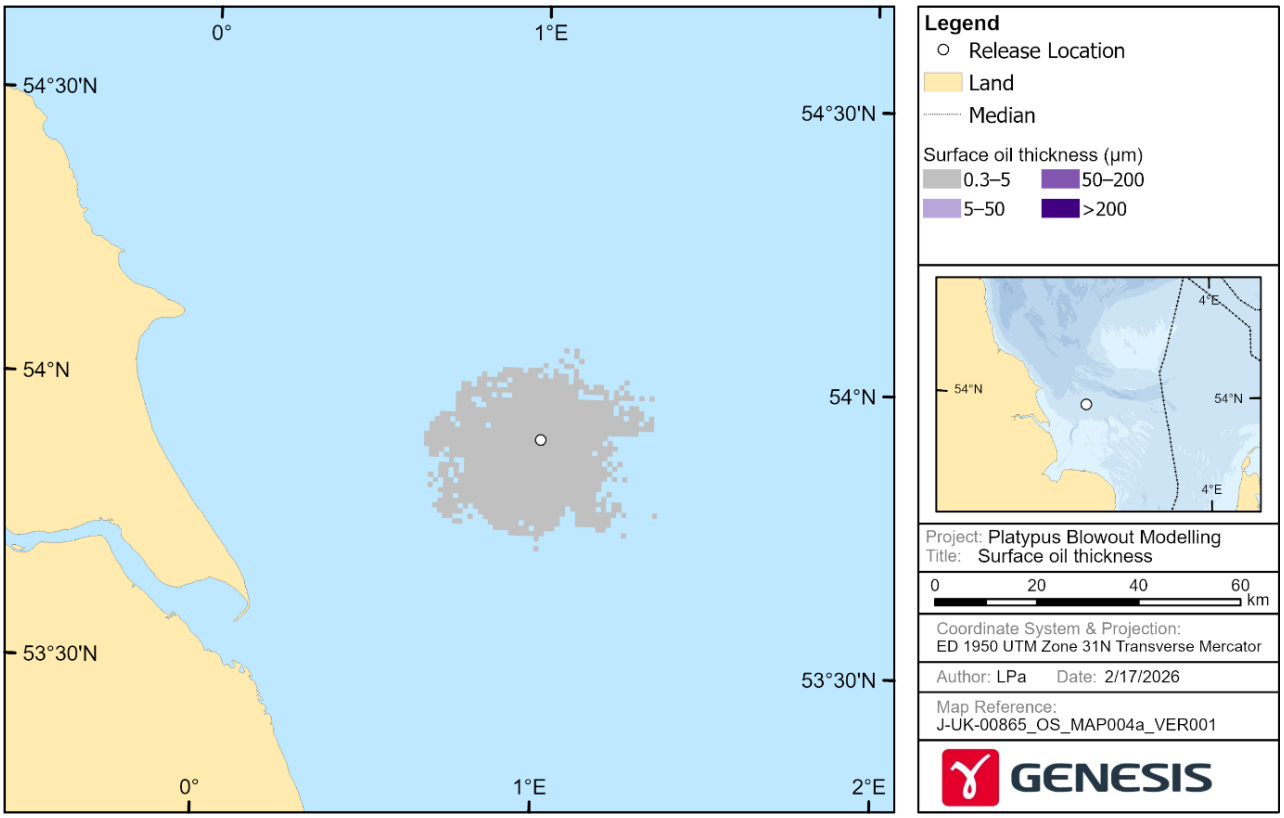


Figure 13-5: Maximum surface sheen thickness as a result of a well blowout (deterministic).

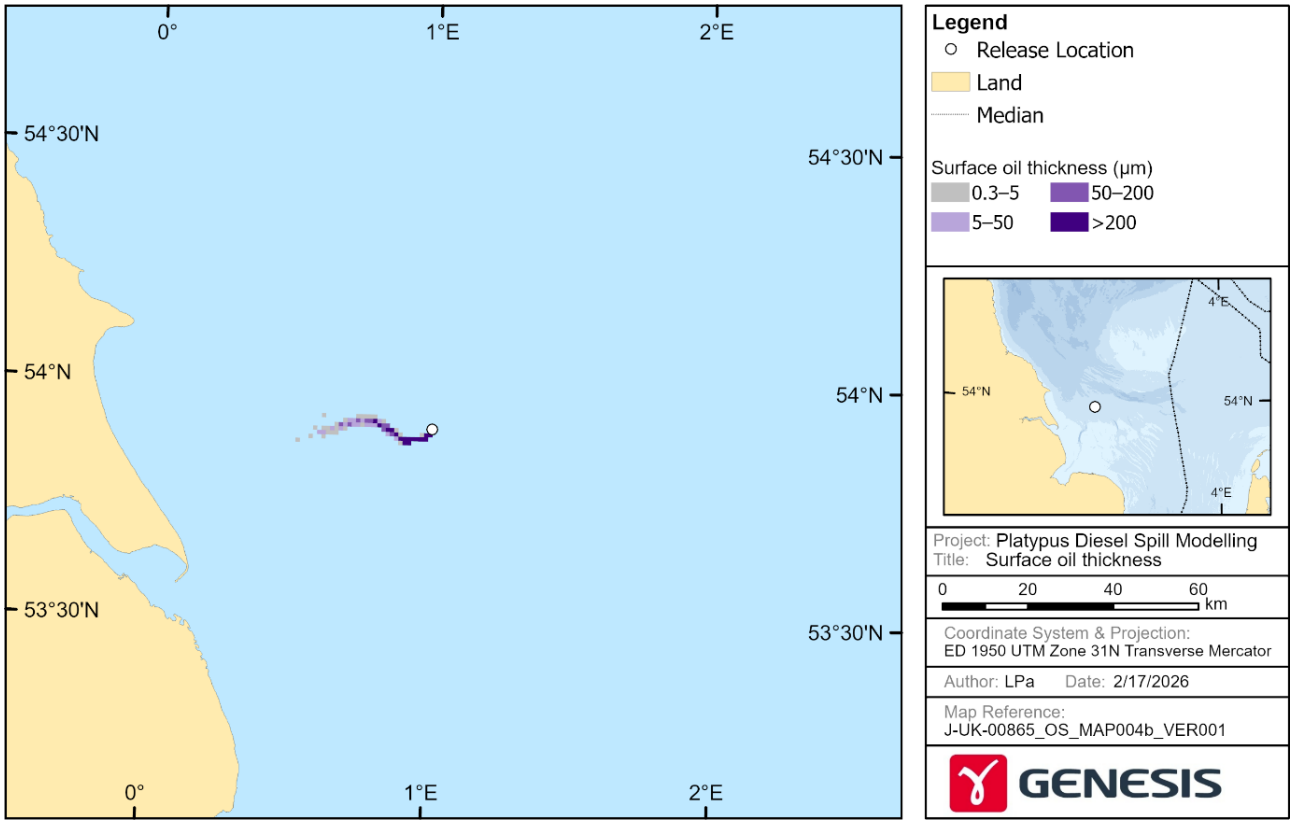


Figure 13-6: Maximum surface sheen thickness as a result of a full diesel inventory loss (deterministic).

13.3.7 Marine Mammals

All cetaceans are EPS. The harbour porpoise and bottlenose dolphin are also Annex II and IV species under the Habitats Directive (JNCC 2019).

Marine mammals may be exposed to hydrocarbons either internally (swallowing contaminated water, consuming prey containing oil-based chemicals, or inhaling of volatile oil related compounds) or externally (oil on skin and body).

The effects of hydrocarbons on marine mammals are dependent upon species but may include:

- Hypothermia due to conductance changes in skin or fur;
- Toxic effects and secondary organ dysfunction due to ingestion of oil, congested lungs;
- Damaged airways;
- Interstitial emphysema due to inhalation of oil droplets and vapour;
- Gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding;
- Eye and skin lesions from continuous exposure to oil;
- Decreased body mass due to restricted diet; and
- Stress due to oil exposure and behavioural changes.

There is little documented evidence of cetacean behaviour being affected by hydrocarbon spills. Evidence suggests they do not necessarily avoid slicks. In the months following the Exxon Valdez spill there were observations of harbour porpoises swimming through light to heavy crude oil sheens. Stressed or panicking cetaceans tend to move faster, breathe more rapidly and therefore surface more frequently into oil and increase exposure (Harvey and Dahlheim, 1994).

Cetaceans have smooth skins with limited areas of pelage (hair covered skin) or rough surfaces. Hydrocarbon tends to adhere to rough surfaces, hair or calluses of animals, so contact may cause only minor adherence. However, cetaceans can be susceptible to inhaling hydrocarbon and hydrocarbon vapour when they surface to breathe. This may lead to damaging of the airways, lung ailments, mucous membrane damage or even death.

The likelihood that a feeding cetacean would ingest a sufficient quantity of hydrocarbon to cause sublethal damage to its digestive system, or to present a toxic body burden, is low (IPIECA-IOGP, 2015). Ingestion of subtoxic quantities may have chronic effects and there is potential for PAHs to accumulate in tissues of whales before they are eventually metabolised, and for contaminants to be passed to juveniles through the mother's milk.

The harbour porpoise has been estimated to occur in the project area at densities of around 0.603 individuals per km^2 (Section 5.3.6.2). Other marine mammals regularly occurring in the project area at relatively low densities are bottlenose dolphin, white-beaked dolphin, common dolphin, minke whale and white- sided dolphin. Therefore, it is likely that cetaceans could encounter hydrocarbons in the event of a large release.

Seals are vulnerable to oil pollution because they spend much of their time near the surface and regularly haul out on beaches. Seals have been seen swimming in hydrocarbon slicks during several documented spills (Geraci and St. Aubin, 1990). Most seals scratch themselves vigorously with their flippers but do not lick or groom themselves, so are less likely to ingest hydrocarbon from skin surfaces. However, a seal mother trying to clean an oiled pup may ingest hydrocarbon, and it is pups that are most vulnerable to hydrocarbon spills when they reach breeding colonies on the shoreline. Furthermore, seals use smell to identify their young in a large colony. If the mother cannot identify its pup because its scent has been masked by hydrocarbons, this can result in abandonment and starvation.

Oil can impact on the mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, anal and urogenital orifices of seals. This can cause corneal abrasions, conjunctivitis and ulcers. Consumption of oil-contaminated prey will lead to the accumulation of hydrocarbons in tissues and organs. Lesions characteristic of hydrocarbon toxicity were found in the brains of seals exposed to the Exxon Valdez spill (Spraker *et al.*, 1994).

Grey seals and harbour seals are likely to be present in the proposed project area (Section 5.3.6.1) and therefore it is expected that seals would encounter spilled hydrocarbons.

The sensitivity of marine mammals in the potentially impacted area is considered to be **High (c)** as they are recognised to be of conservation significance given their EPS status, and the proposed activities will take place within the SNS SAC (designated for harbour porpoise).

As noted in Section 13.3.1 the diesel inventory loss scenario potentially impacts a larger volume of the water column at higher concentrations than the well blowout scenario. Given the water volumes potentially affected in both the scenarios and the lack of transboundary impacts, the magnitude of impacts is classified as **Serious (3)**.

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blow out	High	Serious	Moderate	Low
Diesel Inventory Loss	High	Serious	Moderate	Low

13.3.8 Offshore Protected Areas

The offshore protected areas which could potentially be affected by hydrocarbons released as a result of the well blowout or diesel inventory loss scenarios are summarised in Table 13-4 and shown in Figure 13-7 to Figure 13-12.

The Platypus Development is located in the SNS SAC. This designated area falls within the area where there is a greater than 50% probability of either surface or water column oiling for both the well blowout and diesel inventory loss scenarios. The SNS SAC is designated for receptors potentially present in the water column.

The Holderness Offshore MCZ is designated for sediment features and would not be impacted by oil in the water column or at surface. As previously noted, deterministic modelling predicted that the maximum concentration of oil on the seabed would not exceed the 5 g/m^2 threshold during the well blowout or full diesel inventory loss scenarios.

As these two sites are regional/national importance receptor sensitivity is classed as **High (c)**.

Harbour porpoise could be susceptible to inhaling hydrocarbon and hydrocarbon vapour when they surface to breathe. This may lead to damaging of the airways, lung ailments, mucous membrane damage or even death. The likelihood that a feeding cetacean would ingest a sufficient quantity of hydrocarbon to cause sublethal damage to its digestive system, or to present a toxic body burden, is low (IPIECA-IOGP, 2015).

As noted in Section 13.3.1 the diesel inventory loss scenario potentially impacts a larger volume of the water column at higher concentrations than the well blowout scenario. Given the potential impacts to protected areas, the magnitude of effect is classed as **Serious (3)**.

Table 13-4: Potential impact to offshore protected areas from hydrocarbon releases associated with the proposed project.

Protected Area	Well Blowout		Full Diesel Inventory Loss		Protected Features
	Probability of surface oiling above impact threshold (> 50%)	Probability of water column oiling above impact threshold (> 50%)	Probability of surface oiling above impact threshold (> 50%)	Probability of water column oiling above impact threshold (> 50%)	
SNS SAC	100	100	<50	87	Annex II species: Harbour Porpoise (*P. Phocoena*)
Holderness Offshore MCZ	81	87	<50	<50	Subtidal coarse sediment, subtidal sand, subtidal mixed sediments, ocean quahog *(A. Islandica*) and North Sea glacial tunnel valleys

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	High	Serious	Moderate	Low
Diesel Inventory Loss	High	Serious	Moderate	Low

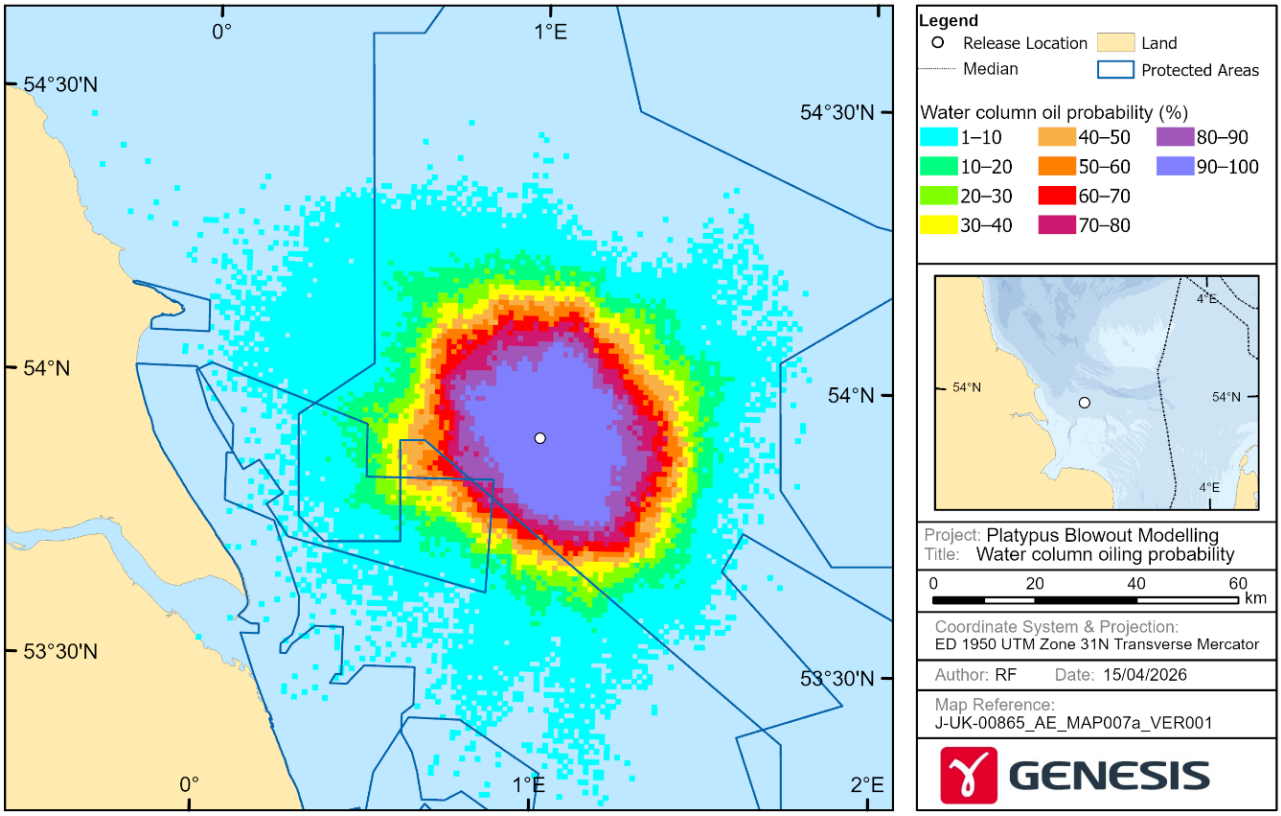


Figure 13-7: Water column oiling and offshore protected areas (well blowout).

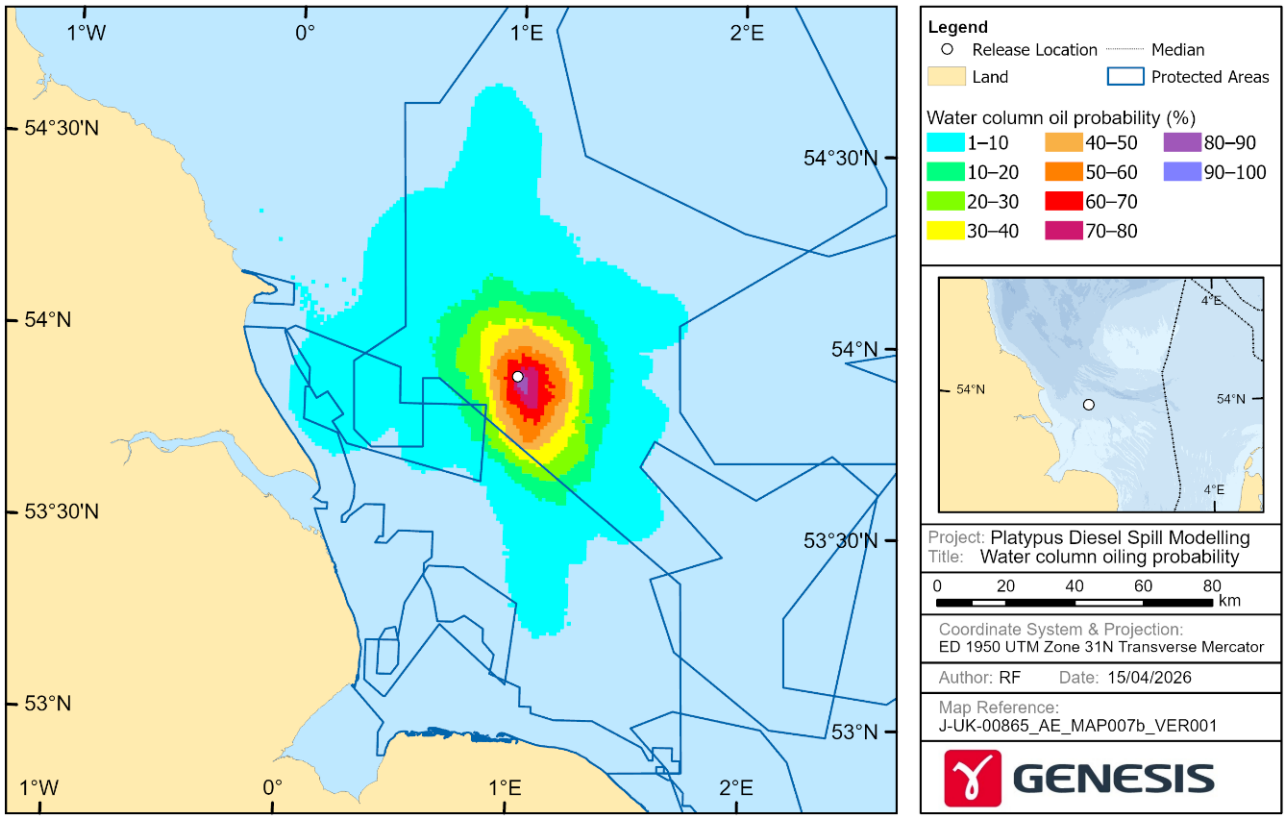


Figure 13-8: Water column oiling and offshore protected areas (full diesel inventory loss).

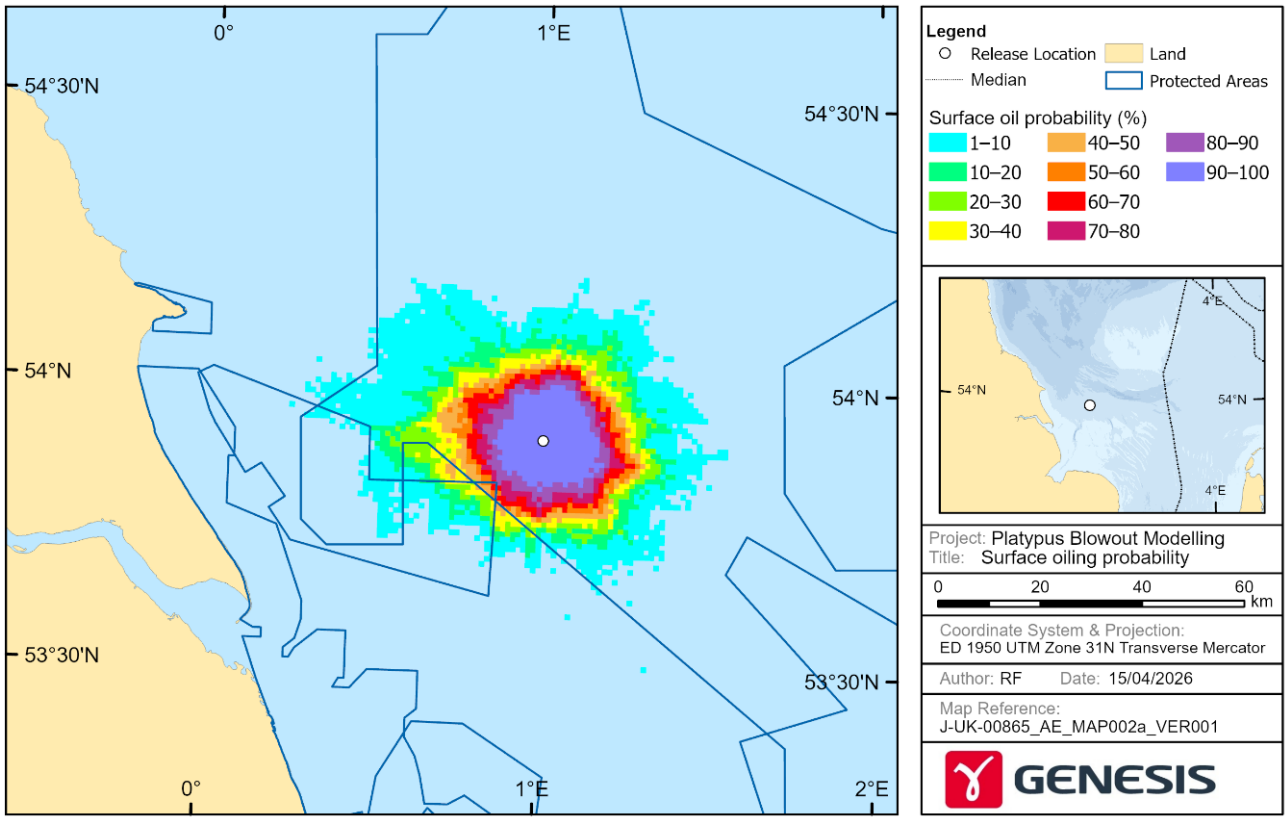


Figure 13-9: Surface oiling and offshore protected areas (well blowout).

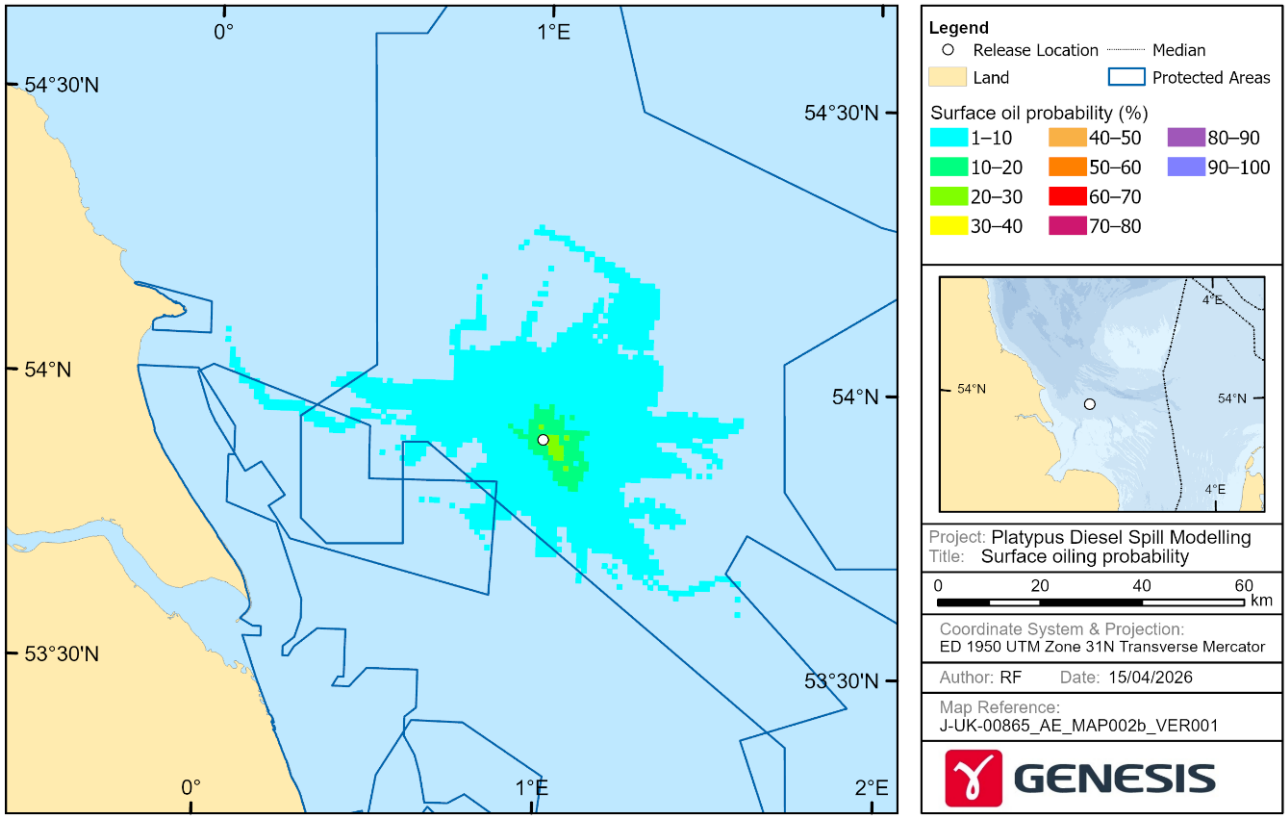


Figure 13-10: Surface oiling and offshore protected areas (full diesel inventory loss).

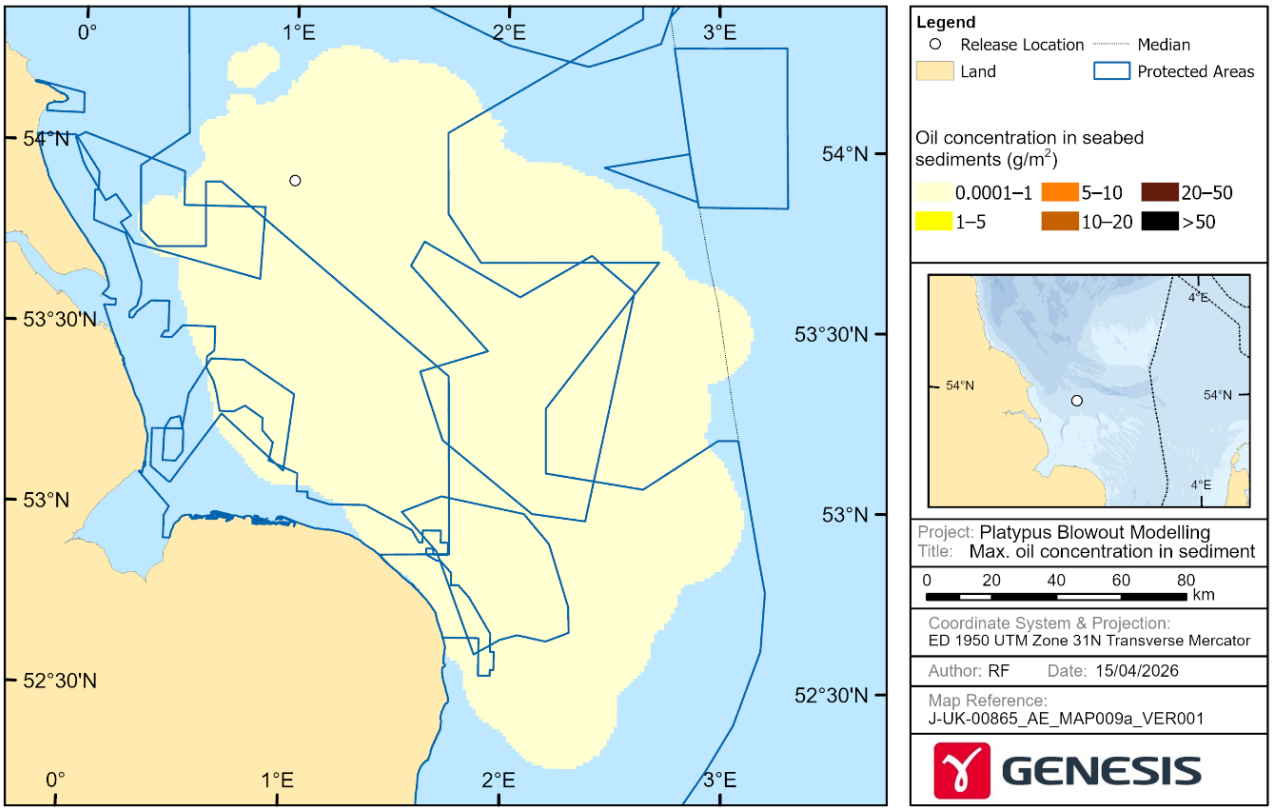


Figure 13-11: Maximum concentration of oil on sediment and offshore protected areas (well blowout).

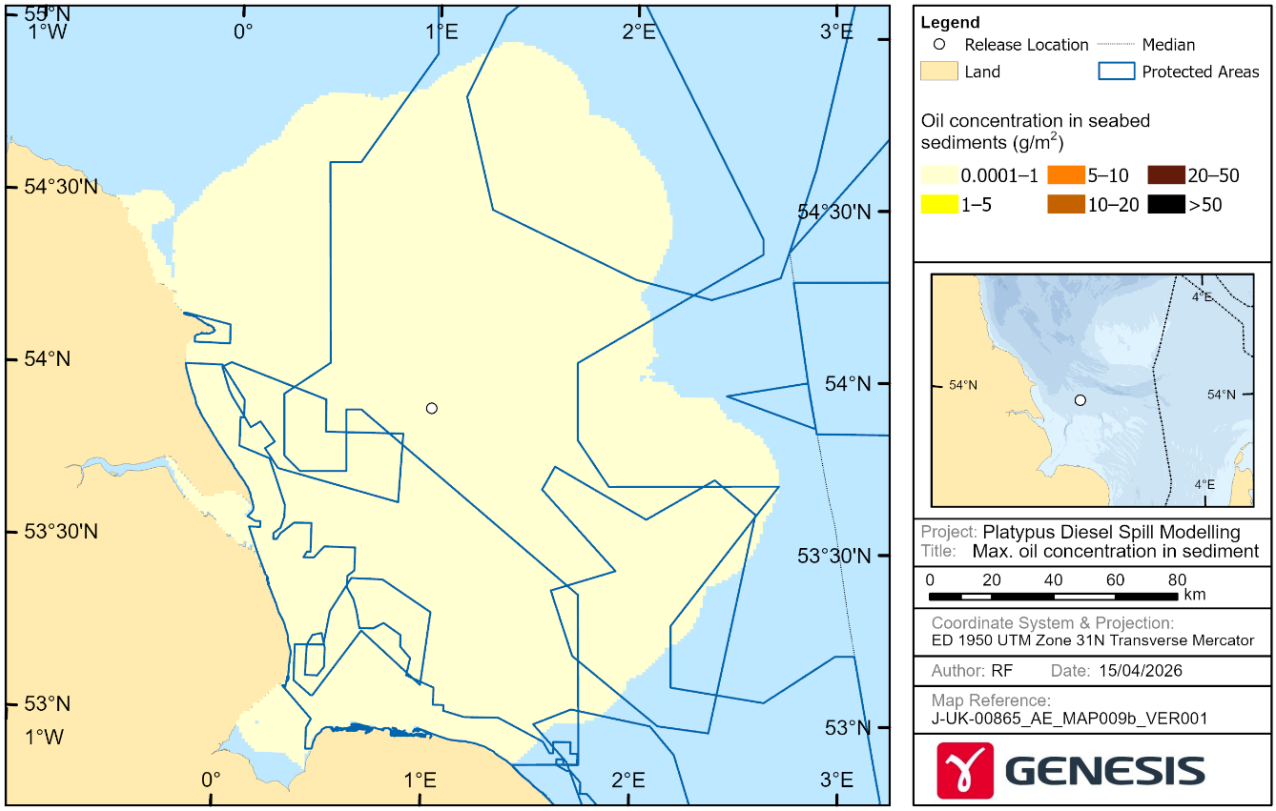


Figure 13-12: Maximum concentration of oil on sediment and offshore protected areas (full diesel inventory loss).

13.3.9 Coastal Protected Areas

The probability of shoreline oiling, resulting from a well blowout or diesel inventory loss, is low (<10%) but could coincide with coastal protected areas (Figure 13-13 and Figure 13-14). Shoreline oil concentrations would not exceed the threshold of 100 g/m^2 (0.1 kg/m^2) above which impacts are considered potentially significant. The protected area sensitivity is considered to be **High (c)** because of the presence of protected areas.

The magnitude of impact to coastal protected areas is considered to have **Negligible (1)** (probability of oiling along the coast is low and no breaches of regulatory compliance).

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	High	Negligible	Low	Low
Diesel Inventory Loss	High	Negligible	Low	Low

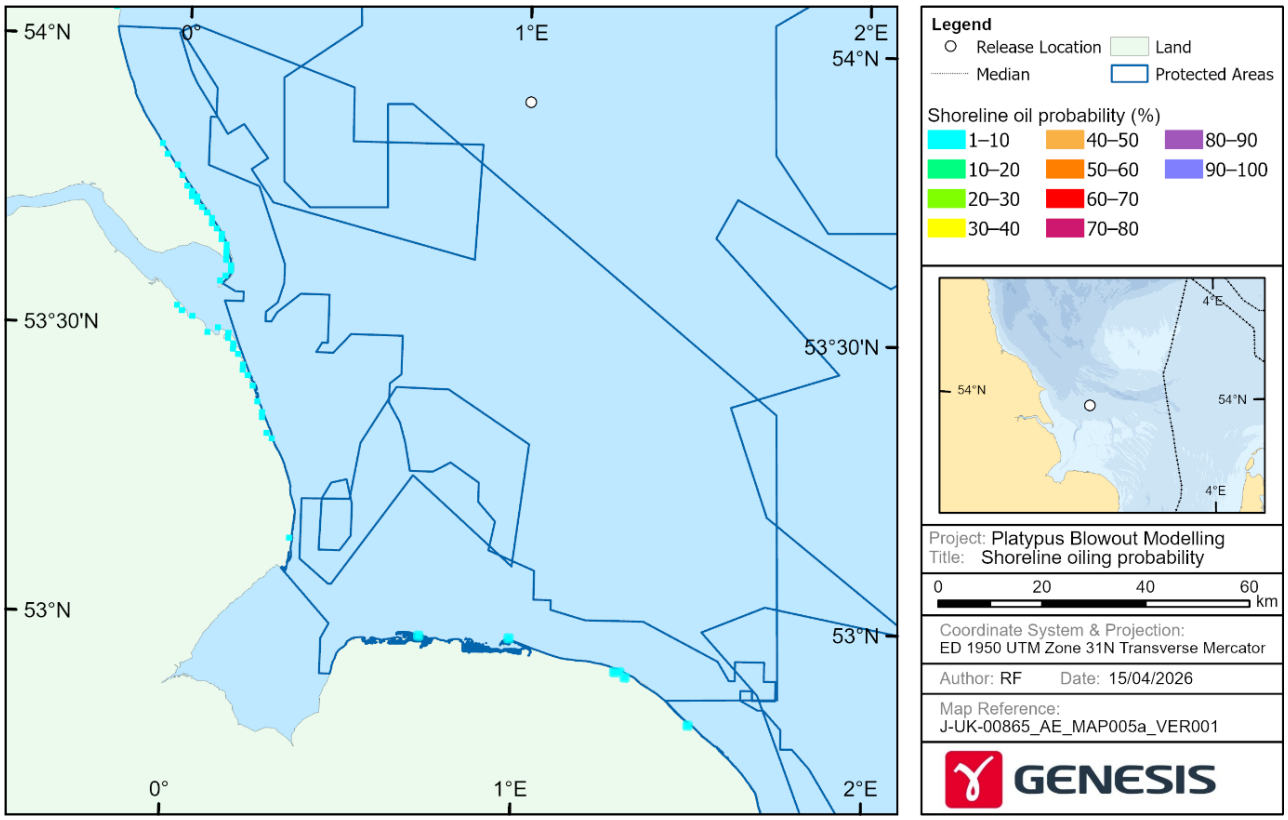


Figure 13-13: Coastal oiling and coastal protected areas (well blowout).

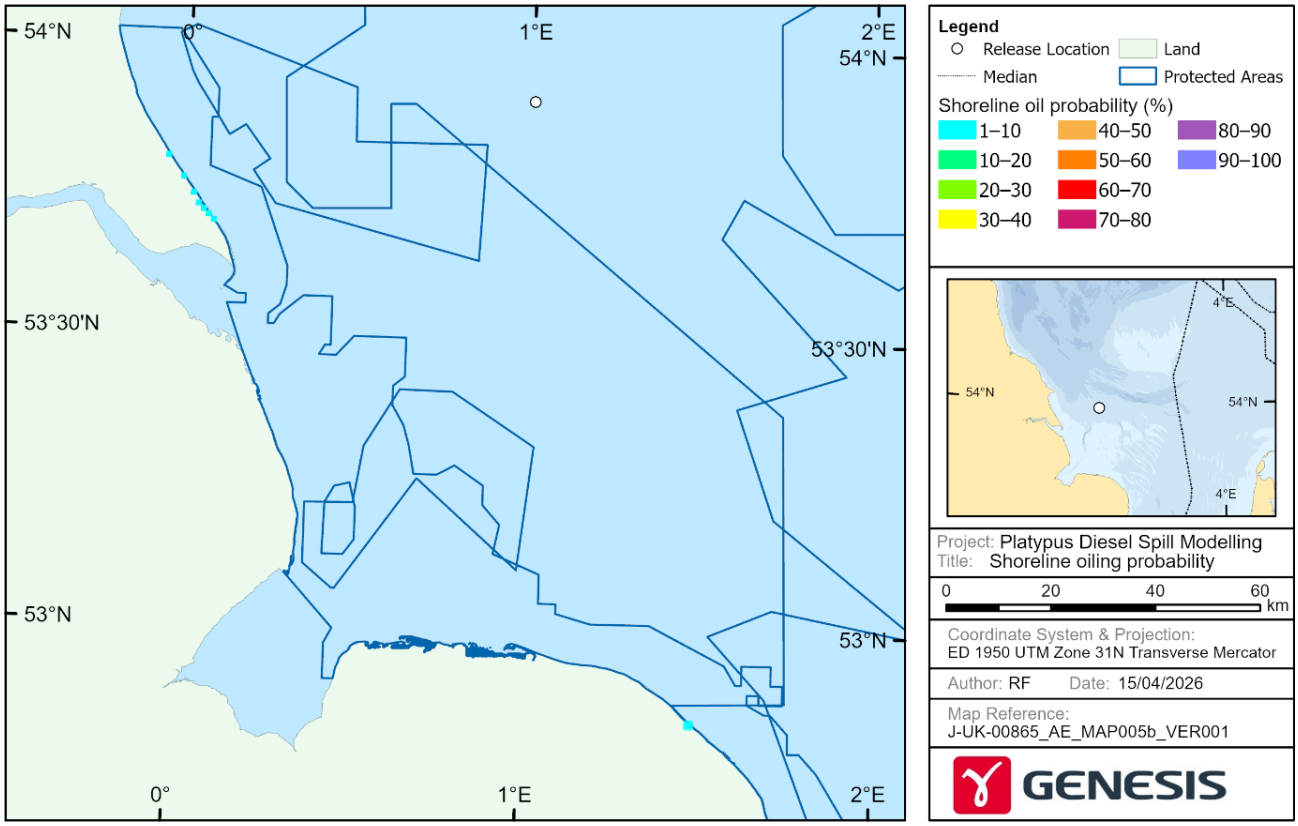


Figure 13-14: Coastal oiling and coastal protected areas (full diesel inventory loss).

13.3.10 Fisheries, Aquaculture and Shellfish Water Protection Areas

Localised mortality of eggs and larvae which may occur following a spill rarely impacts wider fish stocks, and adult fish are relatively resilient to hydrocarbon spills. More significant impacts may be found near shore, where hydrocarbons can accumulate and exposure, particularly of intertidal and shallow subtidal benthos, caged animals and seafood products that are cultivated in fixed locations (ITOPF, 2014).

As discussed in Section 5.6.1, fishing effort in the Platypus Development area is high when compared to other areas of the UKCS. Within the immediate vicinity of the Platypus Development area, fishing is predominately by traps and the majority of fishing effort takes place in the summer months between July and August.

Deterioration of water quality below the conservative 10 µg/l threshold has a probability of greater than 50 %. However, oil spill modelling for the well blowout scenario also indicates that condensate or diesel has a low probability of reaching the coast in areas with sensitive aquaculture sites. Figure 13-15 and Figure 13-16 shows the probability of onshore oiling and the location of aquaculture sites (Scottish Government NMPi).

Sensitivity of the receptor is considered **High (c)** given that fish present in aquaculture site would be unable to swim away from spill and may therefore have a low capacity to absorb change without significant impact.

Given the fact that there are no potential transboundary impacts and low probability of coastal oiling, the magnitude of effect is classed as **Serious (3)**.

Scenario	Receptor	Magnitude of Effect	Environmental significance of impact	Environmental risk
Well Blowout	High	Serious	Moderate	Low
Diesel Inventory Loss	High	Serious	Moderate	Low

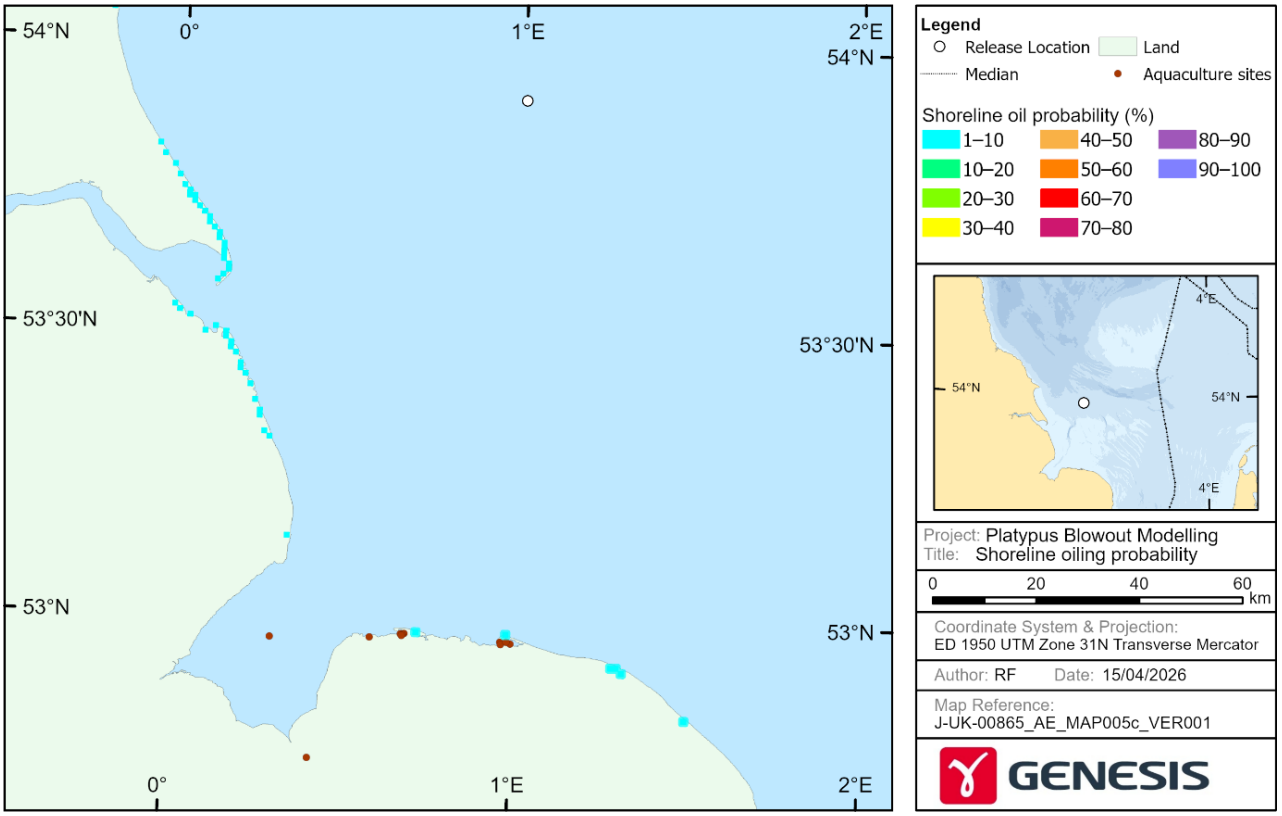


Figure 13-15: Coastal oiling and coastal aquaculture sites (well blowout)

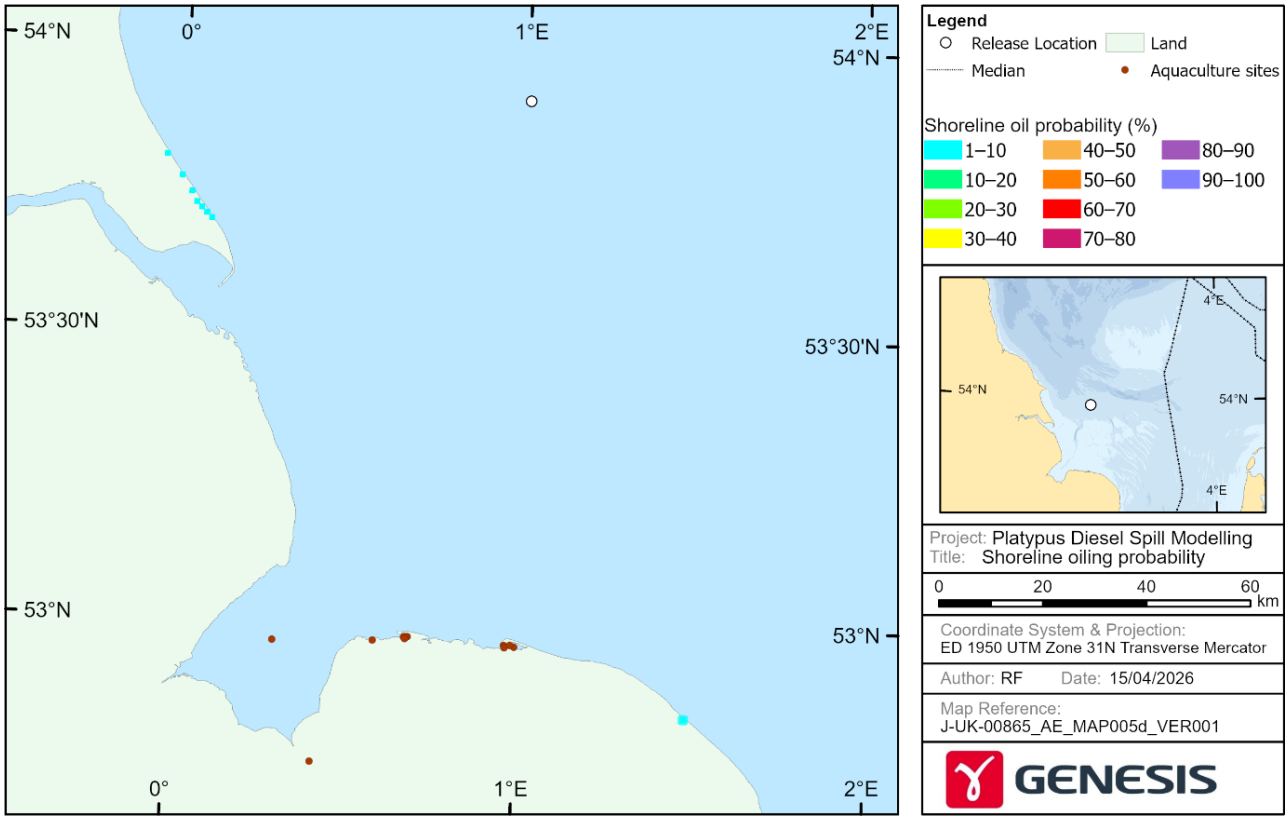


Figure 13-16: Coastal oiling and coastal aquaculture sites (full diesel inventory loss).

13.3.11 Transboundary and Cumulative Impacts

Surface and water column oiling is not likely to cross any median lines.

In the unlikely event of a well blowout, a large volume of gas containing methane, ethane and CO_2 could potentially be released contributing to localised poor air quality and cumulatively to global climate change (as noted following the Deepwater Horizon event, see for example Middlebrook *et al.*, 2012).

13.4 Major Environmental Incident Assessment

13.4.1 MEI Definition

The Offshore Installations (Safety Case etc.) Regulations (SCR) 2015 (HSE, 2015) extends the evaluation of major accidents to include their potential consequences on the safety of personnel and the environment (described as a MEI). The well blowout and diesel inventory loss scenarios are considered to be Major Accident Hazards (MAHs) and were assessed for an MEI potential.

An MEI is defined in the SCR (2015) as an "incident which results, or is likely to result, in significant adverse effects on the environment in accordance with the Environmental Liability 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 incident that results, or is likely to result, in significant adverse effects to protected species and natural habitats, affecting their ability to reach or maintain favourable conservation status of such habitats or species is therefore considered an MEI. The significance of such effects should be assessed with reference to the baseline condition, taking account of the criteria set out in Annex I of Directive 2004/35/EC.

The adopted Impact significance assessment methodology (Chapter 6) considers the magnitude of impact, including the areal extent or number/density of species that could be affected. It also considers receptor sensitivity and accounts for a number of criteria such as conservation status, ecosystem services provided by the species or habitats, number of individuals/ area affected, and reproduction cycle of species and their viability, capacity of a habitat for natural regeneration and capacity / duration for recovery.

13.4.2 MEI Conclusion

Significance of impacts to different receptor categories is discussed in Section 13.3. As noted in Section 13.3 the full diesel inventory loss scenario results in a larger volume/area of the water column and sea surface being impacted, with higher concentrations in the water column and at the sea surface, than the well blowout scenario. This is because there is less time for dispersion and dilution in the case of the diesel inventory loss.

The environmental impacts resulting from either a well blowout or a diesel inventory loss to environmental receptors were assessed as resulting in a low environmental risk, with the low potential to disrupt the function and value of the resource/ receptor with broader systemic (e.g. ecosystem or social well-being) consequences. Accordingly, these receptors were assessed as not having the potential to result in a MEI under the Safety Case Regulation SCR 2015.

Receptor	Environmental risk	
	Well Blowout	Diesel Inventory Loss
Water quality	Low	Low
Sediment quality	Low	Low
Plankton	Low	Low
Benthos	Low	Low
Fish	Low	Low
Seabirds	Low	Low
Marine mammals	Low	Low
Offshore protected areas	Low	Low
Coastal and nearshore protected areas	Low	Low
Fisheries, Aquaculture and Shellfish Water Protected Areas	Low	Low

13.5 Susceptibility to Natural Disasters

Some natural disasters could increase the risk of a major pollution event occurring at the Platypus Development. For example, an earthquake could lead to damage to the infrastructure leading to the release of hydrocarbons, however, the likelihood of an earthquake of sufficient magnitude on the UKCS to impact the infrastructure is extremely remote. To mitigate the potential for damage, offshore structures are designed to withstand seismic forces and vibrations with a reasonably low likelihood of exceedance during their lifetime, with little or no damage, and can maintain integrity without major collapse or loss of life.

Climate change effects, such as sea level change and extreme weather events, are not considered to significantly alter the range of effects considered. Extreme weather may make accidents (e.g. collisions/dropped objects) more likely, but procedures will be in place for making safe and shutting down operations during extreme weather.

13.6 Management and Mitigation Measures

The following measures will be adopted to ensure that the risk and impacts of releases, including large hydrocarbon releases, are minimised to as low as reasonably practicable.

Proposed Mitigation Measures
• Activities will be carried out by trained and competent offshore crews and supervisory teams; • An approved OPEP will be in place prior to any activities being undertaken; • Records will be kept of oil spill training and exercises as required by the OPEP; • Process Safety Assurance Processes will be identified and adhered to; • Shipboard Oil Pollution Emergency Plans (SOPEPs) will be in place for project vessels; and • A co-ordinated industry oil spill response capability will be available. **Wells specific control measures** • A robust BOP pressure and functional testing regime will be in place and the BOP will have fully redundant control systems; • Appropriate mud weights will be used to allow well control to be maintained; • The drilling rig will be appropriately certified; • The drilling rig shall have an approved safety case with all Safety and Environment Critical Elements (SECEs) verified by an independent verification body and managed through a recognised maintenance management system; • A mandatory 500 m safety zone will be in place for drilling rig; • There will be agreed approach procedures to the drilling rig vessels, informed by appropriate collision risk assessments; • Well construction and operation activities to be conducted with multiple barriers in place; and • Well Control Contingency Plan in place detailing relief well plans and arrangements with internal and external well control specialists. **Operations-specific control measures** • Pipelines will have pressure monitoring and low pressure alarms; and • Oil spill control measures will be followed as outlined in the OPEP.

13.7 Conclusions

Two potential hydrocarbon spill scenarios were considered: a full loss of diesel inventory from the drilling rig and a well blowout. The likelihood of any of the two hydrocarbon releases modelled occurring is considered Remote owing to the procedural and operational controls that will be applied during the Platypus Development. Given the likelihood of such releases, and following the application of control and mitigation measures, the overall environmental risk of impacts from a large hydrocarbon release resulting from a well blowout or a total loss of diesel inventory from the project are considered to be **Low**.

14 Conclusion

A detailed assessment of the potential environmental impacts associated with the proposed Platypus Development has been carried out. The identification of the potential impacts is based on the nature of the proposed activities and was informed by available literature and guidance documents, industry specific experience, and consultation with OPRED and their consultees. The commitments made in this ES will be incorporated into environmental management plans for the drilling, installation, commissioning, and operations phases of the proposed project.

14.1 Environmental Effects

The project area is considered to be typical of a Southern North Sea offshore environment in a well-developed oil and gas area.

The potential impacts to the environment from all phases of the project were identified and assessed. The environmental aspects of each of the key activities, for each phase of the project, were identified and quantified in terms of their Receptor Sensitivity and Magnitude of Effect. The results were assessed on the basis of the Impact Significance (for planned activities) or the Environmental Risk posed to the environment (for unplanned events), and were summarised as being either Low, Moderate or High Impact Significance.

The environmental impact assessment considered both planned activities and unplanned events. Key potential impacts assessed included physical presence, emissions to air, discharges to water, seabed disturbance, underwater noise, and accidental events. The assessment showed that, with the application of the mitigation measures identified, the impacts of the planned activities are of **Low** Impact Significance except for impacts to the disturbance to the seabed, which are considered to be of **Moderate** Impact Significance.

Two unplanned events (well blowout and a full loss of diesel inventory from the drilling unit) were considered to be **Low** Environmental Risk, given the Remote likelihood of such releases, and following the application of control and mitigation measures.

14.2 Commitments

Project specific commitments and mitigation measures to minimise the impact of the proposed project on the environment have been highlighted throughout the ES and are summarised in Table 14-1. These commitments will be integrated into the relevant project design, execution, and operational phases.

Table 14-1: Platypus Development commitments.

Aspect	Commitments
Physical Presence	• Optimise vessel use; • Consultation with NFFO for all operations; • Notice to mariners prior to operations starting; • A vessel traffic survey/collision risk assessment will be undertaken (as required); • Key environmental sensitives (i.e. SNS SAC Summer Area) will be considered during the planning of project timing. • Perenco will submit required notifications to the Hydrographic Office, Kingfisher and MoD such that all other users of the area will be notified; • Drilling rig and MFP will have marking and lighting as per the Standard Marking Schedule for Offshore Installations; • Notice will be sent to the Trinity house of MFP installation; any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the rig; • Drilling rig and MFP will have a 500 m exclusion zone to mitigate any collision risk; • Lighting will be minimised as far as practicable; • MCA notified; • Pipelines and umbilical will be trenched and buried.
	Proposed Pre-Production Up Mitigation Measures

Aspect	Commitments
Emissions to Air	• No flaring is planned during initial start-up of Platypus production, however the atmospheric emissions assessment includes contingency flaring to cover the worst case. • Efficient use of vessels through journey planning and ensuring that all contracted vessels are MARPOL compliant and from countries adhering to the IMO convention, will minimise emissions from vessel usage. • To reduce support vessel fuel use and emissions from drilling-related flaring, the wells will, if practicable, be drilled within a single campaign. • Modifications at Cleeton can be managed using the existing capacity of the platform accommodation and will not require additional support or supply vessels or flights, which will minimise pre-production emissions. • Re-use of an existing jacket structure for the MFP, avoiding emissions that would otherwise arise from the fabrication and installation of new infrastructure.
	Proposed Production Mitigation Measures
	Consistent with the North Sea Future Plan, revised NSTA Strategy, Stewardship Expectation 11, and the industry commitments contained within the NSTD, Perenco will incorporate the following: • Development and implementation of an ERAP for Perenco UK SNS Assets including the Cleeton Hub and the Platypus MFP. • Zero routine flaring and venting at the Platypus MFP, or incremental flaring at the host facilities, will occur as a result of the project. • Use of renewable electricity to power the MFP during production. • Production philosophy will use reservoir pressure to flow fluids to Cleeton, and to drive processing at Cleeton and onward export, to avoid almost all sources of additional energy requirements and associated production emissions. • No additional combustion equipment, only minimal incremental increase in diesel and/or fuel gas usage on Cleeton. • Whilst some supply vessels will be required for the MFP during production, the project will not lead to any increase in supply vessels or helicopter flights to Cleeton, and as such logistics emissions during production will be minimised. These measures will help ensure that opportunities to improve efficiency and reduce atmospheric emissions are identified, acted upon where appropriate, and reviewed, while maintaining safe operations.
Discharges to Sea	• Efficient use of vessels, through journey planning; • Perenco will review vessel CMID as part of vessel assurance and all vessels will be compliant with the Company's MAS; • Vessels will be MARPOL compliant; • All contracted vessels will originate from countries adhering to the IMO convention; • Perenco's audit procedures will ensure that the contracted vessels ballasting procedures are in line with IMO Convention aimed at preventing associated harmful effects; • All discharges of ballast water will be monitored, and records maintained; • Jack up vessels routinely test deck water prior to discharge, in cases where legal limits are exceeded deck water is returned to shore and disposed of. Some vessels have Separators onboard which they can use to separate and discharge water. The jack up vessels will adhere to OPPC deck drainage regulations/requirements; • Adherence to OPPC Regulations; • Chemical selection process will aim to select the lowest toxicity chemicals for a given technical requirement; • Cement discharge will be minimised through seabed monitoring via ROV; • Specific muds and cement program; • Chemical Permitting process; • Discharge of fluids will follow procedures which will minimise environmental impact; • Onboard testing of all fluids prior to discharge; • Discharge process will be controlled; maximum rates set that significant changes to the ambient environment are minimised (specified in CPs); • LTOBM contaminated cuttings will be skipped and shipped for onshore disposal, no planned discharge; • All produced water will be re-injected.

Aspect	Commitments
Seabed Disturbance	• Vessels using dynamic positioning will be prioritised where possible, given that DP thrusters are not expected to impact the seabed at water depths present in the project location. • Pre-rig site survey / deep geotechnical surveys aimed to maximise the safe installation of drilling rig / jack-up vessels and minimise potential for re-positioning. • Visual monitoring of cement operations. • ROV to minimise cement patio. • Consideration being given to piled conductors. • Platypus MFP jacket to be lifted from deck and lowered straight to final location. • Pipeline route surveys. • Trench and bury prioritised over rock cover. • The Project Team will continue to explore the option to lay the two lines in the same trench. • Within Platypus and Neptune 500 m zones; mattresses, RFUs and grout bags selected over rock cover. Potential for addition of rock where target trench depth cannot be reached. Quantity of mattresses and grout bags will be optimised.
Underwater Noise	• Efficient use of vessels, through efficient journey planning. • Minimisation of drilling rig movements. • Adherence to JNCC guidelines. • A qualified, trained and equipped Marine Mammal Observer will be present during piling. The Marine Mammal Observer will carry out a pre-piling survey of a 500 m mitigation zone and, if a marine mammal is detected, the piling will be delayed until all marine mammals vacate the 500 m mitigation zone; • A soft-start/ramp-up of hammer energy will be employed where the hammer will commence at a low energy at the start of piling. The soft start will be such that maximum hammer energy will not be reached until after a period of 20 minutes; • PAM will be employed during periods of low visibility to detect marine mammal presence • Underwater Noise Working Group participation, minimising cumulative noise impact on SNS SAC.
Waste	• Perenco will apply the principles of the Waste Management Hierarchy during all activities i.e. Prevent, Reuse, Recycle; • Compliance with MARPOL requirements; • Perenco will look to vessel owner to minimise all wastes during the project (monthly reporting of waste sent to shore; Waste Management Plan and Waste Record Book; Waste Management Duty of Care audit); • Waste minimisation and supply chain management; • Perenco environmental team will undertake audits throughout the project phases; • All wastes to be properly segregated for recycling / disposal / treatment; • Waste will be dealt with in accordance with regulatory requirements (and Contractors will be audited to ensure above); • End of project reporting of waste sent to shore; • Selection of a proven and competent waste contractor for handling drill cuttings; • Only suitably permitted and licensed disposal yards / landfill sites will be used, in compliance with relevant legislation; • Offshore waste will be minimised by large percentage of construction operations being completed onshore.
Accidental Events	• Auditing of helicopter companies to ensure only reputable and • approved companies. • Civil Aviation Authority (CAA) compliance by contractor. • Activities will be carried out by trained and competent offshore crews and supervisory teams; • An approved OPEP will be in place prior to any activities being undertaken; • Records will be kept of oil spill training and exercises as required by the OPEP; • Process Safety Assurance Processes will be identified and adhered to; • SOPEPs will be in place for project vessels; • A Temporary Operations OPEP (TOOPEP) will be in place for drilling operations. • A co-ordinated industry oil spill response capability will be available; and • Enhanced sharing of industry best practices via the OSRF will continue.
	Wells specific control measures

Aspect	Commitments
	• A robust BOP pressure and functional testing regime will be in place, and the BOP will have fully redundant control systems; • Appropriate mud weights will be used to allow well control to be maintained; • The drilling rig will be appropriately certified; • The drilling rig shall have an approved safety case with all SECEs verified by an independent verification body and managed through a recognised maintenance management system; • Well construction and operation activities to be conducted with multiple barriers in place; and • Well Control Contingency Plan in place detailing relief well plans and arrangements with internal and external well control specialists; • A mandatory 500 m safety zone will be in place for drilling rig; and • There will be agreed approach procedures to the drilling rig vessels, informed by appropriate collision risk assessments.
	Operations-specific control measures
	• Bunkering procedures will be developed in line with Best Practice Guidance; • Pipelines will have pressure monitoring and low-pressure alarms; and • Oil spill control measures will be followed as outlined in the OPEP.

14.3 Overall Conclusion

This ES assesses the worst-case impact of the proposed Platypus Development on the environment and is therefore very conservative. A robust design, strong operating practices and a highly trained workforce, along with the implementation of the mitigation measures identified, will help to ensure that any environmental and/or social impacts are minimised. Additional measures will also be in place during the operating phase to effectively respond to potential emergency scenarios.

It is the conclusion of this ES that the current proposal for the Platypus Development can be completed without causing any significant long term environmental impacts or cumulative and transboundary effects.

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Appendix A: Marine Plan and MSFD Compliance Assessment

There is a broad framework of international, national and regional policies and legislation that govern the sustainable use and protection of the marine environment. These policies establish the principles of marine planning, environmental protection, and the management of human activities at sea.

The proposed Platypus Development has been assessed at a national, UK, and global level:

- **National level** - The objectives of the East Offshore Marine Plan (Section A.1);
- **UK level** - The high-level descriptors of the Marine Strategy Framework Directive (MSFD), as implemented in UK legislation (Section A.2); and The UK National Biodiversity Strategy and Action Plan (NBSAP) (Section A.3);
- **Global level** – Global Biodiversity Framework (GBF) targets. Perenco acknowledge their contribution to the cumulative impact of all projects globally on biodiversity and hence consideration of project relevance/impact to targets is summarised below (Section A.3).

A.1. East Offshore Marine Plan

Within English waters there are 11 Marine Plan Areas. The Marine Plan Authority (the Secretary of State in England) is responsible for preparing marine plans for these 11 Marine Plan Areas, with responsibility for plan development delegated to the MMO. The suite of Marine Plans covers the management of both English inshore waters (out to 12 nm) and English offshore waters (12 to 200 nm).

The proposed Platypus Development is located within the East Offshore Marine Plan Area (Figure A-1).

The East Offshore Marine Plan Area encompasses the marine area from 12 nm out to the Exclusive Economic Zone (the maritime borders with the Netherlands, Belgium and France); a total area of approximately 49,000 km^2.

In order to deliver the marine plans vision and support sustainable development, the plans set out general policies and objectives. The East Offshore Marine Plan sets out 11 objectives; the proposed Platypus Development has been assessed against these objectives, details of which can be found in Table A-1.

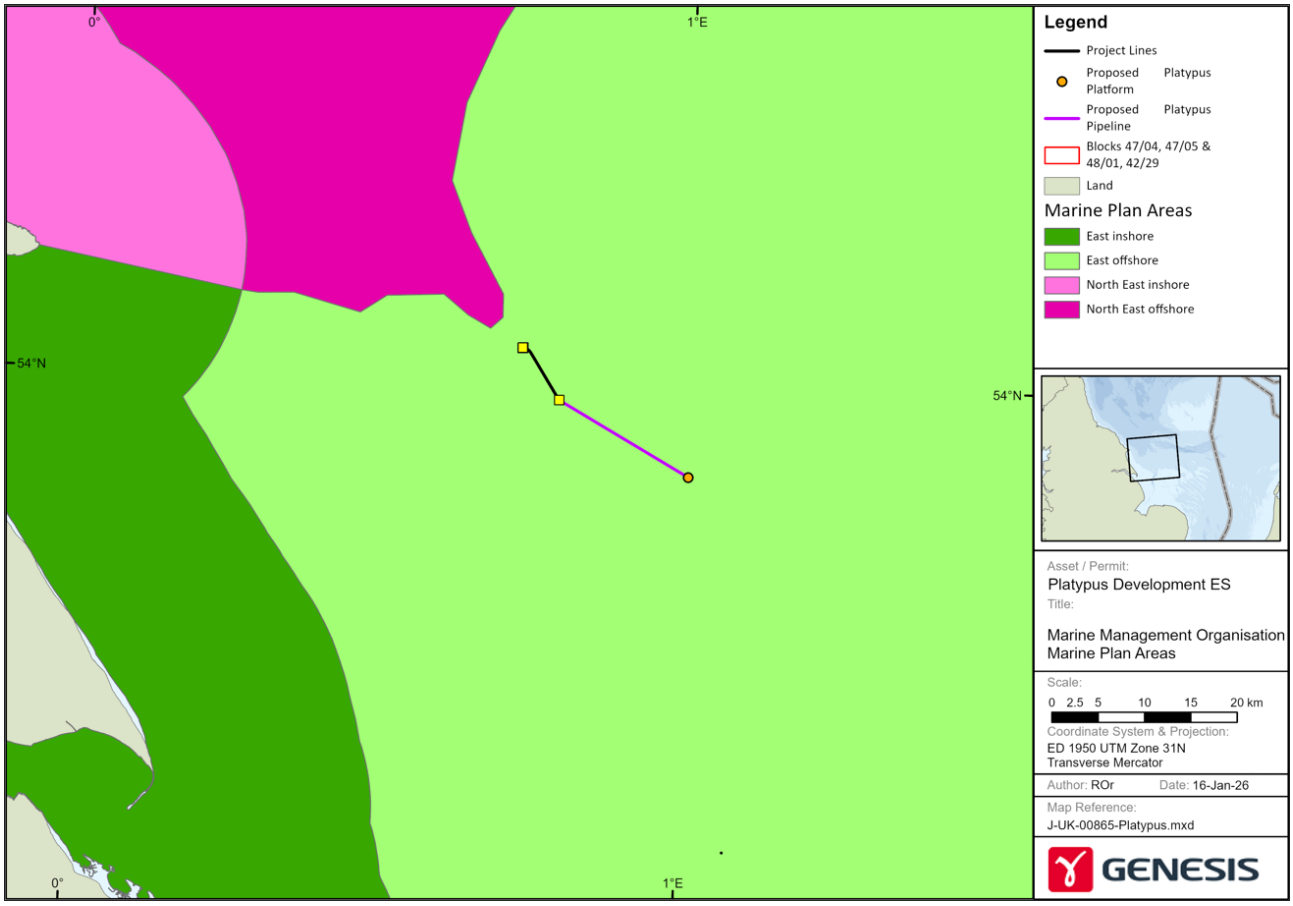


Figure A-1: Location of proposed Platypus Development within the East Offshore Marine Plan.

Table A-1: Assessment of proposed Platypus Development Against East Offshore Marine Plan Objectives.

Objective	East Offshore Marine Plan Objective	Applicable	Assessment Against Objective
1	To promote the sustainable development of economically productive activities, taking account of spatial requirements of other activities of importance to the East marine plan areas.	✓	The proposed Platypus Development supports sustainable economic activity through the efficient recovery of domestic hydrocarbon resources, contributing to UK energy security. Construction of the Platypus MFP will re-use a decommissioned NUI, with the jacket and primary topside framing expected to be retained. This minimises the fabrication of new materials. In addition, the MFP has been intentionally designed to require low electrical demand, eliminating combustion engines and enabling renewable power. The proposed pipeline routing and infrastructure layout have been informed by survey data and taking account of existing subsea infrastructure, to minimise conflict and support co-existence.
2	To support activities that create employment at all skill levels, taking account of the spatial and other requirements of activities in the East marine plan areas.	✓	The Project will generate direct and indirect employment across design, construction, and operational phases, supporting supply chains within the UK. Activities will utilise an established workforce and existing infrastructure, thereby enhancing economic efficiency while aligning with the spatial constraints of other marine users.
3	To realise sustainably the potential of renewable energy, particularly offshore wind farms, which is likely to be the most significant transformational economic activity over the next 20 years in the East marine plan areas, helping to achieve the United Kingdom's energy security and carbon reduction objectives.	×	Although the Platypus MFP will be powered by an onboard renewable energy package thus reducing operating emissions, the Project itself does not generate renewable energy for use by other parties. However, the Project has been designed to avoid and minimise interaction with existing offshore wind developments.
4	To reduce deprivation and support vibrant, sustainable communities through improving health and social well-being.	✓	The Project contributes to national and regional economic resilience through employment generation and tax revenues, supporting wider socio-economic benefits. Although offshore in nature, the Project indirectly supports onshore communities through supply chain engagement and infrastructure utilisation including onshore processing at DGT.
5	To conserve heritage assets, nationally protected landscapes and ensure that decisions consider the seascape of the local area.	×	The Project is located offshore, and no designated heritage assets or protected seascapes are present within the Project footprint. Baseline assessment confirms no significant archaeological or cultural heritage constraints. As such, no adverse effects on heritage assets or seascape character are anticipated.
6	To have a healthy, resilient and adaptable marine ecosystem in the East marine plan areas.	✓	A comprehensive EIA has been undertaken to assess potential impacts on the marine environment. The Project incorporates embedded mitigation measures, including minimisation of seabed disturbance and adherence to regulatory controls on discharges to sea and emissions. Residual impacts are assessed as not significant, ensuring that ecosystem structure and function are maintained.

Objective	East Offshore Marine Plan Objective	Applicable	Assessment Against Objective
7	To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas.	✓	The Project has been designed with explicit consideration of ecological sensitivities identified through site-specific surveys. Potential impacts to the seabed, benthic habitats, fish, marine mammals, and seabirds have been assessed, and mitigation measures (e.g. seabed disturbance minimisation, and adherence to JNCC guidance) have been incorporated. The Project avoids significant adverse effects on biodiversity, supporting the objective of conservation and recovery.
8	To support the objectives of Marine Protected Areas (and other designated sites around the coast that overlap, or are adjacent to the East marine plan areas), individually and as part of an ecologically coherent network.	✓	The Project is located within the SNS SAC. The EIA has confirmed no adverse effect on site integrity. SAC Conservation Objectives have been considered, ensuring maintenance of qualifying features, including harbour porpoise populations as well as their prey.
9	To facilitate action on climate change adaptation and mitigation in the East marine plan areas.	✓	The Project incorporates measures to reduce greenhouse gas emissions, including designing the MFP to require low electrical demand, eliminating combustion engines and enabling renewable power; and re-using a decommissioned offshore asset to construct the Platypus MFP. These measures, along with the use of existing infrastructure to export and process hydrocarbons reduces embodied carbon associated with new development. These measures contribute to climate change mitigation in line with Marine Plan objectives.
10	To ensure integration with other plans, and in the regulation and management of key activities and issues, in the East marine plans, and adjacent areas.	✓	The Project has been developed in alignment with relevant marine policies and spatial plans, including the East marine plan, existing infrastructure, designated areas, and other marine users, ensuring integration and compatibility across sectors.
11	To continue to develop the marine evidence base to support implementation, monitoring and review of the East marine plans.	✓	The Project includes comprehensive environmental survey programmes. Perenco are open to making this data available to contribute to the wider marine evidence base, supporting future planning, monitoring, and management of marine activities.
It is acknowledged that in Autumn 2026 public consultation will begin on a Unified East Marine Plan, which will replace the separate inshore and offshore marine plans.			

Overall, the proposed Platypus Development is considered to be in alignment with the objectives of the East Offshore Marine Plan. The Project has been designed to maximise the efficient use of existing infrastructure through the re-use of a decommissioned offshore asset to construct the Platypus MFP, along with the use of existing infrastructure to export and process hydrocarbons (Neptune, Cleeton, and Dimlington), thereby reducing new seabed disturbance and supporting sustainable economic activity within the marine environment.

The design and routing of infrastructure have been informed by environmental and socio-economic constraints, ensuring co-existence with other marine users, including fisheries, shipping, offshore wind developments, and subsea infrastructure. Potential environmental impacts have been assessed through the EIA and, with the application of identified mitigation measures the residual effects are assessed as acceptable.

The proposed Project has also been developed with explicit consideration of designated sites, including the SNS SAC, with the assessment concluding no significant adverse effect on site integrity. In addition, measures to reduce GHG emissions and the re-use of existing infrastructure contribute to climate change mitigation objectives.

Taken together, the proposed Project supports the sustainable use of marine resources, operates within environmental limits, and is compatible with existing and planned marine activities. It is therefore considered compliant with the relevant Marine Plan objectives.

A.2. Marine Strategy Framework Directive (MSFD)

The MSFD establishes a legislative framework for an ecosystem-based approach to the management of human activities, supporting the sustainable use of marine goods and services. Its overarching aim is to achieve and maintain Good Environmental Status (GES) of marine waters.

Following the UK's withdrawal from the European Union, the requirements of the MSFD have been retained in domestic legislation through the Marine Strategy Regulations 2010 (as amended). These regulations continue to provide the framework for protecting and improving the UK marine environment and for achieving GES across UK waters.

The MSFD outlines 11 high level descriptors of GES in Annex I of the Directive. Table A-2 presents an assessment of the proposed Platypus Development against each of the GES descriptors.

Table A-2: Assessment of proposed Platypus Development Against MSFD GES Descriptors.

MSFD: GES Descriptors	Applicable	Assessment Against Descriptor
Descriptor 1: Marine biodiversity		
Biological diversity is maintained and recovered where appropriate. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.	✓	The Project has been informed by comprehensive environmental baseline surveys and scientific literature. Impact assessment demonstrates that, with the mitigation measures identified, there will be no significant adverse effects on the distribution, abundance, or condition of species and habitats. The Project will not compromise biodiversity status and is consistent with maintaining GES.
Descriptor 2: Non-indigenous species		
Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.	✓	All vessels will comply with international maritime regulations, including the Ballast Water Management Convention. Biosecurity measures and vessel management procedures will minimise the risk of introduction or spread of non-indigenous

MSFD: GES Descriptors	Applicable	Assessment Against Descriptor
		species, ensuring no adverse alteration to ecosystem structure or function.
Descriptor 3: Commercial fish and shellfish		
Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.	✓	Potential impacts to commercially important species (e.g. cod and herring) have been assessed, including effects on spawning and nursery grounds. Seabed disturbance and underwater noise impacts are localised and temporary in nature, with recovery expected. The proposed Project will not affect stock sustainability or population structure at the regional scale, supporting continued GES.
Descriptor 4: Food webs		
All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.	✓	The footprint of the proposed Project is limited and will not result in significant loss of habitat or prey resources. Potential effects on lower trophic levels (e.g. plankton, benthos) are localised and transient. As such, existing food web structure and ecological functioning will be maintained, with no disruption to trophic linkages.
Descriptor 5: Eutrophication		
Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters.	✓	The Project will involve the discharges from vessels, drilling operations, and subsea installation operations. Produced water will be reinjected. Vessel discharge will be MARPOL compliant. Drill cuttings discharge modelling indicate that nutrients and contaminants will rapidly disperse and dilute, with no long-term impact on water column quality or seabed conditions. The proposed Project will not contribute to eutrophication or associated ecological effects.
Descriptor 6: Seabed integrity		
Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.	✓	Seabed disturbance associated with installation will be spatially limited and temporary. Benthic habitats are predominantly sand sediments with moderate resilience and recovery potential. Impact assessment concludes no long-term or large-scale impairment of seabed structure or function, maintaining seabed integrity.
Descriptor 7: Hydrographical conditions		
Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.	✓	The Project will not result in permanent alteration of hydrographical conditions (e.g. currents, temperature, and salinity). Infrastructure footprint is limited and does not influence large-scale hydrodynamic processes, such that there will be no adverse ecological effects resulting from altering of hydrographical conditions.

MSFD: GES Descriptors	Applicable	Assessment Against Descriptor
Descriptor 8: Contaminants		
Concentrations of contaminants are at a level not giving rise to pollution effects.	✓	Discharges and emissions have been assessed and will comply with regulatory standards. Drill cuttings discharge modelling demonstrates that contaminant concentrations will remain within acceptable limits and will not give rise to pollution effects in the marine environment. Produced water will be reinjected.
Descriptor 9: Contaminants in seafood		
Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.	✓	Given the limited and controlled nature of discharges, and the rapid dilution of contaminants, the proposed Project does not result on a pathway for bioaccumulation at levels that would affect seafood quality. The proposed Project will not result in exceedance of regulatory thresholds for contaminants in fish or shellfish.
Descriptor 10: Marine litter		
Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	✓	Waste management procedures will be implemented in accordance with MARPOL requirements and industry best practice. Contractor management plans will control materials handling and prevent accidental release of debris. The planned activities associated with the proposed Project will therefore not contribute to marine litter levels.
Descriptor 11: Energy, including underwater noise		
Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.	✓	Underwater noise associated with piling of the Platypus MFP has been modelled and assessed. With implementation of standard mitigation measures (e.g. JNCC guidance), the risk of injury or significant disturbance to marine mammals is low. Operational noise is not expected to result in significant effects. The introduction of energy is therefore expected to remain within levels consistent with GES.

The assessment presented in Table A-2 demonstrates that the proposed Platypus Development is consistent with the objectives of the MFSD and will not compromise the achievement or maintenance of GES across the relevant descriptors. Environmental impacts have been avoided or minimised through project design, regulatory compliance, and embedded mitigation measures, with residual effects assessed to not adversely affect marine ecosystem structure, function, or resilience at local or regional scales.

A.3. Project Contribution to Biodiversity Outcomes

Table A-3 presents an indicative assessment of the proposed Platypus Development against the 23 targets of the GBF, identifying where the Project contributes to GBF outcomes through biodiversity impact avoidance, minimisation, management and reporting. The assessment also highlights how relevant GBF targets align with the objectives of the UK NBSAP, which sets out the UK's approach to implementation of the GBF.

The following targets are not applicable to the proposed Platypus Development and are therefore not included in Table A-3:

- GBF Target 2 Restore 30% of all Degraded Ecosystems.

- GBF Target 5 Ensure Sustainable, Safe and Legal Harvesting and Trade of Wild Species.
- GBF Target 10 Enhance Biodiversity and Sustainability in Agriculture, Aquaculture, Fisheries, and Forestry.
- GBF Target 11 Restore, Maintain and Enhance Nature's Contributions to People.
- GBF Target 12 Enhance Green Spaces and Urban Planning for Human Well-Being and Biodiversity.
- GBF Target 13 Increase the Sharing of Benefits From Genetic Resources, Digital Sequence Information and Traditional Knowledge.
- GBF Target 17 Strengthen Biosafety and Distribute the Benefits of Biotechnology.
- GBF Target 18 Reduce Harmful Incentives by at Least $500 Billion per Year, and Scale Up Positive Incentives for Biodiversity.
- GBF Target 19 Mobilize $200 Billion per Year for Biodiversity From all Sources, Including $30 Billion Through International Finance.
- GBF Target 23 Ensure Gender Equality and a Gender-Responsive Approach for Biodiversity Action.

Table A-3: Assessment of the proposed Platypus Development against relevant GBF Biodiversity Targets.

Relevant UK NBSAP Theme	Target Description	Assessment of Proposed Project Against Target
GBF Target 1 Plan and Manage all Areas to Reduce Biodiversity Loss		
Mainstreaming biodiversity into decision-making and spatial planning	Ensure that all areas are under participatory, integrated and biodiversity inclusive spatial planning and/or effective management processes addressing land- and sea-use change, to bring the loss of areas of high biodiversity importance, including ecosystems of high ecological integrity, close to zero by 2030, while respecting the rights of indigenous peoples and local communities.	The proposed Platypus Development has been designed and assessed within the framework of UK marine spatial planning and regulatory requirements. Potential impacts on marine habitats, benthic communities, protected species and protected areas have been assessed through the EIA process and compliance with NMP policies is demonstrated in Table A-1. Project design has sought to minimise biodiversity loss through optimisation of infrastructure layout, use of existing Neptune and Cleeton infrastructure, minimising seabed footprint, and the preference for trenching and burying the pipeline.
GBF Target 3 Conserve 30% of Land, Waters and Seas		
Protected areas and effective conservation	Ensure and enable that by 2030 at least 30 per cent of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing indigenous and traditional territories, where applicable, and integrated into wider landscapes, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognising and respecting the rights of indigenous peoples and local communities, including over their traditional territories.	The proposed Platypus Development has assessed potential impacts on designated sites and protected features, including the Southern North Sea SAC. The EIA demonstrates consideration of conservation objectives relating to supporting habitats, ecological processes and prey resources. Project design and mitigation measures have been developed to minimise impacts on protected habitats and species.
GBF Target 4 Halt Species Extinction, Protect Genetic Diversity, and Manage Human-Wildlife Conflicts		
Species recovery and conservation	Ensure urgent management actions to halt human induced extinction of known threatened species and for the recovery and conservation of species, in particular threatened species, to significantly reduce extinction risk, as well as to maintain and restore the genetic diversity within and between populations of native, wild and domesticated species to maintain their adaptive potential, including through in situ and ex situ conservation and sustainable management practices, and effectively manage human-wildlife interactions to minimize human-wildlife conflict for coexistence.	The proposed Platypus Development has undertaken detailed assessment of potential impacts on marine mammals, fish, seabirds, benthic communities and species of conservation interest. Design measures minimise disturbance through limiting the overall infrastructure footprint, re-using existing infrastructure and implementing project-specific mitigation measures. Assessment concluded that impacts are generally localised and are not expected to adversely affect species populations or conservation status.
GBF Target 6 Reduce the Introduction of Invasive Alien Species by 50% and Minimize Their Impact		
Invasive non-native species	Eliminate, minimize, reduce and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by identifying and managing	The proposed Platypus Development will utilise industry-standard vessel management practices and comply with applicable international requirements

Relevant UK NBSAP Theme	Target Description	Assessment of Proposed Project Against Target
	pathways of the introduction of alien species, preventing the introduction and establishment of priority invasive alien species, reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50 per cent by 2030, and eradicating or controlling invasive alien species, especially in priority sites, such as islands.	relating to biosecurity, ballast water management and waste management. Activities are located within an already industrialised area of the Southern North Sea and are not anticipated to create a significant pathway for introduction or spread of invasive non-native species.
GBF Target 7 Reduce Pollution to Levels That Are Not Harmful to Biodiversity		
Pollution reduction	Reduce pollution risks and the negative impact of pollution from all sources by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects, including: (a) by reducing excess nutrients lost to the environment by at least half, including through more efficient nutrient cycling and use; (b) by reducing the overall risk from pesticides and highly hazardous chemicals by at least half, including through integrated pest management, based on science, taking into account food security and livelihoods; and (c) by preventing, reducing, and working towards eliminating plastic pollution.	Pollution prevention is embedded throughout the proposed Platypus Development design and operation. The EIA includes assessment of drilling discharges, atmospheric emissions, underwater noise, waste generation and accidental events. WBM cuttings are limited to upper hole sections, whilst lower-hole LTOBM will be skipped and shipped to shore for treatment and disposal. Produced water associated with Platypus will be processed and reinjected via existing Cleeton infrastructure, and waste management will follow the waste hierarchy.
GBF Target 8 Minimise the Impacts of Climate Change on Biodiversity and Build Resilience		
Climate change and nature resilience	Minimize the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, including through nature-based solutions and/or ecosystem-based approaches, while minimizing negative and fostering positive impacts of climate action on biodiversity.	The proposed Platypus Development incorporates design measures that reduce GHG emissions relative to a conventional offshore development. These include reuse of approximately 1,220 te of existing jacket and topside structures, tie-back to existing Neptune and Cleeton infrastructure, and operation of the MFP using a renewable power package consisting of wind, solar and battery storage. These measures reduce operational emissions and embodied carbon while minimising additional environmental footprint.
GBF Target 9 Manage Wild Species Sustainably To Benefit People		
Sustainable use of biodiversity	Ensure that the management and use of wild species are sustainable, thereby providing social, economic and environmental benefits for people, especially those in vulnerable situations and those most dependent on biodiversity, including through sustainable biodiversity-based activities, products and services that enhance biodiversity, and protecting and encouraging customary sustainable use by indigenous peoples and local communities.	Although not designed as a biodiversity enhancement measure, establishment of statutory 500 m safety zones around offshore installations may reduce fishing activity immediately surrounding the MFP and associated infrastructure. The proposed Platypus Development does not manage wild species directly; however, infrastructure exclusion areas may provide localised opportunities for habitat recovery and refuge from certain fishing pressures during the operational life of the field. Any such benefits would be incidental and are not relied upon as project mitigation.
GBF Target 14 Integrate Biodiversity in Decision-Making at Every Level		
Mainstreaming biodiversity	Ensure the full integration of biodiversity and its multiple values into policies, regulations, planning and development processes, poverty eradication	Biodiversity considerations have been integrated into Project planning and design through environmental surveys, ENVID workshop, EIA assessment,

Relevant UK NBSAP Theme	Target Description	Assessment of Proposed Project Against Target
into development decisions	strategies, strategic environmental assessments, environmental impact assessments and, as appropriate, national accounting, within and across all levels of government and across all sectors, in particular those with significant impacts on biodiversity, progressively aligning all relevant public and private activities, and fiscal and financial flows with the goals and targets of this framework.	consideration of designated sites and identifying mitigation measures. Potential impacts on habitats and species have been evaluated throughout the proposed Platypus Development and have informed project design and operational controls.
GBF Target 15 Businesses Assess, Disclose and Reduce Biodiversity-Related Risks and Negative Impacts		
Business disclosure and accountability	Take legal, administrative or policy measures to encourage and enable business, and in particular to ensure that large and transnational companies and financial institutions: (a) Regularly monitor, assess, and transparently disclose their risks, dependencies and impacts on biodiversity, including with requirements for all large as well as transnational companies and financial institutions along their operations, supply and value chains, and portfolios; (b) Provide information needed to consumers to promote sustainable consumption patterns; (c) Report on compliance with access and benefit-sharing regulations and measures, as applicable; in order to progressively reduce negative impacts on biodiversity, increase positive impacts, reduce biodiversity-related risks to business and financial institutions, and promote actions to ensure sustainable patterns of production.	This ES contributes information that may support broader ESG reporting and future biodiversity-related disclosure frameworks, including TNFD-aligned reporting, by identifying biodiversity receptors, pressures, impacts and mitigation measures.
GBF Target 16 Enable Sustainable Consumption Choices To Reduce Waste and Overconsumption		
Sustainable consumption and resource efficiency	Ensure that people are encouraged and enabled to make sustainable consumption choices, including by establishing supportive policy, legislative or regulatory frameworks, improving education and access to relevant and accurate information and alternatives, and by 2030, reduce the global footprint of consumption in an equitable manner, including through halving global food waste, significantly reducing overconsumption and substantially reducing waste generation, in order for all people to live well in harmony with Mother Earth.	The proposed Platypus Development applies the waste hierarchy through avoidance, reduction, reuse, recycling and responsible disposal of materials. The development also incorporates significant re-use of existing offshore infrastructure, reducing demand for new steel fabrication and associated resource consumption.
GBF Target 20 Strengthen Capacity-Building, Technology Transfer, and Scientific and Technical Cooperation for Biodiversity		
Evidence, monitoring and	Strengthen capacity-building and development, access to and transfer of technology, and promote development of and access to innovation and technical and scientific cooperation, including through South-South, North-	The proposed Platypus Development contributes to the marine evidence base through collection of environmental survey data, the EIA conducted as part of this ES, and ongoing engagement with regulators and statutory consultees.

Relevant UK NBSAP Theme	Target Description	Assessment of Proposed Project Against Target
capacity building	South and triangular cooperation, to meet the needs for effective implementation, particularly in developing countries, fostering joint technology development and joint scientific research programmes for the conservation and sustainable use of biodiversity and strengthening scientific research and monitoring capacities, commensurate with the ambition of the goals and targets of the Framework.	These activities support knowledge sharing and application of scientific evidence in environmental decision-making.
GBF Target 21 Ensure That Knowledge Is Available and Accessible To Guide Biodiversity Action		
Knowledge sharing and transparency	Ensure that the best available data, information and knowledge are accessible to decision makers, practitioners and the public to guide effective and equitable governance, integrated and participatory management of biodiversity, and to strengthen communication, awareness-raising, education, monitoring, research and knowledge management and, also in this context, traditional knowledge, innovations, practices and technologies of indigenous peoples and local communities should only be accessed with their free, prior and informed consent,[2] in accordance with national legislation.	The environmental survey data, EIA conducted as part of this ES and all other supporting documents (e.g. modelling studies) will contribute to the wider evidence base available to regulators and stakeholders. The ES process promotes transparency and enables access to environmental information relevant to marine biodiversity management.
GBF Target 22 Ensure Participation in Decision-Making and Access to Justice and Information Related to Biodiversity for all		
Participation and stakeholder engagement	Ensure the full, equitable, inclusive, effective and gender-responsive representation and participation in decision-making, and access to justice and information related to biodiversity by indigenous peoples and local communities, respecting their cultures and their rights over lands, territories, resources, and traditional knowledge, as well as by women and girls, children and youth, and persons with disabilities and ensure the full protection of environmental human rights defenders.	The proposed Platypus Development is subject to statutory consultation and regulatory review processes, providing opportunities for stakeholders to access information and contribute to environmental decision-making. Biodiversity-related information is presented through the ES and supporting documentation.

Appendix B – ENVID Table - Aspects Register

Row	Aspect	Source/ Activity	Receptors and Potential impacts	Standard Industry Mitigation	Sensitivity	Magnitude of Effect	Significance	Likelihood (L)	Environmental Risk (L)	Notes on Scoring/Actions/ Comments
Node 1: Vessel Use During Drilling, Installation and Commissioning										
1-1	**Emissions to Air from vessels**	Fuel combustion emissions from vessels (CO_2, CO, SOx, NOx, etc.) and helicopter flights for vessel change overs. Vessels to be used during the project include but are not limited to, a Heavy Lift Jack Up Vessel, tug vessels (4 of), jack up drilling rig, jack up barge, pipelay vessel, ROV vessel, Dive Support Vessel (DSV), Platform Supply Vessel (PSV), standby vessels such as Emergency Response and Rescue Vessels (ERRVs), cargo vessels and environmental survey vessels. Note: Vessel use for the production phase is covered in Node 6.	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	Low-sulphur fuel will be used. Efficient use of vessels, through journey planning and potential use of hybrid supply vessels. Furthermore Perenco aims to use resources as efficiently as possible, thus vessels are not held on standby when unnecessary. Review vessel Common Marine Inspection Documents (CMID) as part of vessel assurance (evidence of maintenance). Vessels will be MARPOL compliant. Optimise helicopter transfers. *(For note: the International Maritime Organisation (IMO) 2020 regulation limits sulphur in ships' fuel oil to a maximum 0.50%. The regulation has been in force globally since 1 January 2020, under IMO's MARPOL treaty, with benefits for the environment and human health from a reduction in sulphur oxides in the air. In addition, the North Sea is an Emission Control Area such that the sulphur content should be a maximum of 0.1%).*						Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.
1-2			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low			As the installation activities will take place offshore the Sensitivity of air quality as a receptor is considered Low (A). The relatively short duration of the vessel campaigns, means the Magnitude Effect of the vessel emissions on air quality is considered Negligible (1) such that the overall Impact Significance is considered Low.
1-3	**Physical Presence of vessels**	Physical presence of vessels	Receptor: Other sea users. Navigation hazard, and restriction of fishing operations.	Optimise vessel use. Consultation with National Federation of Fishermen's Organisations (NFFO) for all operations. Notice to mariners prior to operations starting. A vessel traffic survey/collision risk assessment will be undertaken (as required).	B	2	Low			UK fishing industry and vessels in the area have the capacity to absorb change without a significant impact, however acknowledging the spatial squeeze on fishermen from other users of the sea (i.e. wind farms), their Sensitivity is considered to be Medium (B). The Magnitude of Effect on fishermen is considered Minor (2) such that the overall Impact Significance is therefore considered Low.
1-4			Receptor: Marine mammals. Possible behavioural changes in marine mammals e.g. could be attracted to the vessels or may move away from the area.	Optimise vessel use. Key environmental sensitives (i.e. SNS SAC Summer Area) will be considered during the planning of project timing.	C	1	Low			As marine mammals are considered European Protected Species (EPS) and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), as a receptor their Sensitivity is considered to be High (C). The North Sea is a busy shipping area and has well developed fishing, oil and gas industries and offshore wind farms, such that marine mammals in the region are habituated to the presence of vessels. The Magnitude of Effect on marine mammals is therefore considered Negligible (1) such that the Impact Significance of vessels on marine mammals is considered Low. Note: The project will take place within the summer area of the SNS SAC.
1-5			Receptor: Birds The vessels have the potential to cause displacement of seabirds from foraging habitat and may cause migrating birds to detour from their flight routes.	Optimise vessel use.	B	1	Low			Some birds from the coastal SPAs will feed in the Project area such that Sensitivity of birds as a receptor is considered Medium (B). It should be noted that no nesting birds were identified in the most recent Neptune survey (May 2025). Though evidence suggests that the presence of vessels could cause some bird species to be displaced from their foraging area, the area which they are excluded from is a very small proportion of their overall available habitat as such the impact is not considered to be noticeable. In addition, given the existing oil and gas vessel activity in the area, it is expected that the impact of the vessels on bird migration routes (e.g. they could be attracted to the vessel lights at night) is not significant. Therefore, the Magnitude of Effect on birds is considered Negligible (1) such that the Impact Significance of vessels on birds is considered Low.

1-6	**Discharges to Sea**	General discharges to sea associated with normal vessel operations e.g. domestic sewage, food waste, ballast water and biofouling, discharge of hydrocarbons/ chemicals to sea e.g. from machinery space drainage.	Receptor: Water quality. Water quality in immediate vicinity of discharge may be reduced (deoxygenation), but effects are usually minimised by rapid dilution in receiving body of water and non-continuous discharge.	Efficient use of vessels, through journey planning. Perenco will review vessel CMID as part of vessel assurance and all vessels will be compliant with the Company's MAS. Vessels will be MARPOL compliant. All contracted vessels will originate from countries adhering to the IMO Convention. Perenco's audit procedures will ensure that the contracted vessels ballasting procedures are in line with IMO Convention aimed at preventing associated harmful effects. All discharges of ballast water will be monitored, and records maintained. Jack up vessels routinely test deck water prior to discharge, in cases where legal limits are exceeded deck water is returned to shore and disposed of. Some vessels have Separators onboard which they can use to separate and discharge water. Adherence to OPPC Regulations.	A	1	Low			Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A). As all vessels will be IMO and MARPOL compliant and discharges will be in line with permitted limits, the Magnitude of Effect of any discharges is considered Negligible (1) such that the overall Impact Significance is considered Low.
1-7	**Seabed Disturbance**	Interaction of vessels with the seabed. Jack up vessels will be positioned using anchors. As a worst-case, four jack up vessels have been assumed in total, including HLV for installation (6 legs), jack up (4 legs) for drilling, jack up (4 legs) for brown field and potentially an additional jack up (4 legs) for greenfield modifications if not completed with HLV or drill rig). Jack up vessels will also interact with the sea bed via the spud cans. ROVs may cause kick-up of sand on the seabed, however, due to currents in the area it is not planned to land ROVs on the seabed.	Receptors: Benthic flora and fauna. Seabed disturbance in a small area due to anchors and spud cans resulting in potential impact to benthic flora and fauna.	Vessels using dynamic positioning will be prioritised where possible, given that DP thrusters are not expected to impact the seabed at water depths present in the project location. Pre-rig site survey/deep geotechnical surveys aimed to maximise the safe installation of HDJU and minimise potential for repositioning.	C	2	Moderate			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of Features of Conservation Interest (FOCIs). One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. Therefore, activities impacting the seabed are ranked High (C) given that this would impact harbour porpoise prey. Due to the use of anchors involved in the positioning of jack up vessels, and impact of spud cans on the seabed, the Magnitude of Effect is considered Minor (2) such that the Impact Significance is considered Moderate.
1-8		Deposition of rock (loose) to stabilise jack-up vessels' spud cans. Note that is included as contingency only and may not be required.	Receptors: Benthic flora and fauna and sediments.	Site survey / deep geotechnical surveys aimed to maximise the safe installation of jack up vessels.	C	1	Low			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. Therefore, activities impacting the seabed are ranked High (C) given that this would impact harbour porpoise prey. The Magnitude of Effect on benthic fauna and flora and sediments from the use of loose rock to stabilise the spud cans of Jack Up Vessels is considered to be Negligible (1) as the volume of rock to be used is limited, within the 10s of tonnes range. The Impact Significance on the seabed is therefore considered Low.
1-9	**Underwater Noise**	General vessel noise including dynamic positioning. All vessels will use dynamic positioning at some time during project execution.	Receptors: Marine mammals and fish. Noise from dynamic positioning has the potential to cause disturbance to marine mammals and fish in the form of temporary displacement from the area.	Efficient use of vessels, through efficient journey planning and potential use of hybrid supply vessels.	C	1	Low			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), as a receptor their Sensitivity is considered to be High (C). Similarly some of the fish species in the Project area are classified as FOCIs (e.g. Sand eel, herring, cod, whiting, plaice, mackerel, sole, and spur dog) such that their Sensitivity as a receptor would be considered Medium (B). As worst-case, the High (C) sensitivity ranking has been applied for this line item. The North Sea is a busy shipping area and has well developed fishing and oil and gas industries, such that marine mammals and fish in the region are habituated to the presence of vessels. Any impacts from vessel noise on these receptors is expected to be behavioural rather than physical, such that they may cause marine mammals or fish to vacate the area, however they would be expected to return once the vessels have left the location. Given the short duration of works, proximity to existing shipping lanes and other developments (shipping activity map was referred to during the workshop to inform ranking), the Magnitude of Effect of underwater noise, from vessels, on marine mammals and fish is therefore considered to be Negligible (1) such that the Impact Significance is considered Low.

1-10	**Waste**	General operational waste.	Receptor: Landfill take. Waste to landfill.	Compliance with MARPOL requirements. Perenco will look to vessel owner to minimise all wastes during the project (monthly reporting of waste sent to shore; Waste Management Plan and Waste Record Book; Waste Management Duty of Care audit). Waste minimisation and supply chain management. Waste will be managed in line with the waste hierarchy. Perenco environmental team will undertake audits throughout the project phases.	B	1	Low			Sensitivity of landfill as a receptor is considered Medium (B) as landfill availability is considered a finite resource. MARPOL Annex V applies to all ships/vessels and generally prohibits the discharge of all rubbish/garbage into the sea (there are some exceptions which relate for example to food waste and cleaning agents). As vessels will be compliant with MARPOL, there will be no significant impact offshore. Perenco recognise landfill sites as a finite resource, however as the vessels will have Waste Management Plans (WMPs) in place that will adhere to the waste hierarchy principle of reduce, reuse recycle, the Magnitude of Effect is considered to be Negligible (1) and the Impact Significance is considered Low.
1-11	**Use of Resources**	Fuel for power generation.	Receptor: Resource use Energy use.	Efficient use of vessels. MARPOL compliant. Perenco will review vessel CMID as part of vessel assurance (evidence of maintenance). Optimise vessel use. Work plan in place to minimise drilling time and hence vessel use.	A	1	Low			Sensitivity of fuel availability as a receptor is considered Low (A) as it is abundant. Perenco recognise that hydrocarbon-based fuel is a finite resource, however given the relatively short duration of the proposed vessel activities and the use of MARPOL compliant vessels the Magnitude of Effect of fuel use is considered Negligible (1) such that the Impact Significance is considered Low.
1-12	**Unplanned Events**	Helicopter crash. Loss of Heli fuel to sea.	Receptors: Water quality, and marine flora and fauna. Water quality deterioration impacting on marine flora and flora.	Auditing of helicopter companies to ensure only reputable and approved companies. Civil Aviation Authority (CAA) compliance by contractor. Industry standard mitigations.	C	2	Moderate	Remote	Low	In the event of a helicopter crash it is expected that any released Heli fuel would evaporate quickly and would not come into contact with the seabed. Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A), however considering the SNS SAC and presence of marine mammals (considered to be EPS), Receptor Sensitivity is High (C). Total quantities of Heli fuel will be relatively small (c . 1,120 litres - Bristow Sikorsky S76D) and given the high evaporation rate and offshore location, it is expected that any impacts would be Minor (2) such that the Impact Significance is Moderate. With the application of standard industry mitigation the Likelihood of a helicopter crash occurring is considered Remote and therefore the Environmental Risk is considered to be Low.
1-13		Minor chemical / hydrocarbon spill from vessels.	Receptors: Water quality, and marine flora and fauna. Water quality deterioration impacting on marine flora and flora.	Ship Oil Pollution Emergency Plans (SOPEPs) in place. Optimised quantities of chemicals procured & stored on board. COSHH, Task Hazard Assessments are completed and Material Safety Data Sheets (MSDS) are available. Design features including drip pans, bunded areas, process and hazardous drains. Procedures in place for secondary containment should bunding fail. Spill kits located in close proximity to chemical storage areas. Best practise bunkering procedures. Perenco auditing vessels to ensure all above are in place.	C	1	Low	Possible	Low	Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered High (C). Any impact on water quality from a spill is considered to be localised and have a short term, reversible effect therefore the Magnitude of Effect of a minor spill is considered Negligible (1). With the application of standard industry mitigation the likelihood of a spill occurring is considered possible therefore the Environmental Risk is considered Low.
1-14		Major hydrocarbon/ chemical spillage (i.e. vessel collision and loss of containment).	Receptors: Water quality and marine flora and fauna. Water quality deterioration, impact on marine flora and fauna. Immediate oxygen demand on receiving water with consequential impacts on marine fauna.	Emergency response plans in place including vessel SOPEPs. Experienced staff on board (e.g. experienced ship captain therefore reducing likelihood of human error resulting in collisions). Automatic Identification System (AIS) and zone controlled area.	C	4	High	Remote	Medium	Given the proximity to designated sites, Receptor Sensitivity is considered High (C). Similarly some of the fish species in the Project area are classified as FOCIs (e.g. Sand eel, herring, cod, whiting, plaice, mackerel, sole, and spur dog) such that their Sensitivity as a receptor is considered Medium (B). Birds of conservation importance from the coastal SPAs will disperse into the project area following the breeding season and will feed in the Project area such that Sensitivity of birds as a receptor is also considered Medium (B). As worst-case, the High (C) sensitivity ranking has been applied for this line item. The impact of a loss of fuel inventory is likely to extend beyond the project area and in the event that ULSFO or VLSFOs are used on the vessel or rig there is a likelihood of some beaching and possible transboundary effects given the low evaporation rate. Therefore, the Magnitude of Effect on water quality and marine flora and fauna within is considered Major (4) such that the Impact Significance is considered High. With the application of standard industry mitigation the likelihood of a loss of fuel inventory occurring is considered Remote therefore the environmental risk is considered to be Medium.
1-15			Receptor: Other sea users. Indirect societal impacts to commercial fisheries due to exclusion from fishing grounds, contamination of catch, and shipping impact (re-routing of vessels).		C	4	High	Remote	Medium	Large spills have the potential to impact upon fisheries via exclusion and contamination of catch. Furthermore the shipping industry would be disrupted by shipping lane closures and rerouting. Sensitivity of fisheries and shipping is considered Medium (B). The impact of a loss of fuel inventory is likely to extend beyond the project area and in the event that ULSFO or VLSFOs are used on the vessel or rig there is a likelihood of some beaching and possible transboundary effects given the low evaporation rate. Therefore, the Magnitude of Effect on other sea users (commercial fisheries and shipping) is considered Major (4) such that the Impact Significance is considered High. With the application of standard industry mitigation the likelihood of a loss of fuel inventory occurring is considered Remote therefore the environmental risk is considered to be Medium.
Node 2: Drilling Operations										
2-1	**Emissions to Air**	Emissions associated with vessels captured under Node 1.								

2-2		Flaring resulting in release of GHGs (CH_4, CO_2, SOx, NOx, VOC, NOx and particulates). Flare booms are present on the drilling rig and flaring associated with well clean-up may take place. Note that no extended well test is required.	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	UK Air Quality Standards not exceeded. Real time monitoring of flaring (flow rate of gas - combustion not directly monitored). Clearly defined base sediment water (BSW) (volume of sediments and water returning in gas). Flaring will be limited to bring gas into specification for pipeline, no well testing requirement. Considerations will be given to clean up gas being returned to production rather than flared. Third party verification of well clean up package.						Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.
2-3			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low			As described above (Row 1-2) the Sensitivity of air quality at the offshore location is considered Low (A). The relatively short duration of the flaring activities, means the Magnitude of Effect of the flaring emissions on air quality is considered Negligible (1) such that the overall Impact Significance is considered Low.
2-4	**Physical Presence of drilling rig (HDJU)**	Physical presence of drilling rig The drill rig's Physical Presence has been separated out as it will be in one place for a relatively long time compared with other vessels.	Receptor: Other sea users. Navigation hazard, and restriction of fishing operations.	Perenco will submit required notifications to the Hydrographic Office, Kingfisher and Ministry of Defence (MoD) such that all other users of the area will be notified. Drilling rig will have marking and lighting as per the Standard Marking Schedule for Offshore Installations. Notice will be sent to the Trinity house of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the rig.	B	2	Low			UK fishing industry and vessels in the area are expected to have the capacity to absorb change without noticeable impact therefore their Sensitivity is considered to be Medium (B). The drilling rig will operate within a 500 m exclusion zone. Any impacts on other sea users are considered Minor (2) and the Impact Significance is considered Low. It is recognised that depending on the weather conditions, there is the potential that a temporary rig set down location may be used, however this would be for a limited period of time and therefore is not expected to significantly affect fishing in the area. This will be dependent on weather.
2-5			Receptors: Marine mammals. Possible behavioural changes in marine mammals e.g. could be attracted to the drilling rig or may move away from the area.	Lighting will be minimised as far as practicable.	C	1	Low			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). The Magnitude of Effect on marine mammals of the presence of the drilling rig is considered to be Negligible (1) given that marine mammals in the North Sea are habituated to the presence of vessels and offshore oil and gas structures such that the Impact Significance is considered Low.
2-6			Receptors: Birds The drilling rig has the potential to cause displacement of seabirds from foraging habitat and may cause migrating birds to detour from their flight routes.	Lighting will be minimised as far as practicable.	B	1	Low			Birds from the coastal SPAs feed in the project area such that the Sensitivity of birds as a receptor is considered to be Medium (B). The presence of the drilling rig could cause some bird species to be displaced from their foraging area, however this would represent a very small proportion of their overall available habitat such that the Magnitude of Effect on birds is Low (1) and the Impact Significance of the presence of the drilling rig on birds is considered Low.
2-7	**Discharges to Sea**	Deliberate discharge to sea from drilling operations. Sea water and bentonite sweeps, WBM contaminated cuttings, brine, cement, cementing chemicals and clean-up chemicals all required in the drilling process. Excess cement on seabed. Production water (small quantities) resulting from flowing well to clean up from drilling rig.	Receptor: Seabed habitats	Chemical selection process will aim to select the lowest toxicity chemicals for a given technical requirement. Cement discharge minimised through seabed monitoring via ROV. Chemical permitting process. Oil Discharge Permitting process. Specific muds and cement program. Onboard testing of all fluids prior to discharge. LTOBM contaminated cuttings to be skipped and shipped, no planned discharge. Discharge process will be controlled, maximum rates set that significant changes to the ambient environment are minimised. Specified in CPs.	C	2	Moderate			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. Therefore, activities impacting the sand eels are ranked High (C) given that this would impact harbour porpoise prey. Given the proposed mitigation measures the Magnitude of Effect is considered Minor (2) such that the Impact Significance is considered Moderate.
2-8			Receptor: Water quality		A	1	Low			Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A), The Magnitude of Effect on water quality of drilling related discharges is considered to be Negligible (1) given that the discharges will be rapidly dispersed by currents. The Impact Significance is therefore considered Low.
2-9			Receptor: Marine fauna. Impact on species occurring in the water column.		C	1	Low			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Sensitivity is considered to be High (C). The Magnitude of Effect on faunal receptors of drilling related discharges is considered to be Negligible (1) given that the discharges will be rapidly dispersed by currents. Any effects are unlikely to be measurable and will reverse naturally such that the Impact Significance is considered Low.
2-10		General discharges to sea associated with normal vessel operations (ballast water, grey water) have been covered under Node 1.								
2-11	**Seabed Disturbance**	Impacts associated with the discharged cuttings have been assessed in Discharges to Sea Aspect.								
2-12		Cement plateau on seabed as result of cementing the top holes sections.	Receptor: Marine flora and fauna, sediments. Disturbance to seabed impacting on benthic species.	Visual monitoring of cement operations. ROV to minimise cement patio. Consideration to piled conductors still being given.	C	1	Low			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. The Magnitude of Effect on benthic fauna and flora of the cement discharged at the seabed is considered to be Negligible (1) given the small footprint such that the Impact Significance is considered Low.
2-13	**Noise**	Noise and vibration from drilling.	Receptor: Fish and marine mammals. Generates elevated sound levels which can affect the behaviour of fish and marine mammals in the area.	Minimise rig movements i.e. both wells being drilled during the same campaign.	C	1	Low			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). The North Sea is a busy shipping area and has well developed fishing and oil and gas industries, such that marine mammals and fish in the region are habituated to the presence of noise. Any impacts from drilling related noise on these receptors is expected to be behavioural rather than physical, such that they may cause marine mammals or fish to vacate the area, however they would be expected to return once the rig has left the field. The Magnitude of Effect of underwater noise on marine mammals and fish is therefore considered to be Negligible (1) such that the Impact Significance is considered Low.

2-14	**Waste**	Drill cuttings skipped and shipped.	Receptor: Use of landfill. Land take from use of landfill.	All wastes to be properly segregated for recycling / disposal / treatment. Waste will be dealt with in accordance with regulatory requirements. End of project reporting of waste sent to shore; Waste Management Plan and Waste Record Book; Waste management Duty of Care audit. Adhere to waste hierarchy. Proven Competent waste contractor for handling drill cuttings.	B	1	Low			Sensitivity of landfill as a receptor is considered Medium (B) as landfill availability is considered a finite resource. Perenco recognise landfill sites as a finite resource, however as the rig will have a WMP in place that will adhere to the waste hierarchy principle of reduce, reuse recycle, the Magnitude of Effect is considered to be Negligible (1) and the Impact Significance is considered Low.
2-15	**Use of Resources**	Utilities.	Receptor: Resource use. Use of freshwater - potable supply (used for cement and WBM mixing).	No mitigation measures identified.	A	1	Low			Sensitivity of the use of freshwater, materials and chemicals as a receptor is considered Low (A) as all are considered abundant. Given the abundance of these resources the Magnitude of Effect of freshwater, materials and chemicals use is considered Negligible (1) such that the Impact Significance of resource use during drilling is considered Low.
2-16		Materials for well construction/completion.	Receptor: Resource use. Use of materials such as steel.	Well design optimisation.	A	1	Low			Sensitivity of the use of materials such as steel as a receptor is considered Low (A) as steel is considered abundant. Given the abundance of the resource the Magnitude of Effect is considered Negligible (1) such that the Impact Significance of resource use during drilling is considered Low.
2-17		Drilling mud components and chemicals.	Receptor: Resource use. Use of chemicals.	Materials selection. Chemical use minimised where possible. WBM will be recycled and reused during drilling operations.	A	1	Low			Sensitivity of the use of drilling mud and chemicals as a receptor is considered Low (A) as both are considered abundant. Given the abundance of these resources the Magnitude of Effect is considered Negligible (1) such that the Impact Significance of resource use during drilling is considered Low.
2-18		Well clean-up.	Receptor: Resource use. Use of brine and other chemicals/ hydrocarbons.		A	1	Low			Sensitivity of the use of brine and other chemicals as a receptor is considered Low (A) as all are considered abundant. Given the abundance of these resources the Magnitude of Effect is considered Negligible (1) such that the Impact Significance of resource use during drilling is considered Low.
2-19	**Unplanned Events**	Deck drains. Discharge of hazardous drainage water. Note that this line item relates to discharges from the closed drain system on the rig floor during zero discharge mode during drilling work and hence is assessed here as opposed to under Node 1.	Receptor: Water quality, Marine Mammals, Birds, and fish.	Spill kit availability. Drilling rig audits Bunding and containment for chemical storage.	C	1	Low	Unlikely	Low	Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A). However, as marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). The Magnitude of Effect of small drain discharges is considered to be Negligible (1) such that the Impact Significance is considered Low. The likelihood of discharge of hazardous drainage water occurring is considered Unlikely and the Environmental Risk is considered to be Low.
2-20		Accidental Release of LTOBM / WBM, hydrocarbons / chemicals to sea.	Receptor: Water quality, Marine Mammals, Birds, and fish.	Maintenance and work procedures in place. There will be an approved OPEP in place. A rig Health, Safety and Environment Management System audit will ensure contractor has procedure in place to deal with a spill. For local response, dispersant available on board standby vessel. Good hose management. Spill kit availability, drill rig audits, bunding. Bunkering procedures developed in line with Best Practice Guidance. Continuous monitoring during bunkering.	C	3	Moderate	Unlikely	Medium	Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A). However, as marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). The Magnitude of Effect of an unplanned release during bunkering of WBM/LTOBM/chemicals/hydrocarbons is considered to be Serious (3). The Impact Significance is considered Moderate. With the application of standard industry mitigation the likelihood of an unplanned release during bunkering is considered Unlikely therefore the Environmental Risk is considered to be Medium.
2-21		Well blowout. Uncontrolled hydrocarbon (condensate) flow to surface. Note that although a blowout would result in release of both gas and condensate at the same time, these components have been considered in separate line items due to impacting different receptors.	Receptors: Water quality deterioration, Sediment quality deterioration, potentially impacting on plankton, benthic fauna and flora, fish, marine mammals and coastal protected sites and fisheries and aquaculture.	Well design & planning. Drill contractor/ drill rig procedures. Well examination schemes. Compliance with Regulations & Best Practice. Regular BOP testing. Rig designed to be in accordance with IP17 Planning relief well. Crew competence. Audit of drilling contractor. There will be an approved OPEP in place. Safety and Environment Management System audit. Member of OSRL and OPOL.	C	2	Moderate	Remote	Low	Given the presence of marine mammals (EPS), FOCI species (fish), protected areas (SNS SAC and coastal SPAs) the Receptor Sensitivity is considered High (C). Whilst a company intervention would be required to secure the well, impacts from small volumes of condensate released to the water column would result in limited impact to the marine environment and receptors therein, and therefore the Magnitude of Effect is considered Minor (2) such that Impact Significance of a blowout and resultant condensate release on water quality, sediments, and marine fauna is considered Moderate. With the application of standard industry mitigation the likelihood of a blowout occurring is considered Remote therefore the environmental risk is considered to be Low.

2-22		Well blowout. Uncontrolled hydrocarbon (gas) flow to surface. Note that although a blowout would result in release of both gas and condensate at the same time, these components have been considered in separate line items due to impacting different receptors.	Receptor: Climate change. Emissions to atmosphere result in a contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	Well design & planning. Drill contractor / drill rig procedures. Well examination schemes. Compliance with Regulations & Best Practice. Regular BOP testing. Rig designed to be in accordance with IP17. Planning relief well. Crew competence. Audit of drilling contractor. Safety and Environment Management System audit. Member of OSRL and OPOL.	D	3	High	Remote	Medium	The Sensitivity of climate change as a receptor is considered Very High (D) in line with 2021 Climate Change Report produced by the Intergovernmental Panel on Climate Change. A well blowout would result in an uncontrolled flow of gas being released to the atmosphere, as the flow would continue until the well was killed via the drilling of a relief well. Perenco acknowledges that the atmospheric emissions would contribute to climate change, thus the Magnitude of Effect is considered to be Serious (3) such that the overall Impact Significance is considered High. With the application of standard industry mitigation the likelihood of a blowout occurring is considered Remote therefore the environmental risk is considered to be Medium.
2-23		Dropped Objects e.g. string, drill pipe, drill pipe dropped during transfer from PSV.	Receptor: marine flora and fauna. Disturbance to seabed impacting on benthic species.	Risk assessment prior to equipment transfer. Safe handling zones identified. Double securing of heavy lift items. Adhere to LOLER (Lifting Operations and lifting equipment regulations).	C	1	Low	Possible	Low	Due to presence of FOCIs and high density of sand eels (prey species for harbour porpoise as feature of SNS SAC), Receptor Sensitivity is considered High (C). The Magnitude of Effect of a dropped object is considered Negligible (1) given the relatively small size of any of the objects that could be dropped. The Impact Significance is therefore considered Low. Likelihood of an object being dropped during drilling activities is considered Possible, such that the Environmental Risk is considered Low.
Node 3: MFP installation										
3-1	**Emissions to Air**	Emissions associated with vessel use for installation are considered in Node 1.								
3-2	**Physical Presence**	Physical Presence of installation vessels is covered in Node 1.								
3-3		Physical presence of the MFP installation	Receptor: Other sea users. Navigation hazard, and restriction of fishing operations.	Perenco will submit required notifications to the Hydrographic Office, Kingfisher and Ministry of Defence (MoD) such that all other users of the area will be notified. MCA notified. Platform will have marking and lighting as per the Standard Marking Schedule for Offshore Installations. Notice will be sent to the Trinity house of platform installation. 500 m exclusion zone. Navigational risk assessment.	B	2	Low			UK fishing industry and vessels in the area are expected to have the capacity to absorb change without noticeable impact therefore their Sensitivity is considered to be Medium (B). The platform will have a 500 m exclusion zone. Magnitude of Impact of any impacts on other sea users are considered Minor (2) and the Impact Significance is considered Low.
3-4			Receptors: Marine mammals. Possible behavioural changes in marine mammals e.g. could be attracted to the platform or may move away from the area.	Lighting will be minimised as far as practicable.	C	1	Low			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). The Magnitude of Effect on marine mammals of the presence of the platform at the offshore location is considered to be Negligible (1) given that marine mammals in the North Sea are habituated to the presence of offshore oil and gas structures such that the Impact Significance is considered Low.
3-5			Receptors: Birds The platform has the potential to cause displacement of seabirds from foraging habitat and may cause migrating birds to detour from their flight routes.	Lighting will be minimised as far as practicable.	B	1	Low			Birds from the coastal SPAs feed in the project area such that the Sensitivity of birds as a receptor is considered to be Medium (B). The presence of the platform could cause some bird species to be displaced from their foraging area, however this would represent a very small proportion of their overall available habitat such that the Magnitude of Effect on birds is Low (1) and the Impact Significance of the presence of the MFP on birds is considered Low.
3-6	**Discharges to Sea**	Discharges to sea from vessels during platform installation are covered in Node 1.								
3-7	**Seabed Disturbance**	Jacket installation	Receptor: Seabed habitat/ benthic flora and fauna. Seabed disturbance in a small area associated with jacket legs with mud mats and piles (four legged jacket).	Pre-installation survey. Jacket to be lifted from deck and lowered straight to final location.	C	1	Low			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. The Magnitude of Effect on benthic fauna and flora of jacket legs is considered Negligible (1) given the small area of impact. The Impact Significance of jacket installation on the seabed and benthic flora and fauna is therefore considered Low.
3-8	**Noise**	Underwater noise associated with vessels supporting platform installation is considered in Node 1.								
3-9		Piling of platform jacket	Receptors: Marine mammals and fish. Noise from piling has the potential to cause disturbance to marine mammals and fish in the form of temporary displacement from the area.	Adherence to JNCC guidance: Marine Mammal Observers, PAM, soft start. Modelling of underwater noise from piling will be used to ensure that JNCC guidance is adhered to. SIMOPS underwater noise working group - minimising cumulative noise impact on the SNS SAC.	C	2	Moderate			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). Given adherence to JNCC guidance the Magnitude of Effect is considered Minor (2) such that the Impact Significance is Moderate.
3-10	**Waste**	Routine vessel waste during installation is considered in Node 1.								

3-11		General installation waste including scrap metal, wooden crates etc.	Receptor: Use of landfill. Land take from use of landfill.	All wastes to be properly segregated for recycling / disposal onshore. Waste will be dealt with in accordance with regulatory requirements. Contractors will be audited to ensure above. Managed inline with the Waste hierarchy. Offshore waste is minimised by large percentage of construction operations completed onshore.	B	1	Low			Sensitivity of landfill as a receptor is considered Medium (B) as landfill availability is considered a finite resource. Perenco recognise landfill sites as a finite resource, however the majority of waste will be recycled and the installation vessels will have a WMP in place that will adhere to the waste hierarchy principle of reduce, reuse recycle. The Magnitude of Effect is therefore considered Negligible (1) and the Impact Significance is considered Low.
3-12	**Use of Resources**	Fuel use associated with MFP installation vessels is covered under Node 1 Vessel Use.								
3-13		Additional construction materials required, including topsides equipment, piles, and materials used in renewable package (wind turbines, solar panel). Note that jacket and primary topside structure are not included here given planned re-use of existing structures.	Receptor: Resource use. Use of materials such as steel and rare earth metals (finite materials).	Topside facilities design. Pile design.	A	1	Low			Sensitivity of the use of materials (e.g. steel) is considered Low (A) as availability is considered relatively abundant. It was noted during the workshop that materials involved in construction of wind turbines and solar panels are considered plentiful and are easily sourced. Given the abundance of these resources the Magnitude of Effect of materials is considered Negligible (1) such that the Impact Significance of resource use is considered Low.
3-14		Re-use of steel jacket and topside frame from existing NUI.	Receptor: Resource use.	Re-use of existing jacket, forgoing the need to manufacture and construct a new steel jacket and topside frame.	A	0	Positive			Sensitivity of the use of materials (e.g. steel) is considered Low (A) as availability is considered relatively abundant. Given that an existing jacket will be re-used, forgoing the need to manufacture new steel, the Magnitude of Effect of materials is considered Positive / No Effect (0) such that the Impact Significance of resource use is considered Positive (0).
3-15	**Unplanned Events**	Accidental events associated with vessel use is covered under Node 1.								
3-16		Dropped Object - small object.	Receptor: Seabed habitat/ benthic flora and fauna.	Compliance with LOLER (lifting procedures in place). Marine warranty surveyor. Transportation analysis.	C	1	Low	Possible	Low	Due to presence of FOCIs and high density of sand eels and that the project is within the SNS SAC, Receptor Sensitivity is considered High (C). The Magnitude of Effect of a dropped object is considered Negligible (1) given the relatively small size of any of the objects that could be dropped and the fact that there are no live lines in the vicinity of operations at the time of installation, meaning there is no risk of rupture. The Impact Significance is therefore considered Low. Likelihood of an object being dropped during activities is considered Possible, such that the Environmental Risk is considered Low.
3-17		Dropped Object - large object, such as the MPF itself (topsides + Jacket).	Receptor: Seabed habitat/ benthic flora and fauna.	Compliance with LOLER (lifting procedures in place). Marine warranty surveyor. Transportation analysis.	C	3	Moderate	Remote	Low	Due to presence of FOCIs and high density of Sand eels and that the project is within the SNS SAC receptor Sensitivity is considered High (C). The Magnitude of Effect of dropping the MFP is considered Serious (3) given it's size. The Impact Significance is therefore considered Moderate. Likelihood of the MFP being dropped during installation is considered Remote, such that the Environmental Risk is considered Low. Note the MFP will be mobilised without fluids onboard, such that there is not risk of a spill.
Node 4: Pipelines, umbilical and subsea structure installation										
4-1	**Emissions to Air**	Atmospheric emissions associated with the subsea infrastructure installation vessels are covered under Node 1 Vessel Use.								
4-2	**Physical Presence**	Physical Presence of installation vessels is covered under Node 1 Vessel Use.								
4-3		Physical presence of subsea infrastructure	Receptor: Fisheries. Navigation hazard, restriction of fishing operations, snagging risk to fishing nets.	Early consultation with NFFO. Confirmation of safe seabed for fishing trawlability. Minimisation of footprint through design. Will comply with PWA notification requirements. Pipeline routes added to admiralty charts, Kingfisher database, etc. Consent to Locate will be submitted. Pipelines and umbilical will be trenched and buried. 500 m zone around Platypus and Neptune. All spools, mattresses, RFU (rock filled units), and grout bags located within 500 m zones.	B	1	Low			Landings and fishing effort data suggests that the proposed project occurs in an area that is relatively important to the UK fishing industry, however the UK fishing industry and vessels in the area have the capacity to absorb change without noticeable impact therefore their Sensitivity is considered to be Medium (B). The long-term permanent presence of the new infrastructure out with the 500 m safety zones may cause a nuisance to commercial fisheries if they become unburied. Access to fishing grounds will be temporarily inhibited from the installation activities but this will be short term, the Magnitude of Effect on fisheries is considered therefore Negligible (1) such that the overall Impact Significance is considered Low.
4-4			Receptor: Marine flora and fauna. Impacts following installation. Impact associated with installation activities are covered in the seabed disturbance rows.	There are no mid-line crossings present.	C	1	Low			Due to the presence FOCIs (fish), Receptor Sensitivity is considered High (C). Following installation, the Magnitude of Effect on benthic species from installation activities is considered to be Negligible (1) given that the habitats are not unique to the North Sea and recolonisation of the area will occur once the pipelines and umbilicals are buried and therefore the Impact Significance is considered Low.
4-5	**Discharges to Sea**	Discharges to sea associated with the subsea infrastructure installation vessels are covered under Node 1 Vessel Use.								

4-6	**Seabed Disturbance**	Installation of pipelines (production and Methanol lines). Jet trench is preferred installation method, however mechanical plough and backfill has been assessed as worst-case.	Receptor: Seabed habitat/ benthic flora and fauna. Seabed disturbance, temporary suspended solids, impact on benthic organisms.	Pipeline and umbilical route surveys. Trench and bury prioritised over rock cover. The Project Team will continue to explore the option to lay the two lines in the same trench. Within 500 m zones mattresses, RFUs and grout bags selected over rock cover. Potential for addition of rock where target trench depth cannot be reached.	C	3	Moderate			It is assumed as a worst-case that the two lines will be laid in separate trenches. Pipelines and communication cable will be trenched and mechanically buried. Trenches will be cut using a towed plough and mechanically backfilled using a separate towed backfill plough. Seabed will recover naturally once activities are finished. Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. The Magnitude of Effect on benthic flora and fauna from the trenching and burying activities is considered to be Serious (3) given the combined length of the lines, such that the Impact Significance is considered Moderate.
4-7		Dead Man Anchors (DMAs) to stabilise pipeline temporarily.	Receptor: Seabed habitat/ benthic flora and fauna. Sand eels	Minimise use of DMAs.	C	1	Low			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. The Magnitude of Effect on benthic species from installation activities is considered to be Negligible (1) given the very small area of seabed to impacted and that the DMAs will likely be within the disturbance footprint of the trenches. The Impact Significance is considered Low.
4-8		Installation of surface laid spools, mattresses, Rock Filter Units (RFUs) grout bags within the 500 m zones.	Receptor: Seabed habitat/ benthic flora and fauna. Seabed disturbance, loss of habitat, temporary suspended solids, loss of benthic organisms.	Optimising quantity of mattresses and group bags. Assumed that mattresses required in both the Platypus and Neptune 500 m zones. Installation method selected to minimise seabed disturbance.	C	2	Moderate			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. Umbilicals, spools, mattresses and grout bags will all be surface laid within the 500 m safety zones. Area of impact is not considered significant such that Magnitude of Effect is considered Minor (2) and the Impact Significance is Low.
4-9		Contingency rock may be added to pipeline if targeted depth of burial is not achieved.	Receptor: Marine flora and fauna. Seabed disturbance, loss of habitat, temporary suspended solids, loss of benthic organisms.	Pre lay surveys. Installation method selected to minimise seabed disturbance.	C	2	Moderate			Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. One of the SNS SAC Conservation objectives is that the condition of supporting habitats and processes, and the availability of prey is maintained to ensure Harbour porpoises are maintained in a Favourable Conservation Status. Given the relatively sandy habitat, the Magnitude of Effect of the addition of rock cover is considered to be Minor (2) and the Impact Significance is Moderate.
4-10	**Underwater Noise**	Noise associated with subsea installation vessels is covered under Node 1.								
4-11		Noise associated with trenching operations.	Receptor: Marine mammals and fish.		C	1	Low			As above, as a worst-case, it has been assumed that trenching will be undertaken using a mechanical trencher. Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. The Magnitude of Effect of underwater noise generated via trenching is considered to be Negligible (1) and the Impact Significance is Low.
4-12	**Waste**	General vessel waste is covered under Node 1 Vessel Use.								
4-13		General waste from pipelay and installation of infrastructure during routine operations. Note that no scrap metal expected to be generated as a waste product.	Receptor: Use of landfill. Land take from use of landfill.	All wastes to be properly segregated for recycling / disposal onshore. Waste will be dealt with in accordance with regulatory requirements. Contractors will be audited to ensure above.	B	1	Low			Sensitivity of landfill as a receptor is considered Medium (B) as landfill availability is considered a finite resource. Perenco recognise landfill sites as a finite resource, however the majority of waste will be recycled and the installation vessels will have a WMP in place that will adhere to the waste hierarchy principle of reduce, reuse recycle. The Magnitude of Effect is therefore considered Negligible (1) and the Impact Significance is considered Low.
4-14	**Use of Resources**	Fuel use associated with subsea infrastructure installation vessels is covered under Node 1 Vessel Use.								
4-15		Construction of subsea infrastructure.	Receptor: Resource use. Use of materials such as steel.	As part of tendering process carry out vendor prequalification.	A	1	Low			It is acknowledged that the pipelines will be new and constructed for the purposes of the project, as opposed to existing pipelines being re-used. However, sensitivity of the use of materials (e.g. steel) and chemicals as receptors is considered Low (A) as all are considered abundant. Given the abundance of these resources the Magnitude of Effect of materials and chemical use is considered Negligible (1) such that the Impact Significance of resource use during installation of subsea infrastructure is considered Low.
4-16	**Unplanned Events**	Unplanned events impacting on the subsea infrastructure after production has commenced are considered under Production.								
4-17		Failure of installation equipment connection. Loss of hydraulic fluid to sea from pipeline installation equipment.	Receptor: Water quality and marine flora and fauna. Water quality deterioration.	Contractor selection. Follow standard operating procedures and checks.	C	1	Low	Possible	Low	Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. The hydraulic fluids will be water-based and will disperse rapidly in the water column to undetectable levels therefore the Magnitude of Effect is considered Negligible (1). With the application of standard industry mitigation the likelihood of a failure of equipment is considered Possible such that the Environmental Risk is considered Low.
4-18		Dropped objects directly to seabed e.g. a section of line, DMA, stabilisation material, etc.	Receptor: marine flora and fauna. Disturbance to seabed impacting on benthic species.	Risk assessment prior to equipment transfer. Safe handling zones identified. Double securing of heavy lift items. Adhere to LOLER (Lifting Operations and lifting equipment regulations).	C	1	Low	Unlikely	Low	Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. The Magnitude of Effect of a dropped object is considered Negligible (1) given the relatively small size of any of the objects that could be dropped. The Impact Significance is therefore considered Low. Likelihood of an object being dropped activities is considered Possible. The Environmental Risk is considered Low.

4-19		Emergency abandonment of pipeline.	Receptor: marine flora and fauna. Disturbance to seabed impacting on benthic species.	Working within weather windows. Vessel operability windows. Vessel assurance process.	C	3	Moderate	Unlikely	Medium	Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. The Magnitude of Effect of an emergency abandonment of the pipeline is considered Serious (3) as during an emergency abandonment the line would be unsecured and potentially move across the seabed. The Impact Significance is therefore considered Moderate. Likelihood of an emergency pipeline abandonment is considered Unlikely. The Environmental Risk is considered Medium.
Node 5: Neptune and Cleeton modifications and tie-in										
5-1	**Emissions to Air**	Atmospheric emissions associated with vessels required for Neptune and Cleeton modifications are covered in Node 1.								
5-2		Emissions associated with venting during tie-in.	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	Forms part of venting permit. Potential to shut in and vent topsides during topside modifications.						Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.
5-3			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low			As described above, the Sensitivity of air quality as a receptor is considered Low (A). The Magnitude of Effect of the venting emissions on air quality is considered Negligible (1) such that the overall Impact Significance is considered Low.
5-4	**Physical Presence**	Physical presence impacts of vessels required for Neptune and Cleeton topside modifications are covered in Node 1.								
5-5	**Discharges to Sea**	Discharges to sea associated with vessels required for Neptune and Cleeton topside modifications are covered in Node 1.								
5-6	**Seabed Disturbance**	No seabed disturbance will occur as a result of Neptune and Cleeton modifications and tie-in.								
5-7	**Noise**	Noise associated with vessels required for Neptune and Cleeton topside modifications are covered in Node 1.								
5-8	**Waste**	General vessel waste is covered under Node 1.								
5-9		General installation waste including scrap metal, wooden crates etc.	Receptor: Use of landfill. Land take from use of landfill.	All wastes to be properly segregated for recycling / disposal onshore. Waste will be dealt with in accordance with regulatory requirements. Contractors will be audited to ensure above. Managed inline with the Waste hierarchy. Offshore waste is minimised by large percentage of construction operations completed onshore.	B	1	Low			Sensitivity of landfill as a receptor is considered Medium (B) as landfill availability is considered a finite resource. Perenco recognise landfill sites as a finite resource, however the majority of waste will be recycled and the installation vessels will have a WMP in place that will adhere to the waste hierarchy principle of reduce, reuse recycle. The Magnitude of Effect is therefore considered Negligible (1) and the Impact Significance is considered Low.
5-10	**Use of Resources**	Additional construction materials for topside modifications e.g. steel.	Receptor: Resource use. Use of materials such as a small quantity of steel.	Modification design.	A	1	Low			Sensitivity of the use of materials (e.g. steel) is considered Low (A) as availability is considered relatively abundant. Given the abundance of these resources the Magnitude of Effect of materials is considered Negligible (1) such that the Impact Significance of resource use is considered Low.
5-11	**Unplanned Events**	Loss of vessel fuel due to collision is covered under Node 1 Vessel Use.								
5-12		Dropped objects within 500 m zone at Neptune.	Receptor: marine flora and fauna. Disturbance to seabed impacting on benthic species.	Risk assessment prior to equipment transfer. Safe handling zones identified. Double securing of heavy lift items. Adhere to LOLER (Lifting Operations and lifting equipment regulations). Pipelines protected by mattresses. Platform crane is on the opposite side to live line.	C	1	Low	Possible	Low	Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. The Magnitude of Effect of a dropped object is considered Negligible (1) given the relatively small size of any of the objects that could be dropped. The Impact Significance is therefore considered Low. Likelihood of an object being dropped during activities is considered Possible, such that the Impact Significance, the Environmental Risk is considered Low. Note: Position of platform cranes (on the opposite side of the platform to live infrastructure) and presence of protective materials mean that aspect has been ranked based on seabed disturbance impacts only, and do not account for a pipeline line rupture.
5-13		Dropped objects within 500 m zone at Cleeton. .	Receptor: marine flora and fauna. Disturbance to seabed impacting on benthic species.	Risk assessment prior to equipment transfer. Safe handling zones identified. Double securing of heavy lift items. Adhere to LOLER (Lifting Operations and lifting equipment regulations). At Cleeton the cranes do not intersect with live lines.	C	1	Low	Possible	Low	Sensitivity is ranked High (C) as the project is located within the SNS SAC, the presence of high density sand eels, and the presence of FOCIs. The Magnitude of Effect of a dropped object is considered Negligible (1) given the relatively small size of any of the objects that could be dropped. The Impact Significance is therefore considered Low. Likelihood of an object being dropped during activities is considered Possible, such that the Impact Significance, the Environmental Risk is considered Low. Ranked based on seabed disturbance impacts, no pipeline line rupture.
Node 6 A: Platypus MFP Commissioning and Production										
6A-1	**Emissions to Air**	Emissions from walk to work vessels and ERRV throughout production (maximum 8 weeks per year). Note that this line item covers ongoing vessel use	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	Design philosophy, minimal supplies and facilities would be required on the walk to work vessel given the platform is a MFP. Minimal visits, minimising time on site. Optimise the number of vessels used for supply and for inspection and maintenance and keep the duration of operations to a technical minimum. UK Air Quality Standards not exceeded.						Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.

6A-2		during production only, installation / commissioning vessels captured under Node	Receptor: Air quality. Possible reduction in local air quality.		A	1	Low			As described above, the Sensitivity of air quality as a receptor is considered Low (A). The Magnitude of Effect of the vessel emissions on air quality is considered Negligible (1) such that the overall Impact Significance is considered Low.
6A-3		Power generation via renewable sources (wind and solar) on the MFP. Note that there is no requirement for back-up diesel generators.	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	Onboard tried and tested Renewable power generation package.						Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.
6A-4			Receptor: Air quality. Possible reduction in local air quality.		A	0	No Effect			As previously described the Sensitivity of air quality as a receptor is considered Low (A). The Magnitude of Effect of the power generation on air quality is considered positive/No Effect (0) such that the overall Impact Significance is considered No Effect (0).
6A-5		Venting emissions during production i.e. during maintenance or annual shut down. Note that there will be zero venting during normal operations.	Receptor: Climate change. Venting occurs during maintenance or annual shut down. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	Forms part of venting permit. During normal operations it is zero venting. Venting only occurs during maintenance or annual shut down. Requirement for pigging of sphering during modifications, for platypus export line during commissioning.						Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.
6A-6			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low			The Sensitivity of air quality as a receptor is considered Low (A). The Magnitude of Effect of venting during production on air quality is considered Negligible (1) such that the overall Impact Significance is considered Low. Note that Neptune to Cleeton pigging is outside project scope.
6A-7		Scope 3 Downstream emissions i.e. use of the product.	Receptor: Climate change	Emissions to Air has been assessed in Chapter 8 of the ES.						The primary source of GHG emissions from the Platypus project are the indirect emissions that will occur at the point of use of the exported products. This will be almost exclusively somewhere in the UK, but the locations cannot be more firmly known. Furthermore, all GHG emissions add to the global atmospheric concentrations of the GHGs and consequently contribute to climate change and its repercussions on all topics in the Schedule 6(5) of the EIA Regulations, including human health, biodiversity, water, land use, air quality. Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.
6A-8		Scope 3 Incremental Emissions Neptune.	Receptor: Climate change							
6A-9		Scope 3 Incremental Emissions Cleeton.	Receptor: Climate change							
6A-10		Scope 3 Incremental Emissions Dimlington. Condensate and gas.	Receptor: Climate change							
6A-11	**Physical Presence**	Physical presence of Platypus MFP Platform infrastructure is considered in Node 3.								
6A-12		Physical presence of Platypus subsea infrastructure is considered in Node 4.								
6A-14		Physical presence of walk to work vessels and ERRV throughout production (maximum 8 weeks per year). Note that this line item covers ongoing vessel use during production only, installation / commissioning vessels captured under Node 1.	Receptor: Fisheries. Navigation hazard, restriction of fishing operations.	Optimise vessel use. Vessel visits for a maximum of 8 weeks annually.	B	1	Low			UK fishing industry and vessels in the area have the capacity to absorb change without a significant impact therefore their Sensitivity is considered to be Medium (B). The Magnitude of Effect on fishermen is considered Negligible (1) such that the overall Impact Significance is therefore considered Low.
6A-15			Receptors: Birds and marine mammals. Possible behavioural changes in marine mammals e.g. could be attracted to the vessels or may move away from the area. The vessels also have the potential to cause displacement of seabirds from foraging habitat and may cause migrating birds to detour from their flight routes.		C	1	Low			As described above, the sensitivity of marine mammals / SNS SAC in the area is considered High (C) and the Sensitivity of birds is considered Medium (B) therefore as a worst-case the High (C) scoring will be applied. The North Sea is a busy shipping area and has well developed fishing, oil and gas industries and offshore wind farms, such that marine mammals in the region are habituated to the presence of vessels. In addition, the evidence for lethal injury from boat collisions with marine mammals suggests that collisions with vessels are very rare (Cetacean Stranding Investigation Programme, 2011). Vessel visits will be infrequent amounting to *c* . 8 weeks annually. The Magnitude of Effect on marine mammals is therefore considered Negligible (1) such that the Impact Significance of vessels on marine mammals is considered Low. Though evidence suggests that the presence of the vessels could cause some bird species to be displaced from their foraging area, the very small proportion of their overall available habitat that will be occupied by the vessels means the impact is not considered to be noticeable. In addition, given the existing oil and gas vessel activity in the area, it is expected that the impact of the vessels on bird migration routes (e.g. they could be attracted to the vessel lights at night) is not significant. Therefore, the Magnitude of Effect on birds is considered Negligible (1) such that the Impact Significance of vessels on birds is considered Low.

6A-16		Wind turbines on MFP	Receptor: Birds Possible behaviour changes and collision risk (bird strike).	No mitigation measures identified.	B	1	Low			Birds may be impacted by wind turbines through collision, displacement from foraging and migration routes, and habitat loss. Given the small size of the wind turbines aboard the Platypus MFP, the most likely impacts of those listed to occur are collision and displacement from foraging area. Collision risk includes physical interaction with the turbines (blades or tower) and interaction with turbulent air (wake) created by the turbines, which may result in birds losing control of their flight resulting in injury or death. Different species of birds react to wind farms in different ways, however in general birds avoid windfarms. The Platypus MFP will have two turbines onboard, such that some avoidance/displacement may be observed by it would be expected that birds frequenting the area would become habituated to the sound/sight of the turbines. Birds from the coastal SPAs feed in the project area such that the Sensitivity of birds as a receptor is considered to be Medium (B). Given the small size of the turbines to be used, the Magnitude of Effect is expected to be Negligible (1). The Impact Significance is considered to be Low.
6A-17		Heating Loop	Receptor: Plankton, fish, algae.	Heating Loop only required during start-up for *c* . 2 hrs.	C	1	Low			During start up of production, due to pressure differentials, the reservoir gas entering the system is too cold for pipeline tolerances. To overcome this, a subsea heating loop will be installed below the platform to warm the gas before export. The loop will use the surrounding seawater to warm the gas to within export limits. After *c* . 2 hrs of production, gas exiting the reservoir has increased in temperature such that the heating loop is no longer required, at this point the heating loop will be shut in until next required. The sea water surrounding the heating loop will cool during operation as the gas warms. This cooling effect, although limited does have the potential to impact upon organisms living within the water column. As the project is within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). Similarly some of the fish species in the Project area are classified as FOCIs (e.g. Sand eel, herring, cod, whiting, plaice, mackerel, sole, and spur dog) such that their Sensitivity as a receptor is also considered Medium (B). As a worst-case, the High (C) scoring will be applied. Given the short duration, infrequent use, and limited area of impact the Magnitude of Effect is considered Negligible (1) such that the overall Impact Significance is considered Low.
6A-18	**Discharges to Sea**	Routine vessel discharges from of walk to work vessels and ERRV throughout production (maximum 8 weeks per year) e.g. domestic sewage, food waste, ballast water.	Receptor: Water quality. Water quality in immediate vicinity of discharge may be reduced (deoxygenation), but effects are usually minimised by rapid dilution in receiving body of water and non-continuous discharge.	Efficient use of vessels, through journey planning. Perenco will review vessel CMID as part of vessel assurance and all vessels will be compliant with the Company's MAS. Vessels will be MARPOL compliant. All contracted vessels will originate from countries adhering to the IMO Convention. Perenco's audit procedures will ensure that the contracted vessels ballasting procedures are in line with IMO Convention aimed at preventing associated harmful effects. All discharges of ballast water will be monitored, and records maintained.	A	1	Low			Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A). As all vessels will be IMO and MARPOL compliant the Magnitude of Effect of any discharges is considered Negligible (1) such that the overall Impact Significance is considered Low.
6A-19		Leak testing. Potential discharge of chemicals during leak testing of pipelines and umbilical.	Receptor: Water quality. Water quality deterioration.	Chemical selection process will aim to select the lowest toxicity chemicals for a given technical requirement. Discharge of fluids, will follow procedures which will minimise environmental impact. All hydraulic fluids will be water-based.	A	1	Low			Pipelines will be filled with water treated with biocide and oxygen scavenger so there is the potential for chemical discharge during leak/ barrier testing. Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A). Chemicals will be PLONOR where possible and disperse rapidly due to currents, the Magnitude of Effect of any discharges is therefore considered Negligible (1) such that the overall Impact Significance is considered Low.
6A-20		Pipeline Commissioning Chemicals	Receptor: Water quality deterioration, benthic flora and fauna and sediments.	Chemical selection process will aim to select the lowest toxicity chemicals for a given technical requirement. Discharge of fluids will follow procedures which will minimise environmental impact. All hydraulic fluids will be water-based.	C	0	No Effect			Pipeline commissioning chemicals will flow back to the Cleeton platform and be injected downhole into the produced water reinjection well such that there are no effects to the marine environment. Sensitivity of receptors is considered High (C). Chemicals will be reinjected downhole such that the Magnitude of Effect is considered No Effect (0) such that the overall Impact Significance is considered No effect.
6A-21	**Seabed Disturbance**	No seabed disturbance will occur as a result of Platypus MFP Commissioning and Production.								
6A-22	**Noise**	General MFP noise and vibrations from wind turbines.	Receptors: Marine mammals and fish, Benthic communities.	Minimise use of vessels, through efficient journey planning and potential use of hybrid supply vessels.	C	1	Low			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). The noise originating from oil and gas installations is not considered to interfere with marine mammals, as such Magnitude of Effect is considered Negligible (1).
6A-23		General vessel noise including dynamic positioning. All vessels will use dynamic positioning at some time during project execution.	Receptors: Marine mammals and fish. Noise from dynamic positioning has the potential to cause disturbance to marine mammals and fish in the form of temporary displacement from the area.	Efficient use of vessels, through efficient journey planning and potential use of hybrid supply vessels.	C	1	Low			As marine mammals are considered EPS and as the proposed activities will take place within the SNS SAC (designated for harbour porpoise), Receptor Sensitivity is considered to be High (C). The North Sea is a busy shipping area and has well developed fishing and oil and gas industries, such that marine mammals and fish in the region are habituated to the presence of vessels. Any impacts from vessel noise on these receptors is expected to be behavioural rather than physical, such that they may cause marine mammals or fish to vacate the area, however they would be expected to return once the vessels have left the location. Given proximity to shipping lanes, and other developments, and short time annually that vessels are present, the Magnitude of Effect is considered to be Negligible (1) such that the Impact Significance is considered Low.

6A-24	**Waste**	General installation waste including scrap metal, wooden crates etc.	Receptor: Use of landfill. Land take from use of landfill.	All wastes to be properly segregated for recycling / disposal onshore. Waste will be dealt with in accordance with regulatory requirements. Contractors will be audited to ensure above. Managed inline with the Waste hierarchy. Offshore waste is minimised by large percentage of construction operations completed onshore.	B	1	Low			Sensitivity of landfill as a receptor is considered Medium (B) as landfill availability is considered a finite resource. Perenco recognise landfill sites as a finite resource, however the majority of waste will be recycled and given that the platform as an MFP and will be unmanned, quantities of waste produced will be minimal. The Magnitude of Effect is therefore considered Negligible (1) and the Impact Significance is considered Low.
6A-25	**Use of Resources**	Fuel use for walk to work vessels and ERRV throughout production (maximum 8 weeks per year).	Receptor: Resource use Resource use e.g. Energy use for power generation.	MARPOL compliant. Perenco will review vessel CMID as part of vessel assurance (evidence of maintenance). Optimise vessel and helicopter use.	A	1	Low			Sensitivity of fuel availability as a receptor is considered Low (A). Perenco recognise that hydrocarbon-based fuel is a finite resource, however given the relatively short duration of the proposed vessel and helicopter activities and the use of MARPOL compliant vessels the Magnitude of Effect of fuel use is considered Negligible (1) such that the Impact Significance is considered Low.
6A-26		Materials for maintenance. Routine maintenance operations.	Receptor: Resource use Resource use e.g. spares, paint, oil.	Material use minimised where possible. Optimise maintenance activities.	A	1	Low			Sensitivity of resource use as a receptor is considered Low (A) as materials for maintenance are abundant. Maintenance activities will be optimised and materials use is thought to be undiscernible so the Magnitude of Effect is considered to be Negligible (1) and the Impact Significance is considered Low.
6A-27		Fuel use for power generation	Receptor: Resource use .	Not required as renewable package to be used.	A	0	Positive			Line item added to reflect positive impact of selecting renewable energy sources and therefore no requirement for fuel resource use.
6A-28		Chemical use including seawater inhibitors during pipeline commissioning.	Receptor: Resource use Use of chemicals.	Chemical use minimised where possible.	A	1	Low			Sensitivity of the use of materials (e.g. steel) and chemicals as receptors is considered Low (A) as all are considered abundant. Given the abundance of these resources the Magnitude of Effect of materials and chemical use is considered Negligible (1) such that the Impact Significance of resource use during drilling is considered Low.
6A-29		Production chemicals. Methanol (corrosion inhibitor carried within methanol).	Receptor: Resource use. Use of chemicals.	Chemical use minimised where possible. Widely available, industry standard chemicals.	A	1	Low			Sensitivity of chemical availability as a receptor is considered Low (A). The use of chemicals will be minimised as far as practicable however due to the development having a field life 18 years, the Magnitude of Effect is considered Negligible (1) and the Impact Significance is considered Low.
6A-30	**Unplanned Events**	Minor chemical/ hydrocarbon spills.	Receptor: Water quality. Water quality deterioration.	Installation operator will be a member of OSRL and OPOL. Optimised quantities procured & stored. COSHH, Task Hazard Assessments are completed and MSDS sheets are available. Design features including drip pans, bunded areas, process and hazardous drains. Procedures in place for secondary containment should bunding fail. Spill kits located in close proximity to chemical storage areas. Contaminated chemical spill kits disposed of onshore. Statutory reporting of all spills.	A	2	Low	Unlikely	Low	Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A). Any impact on water quality from a minor chemical or hydrocarbon spill is considered to be localised and have a short term, reversible effect. Therefore the Magnitude of Effect of such a spill is considered Minor (2). With the application of standard industry mitigation the likelihood of a spill occurring is considered Unlikely therefore the environmental risk is considered to be Low.
6A-31		Pipeline rupture - Due to pipeline corrosion, or fatigue, snagging, or dropped object.	Receptor: Climate Change	Structure protection will be implemented to prolong the life of the equipment. Cathodic protection (corrosion protection). Pipeline routes added to admiralty charts, Kingfisher database, etc. Follow standard operating procedures and checks. Topsides instrumentation will identify drops in pressure, minimising volumes lost. Pipelines will be trenched and buried. Pipeline protection materials (RFUs, mattresses, grout bags) Emergency shutdown valves.	D	2	Moderate	Remote	Low	Climate change is a global receptor and the sensitivity of it is considered Very High (D). A release from a pipeline rupture would contribute to climate change, however the contribution would be smaller than that of a well blowout such that the Magnitude of Effect is considered Minor (2). The overall Impact Significance is considered Moderate. With the application of standard industry mitigation the likelihood of a pipeline rupture is considered Remote such that the Environmental Risk is considered Low. Note: This has been ranked lower than a well blowout due to the presence of riser ESDVs, in the event of a rupture the ESDVs will close limiting the volume of gas released. From the beginning of the release to the end the overall duration is a lot shorter than that of blowout.
6A-32			Receptor: Water quality, Marine Flora and Fauna.		C	1	Low	Remote	Low	Due to location Sensitivity is considered High (C). Any releases at the seabed could result in long term deterioration of sediment quality in vicinity of the rupture such that the Magnitude of Effect is considered Negligible (1) and the Impact Significance is Low. With the application of standard industry mitigation the likelihood of a pipeline rupture is considered Remote such that the Environmental Risk is considered Low. Note: This has been ranked lower than a well blowout due to the presence of riser ESDVs, in the event of a rupture the ESDVs will close limiting the volume of gas released. From the beginning of the release to the end the overall duration is a lot shorter than that of blowout.
6A-33		Scour protection for pipeline	Receptor: Benthic flora and fauna and sediments.	The pipeline will be trenched and buried.	C	2	Moderate	Possible	Medium	The seabed of the Southern North Sea is considered mobile, with features such as sand waves and ripples common across the region. As such there is the potential that buried pipelines may become unburied and require remediatory action. The seabed in the vicinity of Platypus and along the pipeline route is consider to have low mobility, decreasing the chance that lines may become unburied. Due to presence of FOCIs and high sand eel density Receptor Sensitivity is considered High (C). At this time it is not possible to predict the length of line which may become unburied across the lifetime of the project, thus conservatively the Magnitude of Effect is considered Minor (2). The Impact Significance is therefore considered Moderate. Likelihood of unburial is considered Possible, such that the Environmental Risk is considered Medium.

6A-34		Dropped objects resulting in disturbance to seabed.	Receptor: marine flora and fauna. Loss of seabed habitat, smothering of benthic organisms.	Dropped objects retrieved where possible. Risk assessment prior to equipment transfer.	C	1	Low	Possible	Low	Due to presence of FOCIs, high sand eel density, Receptor Sensitivity is considered High (C). The Magnitude of Effect of a dropped object is considered Negligible (1) given the relatively small size of any of the objects that could be dropped. The Impact Significance is therefore considered Low. Likelihood of an object being dropped during activities is considered Possible, such that the Environmental Risk is considered Low.
Node 6 B: Neptune Commissioning and Production										
6B-1	**Emissions to Air**	Vessel Emissions are considered not applicable as Platypus production will not add to this aspect at Neptune.								
6B-2		Venting emissions - GHG Topside boundary venting. Cold vent.	Receptor: Climate change. Venting occurs during maintenance or annual shut down. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	Forms part of venting permit. During normal operations it is zero venting.						Note that a separate and specific methodology has been adopted to assess the impacts of GHG emissions and as such has not been scored during the ENVID. Emissions to Air has been assessed in Chapter 8 of the ES.
6B-3			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low			The Sensitivity of air quality as a receptor is considered Low (A). The Magnitude of Effect of the venting on air quality is considered Negligible (1) such that the overall Impact Significance is considered Low.
6B-4	**Physical Presence**	The platypus development will not add to the physical presence of Neptune.								
6B-5	**Discharges to Sea**	The Platypus development will not add to the Discharges to Sea at Neptune as Hydrocarbons are flowing over Neptune.								
6B-6	**Seabed Disturbance**	No planned additional seabed disturbance associated with production.								
6B-7	**Noise**	Considered not applicable as Platypus production will not add to this aspect at Neptune.								
6B-8	**Waste**	Considered not applicable as Platypus production will not add to this aspect at Neptune.								
6B-9	**Use of Resources**	Considered not applicable as Platypus production will not add to this aspect at Neptune.								
Node 6 C: Cleeton Commissioning and Production										
6C-1	**Emissions to Air**	Vessel Emission are considered not applicable as Platypus production will not add to this aspect at Cleeton.								
6C-2	**Physical Presence**	The platypus development will not add to the physical presence of Cleeton.								
6C-3	**Discharges to Sea**	Produced water reinjection (and associated hydrocarbons, production chemicals).	Receptor: Water quality. Water quality deterioration.	All produced water to be reinjected.	A	0	No effect			In normal operations, produced water will be reinjected into the reservoir via an existing dedicated reinjection well at Cleeton. Given the open nature of the Southern North Sea, the Sensitivity of water quality as a receptor is considered Low (A). Given the proposed mitigation measures the Magnitude of Effect of any produce water discharges is considered Negligible (1) such that the overall Impact Significance is considered Low.
6C-4	**Seabed Disturbance**	No planned additional seabed disturbance associated with production.								
6C-5	**Noise**	Considered not applicable as Platypus production will not add to this aspect at Neptune.								
6C-6	**Waste**	General waste e.g. additional filter changes (double the number of filter changes).	Receptor: Use of landfill. Land take from use of landfill.	Waste Management Plan and controlled waste transfer notes; Waste management Duty of Care audit. Asset targets to reduce waste. Adherence to waste hierarchy.	B	1	Low			Sensitivity of landfill as a receptor is considered Medium (B) as landfill options in the project area are abundant. As the field life is expected to be 20 years, the quantities of waste generated will be more than in previous project phases such that the Magnitude of Effect is considered to be Minor (2) and the Impact Significance is considered Low.
6C-7	**Use of Resources**	Production chemicals. - Corrosion inhibitor and Methanol	Receptor: Resource use. Use of chemicals.	Chemical use minimised where possible.	A	1	Low			Sensitivity of chemical availability as a receptor is considered Low (A). The use of chemicals will be minimised as far as practicable however due to the development having a field life potentially in excess of 20 years, the Magnitude of Effect is considered Negligible (1) and the Impact Significance is considered Low.
6C-8	**Unplanned Events**	Chemical/ hydrocarbon spills: During Bunkering operation.	Receptor: Water quality. Water quality deterioration.	Installation operator will be a member of OSRL and OPOL. Optimised quantities procured & stored. COSHH, Task Hazard Assessments are completed and MSDS sheets are available. Design features including drip pans, bunded areas, process and hazardous drains. Procedures in place for secondary containment should bunding fail. Spill kits located in close proximity to chemical storage areas. Contaminated chemical spill kits disposed of onshore.	A	2	Low	Unlikely	Low	Given the open nature of the North Sea, the Sensitivity of water quality as a receptor is considered Low (A). Any impact on water quality from a minor chemical or hydrocarbon spill is considered to be localised and have a short term, reversible effect. Therefore the Magnitude of Effect of such a spill is considered Minor (2). With the application of standard industry mitigation the likelihood of a spill occurring is considered Unlikely therefore the environmental risk is considered to be Low.

Appendix C – Drill Cuttings Modelling Report

PERENCO

REPORT



Platypus Development Drill Cuttings Modelling

Prepared for: **Perenco**

Prepared by: **Genesis Energies**
www.genesisenergies.com

Project Title: **Platypus Development Environmental Statement**
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ABBREVIATIONS

'	Minute
"	Second/Inch
%	Percent
‰	Parts per thousand
<	Less Than
>	Greater Than
°	Degrees
°C	Degrees centigrade
µg/l	Microgram per litre
µm	Micrometre
atm	Atmosphere
BEIS	Department for Business, Energy and Industrial Strategy (now Department for Energy Security and Net Zero, DESNZ)
CFSR	Climate Forecast System Reanalysis
CHARM	Chemical Hazard Assessment and Risk Method
cm	Centimetre
DREAM	Dose-related Risk and Effects Assessment Model
ED50	European Datum 1950
HYCOM	Hybrid Coordinate Ocean Model
kg/m^3	Kilogram per cubic metre
km	Kilometre
LTOBM	Low toxicity oil based mud
m	Metre
MEMW	Marine Environmental Modelling Workbench
mm	Millimetre
NCEP	National Centre for Environmental Prediction
NMPi	National Marine Plan interactive
PEC	Predicted Environmental Concentration
PEC$_{sed}$	Predicted Environmental Change
PLONOR	Pose little or no risk
PNEC	Predicted No Effect Concentration
PNEC$_{sed}$	Predicted No Effect Change
Pow	Octanol-water partition coefficient

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PSD	Particle Size Distribution
SNS	Southern North Sea
t	Tonnes
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UTM	Universal Transverse Mercator
WBM	Water-Based Mud

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1.0 INTRODUCTION

Perenco are preparing to develop the Platypus Field, located on the UK Continental Shelf (UKCS) in Block 48/1 in the Southern North Sea (SNS), which lies *c.* 67 km from the UK coastline and *c.* 121 km west of the UK/Netherlands median line (Figure 1-1).

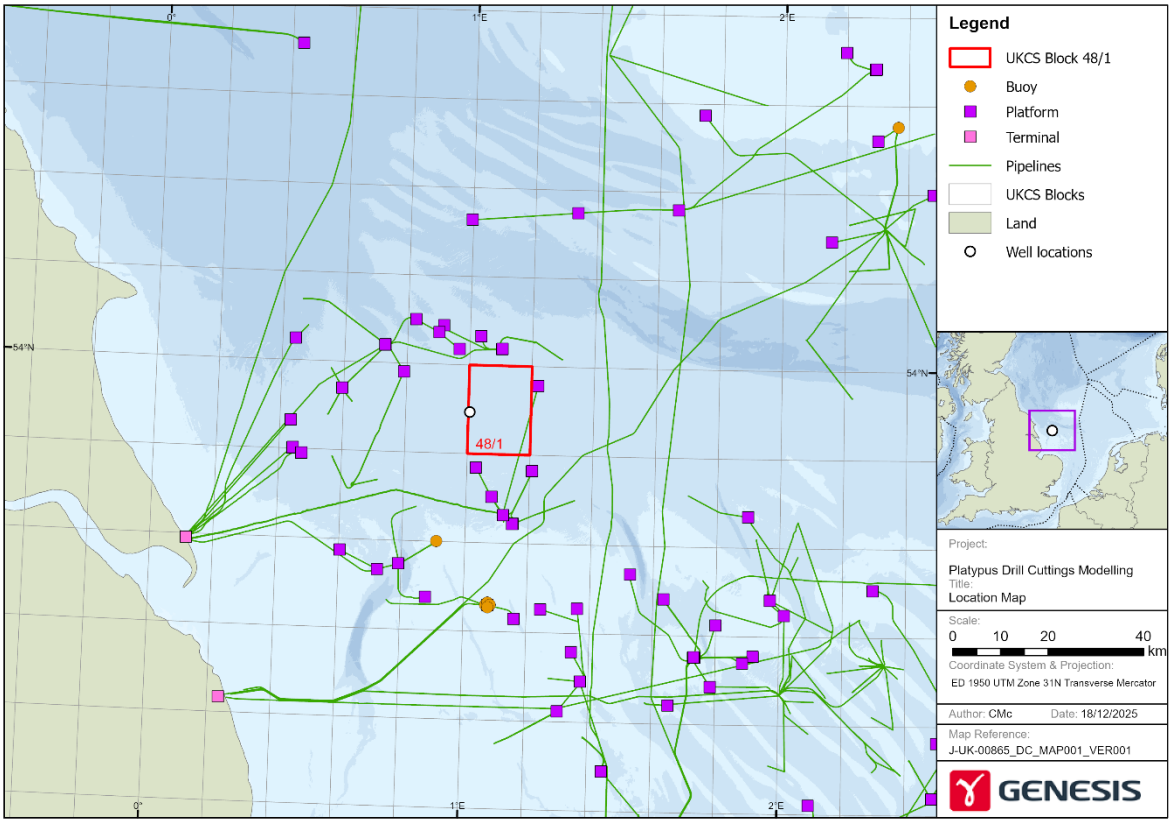


Figure 1-1 Drilling Location

It is proposed to develop the Platypus Field by drilling two wells using a jack up rig. This report details the drill cuttings modelling carried out using the Dose-related Risk and Effect Assessment Model (DREAM) to determine the impact of the discharge of mud and cuttings from these wells. The drill cuttings modelling results presented in this technical note have been used to inform the Environmental Impact Assessment which will be presented in the Environmental Statement.

Drill cuttings modelling was used to predict the fate of discharged cuttings from the wells in terms of:

- Depositional thickness on the seabed;
- Environmental risk to the seabed resulting from burial thickness, grain size change, toxicity and pore water oxygen depletion; and
- Environmental risk in the water column resulting from toxicity and particle stresses.

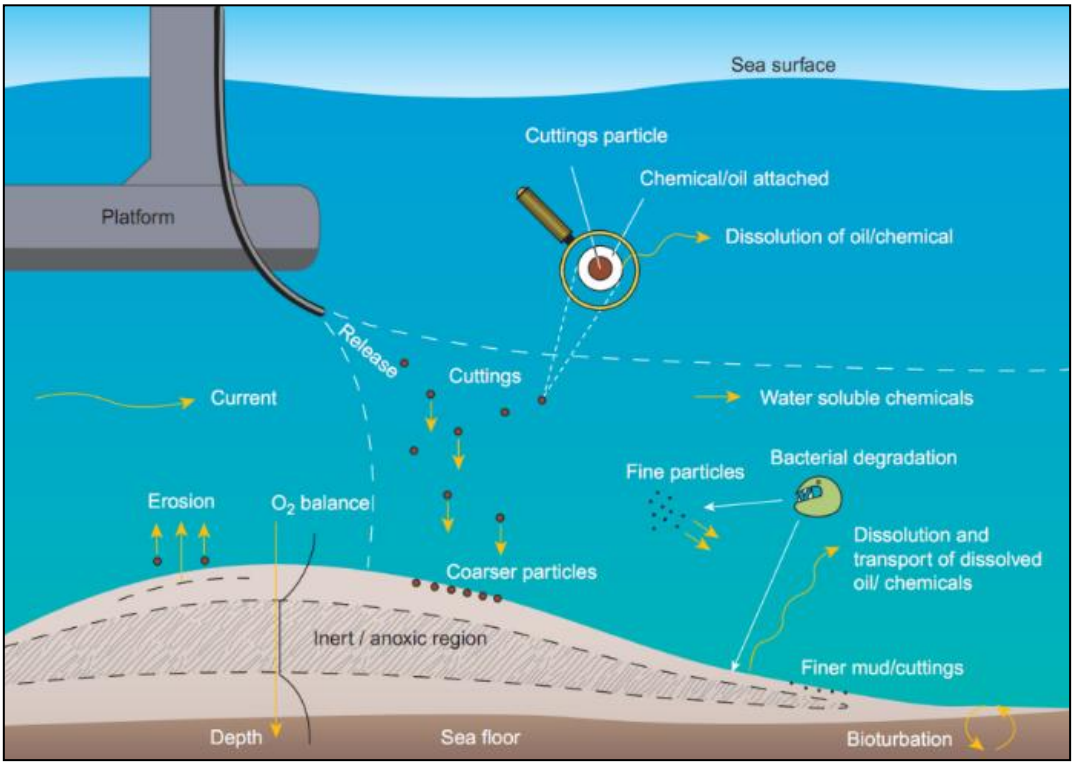
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2.0 OVERVIEW OF THE MODELLING METHODOLOGY

2.1 DREAM/ParTrack

The cuttings discharges were modelled using DREAM published by Sintef, as part of the Marine Environmental Modelling Workbench (MEMW) suite of models, version 15.2. This incorporates the ParTrack sub-model for modelling dispersion and settlement of solids. The model predicts the fate of materials discharged to the marine environment, specifically their dispersion and changes to their physicochemical composition.

The model has been developed to calculate the dispersion and deposition on the seabed of drilling mud and cuttings as well as the dispersion of chemicals in free water masses. The model consists of a plume model and a far-field model. The calculations are based on the "particle" approach, combined with a near field plume model and the application of external current fields for the horizontal advection of the particles. The plume model takes into account effects from water stratification on the near-field mixing, ambient currents and geometrical configuration of the outlet. Once plume advection ceases, particles fall out of the plume and deposit on the seabed. Vertical velocity (rise/fall) of the particles depends on their size and density as well as on the agglomeration of solids in the presence of oil-related components. The far-field model includes the downstream transport and spreading of particles and dissolved matter, once the plume mode is terminated. The processes involved are illustrated in Figure 2-1.



Source: Rye *et al.* (2006)

Note: In this case part of the release will be directly at the seafloor and part at the sea surface.

Figure 2-1 Processes involved in the DREAM model

Model predictions have been validated through field measurements at the Troll-A field in the Norwegian Sea, where reasonably good correspondence was obtained between measured

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and simulated deposition of the cuttings on the sea floor (Rye, 2010; Jødestøl and Furuholt, 2010).

2.2 Risk Assessment Method

The risk assessment method was initially developed for assessing impacts due to the discharge of toxic stressors (i.e. chemicals) to the marine environment or particle stressors (e.g. barite and bentonite) and was primarily intended for the assessment of produced water and other chemical discharges.

The methodology is based on a comparison of modelled concentrations of chemicals in the water column (termed the Predicted Environmental Concentration, (PEC)) and the highest theoretical concentration of the same chemicals at which harmful effects are not expected to occur in marine organisms (termed the Predicted No Effect Concentration, (PNEC)). In cases where the ratio PEC:PNEC exceeds 1, a risk to at least 5% of the most sensitive species occurs. This methodology is used by the DREAM/ParTrack model to calculate the risk to the water column due to toxicity from chemicals in drill cuttings discharges.

The protocol for assessing risks from drill cuttings discharges was further developed by the Environmental Risk Management System joint industry project to include the assessment of risk to seabed sediment and was founded on well-established scientific studies such as those in Smit *et al.* (2006), Trannum (2004), Kjeilen-Eilertsen *et al.* (2004) and Neff (2005). The assessment methodology for sediments is similar to that for the water column and is based on a combined risk approach using the PEC_{sed}:$PNEC_{sed}$ ratio. However, for sediments PEC_{sed} represents the Predicted Environmental Change (as opposed to Predicted Environmental Concentration used for water column), and $PNEC_{sed}$ is the Predicted No Effect Change (as opposed to Predicted No Effect Concentration used for water column). Where PEC_{sed}: $PNEC_{sed}$ exceeds 1, a risk to at least 5% of the most sensitive species occurs. Where there is a risk to less than 5% of the most sensitive species, this is considered a tolerable risk level.

Trannum (2004), Kjeilen-Eilertsen *et al.* (2004) and Neff (2005) established that in the absence of any other stressors sediment risk would exceed 5% when:

- Chemical concentrations in pore water exceeded the PNEC;
- Burial thickness exceeded 6.5 mm;
- Median grain size change exceeded 52.7 µm; and
- Oxygen content was depleted by more than 20%.

The effects of burial include mortality of organisms, reduced growth of some species, reduced larval settlement and changed fauna composition. Effects can be short-term and mainly on an individual level, or they can be more long-term and affecting whole populations (Kjeilen-Eilertsen *et al.,* 2004). In general, the effect of burial mainly depends on the mobility of organisms in the sediment matrix and on the settling rate of particles. Sedentary organisms, which have no or very limited abilities to move, such as attached barnacles or mussels, are very sensitive (Smit *et al.,* 2006).

Following the settlement of drilling particles, benthic communities have been observed to be dominated by opportunistic species which generally are small, with short life spans and high population growth rates. There is considerable variability in species responses to specific sediment characteristics. The factors ultimately controlling infauna distributions may not be sediment grain size *per se* or factors linked to grain size such as organic content, but rather interactions between hydrodynamics, sediments and infauna and how these affect sediment distribution, larval supply, particle flux and pore water chemistry (Smit *et al.,* 2006). DREAM

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uses the change in median grain size to represent the overall changes in sediment characteristics.

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3.0 MODEL INPUT DATA

3.1 Metocean Data

3.1.1 Currents and Winds

The study draws on three-dimensional water column current data (daily resolution) obtained from the Hybrid Coordinate Ocean Model (HYCOM). May 2010 data was used for the model as it is representative of calmer conditions, based on known weather patterns in the North Sea. This approach yields conservative estimates; weaker currents lead to reduced dispersion of cuttings along with reduced dilution and greater thicknesses of deposited cuttings, and potentially higher concentrations of discharged chemicals in the water column.

Further information is given in Section 3.6.1 regarding model uncertainties.

The study draws on two-dimensional wind data obtained from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR). In line with the current data, May 2010 was used.

The wind data is used to generate wave height predictions within the model that feed into surface dispersion and resurfacing calculations.

3.1.2 Temperature and Salinity

Water column temperature and salinity profile information is used in the modelling. Local salinity and temperature data for surface and bottom waters was obtained from Scottish Government's National Marine Plan Interactive (NMPi) maps (Berx and Hughes, 2009). May averages for the area were used in line with the current and wind data.

The average sea temperature varies from 8.88°C at the seabed to 8.39°C at the sea surface. Salinity variation in the water column is minimal and an average value of 34.5‰ was used at the surface and the seabed.

3.2 Bathymetry

Bathymetry data used in the DREAM model is based on the Sea Topo 8.2 database (Jakobsson *et al.,* 2008).

3.3 Seabed Sediments

DREAM requires an average grain size of surrounding sediments to evaluate the change in grain size distribution as a result of the drill cutting discharge. The sediments around the wells are predominantly fine sand (Fugro, 2019), with a median background sediment grain size of 0.19 mm.

3.4 Well Design and Drilling Discharges

Cuttings are to be discharged from the tophole sections of the wells. The lower sections are to be skipped and shipped to shore for treatment and disposal. The model inputs include:

- The well locations;
- The well design and geometry of each section (a single well design has been assumed for both wells);

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- The mass of mud components discharged from each section; and
- An assumed drilling schedule showing the likely drilling duration per section.

3.4.1 Well and Discharge Location(s)

The wells will be drilled from a heavy duty jack up rig. The coordinates of each well are shown in Table 3.1 (these may vary slightly during drilling, but not sufficiently to impact the dispersion modelling results).

Table 3.1 Coordinates of the wells

Well no.	Latitude	Longitude
PLA-NW	53°54'42.670"N	01°00'18.109"E
PLA-SE	53°54'42.630"N	01°00'18.111"E

Coordinate reference system – European Datum 1950 (ED50)

3.4.2 Well Design

The well design comprises of two upper sections, as summarised in Table 3.2, to be drilled using water-based mud (WBM), with the 36” section discharged directly to the seabed and the 17.5” section discharged at the sea surface. Low toxicity oil-based mud (LTOBM) will be used for subsequent lower sections of the wells, and the resulting cuttings will be skipped and shipped for treatment and disposal. Therefore, the discharge of the lower sections is not considered in the model.

It is possible that the section diameters and lengths may change slightly prior to drilling however, this is not expected to significantly change the overall volume of cuttings discharged and therefore would not significantly impact the results of the modelling.

Table 3.2 Well design

Section Diameter (“)	Section Length (m)	Mud Type	Release Depth
36	130	WBM	Seabed
17.5	760	WBM	Sea surface

The following contingencies have been included in the modelling:

- Requirement for re-spuds for each well in the event of unplanned shallow hazards, i.e., additional discharge from 36” and 17.5” sections of each well.

3.4.3 Mud Components

A summary of mud components and the discharged components is shown in Table 3.3.

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Table 3.3 Mud components modelled for each section

Well	Section Diameter (")	Rock Cuttings[1] (t)	Bentonite (t)	Barite (t)
Single well design	36	256.11	0	20
	17.5	325.50	0	80
	Total	**581.61**	**0**	**100**

Notes:

[1] Both sections include a 10% well bore washout.

3.4.4 Added Chemicals and Reservoir Oil

Table 3.4 summarises the primary chemicals used for each well section and the key physico-chemical and toxicological properties of those chemicals are summarised in Table 3.5. Added chemicals that pose little or no risk to the environment (PLONOR) and/or are not amenable to the Chemical Hazard Assessment and Risk Method (CHARM) model, i.e., non-CHARMable chemicals, are not included in the modelling.

Table 3.4 Primary drilling chemicals used in each well section

Chemical (t)	Section		
	36"	17.5"	Total
DUO-VIS	0.125	0.6	**0.725**
GLYDRIL MC	12	44	**56**
Nuosept 78	0.1	0.4	**0.5**

Table 3.5 Physical, chemical and toxicological properties

Component Name	PNEC (µg/l)	Biodegradation		Density (kg/m^3)	Vapour pressure[1]	Solubility[2]	logPow[3]
		Percent (%)	days				
DUO-VIS	207	49	28	1.5	-	Soluble	-0.67
GLYDRIL MC	310	70	28	1.012	-	Soluble	-
Nuosept 78	2.4016	99.99	21	1.16	-	Soluble	-4.05

Notes:

[1] Where no vapour pressure data is available it is assumed to be 1x10^{-6} atm.

[2] All chemicals are soluble in water and therefore a high solubility has been assumed.

[3] $LogP_{OW}$ – log of the octanol-water partition coefficient, Pow – organic carbon-water partition coefficient. Where no LogPow data was available, it was derived from a Pow of 0.001, in line with guidance in Annex 4 of the Risk Based Approach Guidelines (BEIS, 2020).

3.4.5 Particle Size Distribution

The model has a default particle size distribution (PSD) for drill cuttings that was obtained from a review of data from drilling in Norwegian waters during the development of the DREAM/ParTrack model (Saga, 1994). PSDs for barite and bentonite in the model are based on industry standard distributions. Table 3.6 summarises the cuttings PSD used in the model.

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Table 3.6 Cuttings PSD (model default)

Approximate% In Each Size Class[1]	Size Interval (µm)	Fraction (%)	Cumulative Fraction (%)
Fines (silt/clay) Up to 62.5 µm ~50%	1–10	10	10
	10–20	10	20
	20–30	10	30
	30– 45	10	40
	45–60	10	50
Sand 62.5 µm to 2,000 µm ~35%	60–100	10	60
	100–400	10	70
	400–1,000	10	80
Gravel 2,000 to 6,000 µm ~15% Cobbles >6,000 µm (% included in gravel)	1,000–4,000	10	90
	4,000–7,000	10	100

[1] Wentworth Scale (Wentworth, 1922) – note that size intervals used do not exactly match the divisions on the Wentworth scale therefore percentage within each size class is approximate.

3.4.6 Drilling Schedule

The modelled batch drilling schedule for two wells including contingency respuds is illustrated in Figure 3-1 and is compressed compared to the actual proposed drilling time to optimise model run time. The modelled schedule is based on the following assumptions for batch drilling:

- Drilling durations for the tophole sections were calculated by the model based on section length and penetration rate;
- The 36” sections were discharged first (inc. contingencies) followed by the 17.5” sections;
- A 24-hour time gap has been allowed between sections and wells; and
- The model runs for a further five days after drilling is completed to allow for dispersion in the water column.

This gives an overall model run duration of 24 days.

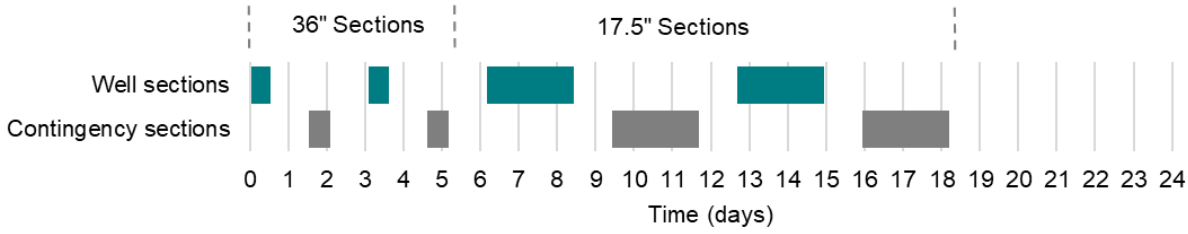


Figure 3-1 Modelled drilling timeline

In reality, the wells will take significantly longer to be drilled than in the model and therefore will allow more time for dispersion between discharges from individual sections. The model set up is thus conservative in that it will potentially result in slightly greater impacts in the water column because there is less time for dispersion between the discharges. Impacts on the seabed are unlikely to be significantly different as a result of the shorter modelled discharge timings, given that seabed recovery takes place over much longer timescales.

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3.5 Model Configuration

A range of grid sizes and model timesteps have been used in order to optimise specific outputs, whilst not resulting in unmanageable model run times.

Different grid sizes were used to evaluate particle dispersion:

- Larger, coarser grid to evaluate risk of impacts to the water column; and
- Smaller, finer grid to evaluate impacts on the seabed.

This reflects the likely extent of particle dispersion. Water column dispersion of dissolved and suspended particles occurs over a wide area, whereas deposition of drill cuttings is a more localised event.

Different timesteps and overall model durations were used to allow short-term and long-term impacts to be investigated. A description of each configuration used is summarised in Table 3.7.

Table 3.7 Model configuration

Aspect	Domain Size	Cell Size	Time Step	Model Duration	Sediment risk model[1]
Water column	40 km × 40 km	100 m × 100 m	30 mins	24 days	Not included
Seabed	1 km × 1 km	10 m × 10 m	30 mins	24 days plus 10 years[2]	Included

[1] Due to the transient nature of risk to the water column, the additional time-series of the sediment risk model is not required [this is standard practice for drill cuttings modelling].

[2] Main DREAM model runs for 21 days using timestep shown, followed by the sediment risk model which was run for 10 years using a 24-hour timestep.

3.6 Model Uncertainties

3.6.1 Metocean Data

Metocean data used was for the year 2010, starting in May, which covers the worst case months when currents are weaker. Use of a different start date or a different set of current data would result in small changes to the precise pattern of cuttings deposition, but the predicted extent of risk is likely to be of a similar magnitude.

3.6.2 Sediment Grain Size

Grain size change is an important parameter and it should be noted that the thresholds for this parameter within the risk assessment are based on the analysis of environmental monitoring data from the Dutch section of the North Sea, the Norwegian Sea and the Barents Sea covering 300 species (Smit *et al.*, 2006). There may be regional differences in prevailing fauna that would give different thresholds for the drilling location. However, the basis of the threshold is considered to represent the best available data and covers a wide range of benthic fauna.

The threshold for burial thickness is based on the probability that a specific species will escape a given depth of burial with both exotic (e.g. drill cuttings) and native sediments. The threshold

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was derived from the burial sensitivity of 33 species (Smit *et al*., 2006 and Kjeilen Eilersten *et al*., 2004).

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4.0 RESULTS

4.1 Terminology

The results of the modelling runs are presented in the following sections in relation to seabed sediment impacts and water column impacts.

The following terms are used throughout:

- The **maximum instantaneous risk** is the area (in the case of seabed sediment) or the volume (in the case of the water column) where the risk to over 5% of the most sensitive species is greatest at a specific point in time during the simulation;
- The **total risk** is the overall area (seabed) or volume (water column) where there has been a risk to over 5% of the most sensitive species at any point in time during the simulation. This can also be referred to as the **cumulative risk**; and
- The maximum instantaneous risk and the total risk can be computed for individual stressors or for all stressors combined. Thus, **combined sediment risk** is the sum of the individual risks resulting from burial thickness, grain size change, oxygen depletion and toxicity of the cuttings.

4.2 Cuttings Thickness

The model predicts a maximum estimated thickness of cuttings around the wells of 0.603 m (602.9 mm) (Figure 4.1 and Figure 4.2). Significant thicknesses (over 6.5 mm) are predicted to occur over an area of 0.0205 km^2 (up to approximately 100 m from the discharge locations). *Arctica islandica* have a high resilience to smothering up to 30 cm (Tyler-Walters & Sabatini, 2017) and thicknesses of over 30 cm are predicted to occur over an area of 0.0024 km^2. To put this into context, a typical exclusion zone around a platform of 500 m radius is equivalent to an area of 0.785 km^2. Over time the area where the thickness is greater than 6.5 mm gradually reduces, this is discussed in Section 4.3.

Very fine particles (<0.5 mm grain size) will spread over larger distances, extending beyond the model domain. The distribution of these very fine particles does not change significantly over time.

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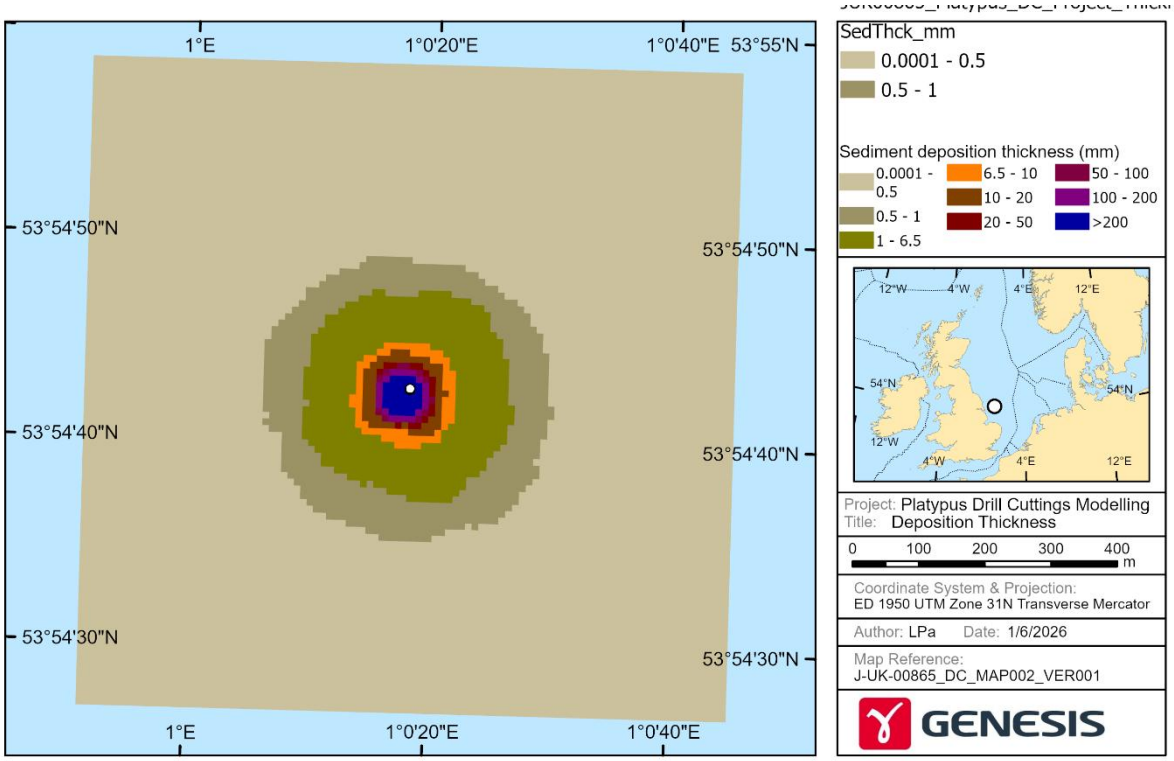
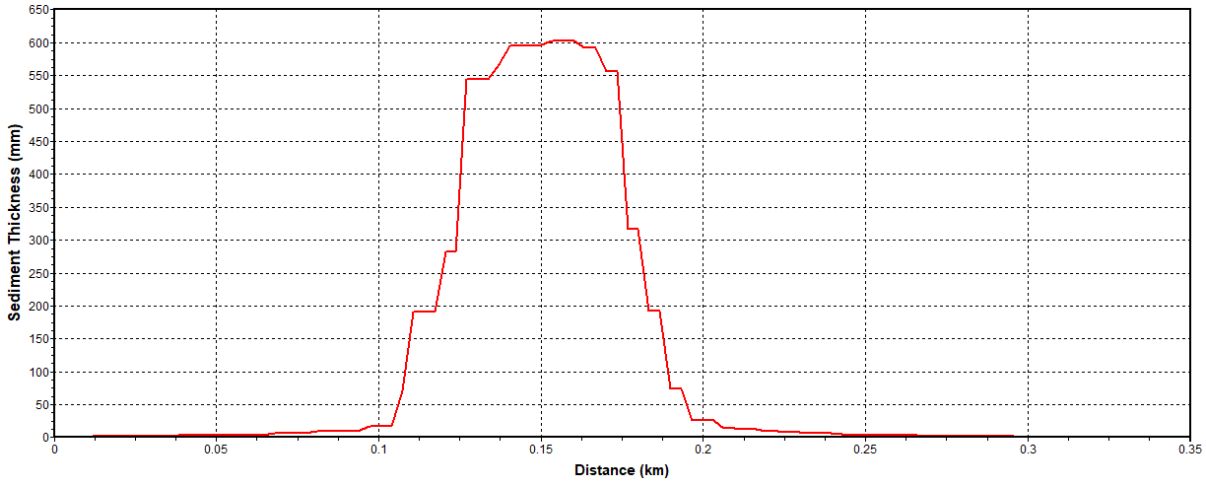


Figure 4-1 Deposition thickness around the drilling location at the end of drilling



Note: Coordinates of cross section: start point (1°00'07"E, 53°54'36"N) and end point (1°00'19"E, 53°54'44"N)

Figure 4-2 West to East cross section of deposition thickness at the end of drilling

4.3 Risk to the Seabed Sediment

Risk to the sediment has been modelled for the duration of drilling and over a 10-year period post drilling. The following sections summarise the predicted risk around the well locations as well as the components making up that risk.

As noted in Section 2.2, combined risk to the seabed sediment is made up of risk contributions resulting from the following stressors:

- Burial thicknesses greater than 6.5 mm;

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- A median grain size change greater than 52.7 µm;
- Oxygen content depletion greater than 20%; and
- Toxicity where chemical concentration exceeds the PNEC.

A risk of less than 5% to the most sensitive species is considered to be tolerable. Figure 4-3 shows the combined sediment risk around the drilling location.

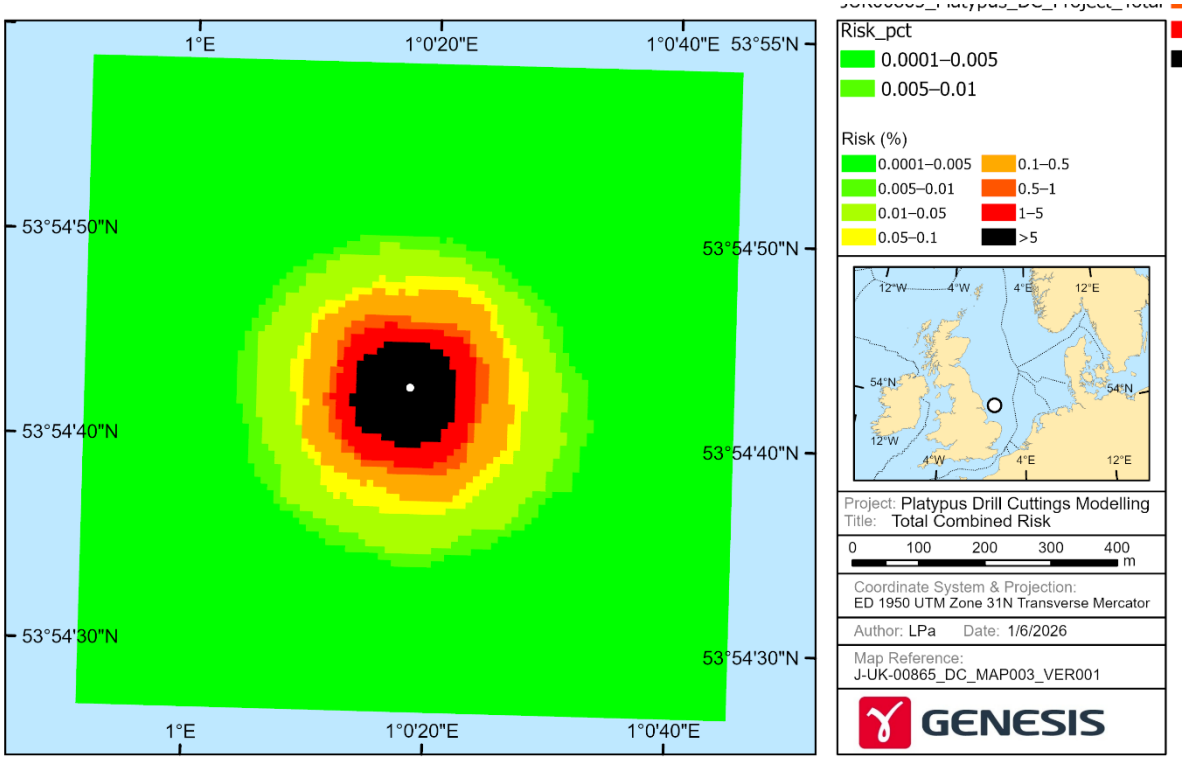


Figure 4-3 Predicted total combined risk to sediments

The contribution to the combined sediment risk can be broken down to establish which stressors are the key contributors. This is shown in Figure 4-4.

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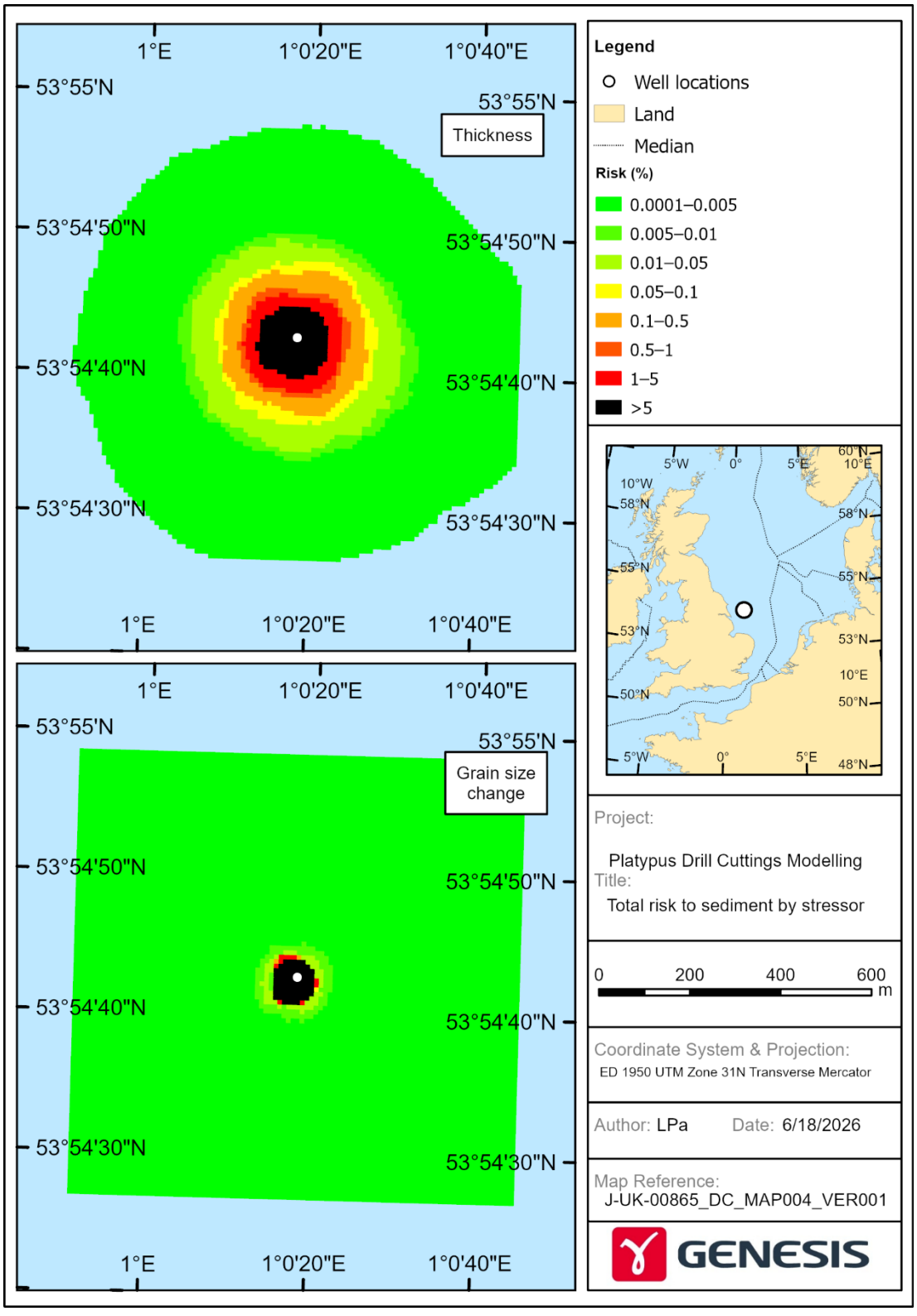


Figure 4-4 Predicted total risk contributions from individual seabed stressors

Time-averaged contributions to risk are summarised in Figure 4.5 and Figure 4.6. The main contributor to the risk is deposition thickness (51.77%) with grain size change making up the remaining risk. There is no contribution to risk from oxygen depletion or toxicity.

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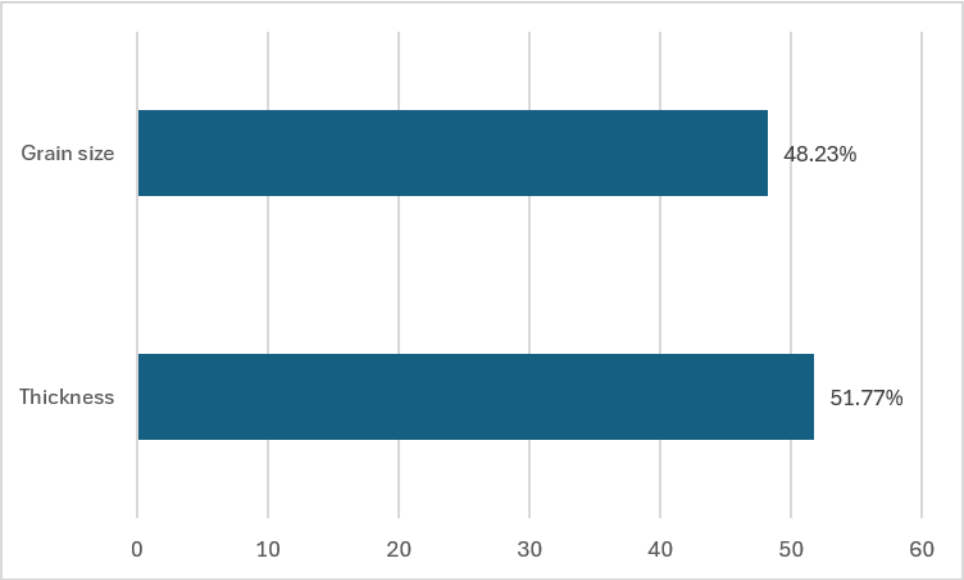


Figure 4-5 Weighted contributions to time averaged risk

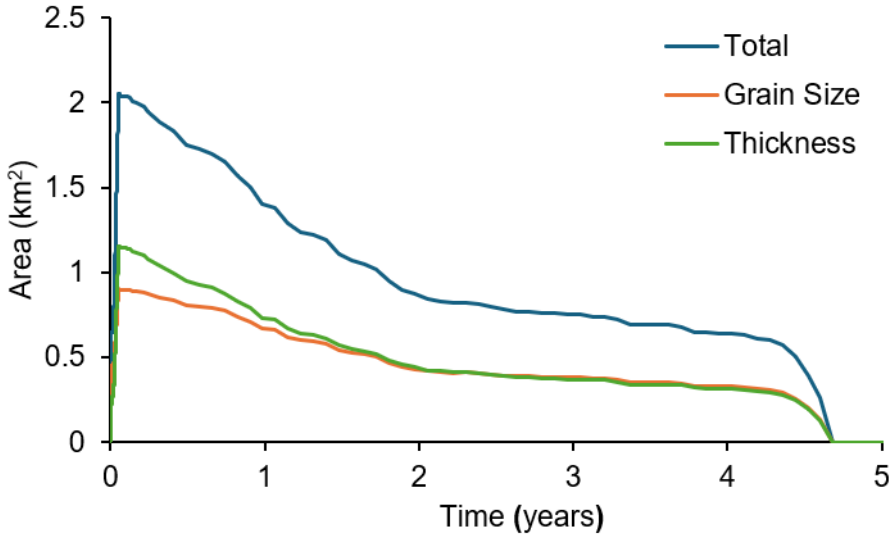


Figure 4-6 Contribution to area where there is a risk to more than 5% of sensitive species over the whole model period for each sediment stressor

The evolution of predicted combined sediment risk (at 19 days (the end of drilling), one year, three years and 4 years 9 months after the end of drilling) is shown in Figure 4-7 and summarised in Table 4.1.

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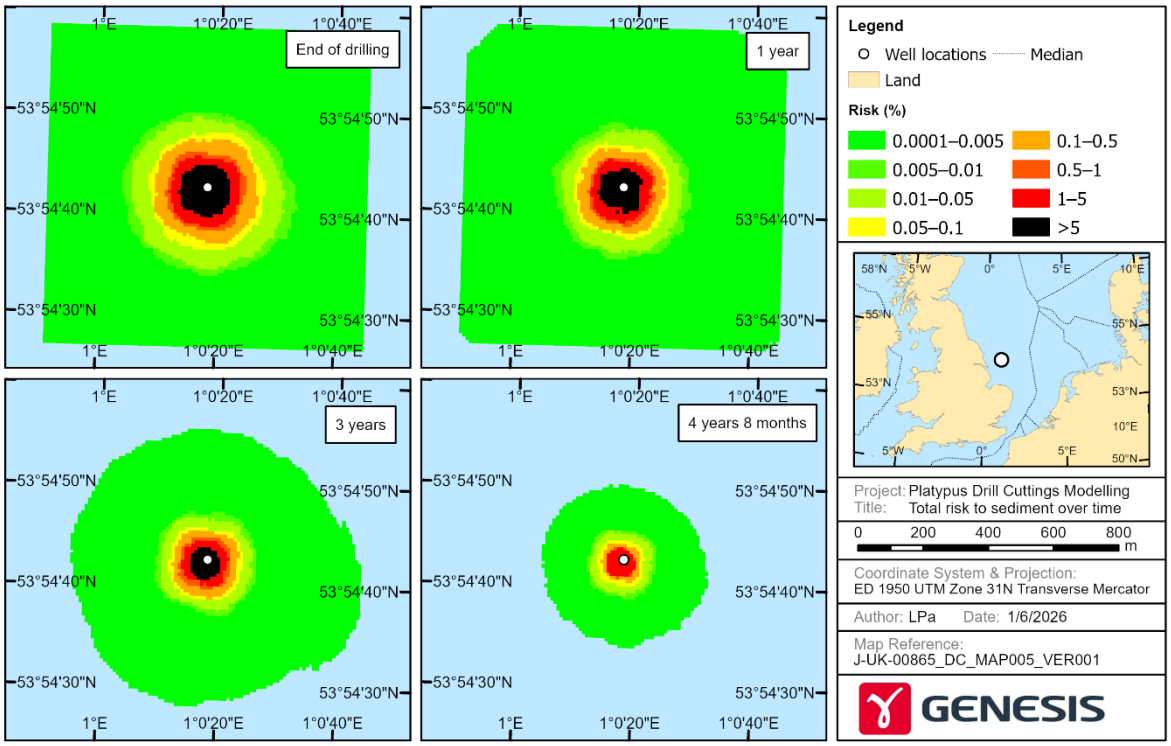


Figure 4-7 Predicted combined risk to the sediment over time

The maximum area where there is a risk to more than 5% sensitive species is 0.0204 km^2 at the end of drilling, which reduces to zero within 4 years and 9 months.

Table 4.1 Predicted combined risk over time

Time description	Area where combined risk is >5% (km^2)	Percentage change in area (%)
End of drilling (maximum combined risk)	0.0204	-
1 year post drilling	0.0116	43
3 years post drilling	0.0078	62
4 years 9 months post drilling	0	100

As noted above the main risk stressor as a result of the modelled drilling discharges is deposition thickness.

It is worth noting that the model calculates the risk resulting from burial thickness based on the areas of the seabed where the thickness of cuttings exceeds 6.5 mm (see Section 2.2). This thickness reduces over time as a result of bioturbation and re-suspension. Both these processes are included in the model. However, the model does not account for recolonization of the sediment over time. Therefore, the area where there is a risk to over 5% of the species is likely to reduce faster than shown and the areas shown in Table 4.1 are conservative.

4.4 Risk to the Water Column

The total risk in the water column is shown in Figure 4-8. Although the volume where the risk to the most sensitive species exceeds 5% is 0.26 km^3, it should be noted that this plot shows the cumulative risk (that is all areas where risk is greater than 5% at any point in time during the entire model run). In practice, the volume where risk exceeds 5% at any instance in time

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would be much smaller than that shown in Figure 4-8. The area of 5% risk and above occurs in the lower water column around the seabed as shown in the cross section (Figure 4-9).

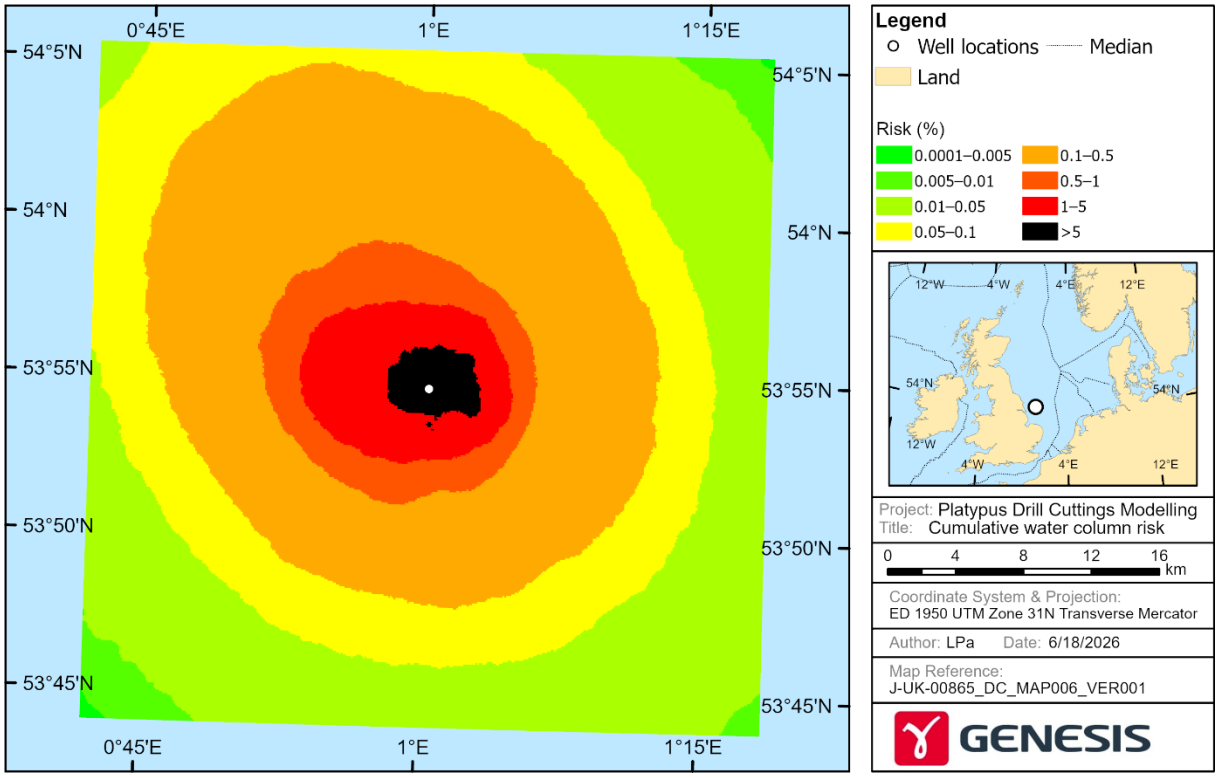


Figure 4-8 Total cumulative risk to the water column

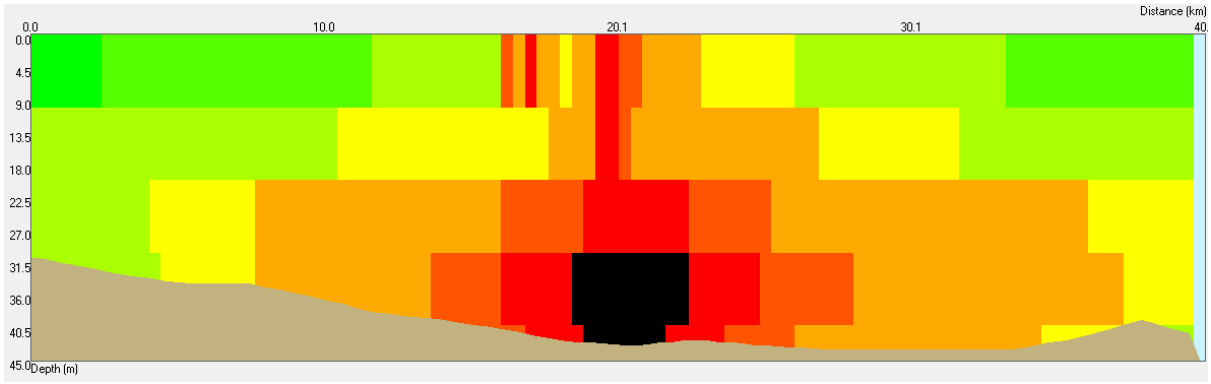


Figure 4-9 West to East cross section of total risk

Figure 4-10 and Figure 4-11 show the maximum instantaneous volume where there is a risk to more than 5% of sensitive species is 0.074 km^3. The area of high risk is in the lower part of the water column where the cuttings from the tophole sections are discharged.

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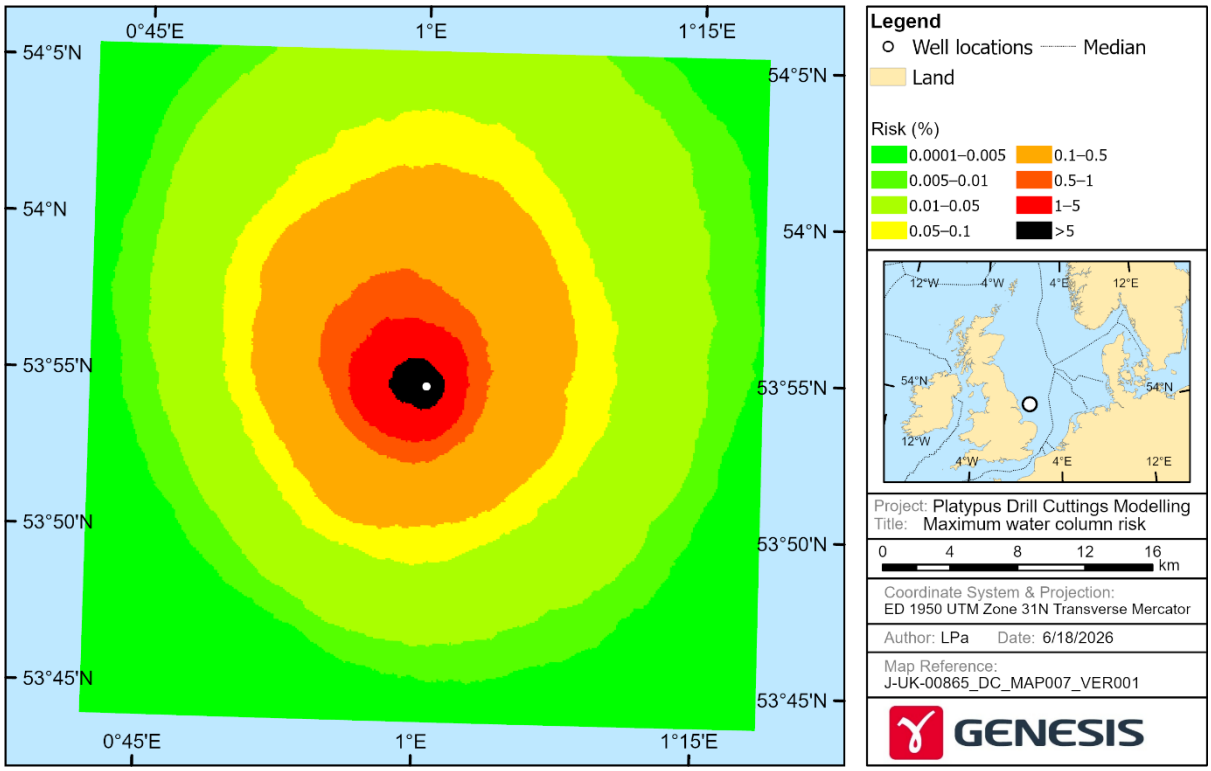


Figure 4-10 Maximum instantaneous risk to the water column

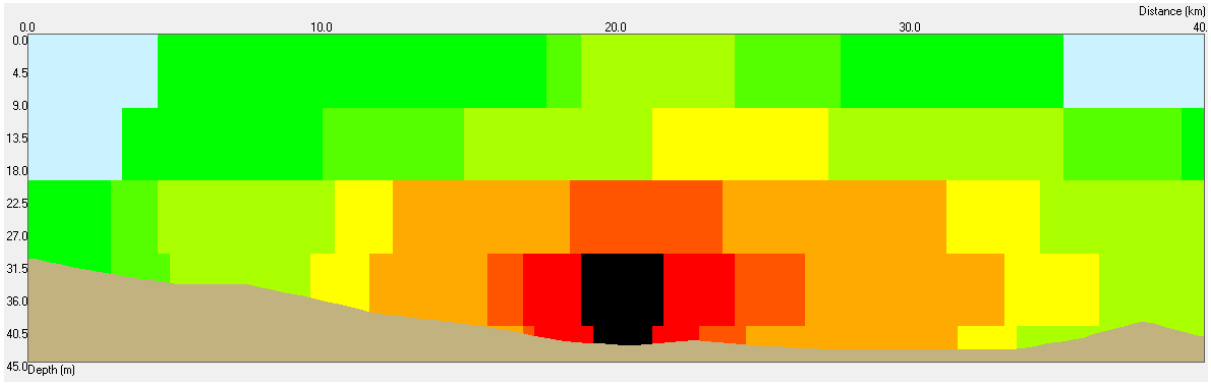
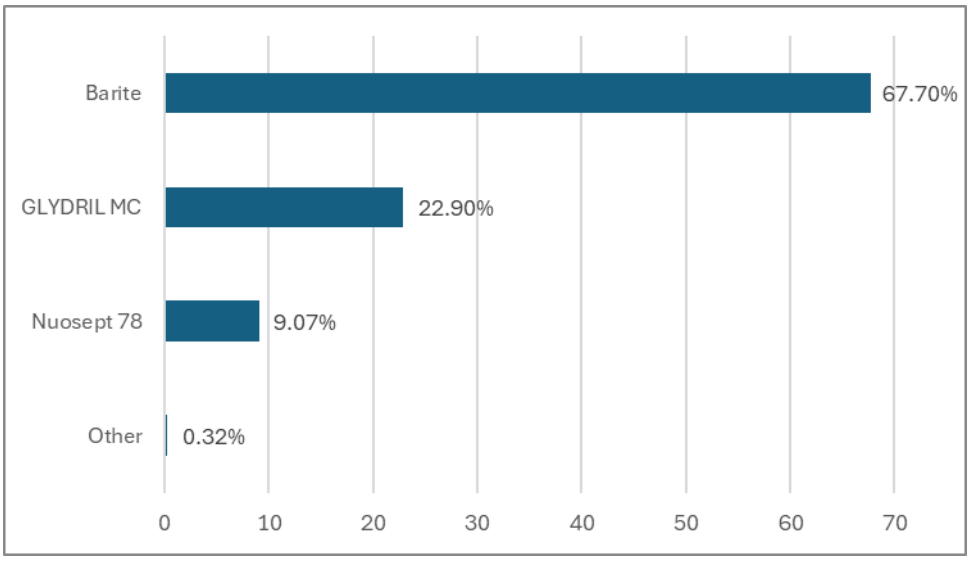


Figure 4-11 West to East cross section of maximum instantaneous risk

The primary contributors to the water column risk are shown in Figure 4-12 with barite particles contributing the highest percentage.

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Note: Other comprises of DUO-VIS and cuttings.

Figure 4-12 Time-averaged contributions to risk in the water column

The volume of water column where there is a risk to over 5% of sensitive species varies over time (Figure 4-13) with the maximum instantaneous risk occurring following the final discharge of the 17.5" section. The volume at risk disappears completely within 24 hours of the end of drilling.

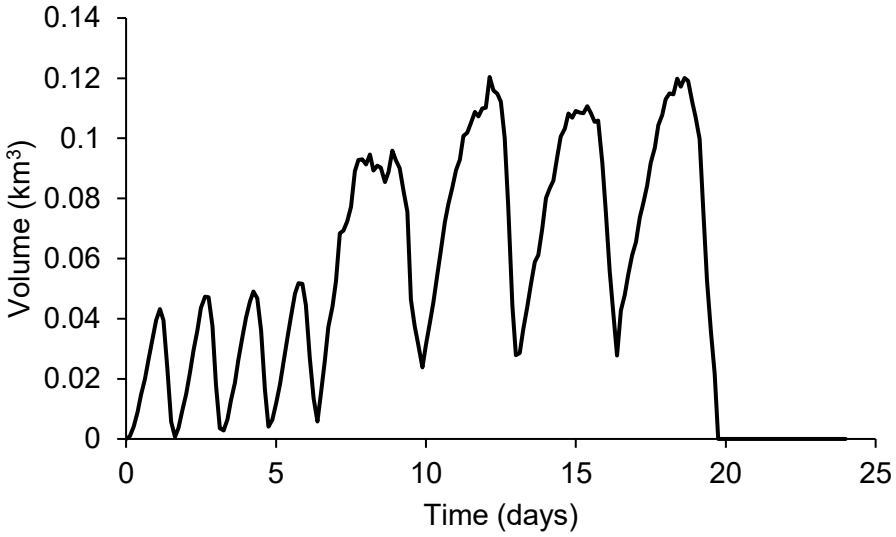


Figure 4-13 Volume of water where there is risk to over 5% of species over time

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4.5 Summary of Outputs

Model outputs are summarised in Table 4.2. The key contributor to risk in sediments is deposition thickness. The risk to the seabed is reduced to zero within 4 years 9 months after the end of drilling. The potential risk to the water column is transient, disappearing shortly after the discharge stops.

Table 4.2 Summary of model outputs

Model output	Criteria	Value
Cuttings deposition		
Thickness	Maximum thickness - end of drilling (m)	0.603
	Area where thickness >6.5 mm - end of drilling (km^2)	0.0205
	Area where thickness >30 cm - end of drilling (km^2)	0.0024
Risk to sediment		
Thickness (%)	>6.5 mm	51.77
Grain size (%)	>52 µm	48.23
Oxygen depletion (%)	>20%	0
Toxicity (%)	Toxicity (PNEC exceeded)	0
Area where there is a total combined sediment risk (>5%) to the most sensitive species (km^2)	End of drilling	0.0204
	1 year (after end of drilling)	0.0116
	3 years (after end of drilling)	0.0078
	4 years 9 months (after end of drilling)	0
Risk to water column		
Barite (%)	Physical effect of particles	67.7
Cuttings (%)	Physical effect of particles	0.03
Toxicity of DUO-VIS (%)	Toxicity (PNEC exceeded)	0.29
Toxicity of GLYDRIL MC (%)	Toxicity (PNEC exceeded)	22.9
Toxicity of Nuosept 78 (%)	Toxicity (PNEC exceeded)	9.07
Volume where combined risk to >5% most sensitive species (km^3)	Maximum instantaneous volume	0.12
	Total cumulative volume	0.26

Note: for comparison 500 m safety zone area is equivalent to 0.785 km^2

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5.0 CONCLUSIONS

Cuttings modelling was undertaken using DREAM to predict environmental risks to the seabed and the water column as a result of the discharge of cuttings during drilling of two proposed wells in Block 48/1. The wells will be drilled using WBM in the top two sections, with discharges occurring at the seabed and sea surface. The subsequent lower sections of the wells, and the resulting cuttings, are to be skipped and shipped for treatment and discharge.

The maximum estimated deposited sediment thickness (cuttings pile height) was 0.603 m, in the immediate vicinity of the wells, reducing with distance.

The following risks were predicted:

- The model predicted that the deposited cuttings from drilling could result in a risk to more than 5% sensitive species in a maximum area of seabed sediment of 0.0204 km^2 at the end of drilling. This area reduces significantly over time and within 4 years and 9 months after drilling there is no area of seabed with a risk to more than 5% sensitive species. In reality, re-colonisation by benthic organisms would result in a faster seabed recovery.
- The risk to the sediment mainly results from deposition thickness (51.77% contribution).
- The volume of the water column where there is a risk to over 5% sensitive species reaches up to 0.12 km^3 at any one point in time but is transient in time and space. The risk to the water column disappears within 24 hours of the cessation of drilling.
- The primary contributor to the water column risk is from barite particles (67.7%). Added chemicals GLYDRIL MC and Nuosept 78 contribute to 22.9% and 9.07% of the risk to the water column, respectively.

As a result of drilling the two proposed wells, the predicted environmental risk of the discharged cuttings to the environment is considered low given (i) the temporary nature of the impacts to the water column and (ii) the fact that after five years there is not expected to be a risk to the seabed.

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Appendix D – Underwater Noise Modelling Report

PERENCO

REPORT

Platypus Field Development Underwater Noise Modelling Report

Prepared for: **Perenco U.K. Limited**
Prepared by: **Genesis Energies**
www.genesisenergies.com

Project Title: **Platypus Field Development Environmental Statement**
Genesis Doc. / Rev No.: 220126C-001-Y-RT-24005/ A
Client Document No.: PLA729-UK-PLA-PT-GEN-RP-G-005

Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval
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2A	19/01/2026	Issued for internal review	[redacted]	[redacted]	[redacted]	
A	03/02/2026	Issued for client review	[redacted]	[redacted]	[redacted]	
0	26/02/2026	Issued for use	[redacted]	[redacted]		

ABBREVIATIONS

dB	Decibel
dB re 1 µPa	Decibels relative to one micropascal
dB re 1 µPa m	Decibels relative to one micropascal metre
dB re 1 µPa^{2}s	Decibels relative to one micropascal square second
dB re 1 µPa^2 m^2 s	Decibels relative to one micropascal metre square second
kg/m^3	Kilograms per cubic metre
Hz	Hertz
kJ	Kilojoule
km	Kilometres
km^2	Square kilometre
m	Metres
m/s	Meters per second
ms	Milliseconds
ED	European Datum
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation Data network
FARAM	Faunal Acoustic Risk Assessment Model
HESS	High Energy Seismic Survey
HF	High Frequency
IAMMWG	Inter-Agency Marine Mammal Working Group
JNCC	Joint Nature Conservation Committee
LF	Low Frequency
MMMP	Marine Mammal Mitigation Protocol
NMFS	National Marine Fisheries Service
MU	Management Unit
PAM	Passive Acoustic Monitoring
RAM	Range-dependent Acoustic Model
rms	Root Mean Square
SAC	Special Area of Conservation
SEL	Sound Exposure Level
SNS	Southern North Sea

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SPL	Sound Pressure Level
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UTM	Universal Transverse Mercator
VHF	Very High Frequency
WOA	World Ocean Atlas

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EXECUTIVE SUMMARY

Underwater noise modelling was undertaken to assess the impacts of the proposed piling activities at Platypus Field Development for the installation of the platform jacket and four conductors. The modelling was carried out in support of the Environmental Impact Assessment, which is required under the Offshore Oil and Gas Exploration, Production, Unloading and Storage Environmental Impact Assessment (EIA) Regulations 2020.

Underwater noise modelling was undertaken using the Genesis in-house modelling software FARAM (Faunal Acoustic Risk Assessment Model). The platform jacket piling activities will use a hammer with a greater maximum energy than the conductor piling activities. Therefore, the platform jacket piling activities have been modelled to show the worst-case impact.

An MHU-800 hydraulic impact hammer will be used for the proposed jacket piling activities. The modelling results were used to assess potential impacts to marine mammals based on a comparison of estimated noise levels with the National Marine Fisheries Service (NMFS, 2024) thresholds for potential auditory injury onset and relevant thresholds for behavioural disturbance. Potential injury to fish species and fish eggs and larvae was also assessed by comparing predicted sound levels to the injury thresholds established by Popper *et al*. (2014).

The results indicate that the likelihood of marine mammals being exposed to noise levels that may cause auditory injury during the piling is low provided that the standard Joint Nature Conservation Committee (JNCC, 2010) guidelines for minimising the risk of injury to marine mammals from piling noise are followed. The modelling predicts that behavioural disturbance to marine mammals could potentially occur up to 17 km from the piling location.

The results indicate that injury to fish species and fish eggs and larvae during the piling will be localised to a small area (within 240 m) around the piling location. The soft start and ramp up of the hammer energy during piling should allow mobile fish species time to move away to distances where they are unlikely to suffer injury.

It is concluded that the proposed Platypus Field Development Project piling activities will not have a significant impact on marine mammals, fish, and fish eggs and larvae.

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1.0 INTRODUCTION

Perenco U.K. Limited (hereafter referred to as Perenco) propose to develop the Platypus gas field. The Platypus gas field is located in UK Continental Shelf (UKCS) Blocks 47/05 and 48/01 in the Southern North Sea (SNS). The Platypus Field Development will involve the installation of a platform. The proposed platform will be located approximately 67 km from the English coastline, and 121 km from the UK/Netherlands median line in a water depth of 40 m (see Figure 1-1).

As part of the project, piling will be required for the installation of the Platypus platform jacket. Four conductors will also be hammered into the seabed prior to drilling. Underwater noise due to piling has the potential to impact marine receptors. The underwater noise modelling will be used to inform Environmental Impact Assessment (EIA), which is required under the Offshore Oil and Gas Exploration, Production, Unloading and Storage Environmental Impact Assessment (EIA) Regulations 2020. This report presents the methodology and results of this modelling.

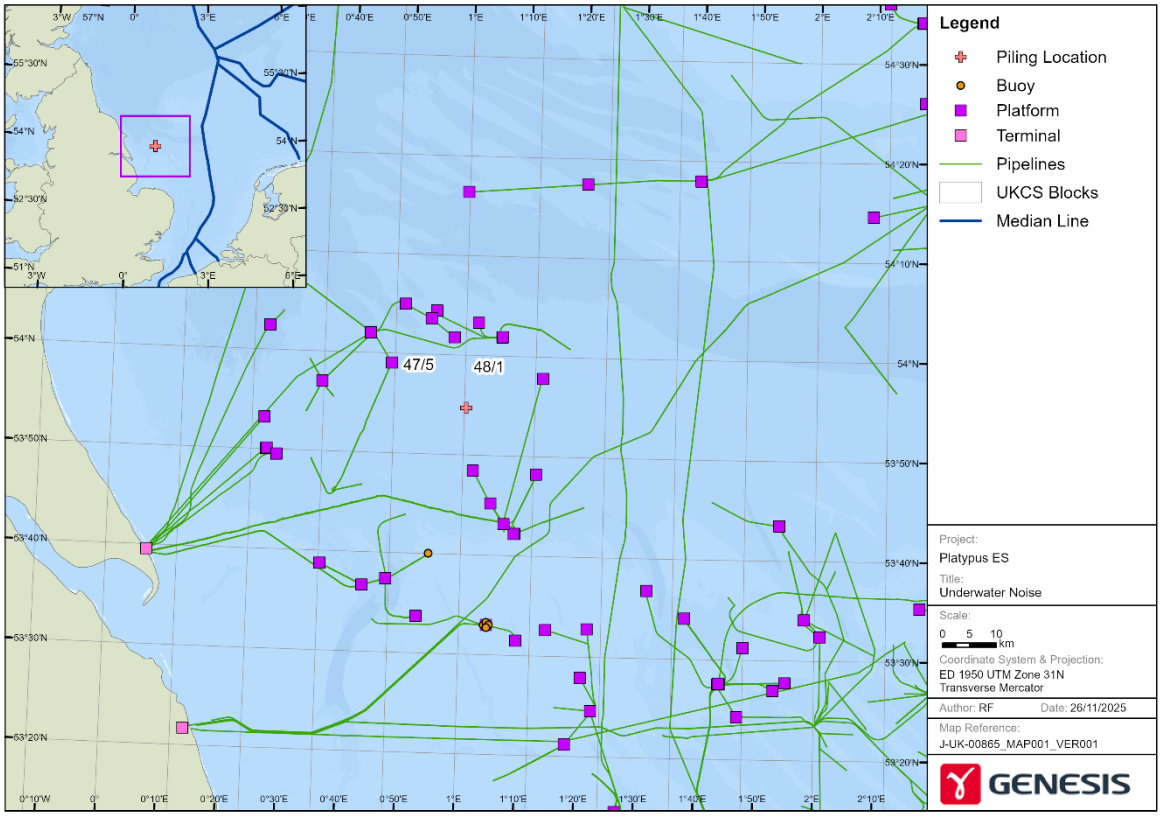


Figure 1-1: Proposed location of the Platypus platform.

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2.0 OVERVIEW OF MODELLING METHODOLOGY

This section discusses the modelling methodology adopted to estimate potential impacts from the piling associated with the project. The platform jacket piling activities will use a hammer with a greater maximum energy than the conductor piling activities. Therefore, the platform jacket piling activities have been modelled to show the worst-case impact.

2.1 Source Characterisation

A pile under percussive driving is a complex underwater acoustic source. The noise levels generated during piling depend on many factors, such as hammer energy, mechanical properties and dimensions of the pile, water depth, and seabed properties. The hammer energy has the biggest influence on the underwater noise levels generated, with higher energy hammers generating higher noise levels (Robinson *et al*., 2007).

To derive source levels for use in the piling noise modelling, a representative third octave band sound exposure level (SEL) frequency spectrum measured during piling with an 800 kJ hammer (Ainslie *et al*., 2012) has been used. The SEL frequency spectrum from Ainslie *et al*., (2012) has been scaled to account for the different hammer energies that will be used during piling of the jacket. It has been assumed that the SEL scales linearly with hammer energy, which has been demonstrated by measurements made throughout the soft start and energy ramp up during piling (Robinson *et al*., 2007).

In the modelling, it has been assumed that the jacket piling will commence with a soft start where the hammer operates at 10% of the maximum hammer energy (i.e., at 78 kJ). The soft start is taken to be conducted for a period of 20 minutes in line with the Joint Nature Conservation Committee (JNCC) guidelines for minimising impacts from piling noise (JNCC, 2010). After the soft start, the hammer energy is ramped up in stages until the maximum hammer energy is reached. The scaled third octave band SEL spectra for the different hammer energies that have been used in the modelling are shown in Figure 2-1.

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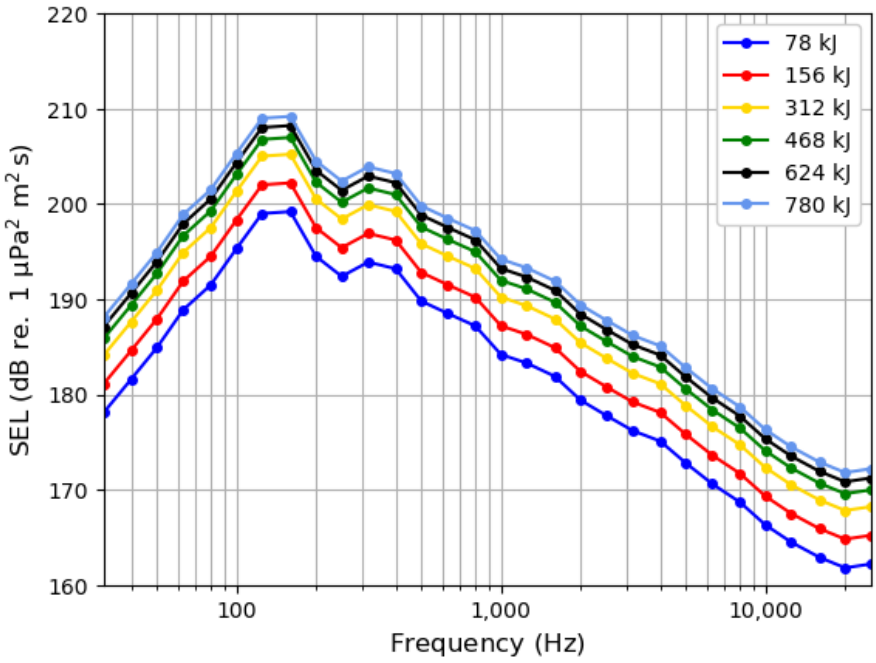


Figure 2-1: Third octave band SEL spectra used in the piling modelling.

The piling soft start and ramp up procedure used in the modelling is shown in Table 2-1, which shows the SEL and zero-to-peak sound pressure level (SPL) source levels used in the modelling for different hammer energies. SEL is a measure of sound energy and incorporates the sound level and the duration of exposure. The zero-to-peak SPL is a measure of the maximum acoustic pressure of a sound wave. A Menck MHU-800 hydraulic hammer with a maximum blow rate of 40 blows/minute will be used.

Table 2-1: Piling procedures and broadband source levels assumed in the modelling.

Hammer Energy (kJ)	Duration (minutes)	Strike Rate (blows/minute)	Source Level	
			Zero-to-peak SPL (dB re 1 µPa m)	SEL (dB re 1 µPa²m²s)
78	20	10	226.9	205.4
156	10	40	229.9	208.4
312	10	40	232.9	211.4
468	10	40	234.7	213.2
624	10	40	235.9	214.4
780	35	40	236.9	215.4

2.2 Noise Propagation Modelling

There are various algorithms that can be used for underwater noise propagation modelling such as parabolic equation, ray tracing, normal mode, wavenumber integration, energy flux density and semi-empirical algorithms (Jensen *et al.*, 2011). The Genesis in-house modelling software FARAM (Faunal Acoustic Risk Assessment Model) has been used in this study. FARAM employs the parabolic equation and ray tracing algorithms developed by Collins

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(1993) and Porter and Liu (1994), respectively, for estimating received sound levels from various noise sources. When estimating received sound levels, FARAM incorporates:

- A site-specific bathymetric grid to account for the influence of varying bathymetry on noise propagation;
- Site-specific range and depth dependent water column temperature, salinity, and sound speed profiles based on modelled hydrological conditions;
- Acoustic properties of the predominant seabed sediments in the modelling area;
- Frequency dependent propagation effects (e.g., volume attenuation, reflection, scattering at different frequencies);
- Specific properties of the noise source under consideration (e.g., spectral content, strike interval);
- Auditory weighting functions that characterise the hearing ability of different marine mammal hearing groups;
- Movement of mobile marine receptors (e.g., swim speed, depth and trajectory) when calculating received cumulative SEL; and
- The most up-to-date thresholds for assessing potential impacts to marine fauna.

2.2.1 Parabolic Equation Algorithm

Parabolic equation models approximate the wave equation, allowing a solution to be found computationally (Jensen *et al*., 2011). This is one of the most popular wave-theory techniques for modelling sound propagation in spatially varying environments (Jensen *et al*., 2011). The computational scheme used in FARAM is the Range-dependent Acoustic Model (RAM) developed by Collins (1993). The RAM algorithm incorporates acoustic propagation effects resulting from varying bathymetry, range dependent sound speed depth profiles, and geo-acoustic properties.

The RAM algorithm is best suited to the calculation of low frequency sound propagation since the computational complexity and implementation time significantly increases with frequency. The RAM algorithm is therefore generally restricted to modelling the propagation characteristics of low frequency sound sources, since modelling of high frequencies becomes prohibitively time consuming. Given this restriction, the RAM algorithm has been used for computation of very low frequency (<100 Hz) sound propagation. For higher frequencies (≥100 Hz), a ray tracing algorithm has been utilised for sound propagation (see Section 2.2.2).

2.2.2 Ray Tracing Algorithm

For modelling sound propagation of higher frequencies, the Bellhop Gaussian beam ray tracing algorithm (Porter and Liu, 1994) has been used. Bellhop is a ray tracing algorithm that is well suited for the modelling of higher frequency sound sources. However, it can also provide accurate results for low frequency propagation in certain circumstances. Bellhop incorporates acoustic propagation effects resulting from varying bathymetry, range dependent sound speed depth profiles, and geo-acoustic properties. Bellhop also accounts for increased sound attenuation due to volume absorption at higher frequencies.

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2.2.3 Environmental Data

FARAM accounts for various site-specific environmental properties including a bathymetric grid, geographically and depth varying sound speed profiles, and geo-acoustic properties of the sediment. To model the effects of these properties, input data is required that describes the surrounding environment.

2.2.3.1 Bathymetry

Accurate bathymetry data is important for propagation modelling since the seabed strongly influences the propagation characteristics of sound. In shallow water regions, there is significant interaction of the sound with the seabed through reflections and scattering effects, and strong attenuation may occur as sound penetrates the seabed. In deep water regions, there is typically less interaction of sound with the seabed and attenuation due to bottom loss is small, which can result in longer propagation distances.

The bathymetry data that has been used in FARAM (Figure 2-2) is provided by European Marine Observation Data network (EMODnet), which is a high-resolution digital terrain model for European Seas (EMODnet Bathymetry Consortium, 2020). The EMODnet bathymetry is based on almost 10,000 datasets obtained from bathymetric surveys, with bathymetric data provided at a spatial resolution of 1/16 arc minutes. The bathymetric depth around the modelled piling location for the jacket is approximately 40 m (Figure 2-2).

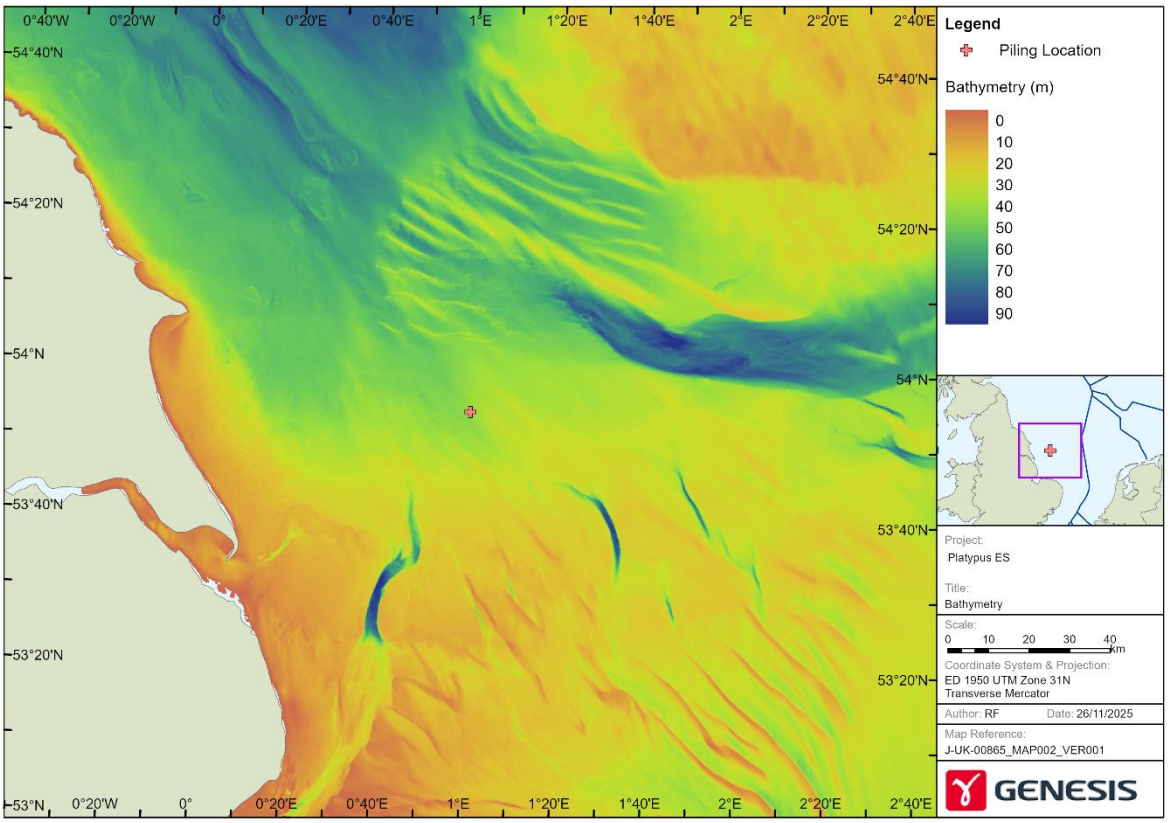


Figure 2-2: Bathymetry in the region of the modelled piling location.

2.2.3.2 Seabed Properties

FARAM accounts for attenuation effects due to interactions with the seabed. Sediments in the region of the piling location are shown in Figure 2-3 (Vasquez *et al.*, 2021). The main sediment types in the region are sands and muds. FARAM is limited to modelling a single seabed substrate. A sandy seabed has been assumed in the model. This is likely to be conservative since harder sediments such as sands typically result in longer range propagation compared to softer sediments such as silts and muds (Jensen *et al.*, 2011). The geo-acoustic properties associated with the seabed that have been used in the modelling are shown in Table 2-2 (Jensen *et al.*, 2011).

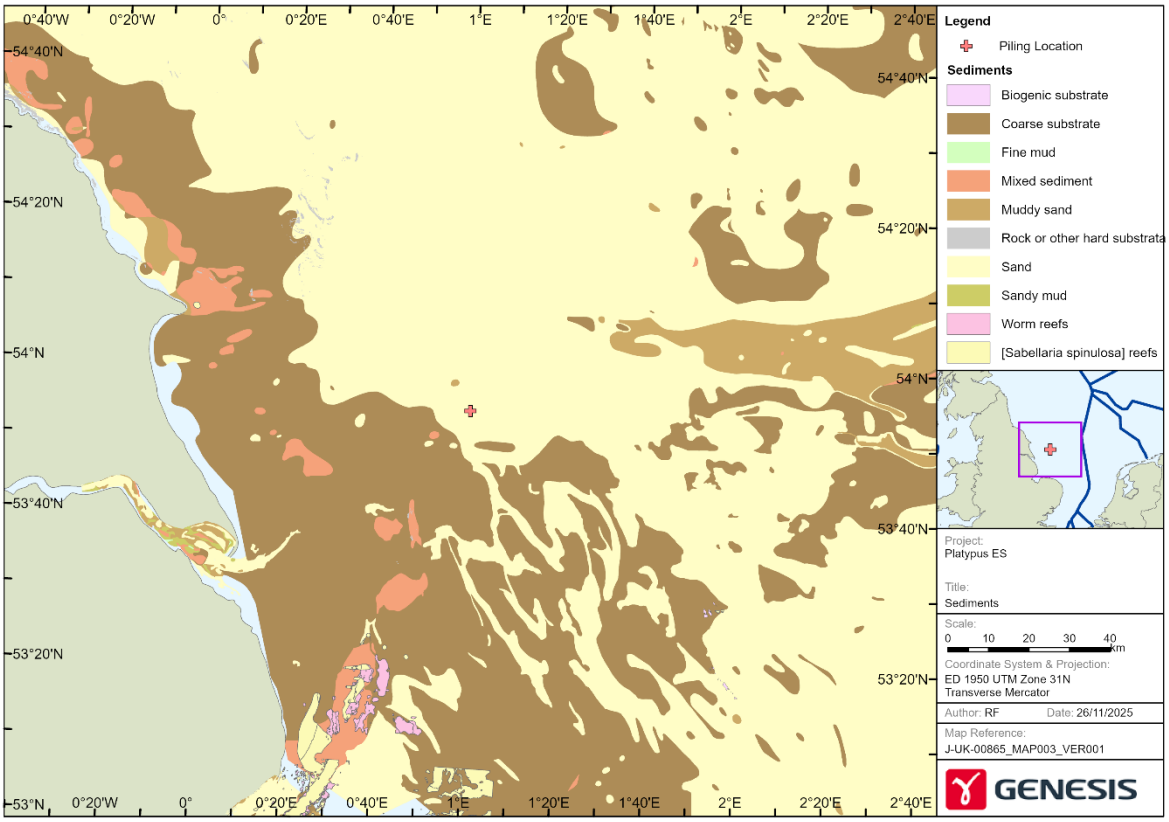


Figure 2-3: Sediments in the region of the modelled piling location.

Table 2-2: Geo-acoustic parameters of the seabed that have been used in the model.

Parameter	Value
Sediment type	Sand
Sound speed in sediment	1,650 m/s
Sound attenuation in sediment	0.8 dB/wavelength
Sediment density	1,900 kg/m^3

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2.2.3.3 Sound Speed

A major factor that influences sound propagation in water is the speed of sound through the water column, which influences how sound refracts as it propagates through the water. FARAM allows for geographically and depth varying sound speed profiles. Sound speed profiles can be derived from water column temperature and salinity profiles (Jensen *et al*., 2011). Sound speed profiles for the model location were derived from temperature and salinity profiles taken from the World Ocean Atlas (Reagan *et al*., 2024) database.

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3.0 IMPACT ASSESSMENT METHODOLOGY

Sound is important to marine mammals and fish for navigation, communication, predator avoidance and prey detection. Underwater noise generated by human activities can have an adverse impact on marine mammals and fish (Richardson *et al*., 1995; Southall *et al*., 2007, 2019, 2021; National Marine Fisheries Service (NMFS), 2024; Popper *et al*., 2014). The thresholds adopted in this report for assessing potential impacts to marine mammals and fish are based on a comprehensive review of evidence of underwater noise impacts.

3.1 Marine Mammals

Potential impacts to marine mammals have been assessed in this report using thresholds for auditory injury and behavioural disturbance. Auditory injury is a permanent change in a marine mammal's hearing sensitivity, whilst behavioural disturbance can vary from low level disturbance such as small changes in normal behaviour to higher levels of disturbance such as displacement from a favourable area.

3.1.1 Auditory Injury

Thresholds for auditory injury have been suggested by NMFS (2024). The injury thresholds proposed by NMFS are based on the most recent studies and are recognised as appropriate criteria for assessing potential impacts to marine mammals from underwater noise.

NMFS proposed grouping marine mammals into different hearing groups for assessing potential impacts. NMFS group marine mammals into low-frequency (LF) cetaceans, high-frequency (HF) cetaceans, very high-frequency (VHF) cetaceans, phocid pinnipeds, otariid pinnipeds, and sirenians. The NMFS injury thresholds for impulsive sound are shown in Table 3-1 for the hearing groups that are relevant to the North Sea. The most sighted marine mammal species in the North Sea (Reid *et al.,* 2003; Gilles *et al.,* 2023; Carter *et al.,* 2022) are also shown in Table 3-1, categorised according to the different hearing groups.

Table 3-1: Marine mammal hearing groups and auditory injury thresholds.

Hearing Group	Species[1]	Auditory Injury Threshold	
		Zero-to-peak SPL (dB re 1 µPa)	Cumulative SEL (dB re 1 µPa^{2}s)
LF cetaceans	**Minke whale**	222	183
HF cetaceans	**Bottlenose dolphin, Common dolphin,** Killer whale, Risso's dolphin, **White-beaked dolphin, White-sided dolphin**	230	193
VHF cetaceans	**Harbour porpoise**	202	159
Phocid pinnipeds	**Grey seal**, Harbour seal	223	183

[1] Species listed are the most sighted marine mammal species in the North Sea (Gilles *et al.,* 2023; Reid *et al.,* 2003; Carter *et al*., 2022). Species highlighted in **bold** are those that are more likely to be present in the region of the project area.

The auditory injury thresholds shown in Table 3-1 are expressed in terms of both zero-to-peak SPL and cumulative SEL metrics. As dual-metric criteria, the onset of auditory injury is considered to potentially occur when either of the thresholds are exceeded (NMFS, 2024).

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The zero-to-peak SPL thresholds are 'unweighted' and do not take into consideration the hearing range of any marine mammals. In contrast, the cumulative SEL threshold is 'weighted' (considers the hearing capabilities of the marine mammal hearing groups by weighting received SEL using generalised auditory weighting filters) and accumulated over a 24-hour period. The auditory weighting functions are shown in Figure 3-1.

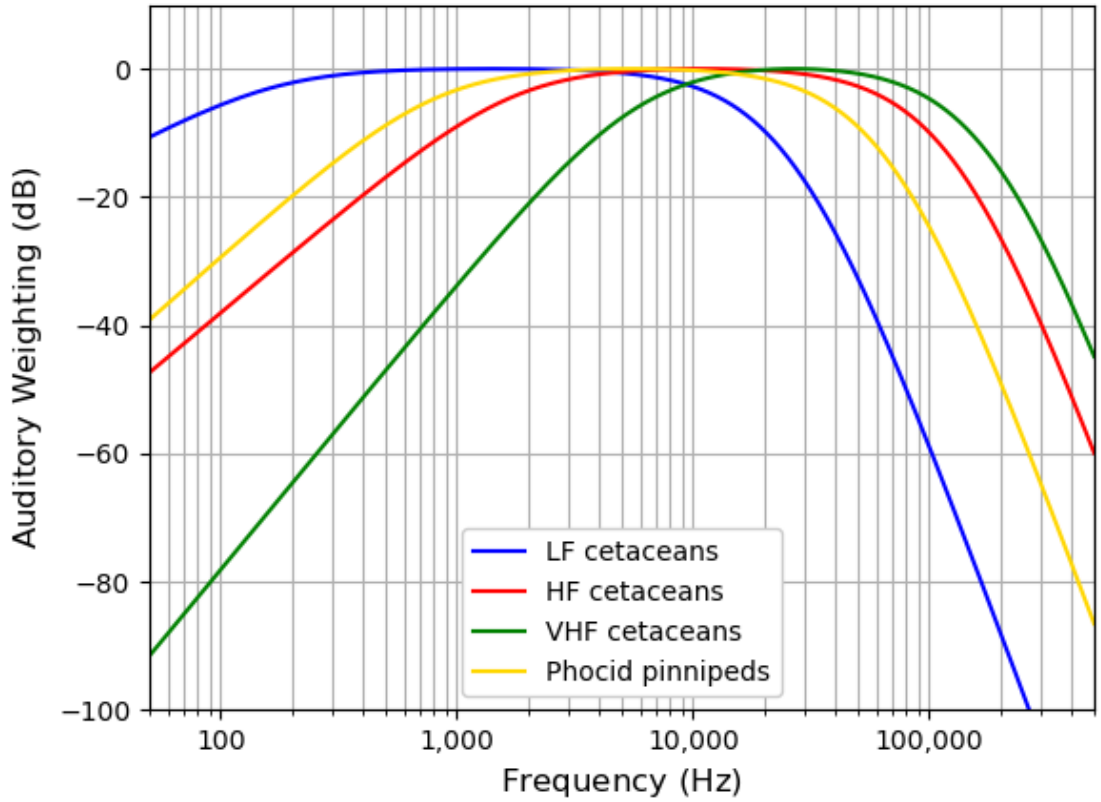


Figure 3-1: Auditory weighting functions for different marine mammal hearing groups.

3.1.2 Behavioural Disturbance

Thresholds for behavioural disturbance to marine mammals are less well defined compared to auditory injury thresholds. Numerous studies on marine mammal behavioural responses to noise exposure have not resulted in consensus regarding the appropriate metric or thresholds for assessing behavioural reactions. Southall *et al*. (2007; 2021) concluded that the available data on marine mammal behavioural responses were too variable and context-specific to justify proposing single value disturbance criteria for all marine mammals. Instead, Southall *et al*. (2007; 2021) recommended assessing whether noise from a specific source could cause disturbance to a particular species by comparing the circumstances of the situation with empirical studies. It is noted that NMFS (2024) does not attempt to define thresholds for behavioural disturbance to marine mammals.

Guidance by Tougaard (2016) suggests a single-pulse unweighted SEL threshold of 145 dB re 1 μPa^2s for assessing disturbance impacts to all marine mammals from seismic surveys and other impulsive noise sources such as piling. Thompson *et al*. (2013) showed that harbour porpoises exhibited avoidance from a seismic survey at unweighted SELs between 145-151 dB re 1 μPa^2s. Lucke *et al.* (2009) also reported that a captive harbour porpoise consistently showed behavioural responses at unweighted SELs exceeding

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145 dB re 1 µPa^{2}s. Brandt *et al.* (2016) analysed the impact of piling on harbour porpoises from the construction of eight offshore wind farms within the German North Sea between 2009 and 2013. Monitoring data from passive acoustic monitoring (PAM) using porpoise detectors was combined with data from aerial surveys and noise level measurements. The results showed that detections of harbour porpoises during piling declined by less than 20% at SELs below 145 dB re 1 µPa^{2}s and that displacement of harbour porpoise at SELs below 145 dB re 1 µPa^{2}s could not clearly be related to noise from piling.

Based on the guidance of Tougaard (2016) and the observations of Thompson *et al.* (2013), Lucke *et al.* (2009) and Brandt *et al.* (2016), a single-pulse unweighted SEL threshold of 145 dB re 1 µPa^{2}s has been used in this assessment for signifying displacement of marine mammals from the proposed piling (Table 3-2). Although this threshold has been derived from observations of displacement of harbour porpoises, it is adopted in this assessment to signify potential displacement of all marine mammals. The adoption of this threshold may overestimate behavioural disturbance impacts to marine mammal species other than harbour porpoise since harbour porpoises may be more sensitive to underwater noise than many other species. This is supported by the fact that the auditory injury thresholds for VHF cetaceans (the hearing group which harbour porpoise belong to) are significantly lower than the thresholds for all other hearing groups (see Table 3-1), suggesting that they are more sensitive to underwater noise than other species.

NMFS currently adopt an unweighted root mean square (rms) SPL of 160 dB re 1 µPa as a threshold for signifying significant behavioural disturbance (referred to as 'Level B Harassment') to all marine mammals. This threshold was derived from the High Energy Seismic Survey (HESS) report (HESS, 1999), which was based on the responses of migrating mysticete whales (LF cetaceans) to airgun noise (Malme *et al.*, 1983, 1984). The NMFS 'Level B Harassment' unweighted rms SPL threshold of 160 dB re 1 µPa is also used in this assessment for estimating behavioural disturbance to all marine mammals. The rms SPL threshold of 160 dB re 1 µPa has been converted to an SEL threshold of 150 dB re 1 µPa^{2}s assuming an integration time of 100 ms. The integration time of most marine mammals' ears is approximately 125 ms (Tougaard *et al.*, 2015). As a conservative measure, a smaller integration time of 100 ms has been used to convert the NMFS 'Level B Harassment' rms SPL threshold to an SEL threshold.

Behavioural disturbance thresholds are difficult to conclusively define since different marine mammal species, and even different individuals from the same species, can exhibit a range of responses to the same sound (Southall *et al.,* 2007, 2021). Furthermore, for many species there is also a lack of sufficient evidence to define appropriate thresholds (Southall *et al.,* 2021). Therefore, in this assessment two different threshold values have been adopted to assess potential disturbance (Table 3-2). This will provide a range of distances and areas at which behavioural disturbance to marine mammals may occur.

Table 3-2: Marine mammal behavioural disturbance thresholds.

Criteria	Behavioural Disturbance Threshold	
	Rms SPL (dB re 1 µPa)	SEL (dB re 1 µPa^{2}s)
NMFS 'Level B Harassment' criteria for behavioural disturbance to all marine mammals	160	150[1]
Tougaard (2016) criteria for behavioural disturbance to all marine mammals	N/A	145
[1] The NMFS 'Level B Harassment' rms SPL threshold of 160 dB re 1 µPa has been converted to an SEL threshold of 150 dB re 1 µPa^{2}s assuming a conservative integration time of 100 ms.		

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3.2 Fish

3.2.1 Injury

Popper *et al.* (2014) have defined criteria for injury to fish based on a comprehensive review of publications related to impacts from various high-energy sources including piling. Injury thresholds are derived in Popper *et al.* (2014) for:

- Fishes with no swim bladder or other gas chamber;
- Fishes with swim bladders in which hearing involves a swim bladder or other gas volume;
- Fishes with swim bladders in which hearing does not involve the swim bladder or other gas volume; and
- Fish eggs and larvae.

The thresholds for potential injury to fish species, eggs and larvae proposed in Popper *et al.* (2014) are shown in Table 3-3.

Table 3-3: Thresholds for potential injury to fish, and fish eggs and larvae.

Fish Group	Potential Mortal Injury Thresholds	
	Zero-to-peak SPL (dB re 1 µPa)	Cumulative SEL (dB re 1 µPa^{2}s)
Fishes with no swim bladder	213	219
Fishes with swim bladder involved in hearing	207	207
Fishes with swim bladder not involved in hearing	207	210
Eggs and larvae	207	210

3.2.2 Behavioural Disturbance

Documented behavioural effects of sound on fish behaviour are variable, ranging from no discernible effect (Wardle *et al.,* 2001) to startle reactions followed by immediate resumption of normal behaviour (Wardle *et al.,* 2001; Hassel *et al.,* 2004). Avoidance of airgun array sound has also been observed (Hassel *et al.,* 2004).

Despite some documented behavioural effects, there are no well-established criteria or thresholds for assessing behavioural disturbance to fish. Therefore, Popper *et al.* (2014) suggested a qualitative approach for assessing potential behavioural disturbance to fish. This approach assigns a relative risk (classified as being either High, Moderate or Low) for three relative distances from the sound source (classified as being either Near, Intermediate or Far).

The suggested ranking of behavioural disturbance to fish species proposed by Popper *et al.* (2014) for piling is shown in Table 3-4. For the purposes of this assessment, a 'near' distance is assumed to be within tens of metres from the sound source, a 'moderate' distance is assumed to be within hundreds of metres from the sound source and a 'far' distance is assumed to be beyond one kilometre from the sound source (Popper *et al.,* 2014). The qualitative criteria suggested by Popper *et al.* (2014) indicates that disturbance to fish species is likely to be very localised and therefore there is unlikely to be a significant impact to fish populations.

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Table 3-4: Qualitative criteria for assessing risk of behavioural disturbance to fish.

Fish Group	Qualitative Distance from Source and Disturbance Classification		
	Near	Intermediate	Far
Fishes with no swim bladder	High	Moderate	Low
Fishes with swim bladder involved in hearing	High	High	Moderate
Fishes with swim bladder not involved in hearing	High	Moderate	Low
Eggs and larvae	Moderate	Low	Low

3.3 Other Species

3.3.1 Plankton

Research on the impacts of underwater noise to plankton is limited. Some research has shown that zooplankton can suffer various anatomical impacts because of noise exposure. Impacts can include internal cellular damage, disorientation, hearing loss and, in some cases, death (McCauley *et al*., 2017; Weilgart, 2018). Noise exposure can also cause elevated levels of stress hormones, which can have subsequent impacts on a variety of homeostatic processes (Nedelec *et al*., 2015). McCauley *et al.* (2017) showed that the use of a single airgun could prove to be fatal to microscopic zooplankton. The impact to zooplankton was shown to extend beyond 1.2 km from the airgun source, with the potential to cause a 64% reduction in abundance within one hour from the airgun pulses (McCauley *et al.,* 2017; Tollefson, 2017).

The proposed piling could impact on plankton within the vicinity of the work. However, given the abundance of plankton in the North Sea and the short duration of the piling work, it is not expected that the piling will have a significant overall impact. There is no reference in the literature to specific impact thresholds, therefore an assessment of impacts to plankton has not been undertaken.

3.3.2 Crustaceans

Exposure to underwater sound from offshore shipping and construction activity can alter the contributions to fluid and particle transport from sediment dwelling invertebrates, which in turn could impact benthic nutrient cycling (Solan *et al*, 2016). The effects of sound may not be lethal, but could have significant functional, fitness and ecological consequences. For example, in the case of *Nephrops*, Solan *et al*. (2016) showed that the addition of an anthropogenic sound source repressed burying and bio irrigation behaviour and reduced locomotion activity.

There is no identified reference in the literature to specific impact thresholds, therefore an assessment of impacts to crustaceans has not been undertaken.

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4.0 MODELLING RESULTS AND IMPACT ASSESSMENT

4.1 Marine Mammals

4.1.1 Auditory Injury

Received noise levels from the proposed jacket piling operations have been predicted in terms of unweighted zero-to-peak SPL to identify potential areas where the instantaneous onset of injury may occur to marine mammals. Figure 4-1 shows the predicted zero-to-peak SPL with the hammer operating at the maximum energy of 780 kJ. The contours in Figure 4-1 highlight the zero-to-peak SPL thresholds for the potential onset of injury to marine mammals (as defined in Table 3-1).

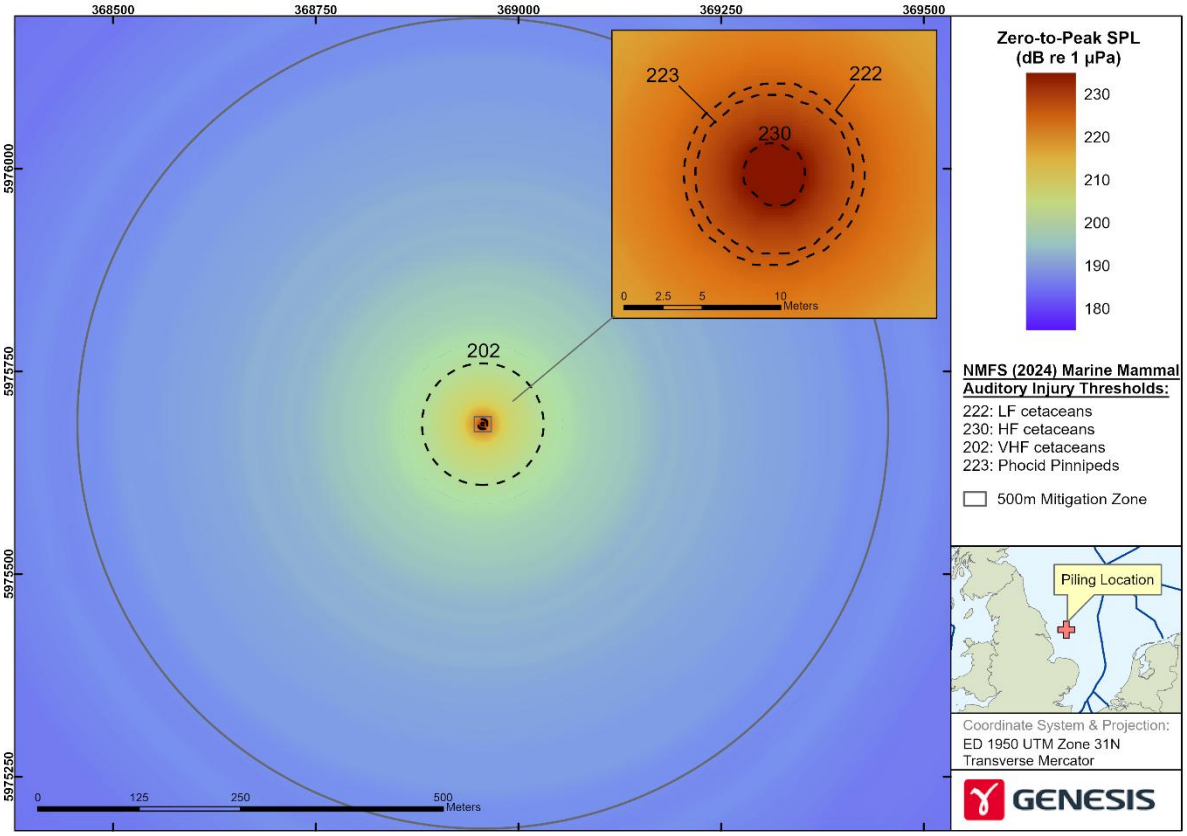


Figure 4-1: Predicted zero-to-peak SPL received by marine mammals during piling with the hammer operating at maximum energy of 780 kJ.

The predicted maximum distances where the zero-to-peak SPL thresholds for auditory injury onset are exceeded during the piling are summarised in Table 4-1. It is predicted that the zero-to-peak SPL generated throughout the piling will not exceed the auditory injury thresholds for any marine mammal hearing group outside the standard 500 m mitigation zone that will be employed during the piling operations (JNCC, 2010).

If any marine mammals are observed in the 500 m mitigation zone before the start of piling, the piling will be delayed until no marine mammals have been detected in the mitigation zone for at least 20 minutes, as per the JNCC (2010) guidance (see Section 5.0). With this mitigation

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measure in place, the probability of zero-to-peak SPLs generated during the piling causing injury to marine mammals is predicted to be low.

Table 4-1: Predicted maximum distances from the piling location where the zero-to-peak SPL thresholds for auditory injury onset to marine mammals are exceeded.

Marine Mammal Hearing Group	Zero-to-peak SPL Auditory Injury Threshold (dB re 1 µPa)	Maximum Distance to Threshold Exceedance (m)[1]
LF cetaceans	222	10
HF cetaceans	230	10
VHF cetaceans	202	80
Phocid pinnipeds	223	10

[1] Predicted distances have been rounded up to the nearest 10 m.

The cumulative SEL received by marine mammals during piling has been predicted and compared to the injury thresholds. In the modelled piling scenario, it has been assumed that piling will commence with a soft start where the hammer will operate at a reduced energy of 78 kJ for 20 minutes. Thereafter, the hammer energy is progressively increased at discrete intervals until the maximum hammer energy is reached (see Table 2-1).

Following the guidance of NMFS (2024), the cumulative SELs received by marine mammals have been calculated by weighting the received SELs from each pile strike using the auditory weighting functions shown in Figure 3-1 and integrating over the exposure period. Marine mammals have been modelled as swimming away from the piling location at the onset of piling, which has been observed during piling activities (Brandt *et al.*, 2011, 2016, 2018; Carstensen *et al.*, 2006; Dahne *et al.*, 2013). The received cumulative SEL has been calculated for marine mammals swimming away from the piling location at different swim speeds.

The predicted minimum initial distances that marine mammals must be from the piling location at the start of piling (i.e., safety distances) in order not to be exposed to cumulative SELs exceeding the injury thresholds, after they swim away, are shown in Table 4-2. The modelling predicts that the auditory injury thresholds will not be exceeded outside the 500 m mitigation zone for HF cetaceans, VHF cetaceans and phocid pinnipeds, assuming that the mammals swim away from the piling location at a minimum speed of 1.5 m/s.

The modelling predicts that the auditory injury threshold for LF cetaceans (e.g., minke whales) may be exceeded at distances of over one kilometre at a swim speed of 1.5 m/s. A swim speed of 1.5 m/s is relatively conservative since marine mammals exposed to high noise levels would likely swim away at faster speeds (Kastelein *et al.*, 2018). LF cetaceans have been shown to have swim speeds of around 2.3 m/s and faster flee speeds of 4.1 m/s (Boisseau *et al.*, 2021). At a swim speed of 2.0 m/s, the cumulative SEL auditory injury threshold for LF cetaceans will not be exceeded outside the 500 m mitigation zone. A 500 m mitigation zone

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and associated mitigation measures (e.g., Marine Mammal Observers, PAM and Marine Mammal Mitigation Protocol (MMMP)) is expected to be sufficient to mitigate against auditory injury to marine mammals.

Table 4-2: Predicted distances that marine mammals must be from the piling location at the start of piling in order to not be exposed to cumulative SEL exceeding the auditory injury threshold when they swim away at different swim speeds.

Marine Mammal Hearing Group	Cumulative SEL Threshold for Auditory Injury (dB re 1 µPa^{2}s)	Swim Speed (m/s)	Maximum Distance to Threshold Exceedance (m)
LF cetaceans	183	1.5	1,300
		2.0	120
		2.5	20
HF cetaceans	193	1.5	0
		2.0	0
		2.5	0
VHF cetaceans	159	1.5	10
		2.0	0
		2.5	0
Phocid pinnipeds	183	1.5	0
		2.0	0
		2.5	0

4.1.2 Disturbance

As noted in Section 3.1.2, it is difficult to conclusively define behavioural disturbance thresholds for marine mammals since different marine mammal species and even individuals from the same species could exhibit a range of behaviours from underwater noise. Furthermore, there is insufficient evidence for many species to define appropriate thresholds (Southall *et al*., 2021). Therefore, two different thresholds for behavioural disturbance have been adopted in this assessment (see Table 3-2), which provide a range of distances and areas where behavioural disturbance may occur to marine mammals.

Figure 4-2 shows the maximum predicted unweighted SEL from single pile strikes during piling of the jacket with the hammer operating at maximum hammer energy of 780 kJ. The contours highlighted in Figure 4-2 signify the thresholds that have been adopted for assessing potential disturbance to all marine mammals.

Table 4-3 summarises the predicted distances and areas where behavioural disturbance might occur to marine mammals from the piling. The NMFS 'Level B Harassment' threshold suggests that disturbance to marine mammals could occur at distances out to 9 km, whilst the Tougaard (2016) threshold suggests that disturbance could occur out to 17 km.

The estimated number of marine mammals that could potentially be disturbed or exhibit behavioural responses are shown in Table 4-4. The estimated number of marine mammals that may be disturbed have been compared to the management unit (MU) populations proposed by the Inter-Agency Marine Mammal Working Group (IAMMWG, 2021). The

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estimated numbers of marine mammals that may be disturbed are relatively small compared to the relevant MU populations.

Studies based on impacts from piling noise have indicated that marine mammals displaced by noise return to the area within relatively short periods of time, usually within three days once the piling has ceased (Brandt *et al*., 2011, 2016, 2018; Carstensen *et al*., 2006). It has been demonstrated that even long-term piling over several months or years (e.g., during the construction of wind farms) is unlikely to have a significant long-term impact on marine mammal populations levels (Nabe-Nielsen *et al*., 2018; Nabe-Nielsen, 2020). It is expected that any marine mammals disturbed by piling associated with the project will return to the area within a short period of time after the piling has finished. The piling is therefore not expected to have a significant adverse impact on any marine mammal population.

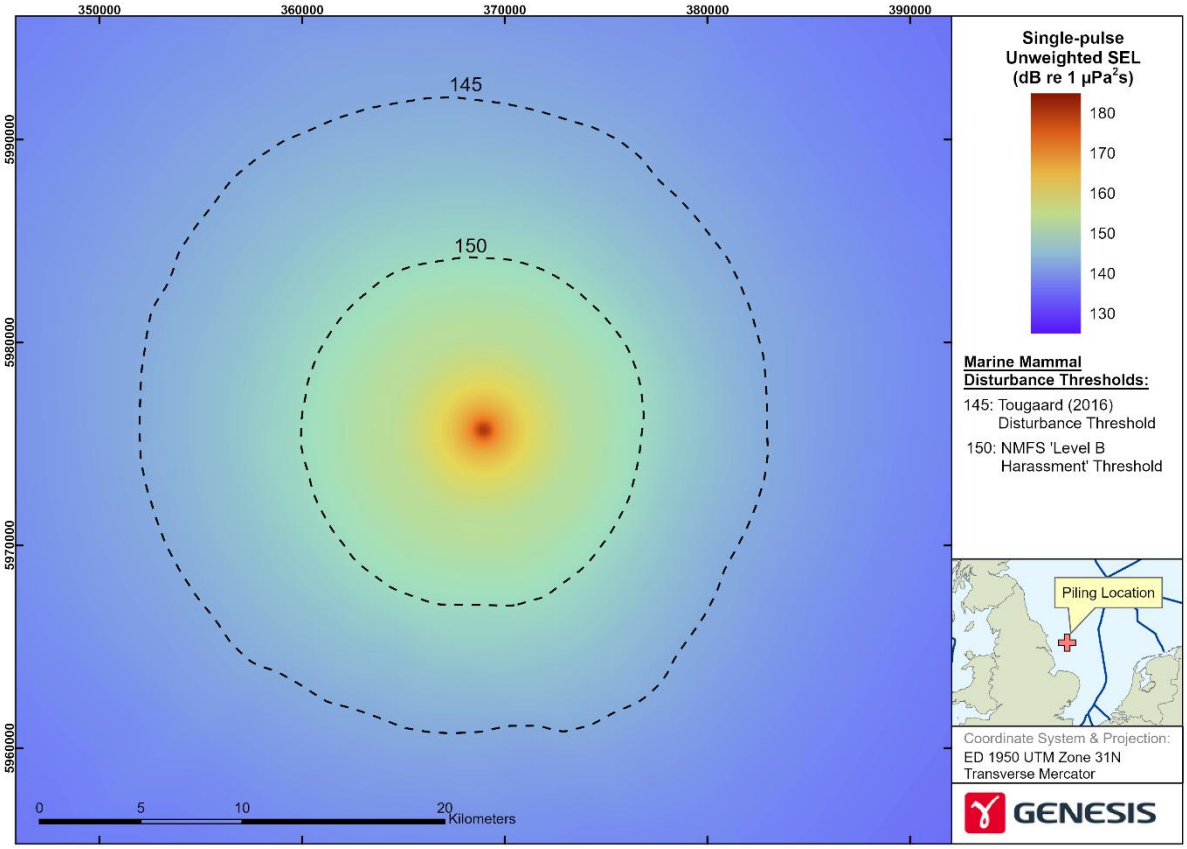


Figure 4-2: Predicted unweighted SEL received by marine mammals during piling with the hammer operating at maximum energy of 780 kJ.

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Table 4-3: Predicted distance and areas where the adopted marine mammal behavioural disturbance thresholds are exceeded.

Criteria	SEL Behavioural Disturbance Threshold (dB re 1 µPa²s)	Maximum Distance to Threshold Exceedance[1] (km)	Area of Threshold Exceedance[2] (km²)
NMFS 'Level B Harassment' criteria for behavioural disturbance to all marine mammals	150 [3]	9	230
Tougaard (2016) criteria for behavioural disturbance to all marine mammals	145	17	772

[1] Predicted distances have been rounded to the nearest 1 km.
[2] Predicted areas have been rounded up to the nearest 1 km².
[3] The NMFS 'Level B Harassment' rms SPL threshold of 160 dB re 1 µPa has been converted to an SEL threshold of 150 dB re 1 µPa²s assuming a conservative integration time of 100 ms.

Table 4-4: Estimated number of marine mammals disturbed during piling modelled.

Species	Disturbance Area (km²)	Animal Density (animals/km²)	Number of Animals Disturbed	MU Population	Percentage of MU Population Disturbed (%)
Disturbance over entire survey duration based on modelled received sound levels compared to the NMFS Level B Harassment and Tougaard (2016) threshold values [1].					
Harbour porpoise	230 - 772	0.603	139 - 465	346,601	0.04 - 0.134
White-beaked dolphin	230 - 772	0.015	3 - 12	43,951	0.007 - 0.027
Minke whale	230 - 772	0.007	2 - 5	20,118	0.01 - 0.025
Bottlenose dolphin	230 - 772	0.042	10 - 32	2,022	0.495 - 1.583
Common dolphin	230 - 772	0.003	1 - 2	102,656	0.001 - 0.002
Grey Seal	230 - 772	0.793	182 – 612	N/A	
Harbour Seal	230 - 772	0.008	2 - 6		

[1] The smaller disturbance area estimated from the modelling results is based on comparison of estimated received sound levels with the NMFS Level B Harassment disturbance threshold, whilst

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Species	Disturbance Area (km^2)	Animal Density (animals/km^2)	Number of Animals Disturbed	MU Population	Percentage of MU Population Disturbed (%)
the larger estimated disturbance area results are based on comparison of estimated received sound levels with the Tougaard (2016) disturbance threshold. N/A – No management unit population available for species.					

4.1.3 Protected Areas

The proposed piling is located in the SNS Special Area of Conservation (SAC) 'Summer Area', which is applicable during the months of April – September when harbour porpoises are more abundant in the area (JNCC, 2020). If the piling is undertaken between April – September, a cumulative noise impact assessment will be required prior to the commencement of the works, in line with JNCC guidance (JNCC, 2020).

The JNCC guidelines (JNCC, 2020) suggest that disturbance within an SAC from an activity (individually or in combination) is significant if it excludes harbour porpoises from more than:

- 20% of the relevant area of the site in any given day; or
- an average of 10% of the relevant area of the site over a season.

If the piling is undertaken between April – September, potential disturbance to harbour porpoises in the SNS SAC will have to be estimated for the proposed piling activities by themselves, as well as in combination with other activities that could be conducted at the same time. This will be undertaken during the permitting stage once more accurate information on potential concurrent works are known.

4.2 Fish

4.2.1 Injury

To quantitatively assess potential injury to fish and fish eggs and larvae from the proposed piling, received noise levels in terms of unweighted zero-to-peak SPL and unweighted cumulative SEL have been predicted and compared to the Popper *et al*. (2014) thresholds for injury (see Table 3-3 in Section 3.2.1).

Figure 4-3 shows the predicted zero-to-peak SPL with the hammer operating at the maximum hammer energy of 780 kJ. The contours in Figure 4-3 highlight the Popper *et al*. (2014) zero-to-peak SPL thresholds for potential injury to fish and fish eggs and larvae.

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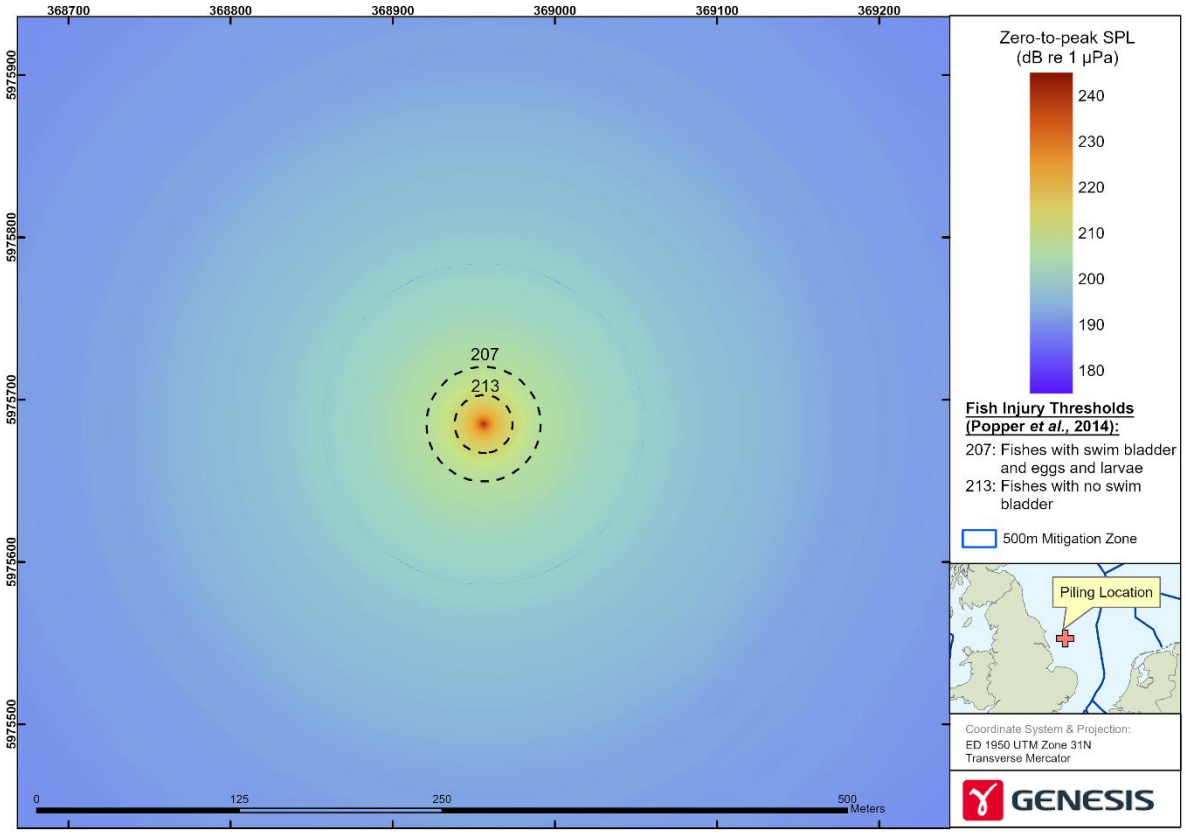


Figure 4-3: Predicted zero-to-peak SPL received by fish during piling with the hammer operating at maximum energy of 780 kJ.

The predicted distances where the zero-to-peak SPL thresholds for injury to fish species and fish eggs and larvae are exceeded are shown in Table 4-5. When the hammer is operating at maximum energy, the zero-to-peak SPL is predicted to potentially cause injury to fish species and fish eggs and larvae within 40 m from the proposed piling location. It is expected that the hammer soft start and gradual ramp up of hammer energy throughout the piling should allow mobile fish sufficient time to move away from the piling location to distances where the zero-to-peak SPLs generated will not cause injury. However, it is acknowledged that fish eggs and larvae will not be able to move away.

The cumulative SEL received by fish species and fish eggs and larvae has also been calculated. In the cumulative SEL modelling, it is assumed that mobile fish will swim away from the piling location at 0.5 m/s, whilst fish eggs and larvae are assumed to remain stationary.

The predicted minimum initial distances that fish must be from the pile sound source at the start of pile driving operations (i.e., safety distances), in order to not be exposed to cumulative SELs above the Popper *et al*. (2014) thresholds for potential injury, are summarised in Table 4-6. The modelling predicts that the cumulative SEL injury thresholds will not be exceeded if fish swim away from the piling location at 0.5 m/s. This indicates that the hammer soft start and gradual ramp up in energy allows sufficient time for mobile fish to move to safe distances where they will not suffer injury.

It is predicted that fish eggs and larvae that cannot move away from the piling may potentially be injured at distances of up to 240 m from the piling location. However, given the relatively

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small impact area compared to the large spawning grounds in the North Sea, it is not expected that the piling operations associated with the project will have a significant adverse effect.

Table 4-5: Predicted distances from the modelled piling location where the zero-to-peak SPL thresholds for injury to fish and fish eggs and larvae are exceeded.

Fish Group	Zero-to-peak SPL Injury Threshold (dB re 1 µPa)	Maximum Distance to Threshold Exceedance (m)[1]
Fishes with no swim bladder	213	20
Fishes with swim bladder involved in hearing	207	40
Fishes with swim bladder not involved in hearing	207	40
Eggs and larvae	207	40

[1] Predicted distances have been rounded up to the nearest 10 m.

Table 4-6: Predicted distances that fish species and fish eggs and larvae must be from the modelled piling location at the start of piling in order to not be exposed to cumulative SEL exceeding injury thresholds.

Fish Group	Cumulative SEL Threshold for Injury (dB re 1 µPa^{2}s)	Swim Speed (m/s)	Maximum Distance to Threshold Exceedance (m)[1]
Fishes with no swim bladder	219	0.5	0
Fishes with swim bladder involved in hearing	207	0.5	0
Fishes with swim bladder not involved in hearing	210	0.5	0
Eggs and larvae	210	Stationary	240

[1] Predicted distances have been rounded up to the nearest 10 m.

4.2.2 Disturbance

Behavioural disturbance to fish cannot be quantitively predicted from the propagation modelling since there are no well-established disturbance thresholds for fish. The qualitative

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criteria established by Popper *et al*. (2014) (see Table 3-4) suggest that any disturbance to fish species will likely be localised, with higher levels of disturbance only occurring in regions near to the source (e.g., within a few hundred metres). At further distances from the source (e.g., beyond one kilometre), the risk of behavioural disturbance to fish is likely to be low. Fish are mobile and would be expected to move away from a sound source that had the potential to cause them harm. If fish are disturbed by sound, evidence suggests they will return to an area once the activity generating the sound has ceased (Slabbekoorn *et al*., 2010).

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5.0 MITIGATION MEASURES

To minimise the risk of potential impacts of sound from the piling, the following mitigation measures recommended by the JNCC (2010) guidelines for minimising the risk of injury to marine mammals from piling noise are suggested:

- A qualified, trained, and equipped Marine Mammal Observer should be present and dedicated to the observation of marine mammals. The Marine Mammal Observer should carry out a 1-hour pre-piling survey of a 500 m mitigation zone and, if an animal is detected, the piling should be delayed until no marine mammals have been detected in the mitigation zone for at least 20 minutes. The Marine Mammal Observer and PAM operative should track any marine mammals detected and ensure they are satisfied they have left the mitigation zone before the start of any piling activities;
- A soft start and ramp up of hammer energy should be employed where the hammer should commence at a low energy at the start of piling. The soft start should be conducted over a period of at least 20 minutes; and
- PAM should be employed during periods of low visibility and darkness to detect marine mammal presence, and any detections during the pre-piling survey should result in an appropriate delay to the start of piling.

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6.0 CONCLUSIONS

This report has presented underwater noise propagation modelling results for the proposed jacket and conductor piling associated with the Platypus Field Development project. The jacket piling modelling results were used to assess any potential impacts to marine mammals based on a comparison of estimated noise levels with the NMFS (2024) thresholds for potential auditory injury onset and relevant thresholds for behavioural disturbance. Potential injury to fish species and fish eggs and larvae was also assessed by comparing predicted sound levels to the injury thresholds established by Popper *et al*. (2014).

The results indicate that the likelihood of marine mammals being exposed to noise levels that may cause auditory injury during the piling is low, provided that the standard JNCC (2010) guidelines for minimising the risk of injury to marine mammals from piling noise are followed. The guidelines will be followed throughout the piling operations.

The modelling predicts that behavioural disturbance to marine mammals could potentially occur up to 17 km from the piling location. However, any behavioural disturbance that may occur will only be temporary. If any marine mammals are disturbed, they will return to the area once the piling has been completed. Therefore, it is not expected that the piling associated with the project will have any long-term significant effects on marine mammal populations.

The results indicate that injury to fish species and fish eggs and larvae during the piling will be localised to small areas (within 240 m) around the piling location. The soft start and ramp up of the hammer energy during piling should allow mobile fish species time to move away to distances where they are unlikely to suffer injury. Fish eggs and larvae will not be able to move away from the piling location and will therefore be susceptible to injury. However, given the predicted small areas where fish eggs and larvae may suffer injury, relative to the large spawning areas across the North Sea, it is not expected that the piling will have a significant effect on fish eggs and larvae.

It is concluded that the proposed Platypus project piling activities will not have a significant impact on marine mammals, fish, and fish eggs and larvae.

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Appendix E – Hydrocarbon Release Modelling Report

REPORT

Spill Modelling at Platypus



Prepared for: **Perenco**

Prepared by: **Genesis Energies**
www.genesisenergies.com

Project Title: **Platypus Development Environmental Statement**
Document / Rev No.: 220126C-001-Y-RT-24006/ 0
Client Document No.: PLA729-UK-PLA-PT-GEN-RP-G-006

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ABBREVIATIONS

'	Minute
"	Second/Inch
%	Percent
‰	Parts per thousand
<	Less Than
>	Greater Than
°	Degrees
°C	Degrees centigrade
µg/l	Microgram per litre
µm	Micrometre
BEIS	Department for Business, Energy and Industrial Strategy (now Department for Energy Security and Net Zero, DESNZ)
cm	Centimetre
ED50	European Datum 1950
g/m^2	Grams per square metre
HYCOM	Hybrid Coordinate Ocean Model
ITOPF	International Tanker Owners Pollution Federation
kg/m^3	Kilogram per cubic metre
km	Kilometre
m	Metre
mm	Millimetre
MODU	Mobile Offshore Drilling Unit
NOEC	No Observed Effect Concentration
NMPi	National Marine Plan interactive
OPEP	Oil Pollution Emergency Plan
PNEC	Predicted No Effect Concentration
ppb	Parts per billion
SNS	Southern North Sea
t	Tonnes
t/m^3	Tonnes per cubic metre
TPH	Total Petroleum Hydrocarbons
UK	United Kingdom
UKCS	United Kingdom Continental Shelf

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UTM	Universal Transverse Mercator
VLSFO	Very Low Sulphur Fuel Oil

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1.0 INTRODUCTION

Perenco are preparing to develop the Platypus gas field, located on the UK Continental Shelf (UKCS) in Block 48/1 in the Southern North Sea (SNS), which lies *c.* 65 km from the UK coastline and *c.* 121 km west of the UK/Netherlands median line (Figure 1-1).

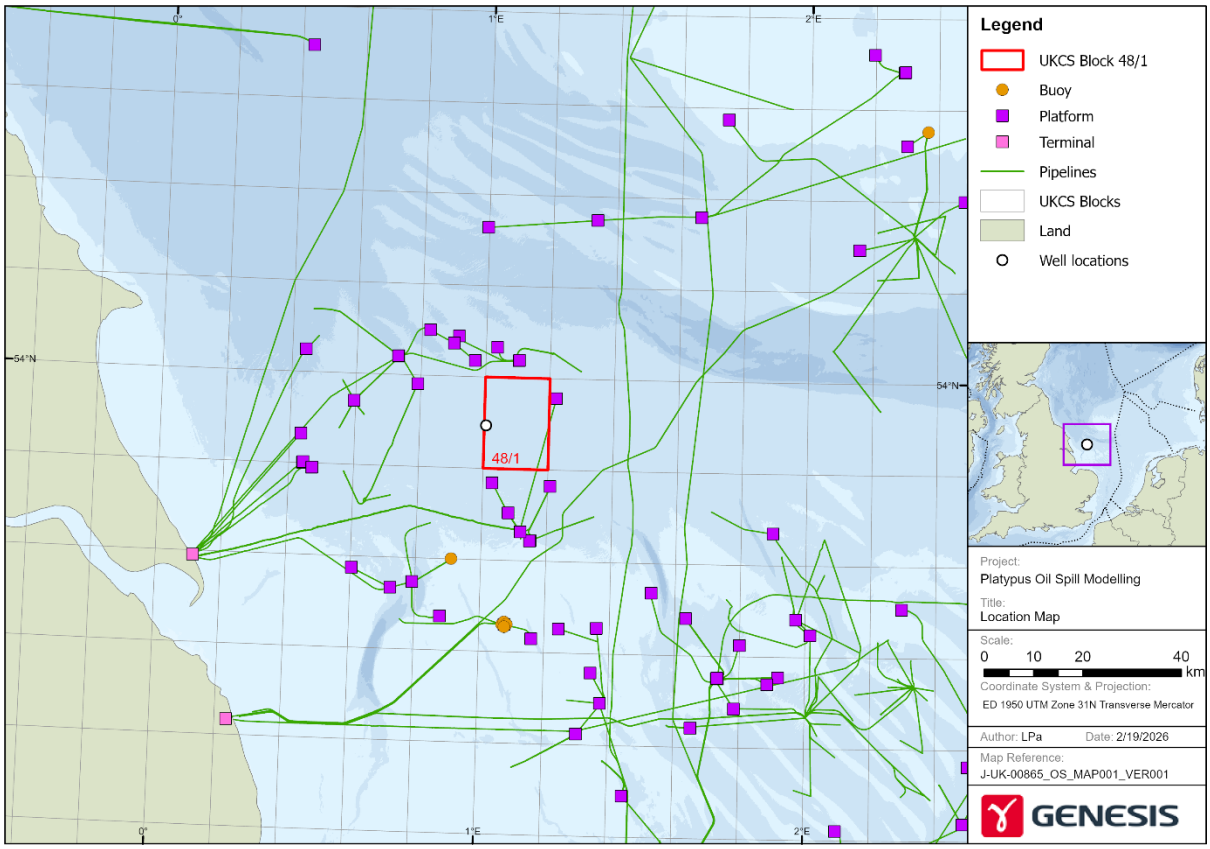


Figure 1-1 Drilling Location

It is proposed to develop the Platypus gas field by drilling two wells using a jack up rig. The spill modelling detailed herein represents two scenarios; a loss from a well blowout and a total diesel inventory loss.

Modelling results presented in this technical note have been used to inform the Environmental Impact Assessment which will be presented in the Environmental Statement.

This report presents the potential magnitude of the spills in terms of probability (likelihood of a spill reaching a particular area) and extent (volume, area, thickness etc for a specific set of worst-case meteorological conditions). Worst-case results are presented, assuming no intervention; therefore, in the unlikely event that a spill occurred and taking into consideration barriers and controls in place, it is likely that the magnitude of the spill would be lower than that modelled.

Two scenarios have been modelled:

Scenario 1: A worst-case condensate release as a result of a well blowout with a flowrate of 15.5 m^3/day over a period of 98 days; and

Scenario 2: An instantaneous worst-case full diesel inventory loss of 1,050 m^3 in 1 hour (full diesel inventory stored on the Mobile Offshore Drilling Unit (MODU)).

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The modelling has been carried out in line with the DESNZ Oil Pollution Emergency Plan (OPEP) Guidelines (BEIS, 2022)[1].

The spill scenarios were modelled using the Oil Spill Contingency and Response (OSCAR, version 15.2) model developed by Sintef.

The objectives of the modelling were to understand:

- How the hydrocarbons are likely to disperse over time (both on the sea surface and in the water column);
- The extent to which hydrocarbons are likely to arrive on any shoreline; and
- Where hydrocarbon concentrations could exceed certain thresholds on the sea surface, in the water column, onshore, and in sediments.

[1] DESNZ = Department for Energy Security and Net Zero, formerly the Department for Business, Energy and Industrial Strategy (BEIS).

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2.0 OVERVIEW OF THE MODELLING METHODOLOGY

When hydrocarbons are spilled on the surface of the sea, it is subjected to a number of processes including spreading, evaporation, dissolution, emulsification, natural dispersion, photo-oxidation, sedimentation and biodegradation. The fate and effect of hydrocarbons are dependent on the chemical and physical properties of the hydrocarbons, and the physico-chemical changes to which it is subjected. These vary depending on the hydrocarbon type, the volume spilled and the prevailing weather and sea conditions. Some of these changes lead to its disappearance from the sea surface while others, for example emulsification, may cause it to become more persistent.

Figure 2-1 highlights the various processes hydrocarbons are subjected to after being released at sea. These processes are all modelled within the OSCAR modelling software to predict the fate and behaviour of discharged hydrocarbons over time.

Two different types of simulation are supported in OSCAR: stochastic (probabilistic) and deterministic simulations. The stochastic modelling feature of OSCAR allows for a spill scenario to be modelled multiple times over different weather conditions, with the results from each individual stochastic run being aggregated, and a number of statistical parameters computed. The stochastic modelling results presented in this report examine:

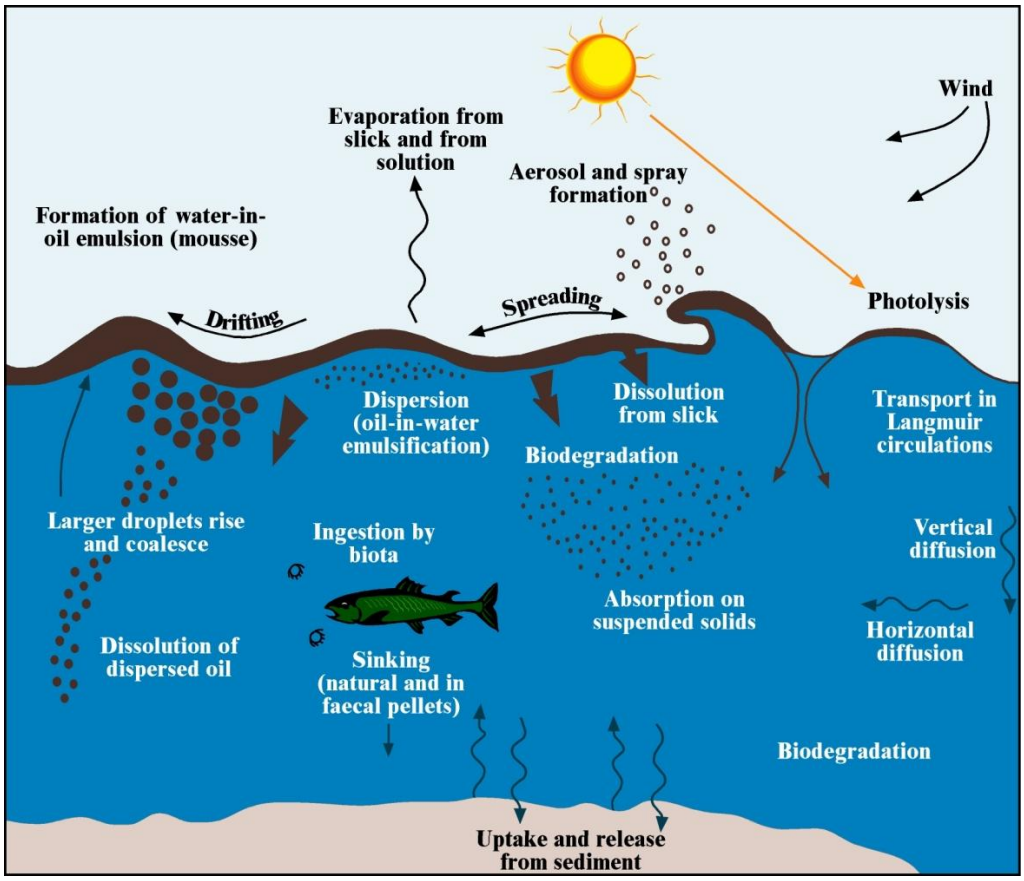
- The probability of condensate and diesel above a predefined threshold appearing on the sea surface;
- The probability of condensate and diesel above a predefined threshold being present throughout the water column; and
- The probability of condensate and diesel arriving on the shoreline.

It is important to note that the stochastic modelling results do not represent a single spill scenario but rather show the aggregation of results computed by running the spill scenario multiple times over different weather conditions.

To analyse a single spill scenario, the deterministic mode of OSCAR allows for the spill scenario to be modelled over a single specified time interval and outputs can be presented in terms of key parameters such as hydrocarbon thickness on the sea surface, concentrations on the shoreline, in the sediment and in the water column. One deterministic scenario is selected based on the individual stochastic run which gives the worst-case shoreline oiling (i.e., the greatest mass of oil arriving onshore). The deterministic model results presented in this report examine:

- The maximum thickness of hydrocarbon appearing on the sea surface;
- The maximum concentrations of hydrocarbon present in the water column;
- The maximum concentrations of hydrocarbon reaching the shoreline; and
- The maximum concentrations of hydrocarbon being deposited in the sediment.

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Source: adapted from Koops *et al.* (1985)

Figure 2-1: Fate and behaviour of spilled hydrocarbons at sea.

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3.0 INPUT DATA

The OSCAR model considers the properties of the hydrocarbons being released as well as a range of environmental factors such as bathymetry, current and wind speed and direction, water column salinity and temperature, as well as seabed and coastal sediment types.

3.1 Modelling Parameters

The main release parameters for the well blowout scenario are summarised in Table 3-1 and the parameters for the full diesel inventory loss are summarised in Table 3-2. The OSCAR modelling parameters adopted for both studies are outlined in Table 3-3.

The release of the condensate inventory from a well blowout is assumed to occur at the sea surface with a release duration of 98 days. This is based on the estimated time taken to mobilise a drilling rig and to drill a relief well. This results in a total modelled condensate release of 1,519 m^3.

The model assumed no intervention (i.e., no response efforts were included in the modelling, in line with OPEP guidance, BEIS, 2022). The results in terms of estimated impacts can therefore be considered conservative.

A constant condensate flow rate of 15.5 m^3 per day was simulated in the model.

Table 3-1 Well blowout scenario release parameters.

Release location (projection: WGS 84)	Hydrocarbon type	Release rate (m^3 per day)	Duration (days)	Release depth (m below sea surface)	Release temperature (°C)
53° 54' 39.859" N 1° 0' 12.933" E	Condensate	15.5	98	0.5	38

For the full diesel inventory loss, a total volume of 1,050 m^3 was modelled as an instantaneous release (full inventory released in 1 hour) at the same location, at the sea surface.

Table 3-2 Full inventory loss scenario release parameters.

Release location (projection: WGS 84)	Hydrocarbon type	Total volume (m^3)	Duration (hours)	Release depth (m below sea surface)	Release temperature (°C)
53° 54' 39.859" N 1° 0' 12.933" E	Diesel	1,050	1	0.5	10.10 (ambient sea surface temperature)

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Table 3-3: OSCAR modelling parameters.

Modelling parameter		Well blowout	Diesel inventory loss
Model duration (days)		128	30
Model time step (hours)		0.5	
Output interval (hours)		3	
Grid resolution (cell size)	Cell size	1 km × 1 km	
	Grid size	500 km × 500 km	
	Maximum Depth (m)	140	
Number of particles	Liquid/ Solid	20,000	
	Dissolved	20,000	
	Gas	50	

It is normal to run scenarios for the entire duration of the blowout/spill, and for sufficient time afterwards to determine the behaviour and location of the hydrocarbons, before taking a view on whether this poses a risk to receptors. Often some dispersed and surface hydrocarbons remain at sea at the end of the scenarios; this is in a very dispersed form and less likely to cause acute pollution than during or shortly after the releases. Thus, for the blowout scenario the model was run for 128 days (98 days duration of blowout plus a further 30 days to allow sufficient time for dispersion) and the diesel scenario was run for 30 days total.

3.2 Hydrocarbon Properties

OSCAR includes a database that contains various hydrocarbon types. A suitable analogue was selected from this database to represent the Platypus condensate for the well blowout. “Kristin Kondensat” was selected based on its properties as shown in Table 3-4.

The Marine Diesel analogue within the OSCAR database was selected for the full diesel inventory loss.

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Table 3-4: Properties of selected OSCAR analogues.

Property	Well Blowout		Full Inventory Loss
	Platypus Condensate[1]	OSCAR ANALOGUE (Rev 2009 13 Grader C)	Marine Diesel
API (°)	43	45.8	-
Specific gravity[2]	0.81	0.798	0.843
Viscosity (cP)	< 0.7 @ 30°C	4.0 (at 13°C)	3.9
Pour Point (°C)	< -48	-27	-36
Asphaltene content (% weight)	< 0.1	0.6	0.05
Wax content (% weight)	0.0	7.3	0.05

[1]Where Platypus condensate properties were unavailable, Cleeton hub condensate properties were used to select an appropriate analogue. These values are highlighted in yellow.
[2]Specific gravity is the ratio of the density of the substance (condensate/diesel) to the density of sea water.

Although the pour point is lower in the Platypus condensate than for the "Kristin Kondensat", the pour point temperature will not be reached in the North Sea (minimum annual average temperature is around 10°C) and therefore this will not influence the behaviour of the condensate. All other parameters are very close matches.

3.3 Environmental Data

3.3.1 Bathymetry

The bathymetry data used in the OSCAR model is Sea Topo 8.2 as supplied by Sintef with the OSCAR model.

3.3.2 Ocean Currents

Three-dimensional water column current data for the region was obtained from the Hybrid Coordinate Ocean Model (HYCOM) covering the years 2009–2014. The dataset contains three-dimensional ocean currents with a temporal resolution of one day; in other words, the currents change speed and direction at daily intervals.

3.3.3 Winds

Wind data sets have been obtained from the European Centre for Medium-Range Weather Forecasts for the same period as the currents were used. OSCAR uses wind data to generate waves for surface turbulent mixing processes.

3.3.4 Ocean Temperature and Salinity

Annual average salinity and temperature values were obtained from the Scottish Government's National Marine Plan interactive (NMPi) (Berx and Hughes, 2009).

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The average sea temperature at the Platypus gas field varies from 9.76°C at the seabed to 10.10°C at the sea surface. Salinity variation in the water column is minimal and an average value of 34.56‰ was used at the surface and the seabed.

3.4 Model Uncertainties

There are uncertainties associated with simulation of hydrocarbon spills and therefore conservative assumptions have been used to take account of these uncertainties. Results should be treated as indicative and used to draw conclusions at a high level.

3.4.1 Hydrocarbon Characteristics

For the well blowout scenario, hydrocarbon weathering properties have been adopted from an analogue which is closest to the Platypus condensate description provided. The match is considered representative for the purposes of this assessment. “Kristin Kondensat” was selected as a suitable analogue based on its properties as shown in Table 3-4. Selection of a different analogue would result in some changes to how the hydrocarbon behaves following release into the sea; however, results would be broadly similar.

For the full diesel inventory loss, marine diesel was selected as a suitable analogue. It is possible that the fuel inventory could be made up of a different fuel type such as very low sulphur fuel oil (VLSFO). VLSFOs can vary significantly in their make-up and properties but tend to be denser and more viscous than diesel with low pour points and high wax content. If VLSFO was modelled, this would result in changes to how the hydrocarbon behaves following release into the sea, with likely lower evaporation and greater persistence at the sea surface due to potential for the oil to emulsify with lower water column concentrations. This ultimately depends on the properties of the specific VLSFO.

3.4.2 Metocean Data

Currents and wind data used in this study are modelled for the years 2009–2014. Therefore, future currents and winds may differ from those used for the simulations. A simulation with more recent data (days before the event if possible) or forecasting data should ideally be used in the event of a real spill to aid the response effort. However, for the purposes of this modelling exercise, which uses data across multiple years to calculate probabilities, the variation is considered acceptable.

3.5 Output Thresholds

The OSCAR model can track the fate of hydrocarbons in smaller and smaller concentrations and masses (over time and space), beyond the point where they represent a significant risk or are even detectable against background levels. To ensure the model outputs are proportionate to the risks, while still retaining a precautionary approach, output thresholds are normally applied, prior to modelling, to thicknesses of surface hydrocarbons and to concentrations in the water column. The thresholds adopted in the modelling are discussed in the following sections.

3.5.1 Surface Thickness

A surface thickness threshold of 0.3 µm has been adopted. This threshold is based on the Bonn Agreement oil appearance code (Bonn Agreement, 2016), which states that a rainbow sheen could be visible above this threshold (Table 3-5). Oil thicknesses lower than 0.3 µm become unlikely to be visible in many conditions and an oil thickness lower than 0.04 µm is

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considered “not visible”, even under good conditions. The OPEP guidelines (BEIS, 2022) for the UKCS state that oil spill model results must be displayed to a minimum oil thickness of 0.3 µm and therefore this threshold has been adopted for the current study.

Table 3-5: Bonn agreement oil appearance code.

Code	Appearance description	Layer thickness (µm)
1	Sheen (silver/grey)	0.04–0.3
2	Rainbow	0.3–5.0
3	Metallic	5.0–50
4	Discontinuous true oil colour	50–200
5	Continuous true oil colour	>200

Source: Bonn agreement (2016).

3.5.2 Hydrocarbon in Water Concentration

A range of standards for the concentration of hydrocarbon in water have been considered, which are summarised in Table 3-6.

Table 3-6: Standards for hydrocarbon concentration in the water column.

Region	Source	Context	Parameter	Standard
North Sea and North East Atlantic	OSPAR Agreement 2014/05 (OSPAR, 2014)	Predicted no-effect concentrations (PNEC) of substances in produced water	Dispersed oil	No Observed Effect Concentration (NOEC) 70.5 µg/l (70.5 ppb)
International	Patin (2004)	Fate and effect of crude oil spills	Total Petroleum Hydrocarbons (TPH)	NOEC 10 µg/l (10 ppb)
Norway	Sintef	Pre-defined toxicity levels of oil components in OSCAR database	Any hydrocarbon component	Acute toxicity PNEC 50–15,500 ppb. Chronic toxicity PNEC 5–1,550 ppb

A total hydrocarbon in seawater (in the water column) concentration above 10 µg/l has been used as the threshold for the current model. This is based on the NOEC highlighted by Patin (2004). The NOEC is the level at which biological effects are either absent or manifest themselves as primary (mostly reversible) physiological and biochemical responses. A threshold of 10 µg/l is considered conservative given it is at the lower end of the range of standards shown in Table 3-6.

3.5.3 Shoreline Concentration of Hydrocarbons

No threshold has been applied within the model to the shoreline hydrocarbon density as, in the interest of transparency, it is considered best practice to report all shoreline hydrocarbons (however small) in the results.

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To allow an assessment of impacts when reviewing model outputs, a mass of oil on the shoreline above 0.1 kg/m^2 has been considered as potentially significant. This is considered to be an impact threshold for oiling of birds by the US Army Corps of Engineers (2003) and is reinforced by McCay (2009), who notes that 0.1 kg/m^2 would be enough to coat benthic epifaunal invertebrates living in intertidal habitats on hard substrates. It is also inferred from the level of 'light' oiling defined by the International Tanker Owners Pollution Federation (ITOPF) Technical Information Paper 6 (ITOPF, 2014).

3.5.4 Hydrocarbon in Sediment

No threshold has been applied to sediment concentrations within the model.

To allow an assessment of impacts when reviewing model outputs, an environmental threshold of 50 mg/kg has been taken as the level above which toxic effects on benthic fauna may begin to be discernible. This threshold was adopted by the Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR, 2006) and UK Offshore Operators Association (1999) in the context of oil-based mud contamination. Given that deposition will distribute vertically through the surface of the seabed, this equates to 5 g/m^2, assuming that the oil will distribute through a 5 cm sediment layer and assuming a sediment density of 2.0 t/m^3. Thus, 5 g/m^2 is adopted as the threshold above which toxic effects are considered to begin to be discernible in seabed sediments.

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4.0 RESULTS AND DISCUSSION

This section presents the results obtained from the OSCAR simulations for the scenarios detailed in Table 3-1 and Table 3-2. The stochastic simulations comprised 100 individual deterministic simulations, which were randomly spread throughout the 4 years of current and wind data (see Section 3.3). Annual results are presented.

4.1 Well Blowout

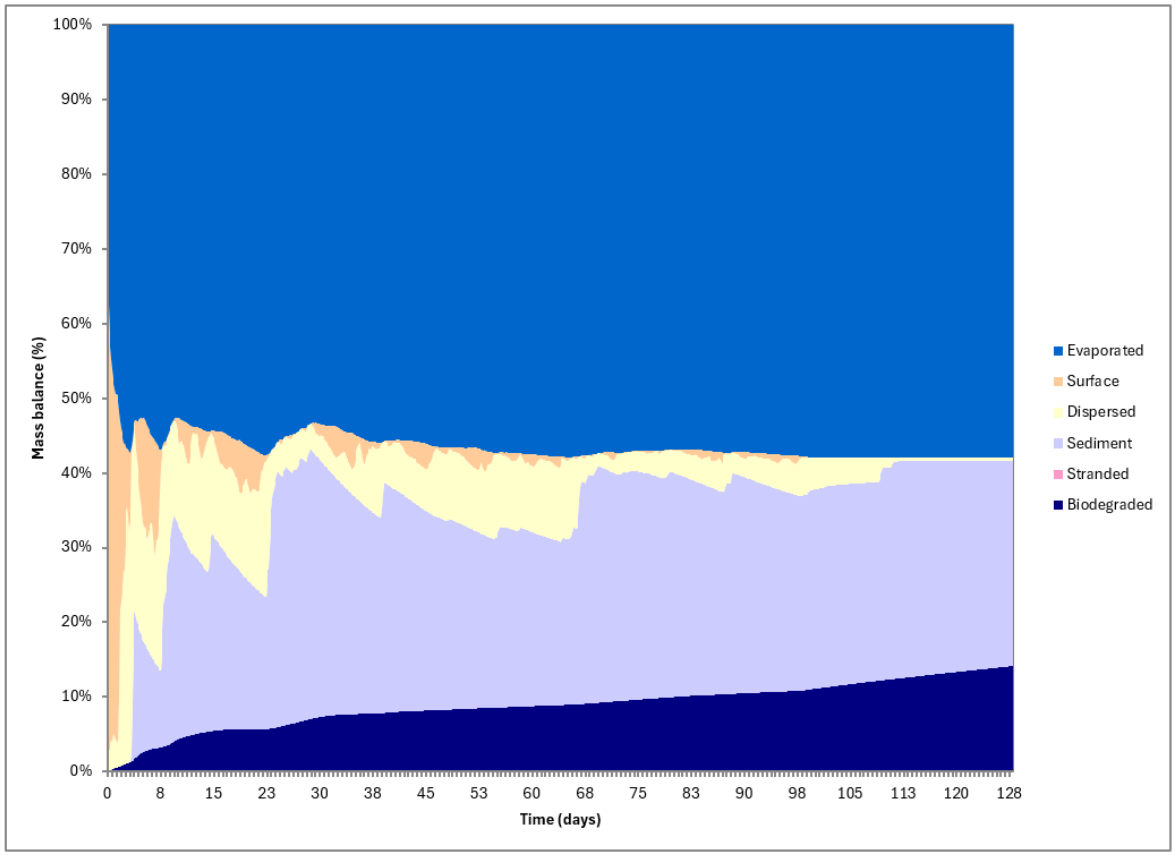
4.1.1 Fate of Hydrocarbons (Mass Balance)

Figure 4-1 shows the mass balance over time both as (A) a percentage and as (B) tonnes (t). At the end of the simulation (day 128) the mass balance of the spilled hydrocarbon was:

- Evaporated: 57.9 % (711 t)
- Deposited on the seabed: 27.5 % (338 t)
- Biodegraded: 14.2 % (174 t)
- Water column: 0.4 % (5 t)
- Stranded on shorelines: 0.01 % (0.1 t)
- Sea surface: 0% (0 t)

The majority of the condensate is shown to evaporate. Most of the remaining condensate is predicted to biodegrade or end up on the seabed by the end of the simulation (day 128). Condensate is present in the water column in trace amounts at the end of the simulation, with a small amount expected to reach the shoreline. By the end of the simulation, no condensate remains on the sea surface.

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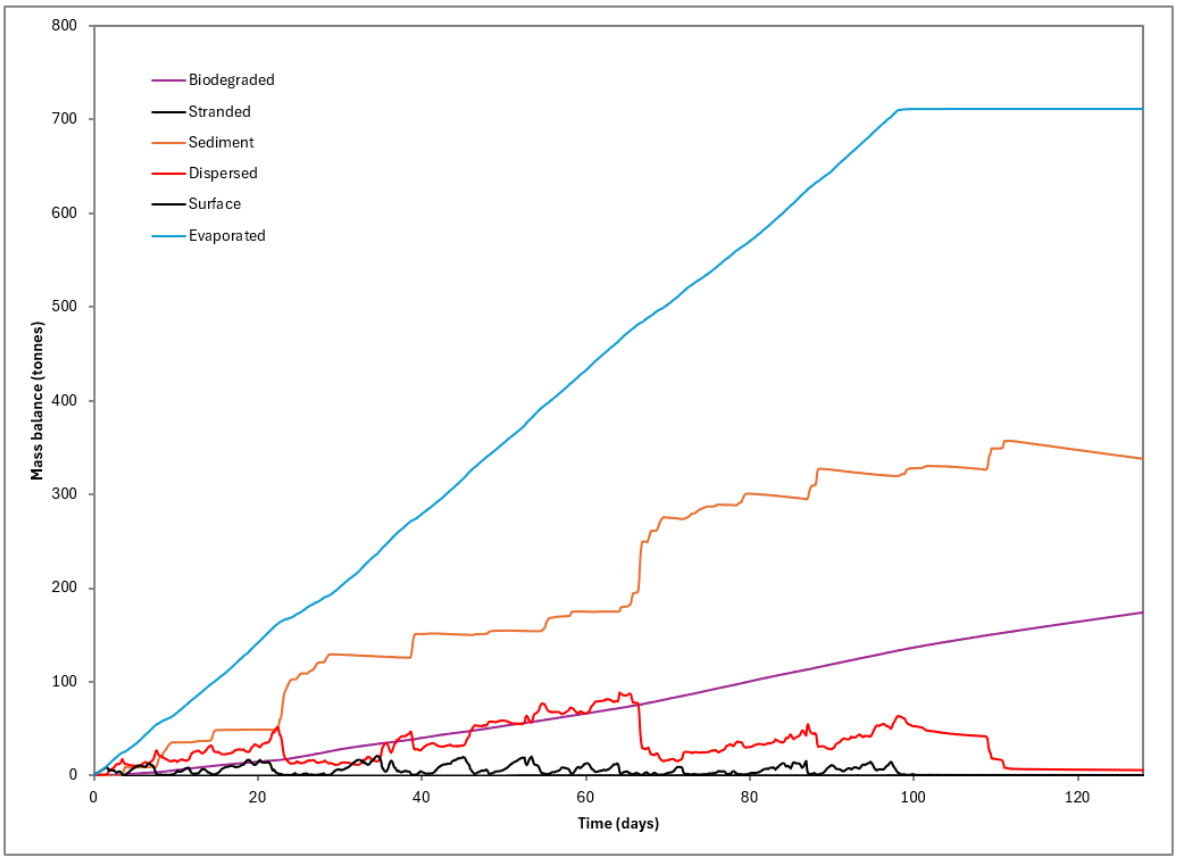


Figure 4-1: Condensate mass balance over time (deterministic).

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4.1.2 Condensate on the Sea Surface

The probability of a visible surface sheen with a thickness ≥0.3 µm is shown in Figure 4-2, with sea surface arrival times shown in Figure 4-3.

The visible surface sheen could extend to a maximum distance of 12.6 km from the spill location with a 90–100% probability, and 22.1 km from the spill location with a 40–50% probability.

The model predicts that the visible surface sheen with a thickness ≥0.3 µm will not reach any median lines.

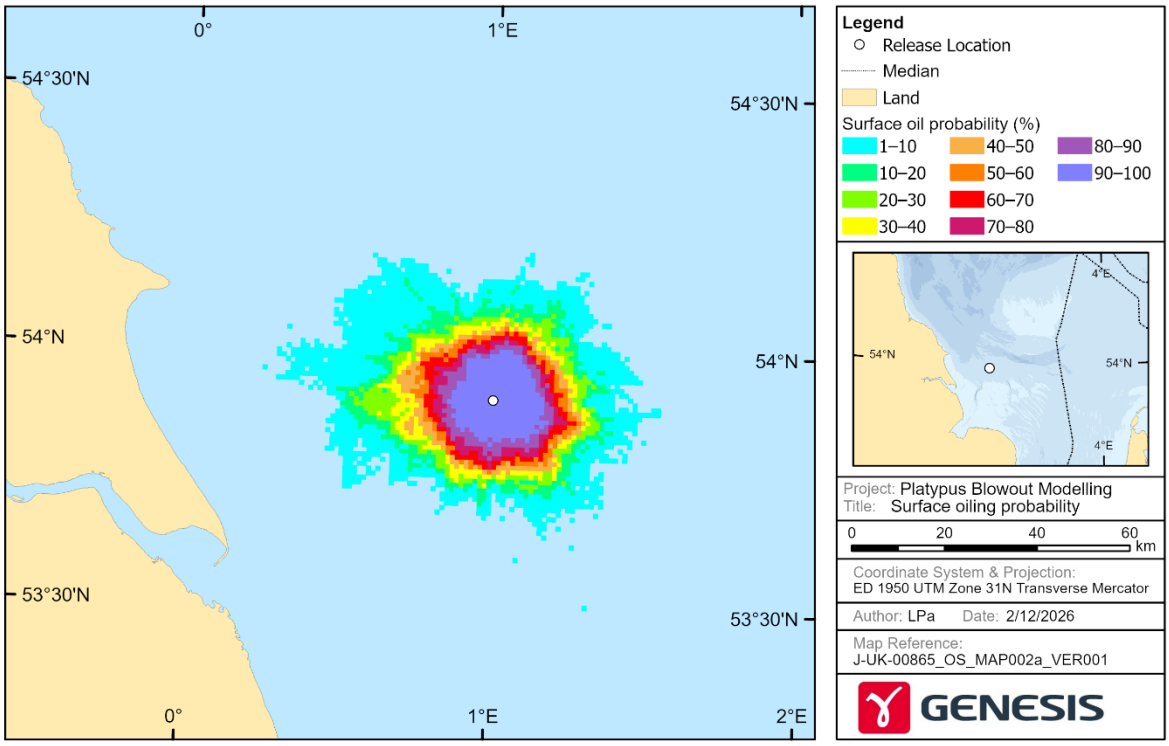


Figure 4-2: Probability of a condensate surface sheen ≥ 0.3 µm (stochastic).

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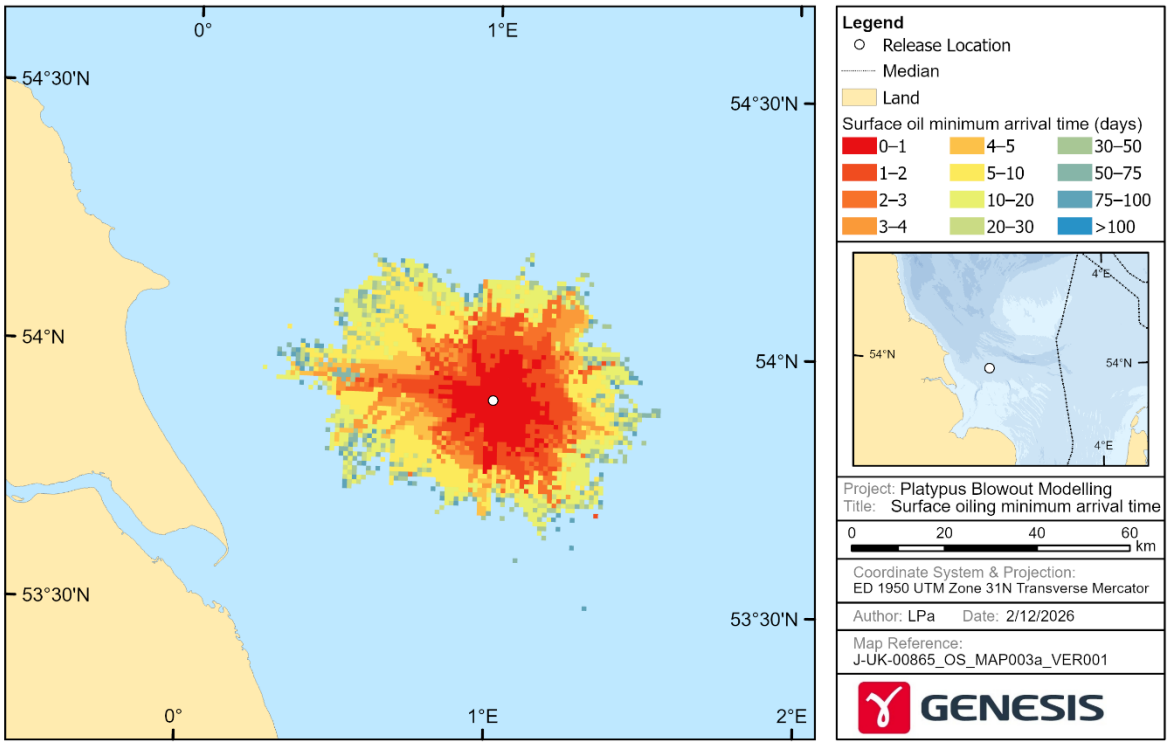


Figure 4-3: Minimum arrival time of a condensate surface sheen ≥ 0.3 µm (stochastic).

A worst-case deterministic simulation was run to further assess the impact to the sea surface. Figure 4-4 shows the maximum sea surface area impacted by condensate at any point during the simulation (swept path). The simulation estimated that the total sea surface impacted by oil with a thickness ≥ 0.3 µm is approximately 997 km^2. The maximum thickness estimated anywhere at the sea surface is 4.6 µm (0.0046 mm).

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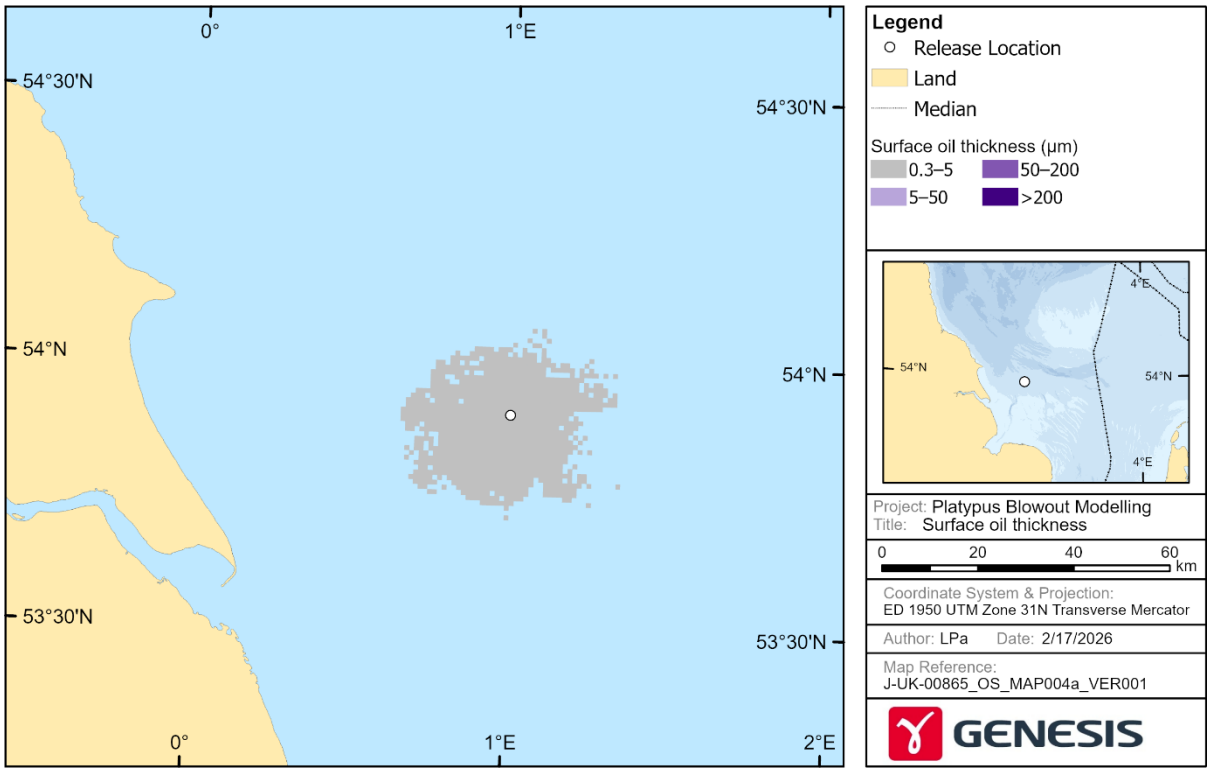


Figure 4-4: Maximum thickness of condensate at sea surface (deterministic, swept path)

By the end of the deterministic simulation, trace amounts of condensate remain at the sea surface.

4.1.3 Shoreline Stranding of Condensate

The modelling results indicate a low probability of condensate reaching the shoreline. The probability of condensate reaching the shoreline across all stochastic simulations is shown in Figure 4-5, with shoreline minimum arrival times shown in Figure 4-6. Table 4-1 details the values for the probability of shoreline oiling and minimum time of arrival to shore along various sections of the coastline. The simulation indicated that the greatest distance from the release site with potential shoreline impact is 124.2 km, with a probability of 1%.

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Table 4-1: Probability and minimum time of arrival to shore (stochastic).

Location	Probability (%)	Minimum time of arrival (days)
East Yorkshire and Northern Lincolnshire	10	6.63
Lincolnshire	4	9.52
East Anglia	1	34.17
North Yorkshire	1	81.27

Note: probability refers to the maximum probability oil reaching each shoreline and the minimum time of arrival refers to the minimum time taken for oil to reach that shoreline on any given simulation.

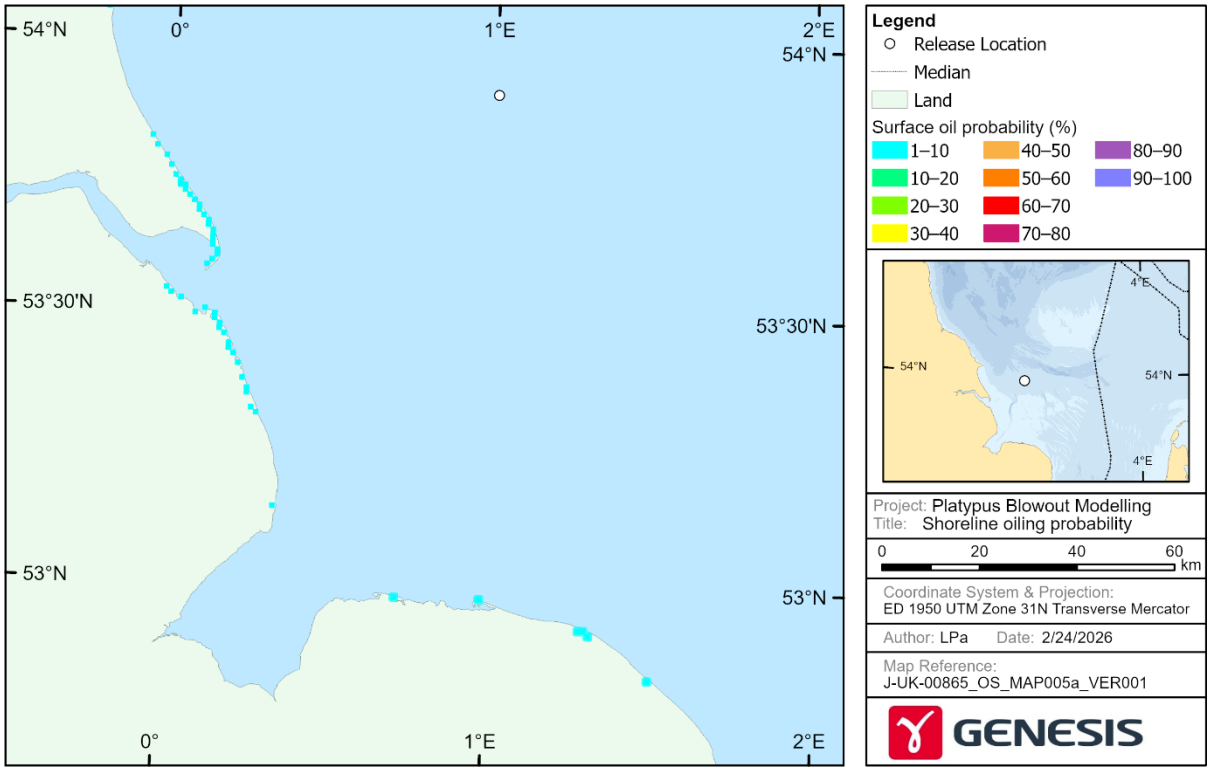


Figure 4-5: Probability of condensate reaching the shoreline (stochastic).

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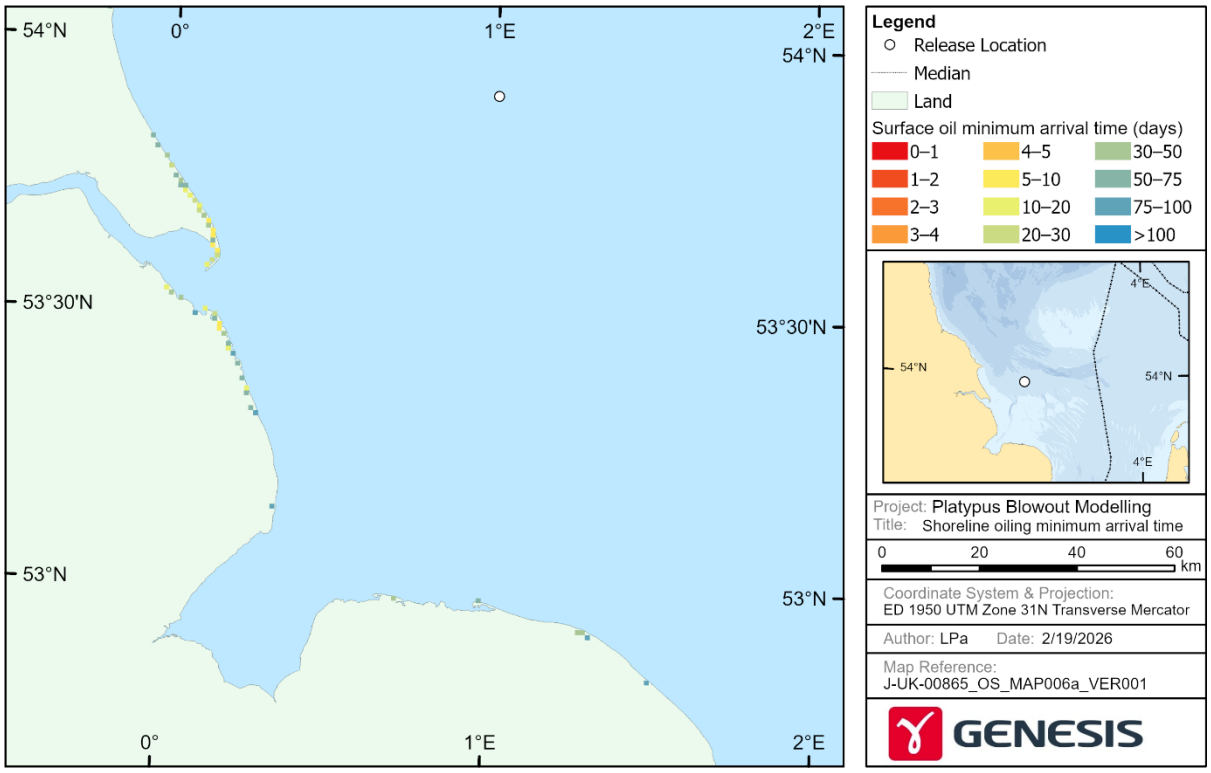


Figure 4-6: Minimum arrival time of condensate at shoreline (stochastic).

To allow an assessment of impacts when reviewing model outputs, as described in Section 3.5.3, a concentration of oil on the shoreline above 0.1 kg/m^2 has been considered as potentially significant. This is the impact threshold for oiling of birds used by the US Army Corps of Engineers (2003) and is reinforced by McCay (2009), who notes that 0.1 kg/m^2 would be enough to coat benthic epifaunal invertebrates living in intertidal habitats on hard substrates. It is also inferred from the level of 'light' oiling defined by the International Tanker Owners Pollution Federation (ITOPF) Technical Information Paper 6 (ITOPF, 2014).

The maximum oil reaching the coast based on the deterministic simulation is shown in Figure 4-7. The maximum mass of oil landed onshore from this scenario is 0.082 t, 100 days into the simulation. This reduces to 0.070 t at the end of the model run. As noted from the stochastic modelling, there is a low probability of this scenario happening given prevailing metocean conditions in the North Sea. The model does not predict any portion of the coastline to have a mass of oil of more than 0.1 kg/m^2, which is the threshold above which impacts are considered to be potentially significant.

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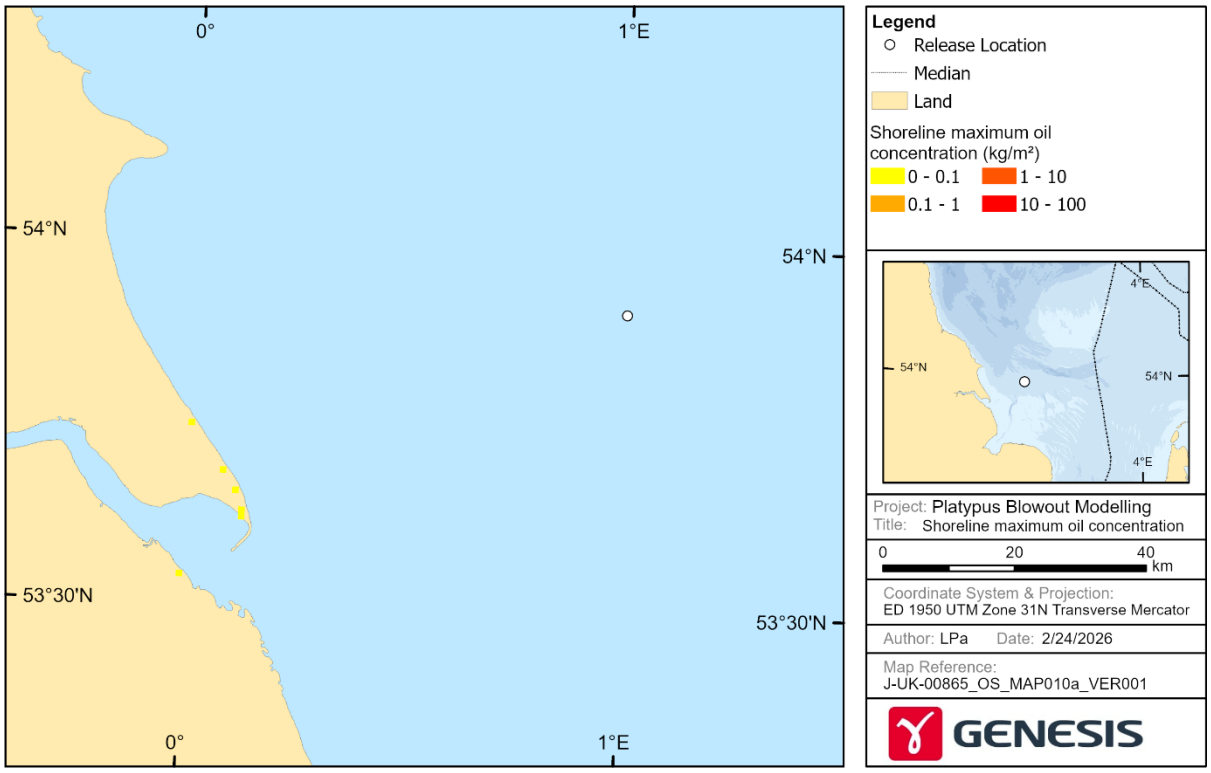


Figure 4-7: Concentration of oil at the coast (deterministic, 100 days).

4.1.4 Water Column Concentrations

The probabilities of hydrocarbon concentrations ≥ 10 µg/l (see Section 3.5.2) in the water column are shown in Figure 4-8. The simulation estimated that water column concentrations above the threshold of 10 µg/l could occur up to a maximum distance of approximately 77 km from the well and up to a depth of 40 m with a probability of ≥ 80%.

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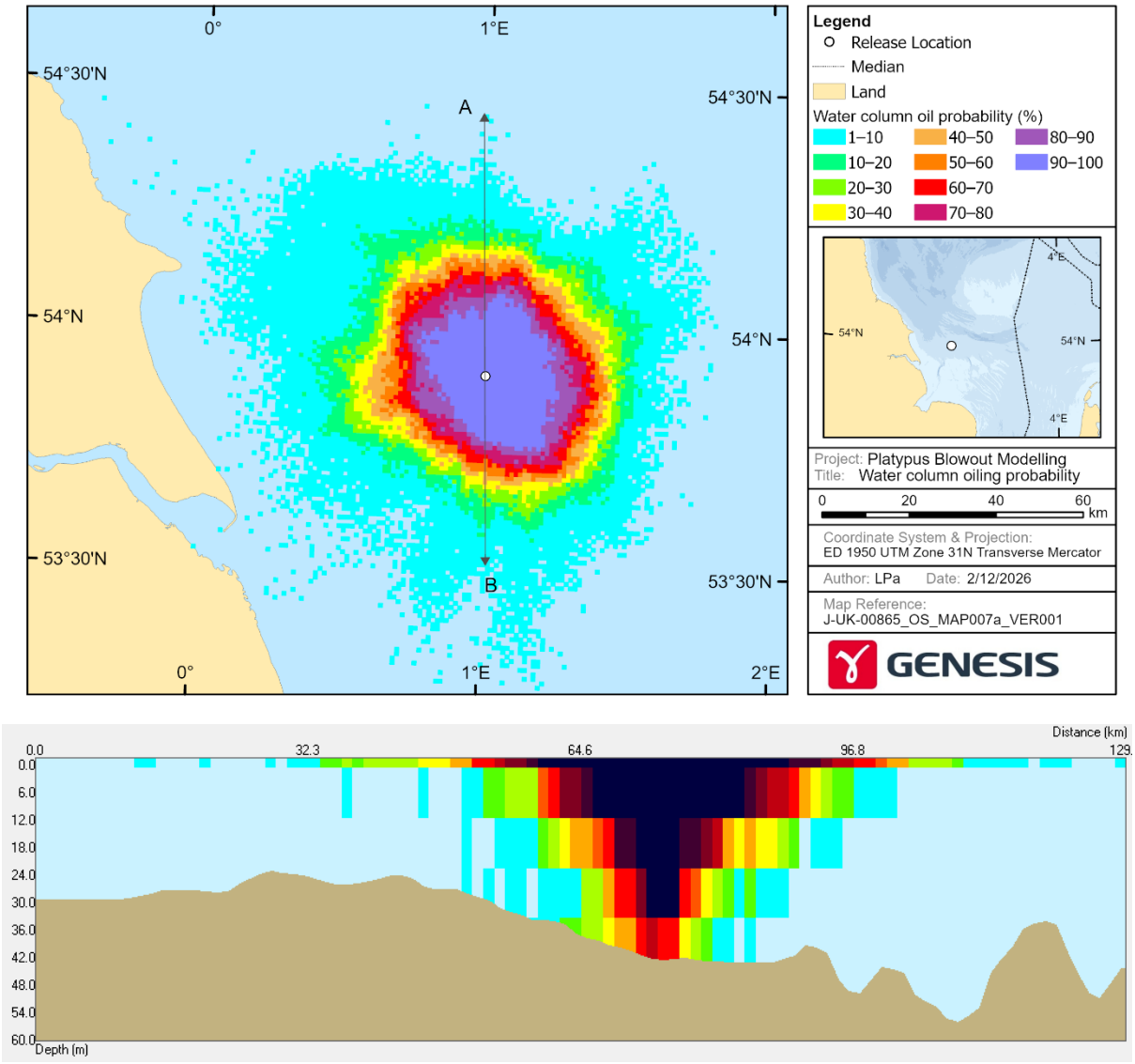


Figure 4-8: Probability of condensate concentrations in the water column ≥ 10 µg/l (stochastic).

A deterministic simulation was run to further assess the impact to the water column. Figure 4-9 shows the maximum total concentrations that were observed at any point in time through the water column for the deterministic simulation (swept path). The deterministic simulation estimated that the total water column volume impacted by ≥ 10 µg/l oil concentration would be approximately 15.5 km^3.

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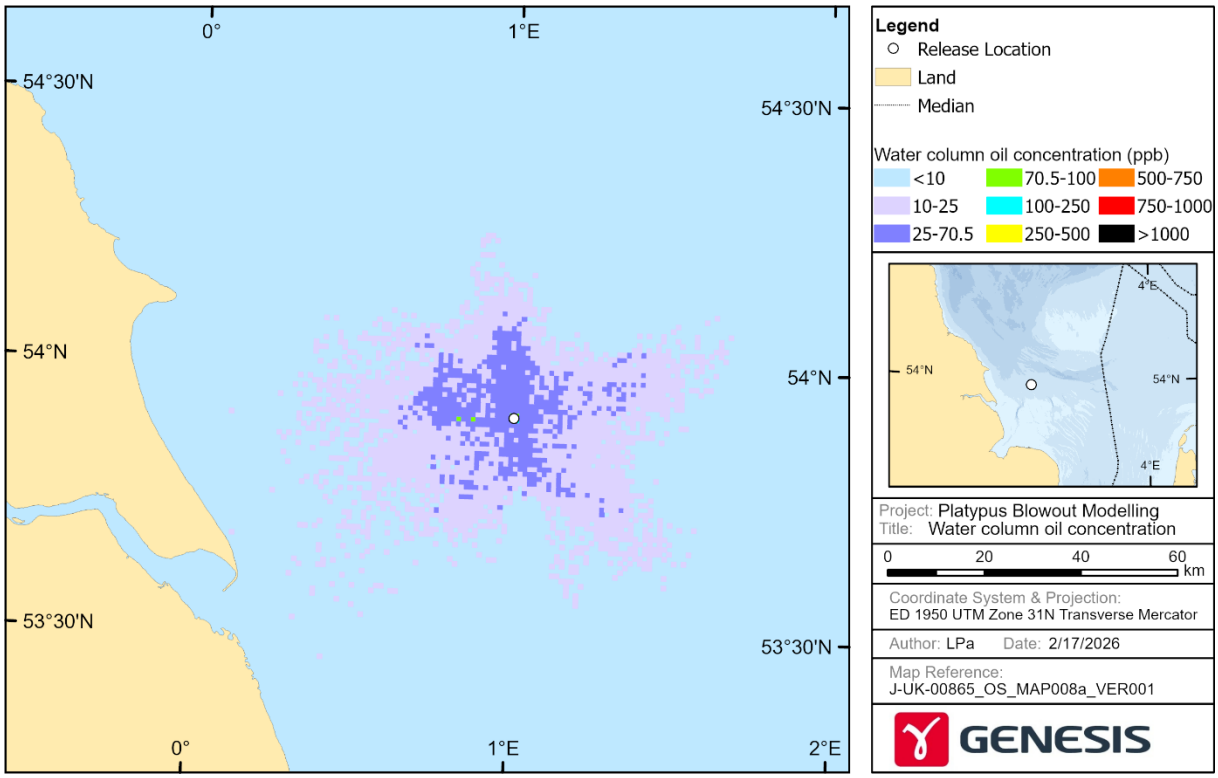


Figure 4-9: Maximum condensate concentration in the water column (deterministic, swept path)

4.1.5 Deposition of Condensate on Sediment

To allow an assessment of impacts when reviewing model outputs, as described in Section 3.5.4, 5 g/m^2 is adopted as the threshold above which toxic effects are considered to begin to be discernible.

The deterministic simulation estimated that the maximum concentration of oil on the seabed (at any one point in time) did not exceed the threshold of 5 g/m^2 at any point as shown in Figure 4-10.

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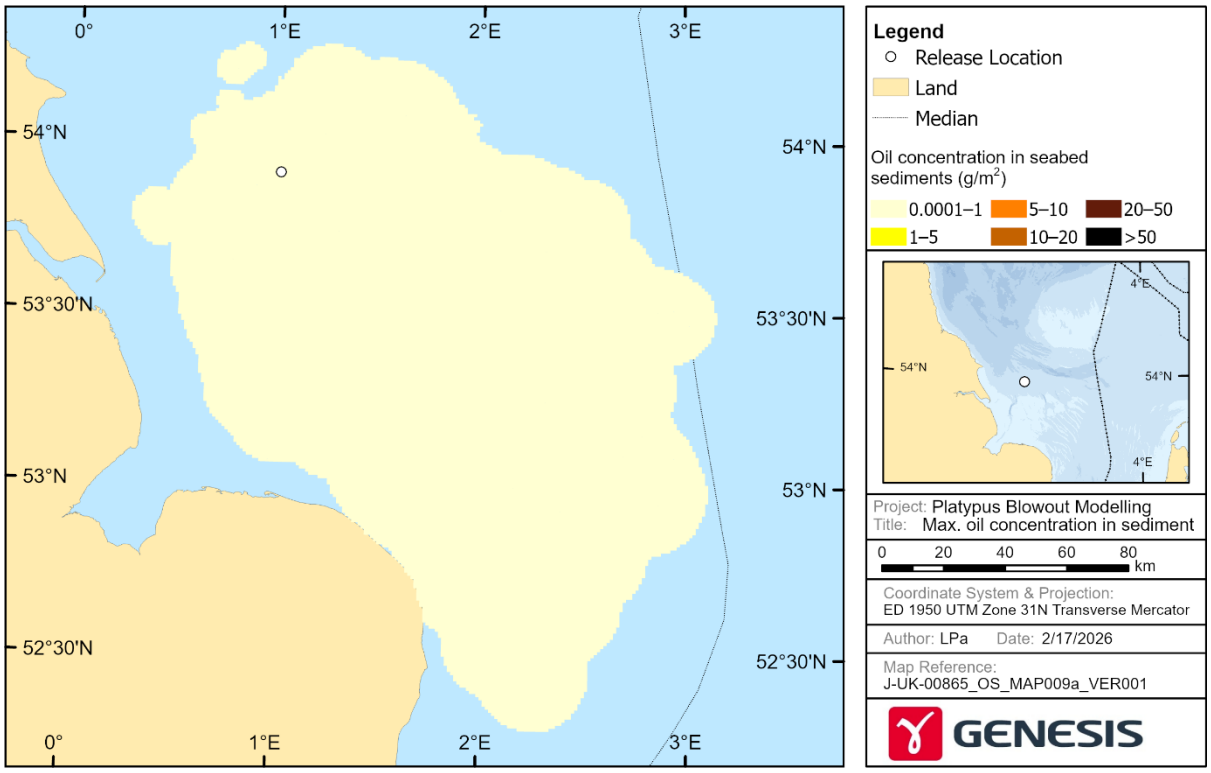


Figure 4-10: Maximum condensate concentration in seabed sediments (deterministic, at 101 days).

4.2 Full Diesel Inventory Loss

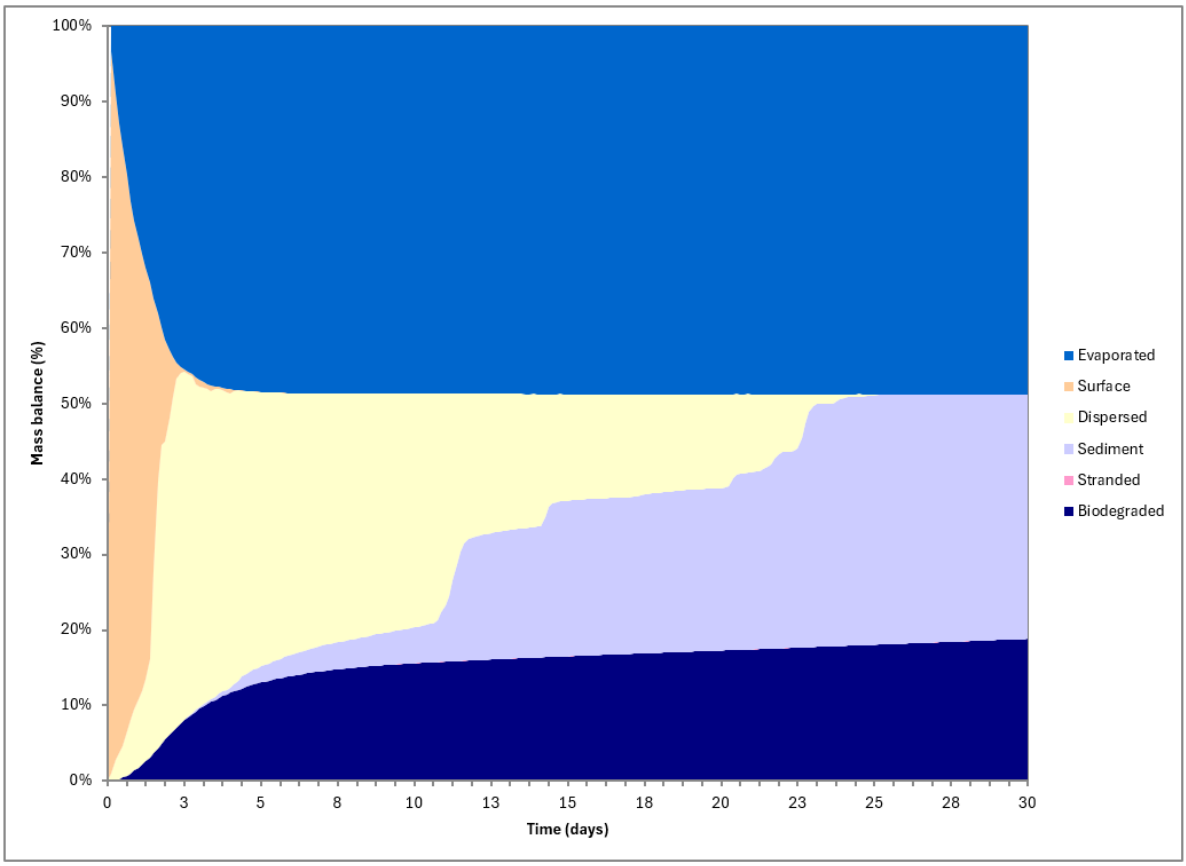
4.2.1 Fate of Diesel (Mass Balance)

Figure 4-11 shows the mass balance over time both as (A) a percentage and as (B) tonnes. At the end of the simulation (day 30) the mass balance of the spilled hydrocarbon was:

- Evaporated: 48.8% (445 t)
- Deposited on the seabed: 32.4% (295.6 t)
- Biodegraded: 18.8% (171.4 t)
- Water column: <0.01% (0.08 t)
- Stranded on shorelines: <0.01% (0.04 t)
- Sea surface: 0% (0 t)

The model indicates that 48.8 % of the diesel is shown to evaporate. The remaining diesel is mostly deposited on the seabed or biodegraded. A small amount is expected to reach the shoreline. By the end of the simulation, no diesel remains on the sea surface.

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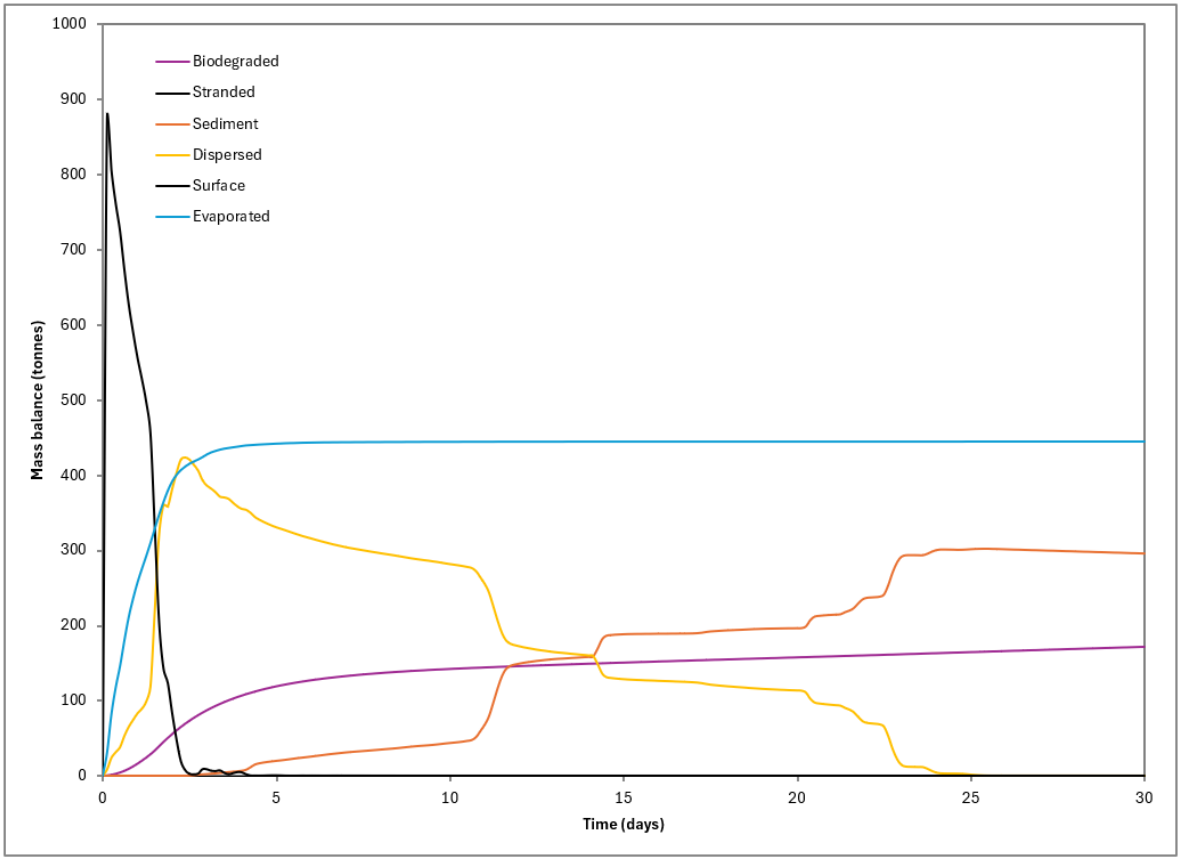


Figure 4-11: Diesel mass balance over time (deterministic).

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4.2.2 Diesel on the Sea Surface

The probability of a visible surface sheen with a thickness ≥0.3 µm is shown in Figure 4-12, with sea surface arrival times shown in Figure 4-13.

From the modelling, there is <40% probability that a diesel spill would result in a visible surface sheen.

The model predicts that the visible surface sheen with a thickness ≥0.3 µm will not reach any median lines.

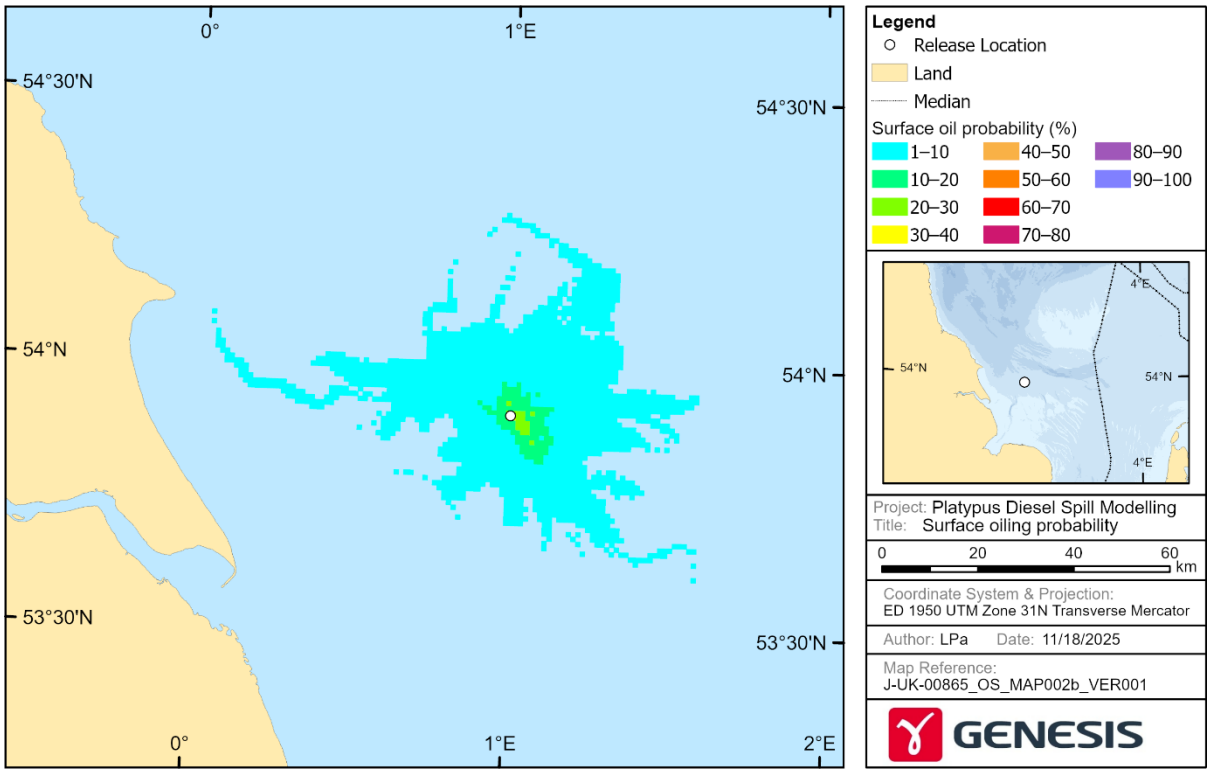


Figure 4-12: Probability of a diesel surface sheen ≥ 0.3 µm (stochastic).

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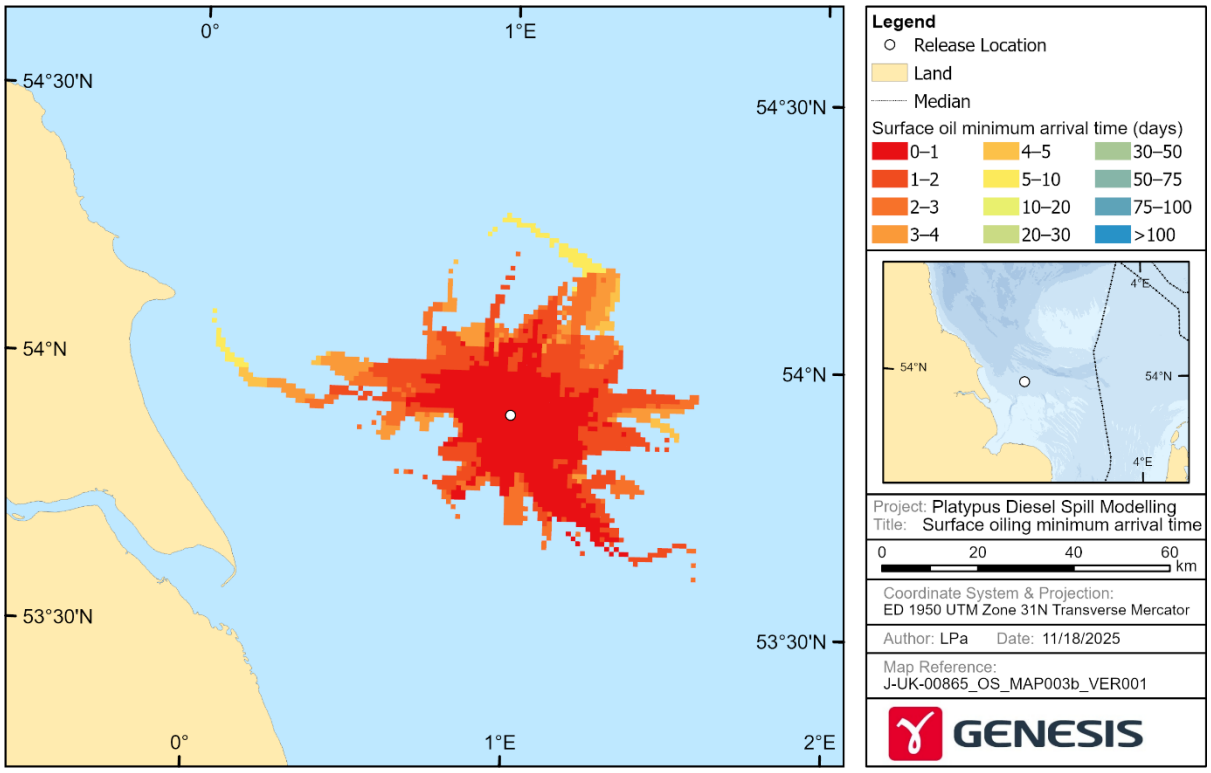


Figure 4-13: Minimum arrival time of a diesel surface sheen ≥ 0.3 µm (stochastic).

A worst-case deterministic simulation was run to further assess the impact to the sea surface. Figure 4-14 shows the maximum sea surface area impacted by oil at any point during the simulation (swept path). The simulation estimated that the total sea surface impacted by oil with a thickness ≥0.3 µm is approximately 67 km^2. The maximum thickness estimated anywhere at the sea surface is 836 µm (0.836 mm).

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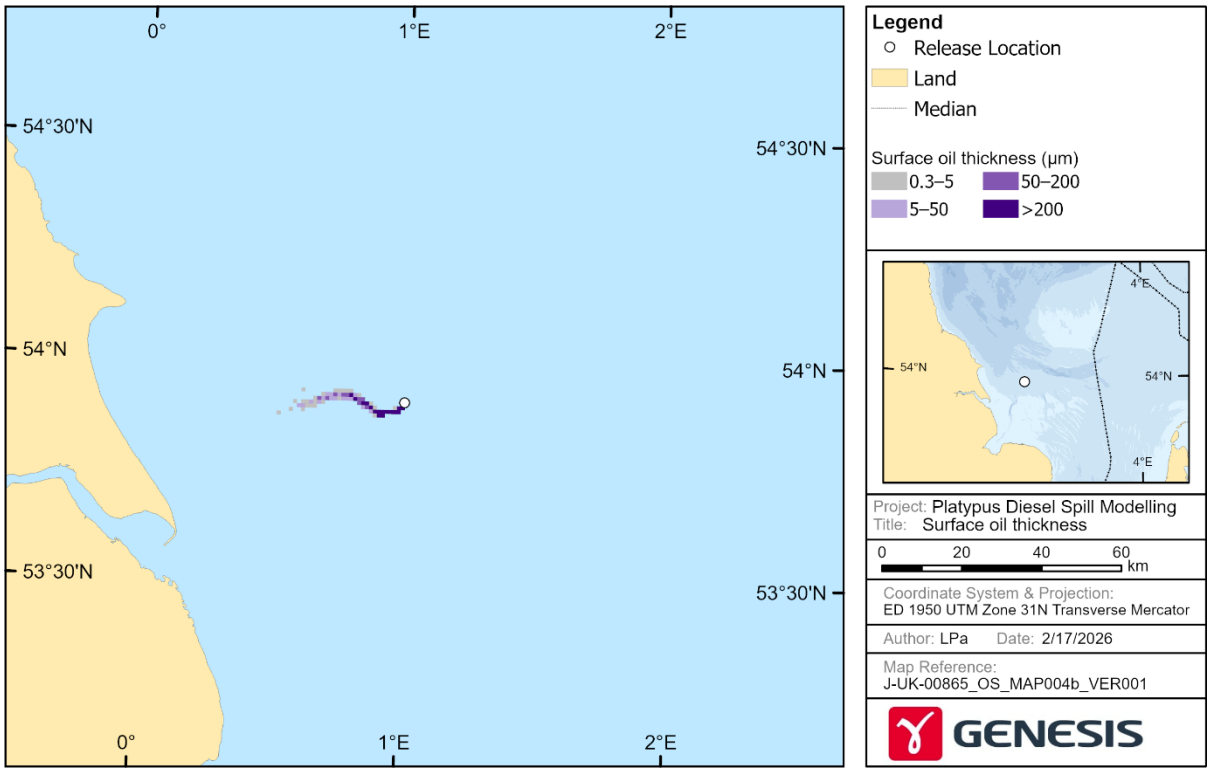


Figure 4-14: Maximum thickness of diesel at sea surface (deterministic, swept path).

By the end of the deterministic simulation, no diesel remains at the sea surface.

4.2.3 Shoreline Stranding of Diesel

The modelling results indicate a low probability of diesel reaching the shoreline. The probability diesel reaching the shoreline across all stochastic simulations is shown in Figure 4-15, with shoreline arrival times shown in Figure 4-16. Table 4-2 details the values for the probability of shoreline oiling and minimum time of arrival to shore along various sections of the coastline. The simulation indicated that the greatest distance from the spill location with potential shoreline impact is 122.7 km, with a probability of 1%.

Table 4-2: Probability and minimum time of arrival of diesel to shore (stochastic).

Location	Probability (%)	Minimum time of arrival (days)
East Yorkshire and Northern Lincolnshire	1	5.98
East Anglia	1	6.23

Note: probability refers to the maximum probability oil reaching each shoreline and the minimum time of arrival refers to the minimum time taken for oil to reach that shoreline on any given simulation.

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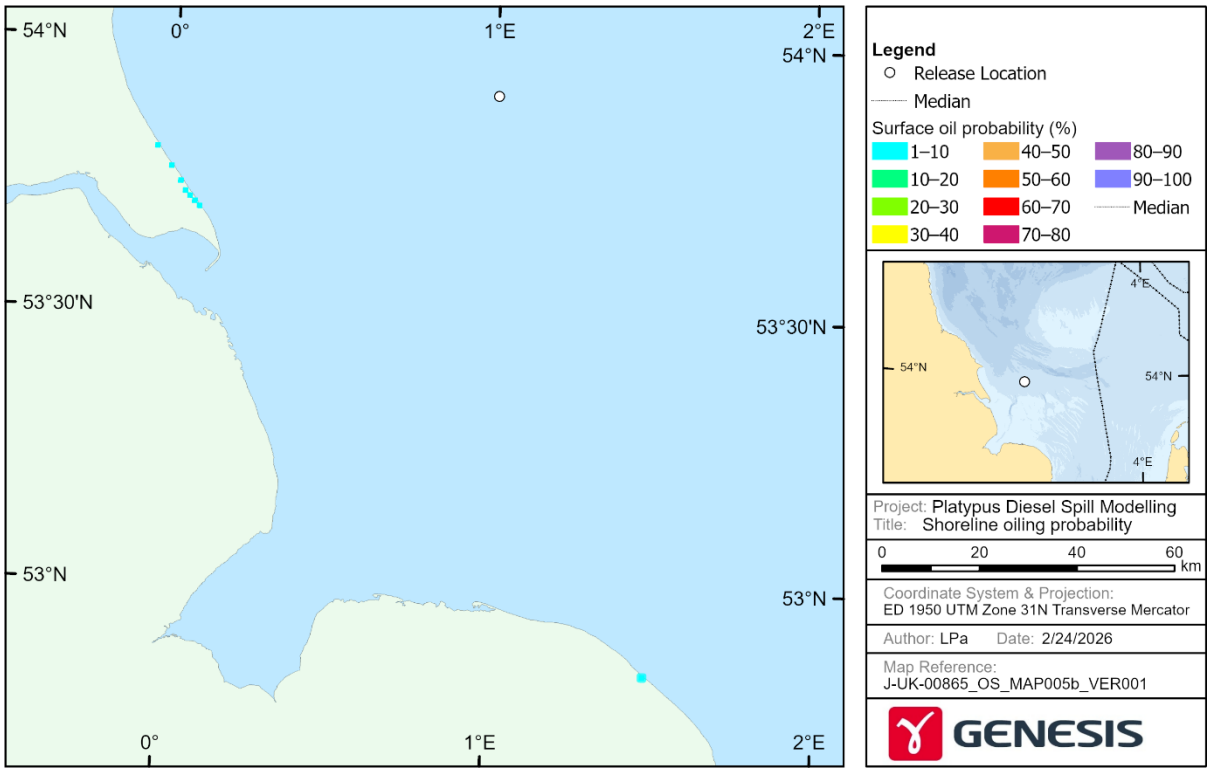


Figure 4-15: Probability of a diesel reaching shoreline (stochastic).

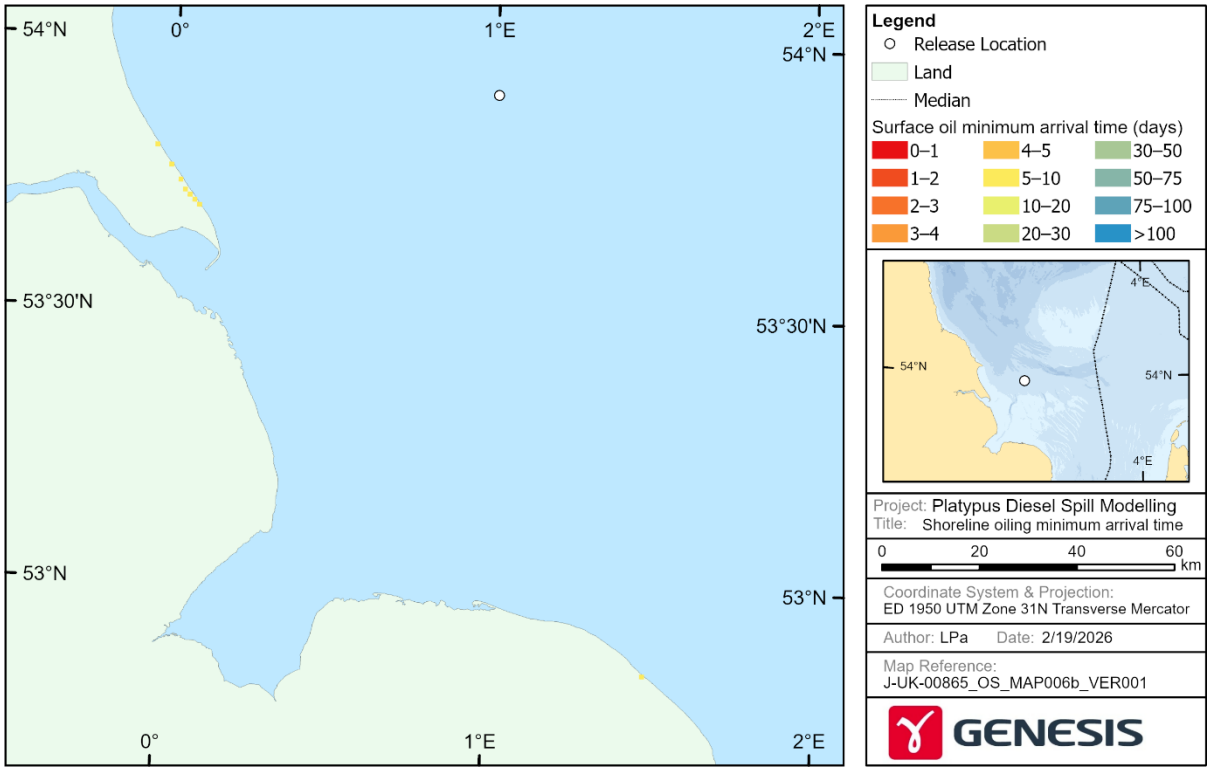


Figure 4-16: Minimum arrival time of diesel at shoreline (stochastic).

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The maximum oil reaching the coast based on the deterministic simulation is shown in Figure 4-17. The maximum mass of oil landed onshore from this scenario is 0.087 t, 8 days into the simulation. This reduces to 0.004 t at the end of the model run. As noted from the stochastic modelling, there is a low probability of this scenario happening given prevailing metocean conditions in the North Sea. The model does not predict any portion of the coastline to have a mass of oil of more than 0.1 kg/m^2, which is the threshold above which impacts are considered to be potentially significant.

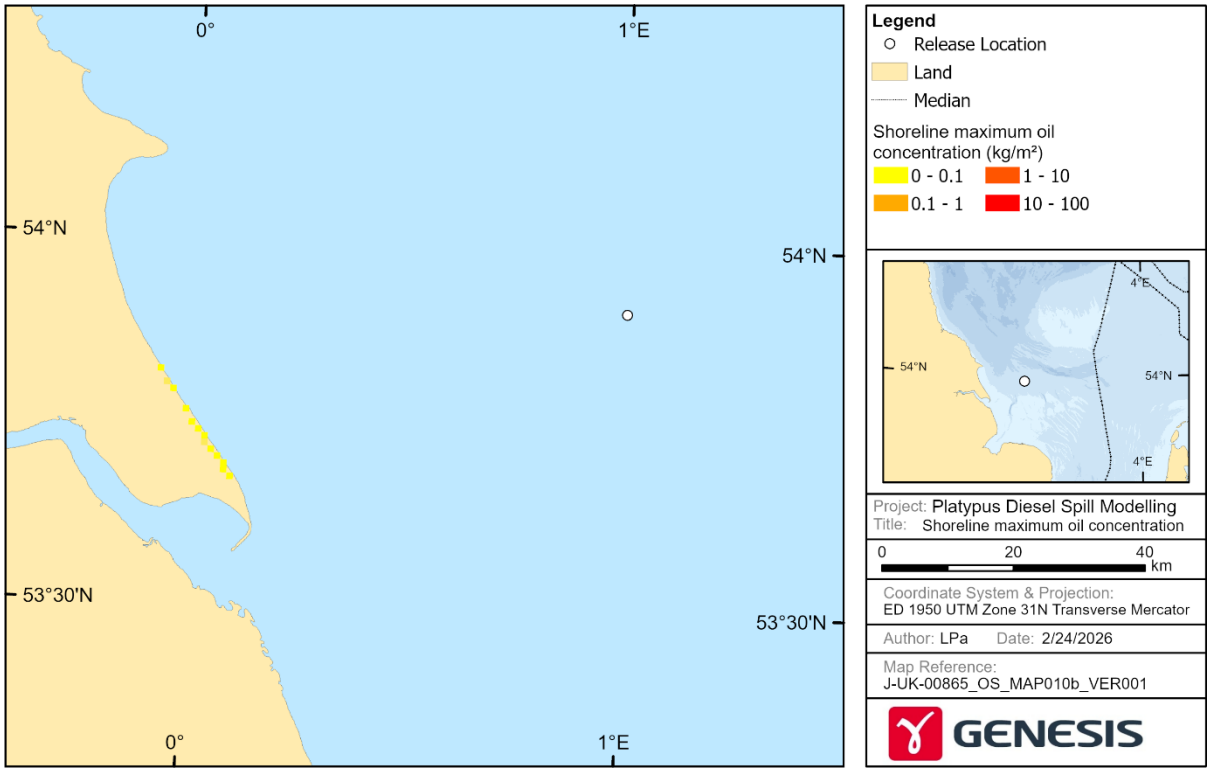


Figure 4-17: Concentration of oil at the coast (deterministic, 8 days).

4.2.4 Water Column Concentrations

The probabilities of diesel concentrations ≥ 10 µg/l (see Section 3.6.2) in the water column are shown in Figure 4-18. The simulation estimated that water column concentrations above the threshold of 10 µg/l could occur up to a maximum distance of approximately 85.4 km from the well and up to a depth of 40 m with a probability of ≥ 50%.

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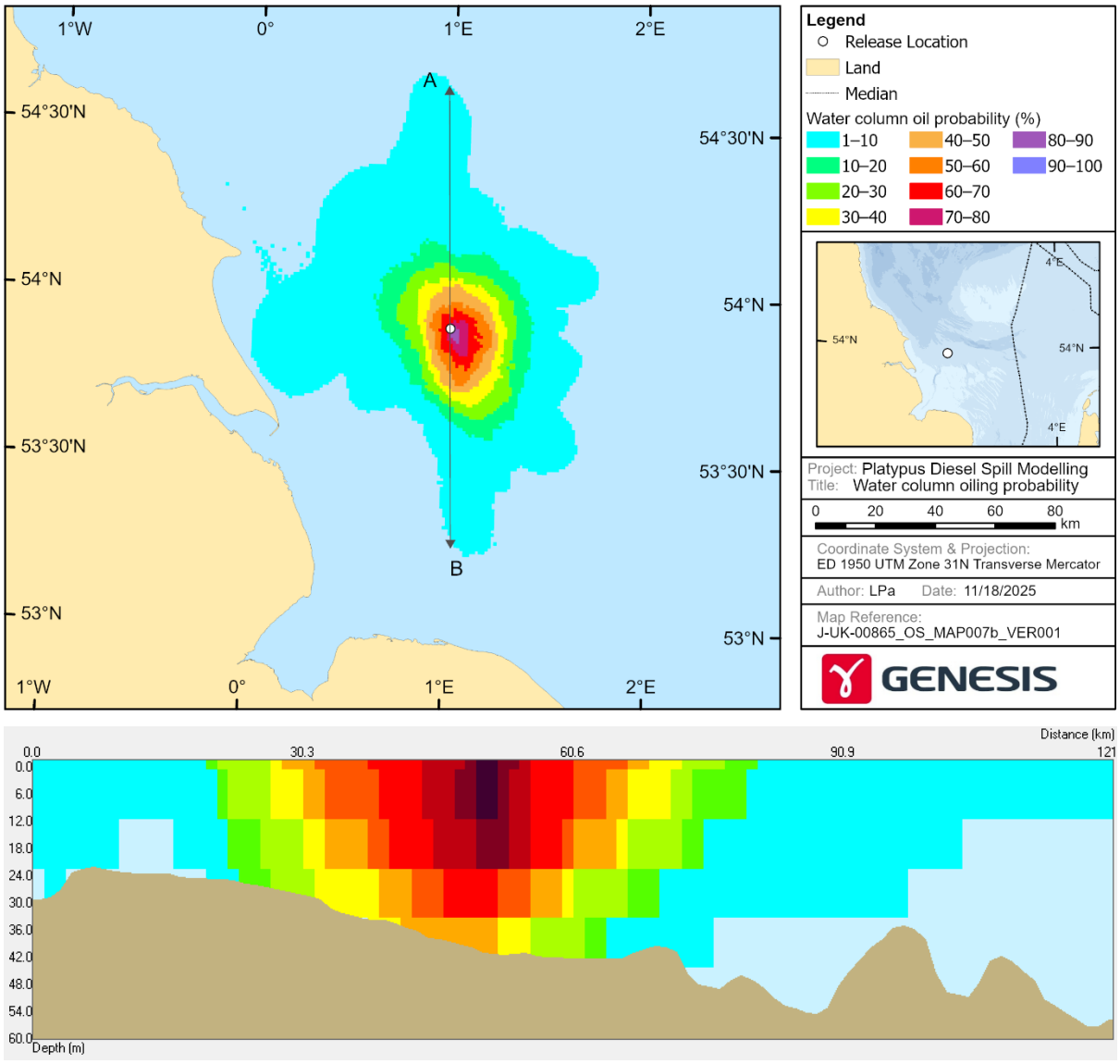


Figure 4-18: Probability of water column concentrations ≥ 10 µg/l (stochastic)

A deterministic simulation was run to further assess the impact to the water column. Figure 4-19 shows the maximum total concentrations that were observed at any point in time through the water column for the deterministic simulation (swept path). The deterministic simulation estimated that the total water column volume impacted by ≥ 10 µg/l oil concentration would be approximately 24.4 km^3.

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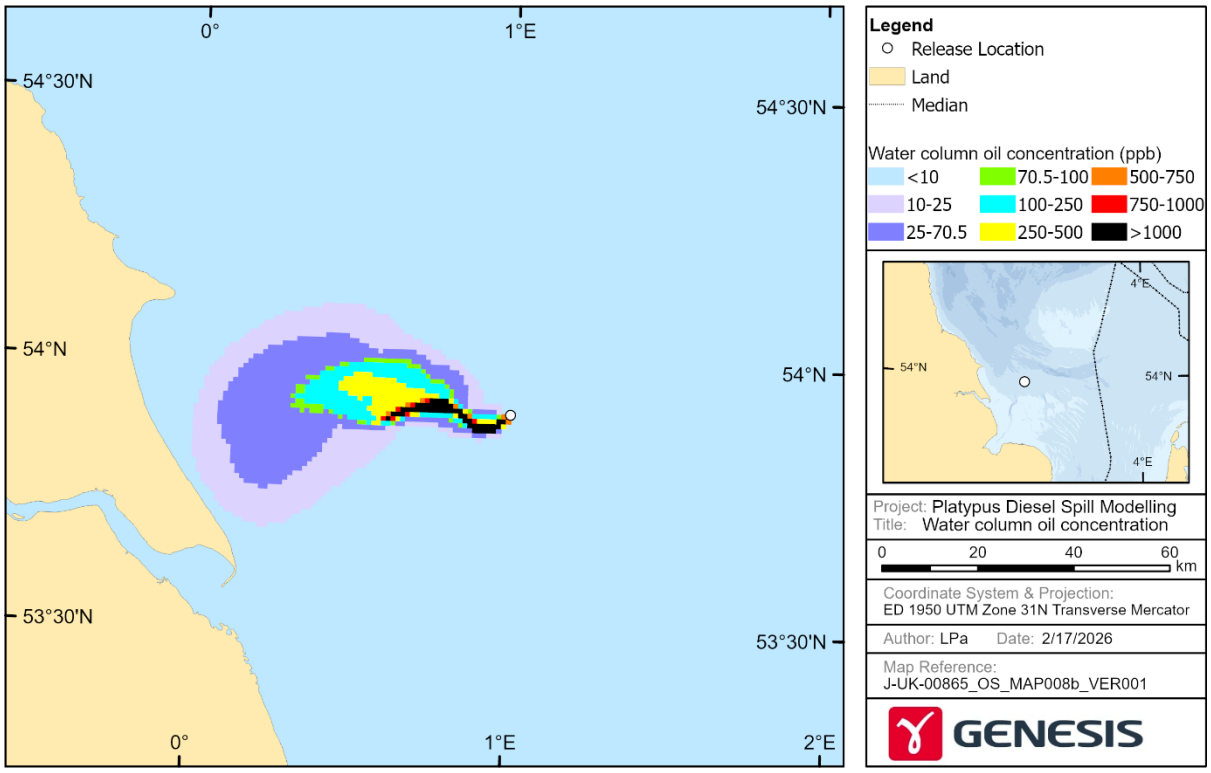


Figure 4-19: Maximum diesel concentration in the water column (deterministic, swept path)

4.2.5 Deposition of Diesel on Sediment

To allow an assessment of impacts when reviewing model outputs, as described in Section 3.5.4, 5 g/m^2 is adopted as the threshold above which toxic effects are considered to begin to be discernible.

The deterministic simulation estimated that the maximum concentration of oil on the seabed (at any one point in time) did not exceed the threshold of 5 g/m^2 at any point, as shown in Figure 4-20.

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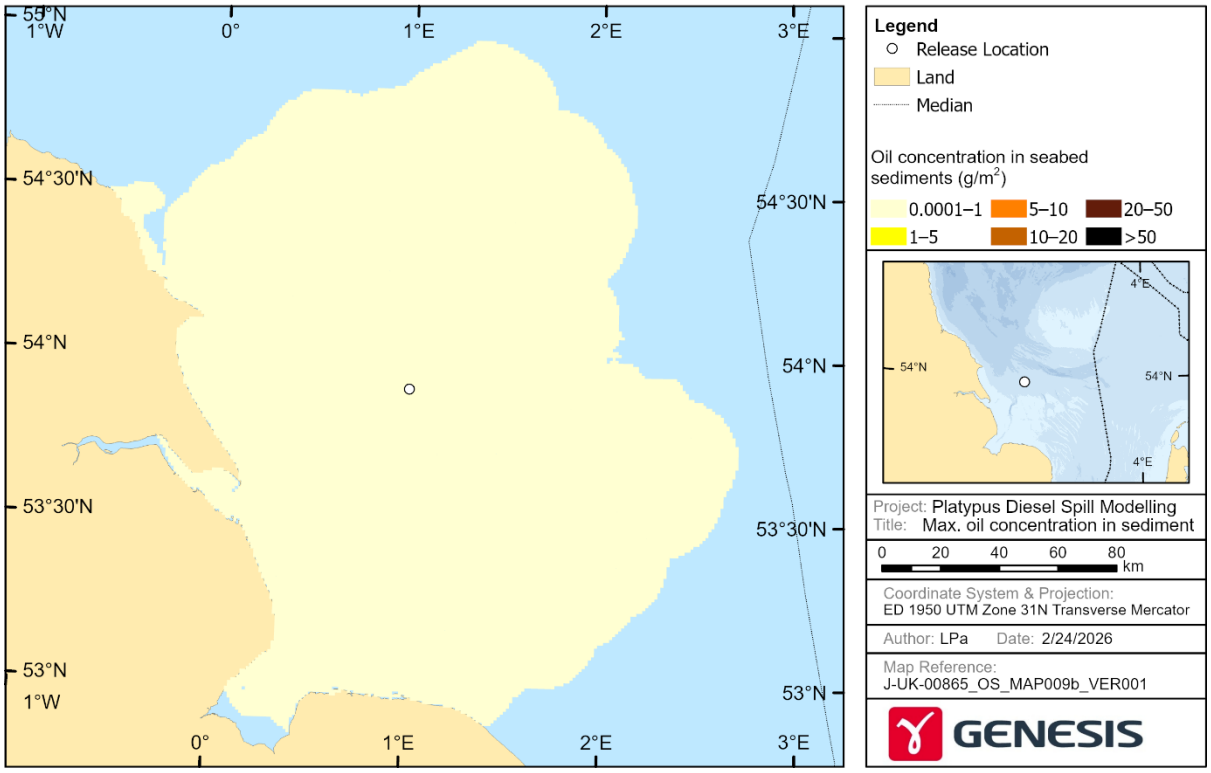


Figure 4-20: Diesel concentration in seabed sediments (deterministic, at 30 days).

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5.0 CONCLUSION

A combination of stochastic (probabilistic) and deterministic modelling was undertaken for two spill scenarios at the Platypus gas field:

Scenario 1: A worst-case condensate release as a result of a well blowout with a flowrate of 15.5 m^3/day over a period of 98 days; and

Scenario 2: An instantaneous worst-case full diesel inventory loss of 1,050 m^3 in 1 hour (full diesel inventory stored on the MODU).

The modelling undertaken represents potential worst-case scenarios in terms of hydrocarbons released as it assumes no intervention.

For Scenario 1, the model was run for 128 days (98 days duration of blowout plus a further 30 days to allow sufficient time for dispersion) and Scenario 2 was run for 30 days total, again allowing sufficient time for dispersion.

A summary of the main simulation outputs for each scenario is detailed in Table 5-1.

In the unlikely event that a blowout occurred, the thresholds considered to result in a noticeable environmental impact would be exceeded for surface sheen thickness and hydrocarbon concentration in the water column. The modelling results indicate that the area where the threshold for toxic effects of hydrocarbons in the sediment, and the concentration of oil on the shoreline, are not exceeded.

In the unlikely event of a full diesel inventory loss, the thresholds considered to result in a noticeable environmental impact would be exceeded for surface sheen thickness and hydrocarbon concentration in the water column. The threshold for surface sheen thickness would be exceeded across a smaller area than the well blowout and, for hydrocarbon concentration in the water column, the threshold would be exceeded over a larger volume of water than the well blowout, but over a shorter timeline. By the end of the 30-day simulation, the model predicts diesel will be evaporated, biodegraded or deposited on the seabed, with no diesel remaining at the sea surface. The modelling results indicate that the area where the threshold for toxic effects of hydrocarbons in the sediment, and the concentration of oil on the shoreline, are not exceeded.

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Table 5-1: Summary of simulation outputs.

Variable	Environmental Fraction	Surface Well Blowout	Full Inventory Loss
Release volume over whole simulation		1,519.1 m^3	1,050 m^3
Mass Balance			
% total oil in environmental fraction; (end of deterministic simulation)	Sea surface	0%	0%
	Shoreline	0.01%	0.004%
	Water Column	0.4%	0.008%
	Seabed sediment	27.5%	32.4%
	Evaporated	57.9%	48.8%
	Biodegraded	14.2%	18.8%
Total oil (tonnes) in environmental fraction; (end of deterministic simulation)	Sea surface	0 t	0 t
	Shoreline	0.1 t	0.04 t
	Water Column	5 t	0.08 t
	Seabed sediment	338 t	295.6 t
	Evaporated	711 t	445 t
	Biodegraded	174 t	171.4 t
Environmental Thresholds			

Extent above thresholds (deterministic simulations)	Fraction	Thresholds	Surface Well Blowout	Full Inventory Loss
	Sea surface	0.3 µm	997 km^2	67 km^2
	Shoreline	0.1 kg/m^2 (100 g/m^2)	0 km	0 km
	Water column	10 µg/l (10 ppb)	15.5 km^3	24.4 km^3
	Seabed sediment	5 g/m^2	0 km^2	0 km^2

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Appendix F Supplementary Climate Baseline Information

F.1 Global Surface Temperature

Over the past century, global temperatures have risen significantly, largely due to increased GHG emissions. Currently, the Earth's average surface temperature is approximately 1.1°C higher than pre-industrial levels (see Figure F-1) (Met Office, 2026a). Temperature data collected worldwide indicate this warming trend.

Figure F-1 illustrates the correlation between atmospheric CO_2 levels and the global mean temperature (Met Office, 2026a). This relationship highlights temperature as a key climate indicator. Recent years have been among the warmest on record; notably, 2024 was the warmest year to date, with an estimated global near-surface temperature about 1.55 °C ± 0.13 °C above the 1850–1900 baseline (WMO, 2025).

According to the IPCC (IPCC, 2023) "*global net anthropogenic GHG emissions were 59 Gt CO_2eq 15 (+/- 6.6 Gt CO_2eq) in 2019*", with "*the largest share and growth in gross GHG emissions occurring in CO_2 from fossil fuels combustion and industrial processes, followed by methane*". Furthermore, the IPCC (IPCC, 2023) state that "*in 2019, approximately 79% of global GHG emissions came from the sectors of energy, industry, transport and buildings together and 22% from agriculture, forestry and other land use*".

More recently updated GHG emission estimates indicate that total global GHG emissions were 55.4 $GtCO_2eq$ (+/- 5.1 $GtCO_2$) in 2023, of which CO_2 emissions from fossil fuel combustion and industry contributed 37.8 $GtCO_2eq$ (+/- 3.0 $GtCO_2$) (Forster et. al, 2025).

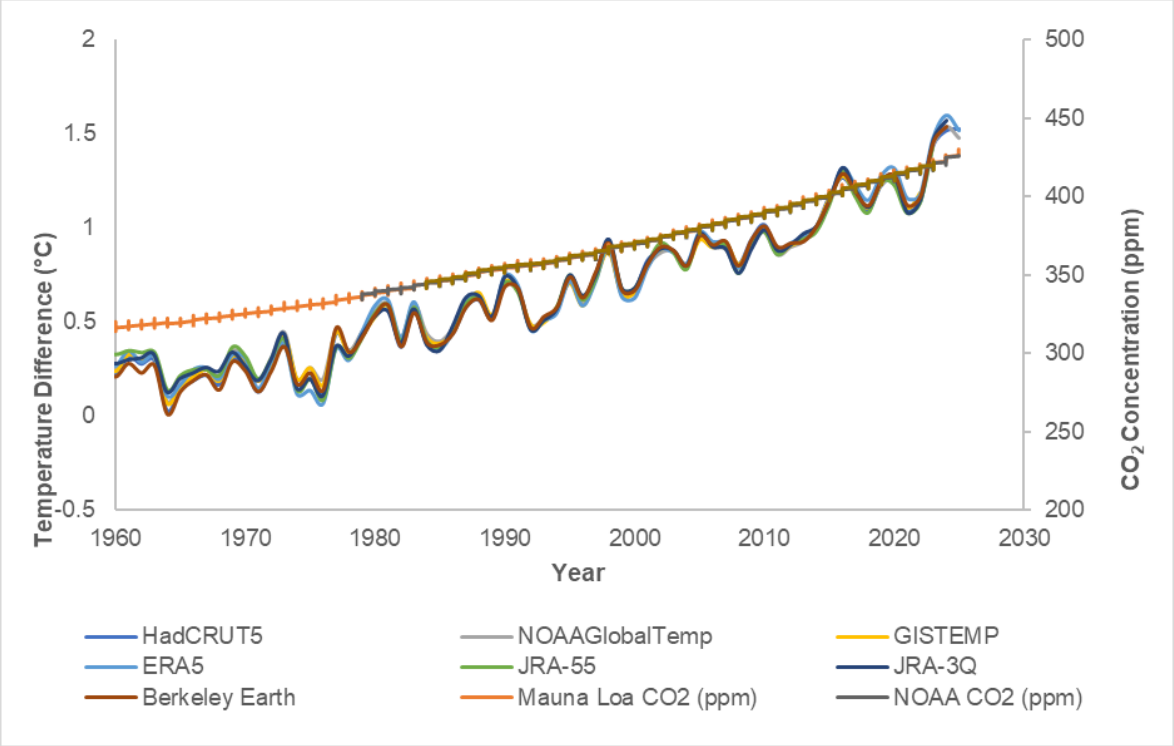


Figure F-1: Correlation between carbon dioxide concentrations in the atmosphere and annual global mean temperature difference from pre-industrial conditions [Extrapolated (Met Office, 2026a)]

The Emissions Database for Global Atmospheric Research (EDGAR) provides country by country estimates of GHG emissions (excluding land use, land use change, and forestry) from 1990 to 2024 (EDGAR, 2025). EDGAR estimates that total global GHG emissions during this period have risen by 65%. Furthermore, EDGAR provides estimates of country-by-country fossil fuel-based CO_2 emissions from 1990 to 2024. During this period, global fossil fuel-based CO_2 emissions have risen by 75%.

The Intergovernmental Panel on Climate Change (IPCC) AR6 (IPCC, 2023) confirms a "*near-linear relationship between cumulative CO_2 emissions and global temperature rise.*" If current trends continue, warming will persist, potentially exceeding 2°C above pre-industrial levels.

F.2 Extreme Weather and Climate Events

An extreme weather event is defined as *"an event that is rare at a particular place and time of year"* and an extreme climate event is defined as *"a pattern of extreme weather that persists for some time, such as a season"* (IPCC, 2021).

In recent years, shifts in weather and climate extremes have been recorded globally, including more intense heatwaves, heavier rainfall, prolonged droughts, and tropical cyclones.

Current observations of global temperature extremes, heavy precipitation and droughts are presented in further detail below and summarised in Figure F-2. Figure F-2 summarises the projected increases in frequency and intensity increase of these extreme weather events relative to the 1850-1900 baseline.

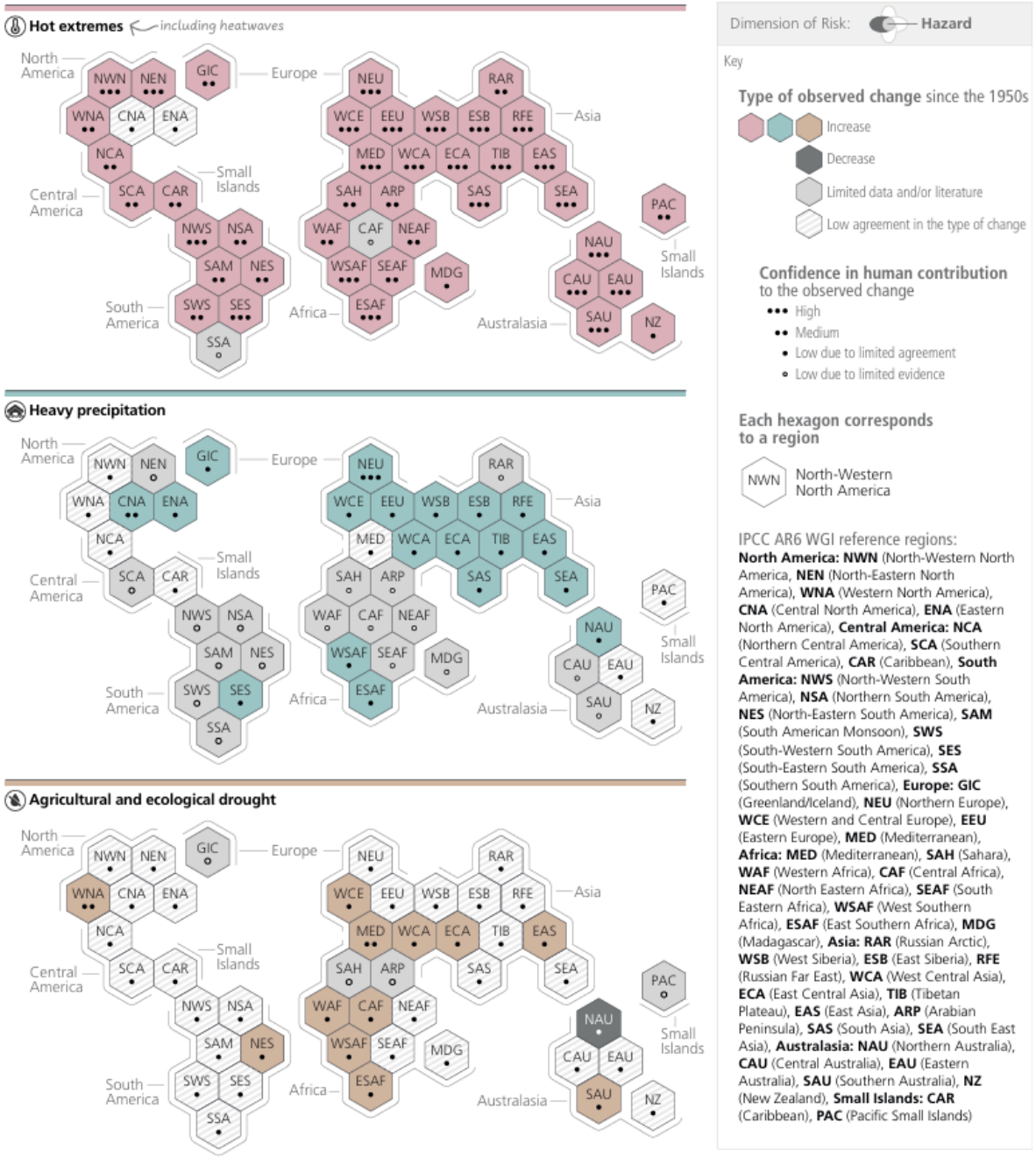


Figure F-2: Summary of globally observed changes since the 1950s in temperature extremes (including heatwaves), heavy precipitation and drought, and the confidence level in the role of human influence to the observed changes (IPCC, 2023a)

F.2.1 Temperature Extremes

Since 1950, there has been an increase in frequency and intensity of global hot extremes and a decrease of cold extremes. Heatwaves have also become more intense, longer lasting, and more frequent worldwide. These trends are likely evident across Europe, Asia, Australia, and North America, with moderate to high confidence in Africa and South America. Notably, land-based minimum temperatures have increased around 3 times more than global surface temperatures since the 1960s, particularly in the Arctic (IPCC, 2021).

F.2.2 Heavy Precipitation

Heavy precipitation events have increased in frequency and intensity across most global land regions. Since 1950, the annual maximum precipitation occurring over a day and 5-day periods has likely increased in more regions than it has decreased. At the continental scale, heavy precipitation has likely intensified across North

America, Europe, and Asia. However, there remains very low confidence in observed changes in extreme precipitation occurring over shorter periods (i.e. less than a day) due to limited data and a small number of relevant studies (IPCC, 2021).

F.2.3 Droughts

Droughts are extended periods of significantly reduced moisture, often affecting large regions, in which limited water availability results in adverse impacts on natural systems and economic sectors (IPCC, 2021). The four common types of drought types are: meteorological drought, agricultural drought, ecological drought and hydrological drought. These are defined further in Table F-1.

Global observations show that droughts have become more widespread and impactful in recent decades. While drought trends vary by region and drought type, there is strong evidence that agricultural and ecological droughts have increased globally from the 1950s onwards (IPCC, 2021).

Table F-1: Definitions of common drought types (Met Office, 2026b)

Drought Type	Definition
Meteorological	A period of below-average precipitation for a region, lasting from weeks to months or longer.
Agricultural	Occurs when reduced rainfall and higher temperatures lower soil moisture, limiting water availability for crops and/or natural vegetation.
Ecological	Develops when prolonged soil moisture deficits and heat causes stress or damage to ecosystems such as forests, wetlands and greenlands.
Hydrological	Occurs when persistent lack of rainfall reduces water availability in rivers, lakes, reservoirs and groundwater, impacting water supply.

Globally, there is no clear long-term trend in meteorological drought based on global precipitation records, with observed changes limited to a few regions rather than representing a global pattern (Sergio et. al, 2022). However, increases in temperature have raised atmospheric evaporative demand, causing soils, vegetation, rivers, and reservoirs to dry out more rapidly. This has led to more severe and longer-lasting agricultural and ecological droughts, even in some regions where rainfall has not declined significantly. This drying effect has been the strongest in warm seasons and is particularly noticeable in mid-latitude and subtropical regions (Sergio et. al, 2022).

Drought indices that incorporate temperature-driven evaporation (e.g. SPEI) indicate slightly greater increases in drought frequency and severity over recent decades than precipitation-only indices (SPI), particularly in regions experiencing drying such as Western and Southern Africa, the Mediterranean, and East Asia. This is consistent with observed declines in soil moisture. Figure F-3 shows observed worldwide trends in drought and precipitation indices from 1951-2016 (IPCC, 2021).

Satellite observations over the past two decades also confirm that extreme dry events are occurring more frequently and with greater intensity. These datasets show an increase in both the duration and spatial extent of droughts across multiple continents, linked closely to global warming (Rodell & Li, 2023).

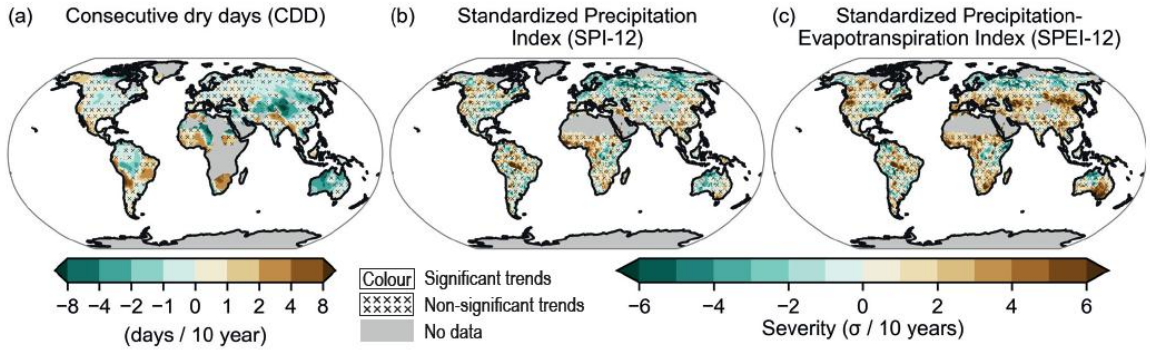


Figure F-3: Observed linear trend for (a) consecutive dry days (CDD) during 1960–2018, (b) standardised precipitation index (SPI) and (c) standardised precipitation-evapotranspiration index (SPEI) during 1951-2016 (IPCC, 2021b)

Overall, current global observations indicate that droughts are becoming more intense, longer-lasting, and more damaging, particularly for agriculture and ecosystems. As stated by the IPCC in AR6 (IPCC, 2023), *"human influence has contributed to increases in agricultural and ecological droughts in the dry season in some regions due to increases in evapotranspiration. The increases in evapotranspiration have been driven by increases in atmospheric evaporative demand induced by increased temperature, decreased relative humidity and increased net radiation over affected land areas."*

Table F-2: Projected changes in the intensity and frequency of hot temperature extremes over land, extreme precipitation over land, and agricultural and ecological droughts in drying regions (IPCC, 2021a)

	1850-1900 Baseline*	Current Observations (1°C)	Future Global Temperature Increase		
			1.5°C	2°C	4°C
Hot temperature extremes over land**					
Frequency per 10 years	Once	Now likely occurs 2.8 times (1.8 – 3.2)	Will likely occur 4.1 times (2.8 – 4.7)	Will likely occur 5.6 times (3.8 – 6.0)	Will likely occur 9.4 times (8.3 – 9.6)
Intensity Increase	-	+1.2°C warmer	+1.9°C warmer	+2.6°C warmer	+5.1°C warmer
Frequency per 50 years	Once	Now likely occurs 4.8 times (2.3 – 6.4)	Will likely occur 8.6 times (4.3 – 10.7)	Will likely occur 13.9 times (6.9 – 16.6)	Will likely occur 39.2 times (27.0 – 41.4)
Intensity Increase	-	+1.2°C warmer	+2.0°C warmer	+2.7°C warmer	+5.3°C warmer
Heavy precipitation over land***					
Frequency per 10 years	Once	Now likely occurs 1.3 times (1.2 – 1.4)	Will likely occur 1.5 times (1.4 – 1.7)	Will likely occur 1.7 times (1.6 – 2.0)	Will likely occur 2.7 times (2.3 – 3.6)
Intensity Increase	-	+6.7% wetter	+10.5% wetter	+14.0% wetter	+30.2% wetter
Agricultural & ecological droughts in drying regions****					
Frequency per 10 years	Once	Now likely occurs 1.7 times (0.7 – 4.1)	Now likely occurs 2.0 times (1.0 – 5.1)	Now likely occurs 2.4 times (1.3 – 5.8)	Now likely occurs 4.1 times (1.7 – 7.2)
Intensity Increase	-	+0.3 standard deviations drier	+0.5 standard deviations drier	+0.6 standard deviations drier	+1.0 standard deviations drier

*Projected changes are shown at global warming levels of 1°C, 1.5°C, 2°C, and 4°C and are relative to a baseline of 1850–1900 which represents a climate without human influence.
**Hot temperature extremes are defined as the daily maximum temperatures over land that were exceeded on average once in a decade (10-year event) or once in 50 years (50-year event) during the 1850–1900 baseline.
***Extreme precipitation events are defined as the daily precipitation amount over land that was exceeded on average once in a decade during the 1850–1900 baseline.
****Agricultural and ecological drought events are defined as the annual average of total column soil moisture below the 10th percentile of the 1850–1900 baseline. Intensity changes are expressed as fractions of standard deviation of annual soil moisture.

F.3 Global Mean Sea Level

Global mean sea level rose by approximately 0.16 m (0.12 - 0.21 m) between 1902 and 2015. The rate of sea level rise has increased significantly in recent decades, reaching 3.6 mm per year (3.1 – 4.1 mm per year) between 2006–2015. This is approximately 2.5 times higher than the mean rate of 1.4 mm per year (0.8 – 2.0 mm per year) observed during 1901–1990 (IPCC, 2021).

Between 2015 to 2025, the mean rate of sea level rise was approximately 4.75 ± 0.3 mm per year (WMO, 2026). In recent years, satellite observations show that global mean sea level rose rapidly by around 5mm during 2023 and 2024, driven by a strong El Niño that ended in early 2024. Sea level remained similarly high in 2025 as conditions shifted toward a weak La Niña, resulting in a smaller annual rise than the previous period. By the end of 2025, global mean sea level was approximately 11 cm higher than in 1993. Figure F-4 shows the change in global mean sea level from the start of satellite records in 1993 to 2025 (WMO, 2026).

Recent sea level rise is primarily driven by mass loss from glaciers and ice sheets at a rate of 1.8 mm per year (1.7 – 1.9 mm per year) during 2006–2015. This exceeds the contribution from thermal expansion of ocean water over the same period at a rate of 1.4 mm per year (1.1 – 1.7 mm per year). Ice loss from the Greenland

and Antarctic ice sheets has increased substantially, contributing to an acceleration in sea level rise (IPCC, 2021).

While sea level has increased across nearly all oceans since 1993, the fastest rises have occurred in parts of the Pacific, particularly the tropical and south-western regions, whereas slower rises have been observed in the eastern Pacific, southern Indian Ocean, and parts of the North Atlantic (WMO, 2026).

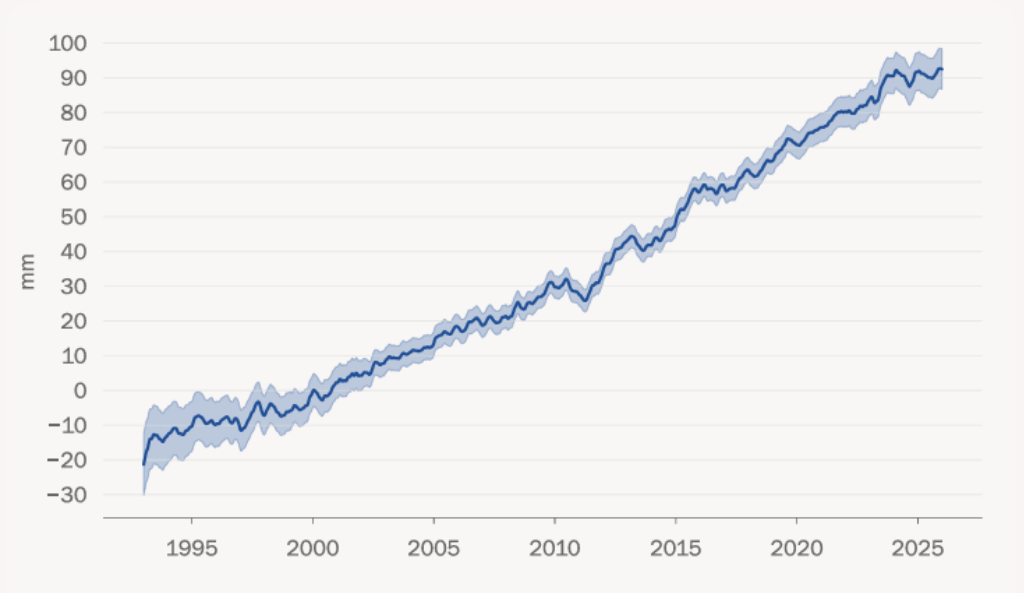


Figure F-4: Global mean sea level change shown for 1993–2025 (with the seasonal cycle removed from the data and uncertainty represented by the shaded area) (WMO, 2026).

According to the IPCC's Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC, 2019), *"the dominant cause of global mean sea level rise since 1970 is anthropogenic forcing"*. Ice sheet mass loss has intensified, with Antarctic ice mass loss tripling and Greenland ice mass loss doubling in the most recent decade compared to the previous one. This ongoing acceleration represents a key risk for long-term coastal impacts (IPCC, 2019).

F.4 Cryosphere Changes

The IPCC's Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC, 2019) highlights that, *"Over the last decades, global warming has led to widespread shrinking of the cryosphere, with mass loss from ice sheets and glaciers, reductions in snow cover and Arctic sea ice extent and thickness, and increased permafrost temperature."* Between 2006 and 2015:

- The Greenland Ice Sheet lost ice at an average rate of 278 ± 11 Gt per year (equivalent to 0.77 ± 0.03 mm per year of global sea level rise), mainly from surface melting.
- The Antarctic Ice Sheet lost ice mass at an average rate of 155 ± 19 Gt per year (0.43 ± 0.05 mm per year), largely driven by the rapid thinning and retreat of major glaciers flowing out of the West Antarctic Ice Sheet.
- Glaciers outside of Greenland and Antarctica have lost ice mass at an average rate of 220 ± 30 Gt per year (equivalent to 0.61 ± 0.08 mm per year sea level rise) (IPCC, 2019).

Since the 1980s, permafrost has warmed to record levels, with warming of up to 2–3°C observed at depths of approximately 10–20 m in some locations compared with temperatures recorded 30 years ago. The rate of permafrost temperature increase was around 0.29°C ± 0.12°C between 2007 to 2016 across polar and high mountain regions worldwide. An estimated 1460-1600 Gt organic carbon is stored in arctic and boreal

permafrost, almost double the amount of carbon currently in the atmosphere. While there is some evidence that thawing permafrost may be increasing CH_4 and CO_2 emissions, scientific agreement on this is limited. Thawing permafrost, combined with retreating glaciers, has also reduced the stability of slopes in many high-mountain regions (IPCC, 2019).

Between 1979 and 2018, Arctic sea ice has declined during all months throughout the year, with sea ice reductions in September being around 12.8 ± 2.3% per decade. Additionally, Arctic sea ice has thinned, with much older ice disappearing. These losses have amplified warming in the Arctic to more than twice the global average. In contrast, Antarctic sea ice shows no clear long-term trend due to strong regional differences (IPCC, 2019).

In 2025, both Arctic and Antarctic sea-ice extents remained below their respective 1991–2020 averages throughout the year, as shown in Figure F-5. Arctic sea ice recorded one of the lowest annual average extents since 1979, at 10.10 ± 0.33 million km^2 (approximately 0.9 million km^2 below the long-term mean). Antarctic sea ice also remained notably low, with the 2025 annual average ranking as the third lowest on record, at 10.81 ± 0.26 million km^2, exceeded only by the unusually low extents observed in 2023 and 2024 (WMO, 2026).

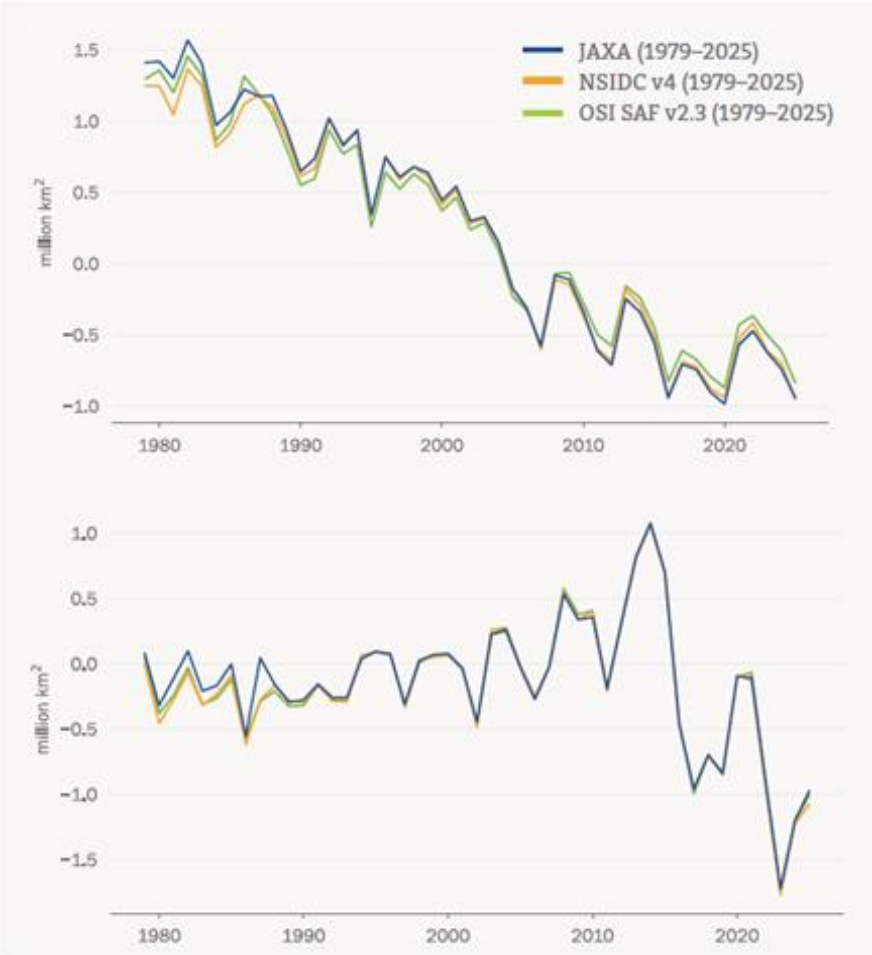


Figure F-5: Annual Arctic (upper panel) and Antarctic (lower panel) sea-ice extent anomalies in millions of square kilometres from 1979-2025 (relative to the 1991–2020 average). Data sets from 3 sources are shown: the USA National Snow and Ice Data Center (NSIDC), Japan Aerospace Exploration Agency (JAXA) and OSI SAF (WMO, 2026).

F.5 Oceanic Changes

F.5.1 Ocean Warming

F.5.1.1 Ocean Surface Temperatures

The ocean surface has warmed significantly since pre-industrial times. Compared to the late 1800s (1850–1900), the average ocean surface temperature has increased by around 0.88°C (0.68°C – 1.01°C) in 2011-2020. Most of this warming, around 0.6°C (0.44°C - 0.74°C) has occurred since 1980, showing that ocean warming has accelerated in recent decades (IPCC, 2021a).

Figure F-6, using data from the Met Office, shows the change in global average sea-surface temperature from 1850 to 2025, expressed as a difference relative to the 1981-2010 average (with values below 0°C indicating cooler conditions and values above 0°C indicator warmer conditions than the reference period). A long-term increase in global sea-surface temperatures is evident, with especially rapid warming since the late 20th century. This trend is visible in both independent datasets (HadSST4 and ERSSTv5) shown in Figure F-6, reinforcing the conclusion that the world's oceans are warming over time (Met Office, 2026a).

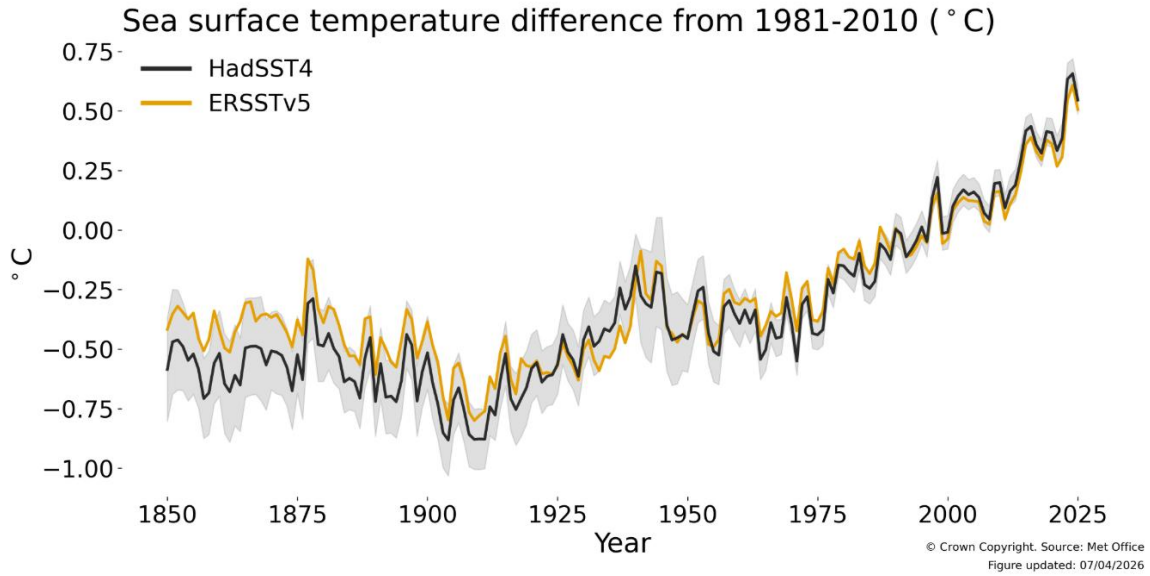


Figure F-6: Annual global mean sea-surface temperature difference from 1850 to 2025 relative to the 1981-2010 average (Met Office, 2026a)

F.5.1.2 Ocean Heat Content

Annual ocean heat content from 1960-2025 is shown in Figure F-7. In 2025, global ocean heat content in the upper 2,000 m of the ocean reached a new record since observations began in the 1960s, surpassing the previous record set in 2024 by 24 ± 16 ZJ. The rate of ocean warming increased to 11.0–12.2 ZJ per year over 2005–2025, more than double the 1960–2005 rate of 3.05–3.91 ZJ per year (WMO, 2026).

Consistent with IPCC findings attributing the increase primarily to human influence, ocean heat content rose by 5.8 ± 0.5 ZJ per year from 1971 to 2025, while the deep ocean warmed at about 1 ± 0.2 ZJ per year between 1970 and 2025.

Observations show that global ocean heat content has increased steadily since the 1970s, with the rate predominantly driven by human influence (IPCC, 2021a). Global ocean heat content rose by an average of 5.8 ± 0.5 ZJ per year across the ocean basin between 1971 and 2025. Over the same period, the deep ocean (2,000–6,000 m) also warmed, at a rate of 1 ± 0.2 ZJ per year (WMO, 2026).

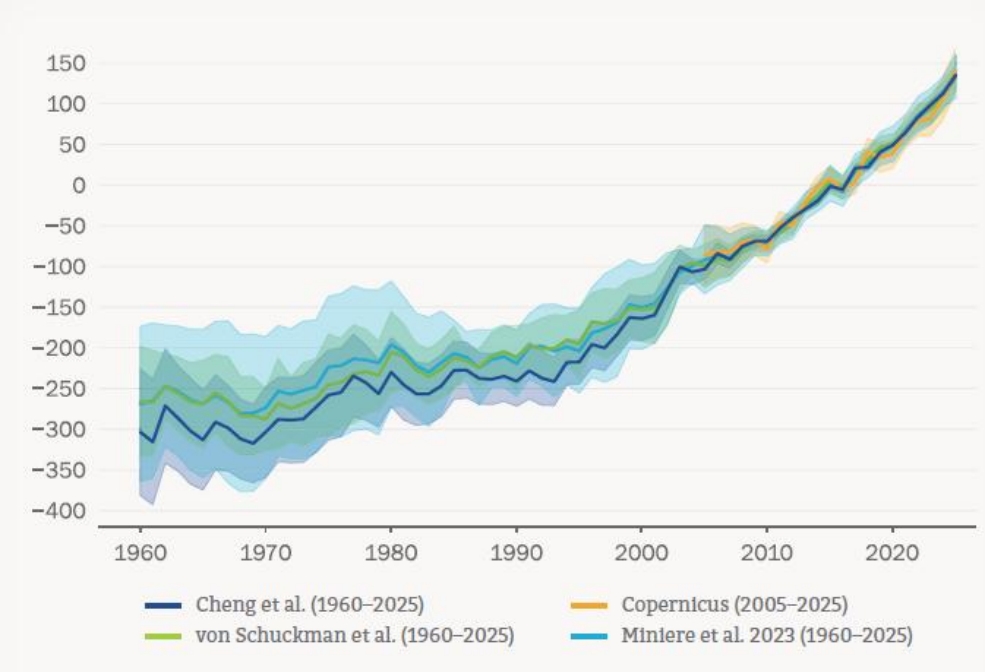


Figure F-7: Annual global ocean heat content (zettajoules (ZJ) down to 2,000 m depth for the period 1960–2025. One ZJ is the equivalent of 10^{21} Joules. The shaded area represents the uncertainty (WMO, 2026).

Marine heatwaves have become more frequent, longer, and more intense, since the 1980s. During the 1982-2016 reference period, their global frequency doubled, the average number of marine heatwave days per year increased from approximately 2.5 to 5 days, and their intensity rose by around 0.15°C. Marine heatwaves are projected to increase several-fold this century, particularly in tropical oceans and the Arctic (IPCC, 2019).

At the same time, the upper ocean has become more stratified due to surface warming and freshening, reducing mixing with deeper waters. This stratification is expected to continue increasing throughout the 21st century, with important effects on ocean circulation and ecosystems.

F.5.2 Ocean Acidification

The physical–chemical process by which the ocean absorbs CO_2 is often called the air–sea CO_2 exchange and carbonate chemistry system, which involves a sequence of linked physical and chemical steps.

Atmospheric CO_2 diffuses across the air–sea interface into surface seawater, with the rate of uptake controlled by factors including:

- The CO_2 partial-pressure gradient between air and surface ocean
- Wind speed and turbulence
- Sea temperature (with colder waters absorbing more CO_2).

When atmospheric CO_2 concentrations exceed those in surface waters, net transfer occurs into the ocean.

Once dissolved in seawater, CO_2 reacts with water to form carbonic acid, which subsequently dissociates. This process reduces the concentration of carbonate (CO_3^{2-}) ions while increasing bicarbonate (HCO_3^-) and hydrogen (H^+) ion concentrations. The resulting shift in carbonate chemistry toward a less alkaline state is commonly referred to as ocean acidification (IPCC, 2023).

Since the 1980s, the ocean has absorbed an estimated 20-30% of anthropogenic CO_2 emissions, leading to increased ocean acidification. As a result, surface ocean pH has fallen by around 0.017 – 0.027 pH units per decade since the late 1980s, as shown in Figure F-8. For over 95% of the ocean's surface, the drop in pH is

now clearly outside the range of normal, natural fluctuations and is likely to have been caused by human driven activities (IPCC, 2019).

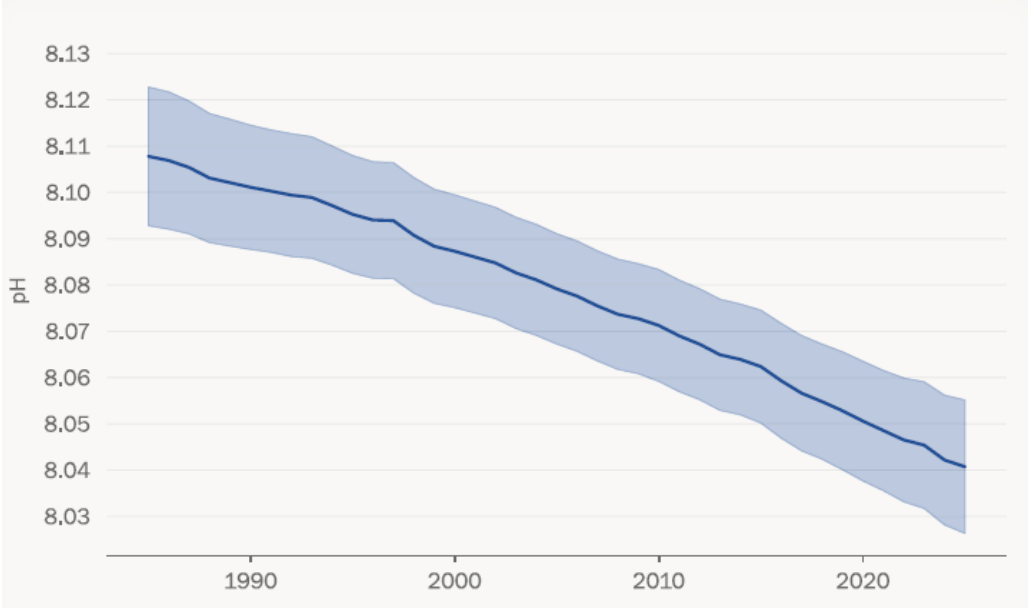


Figure F-8: Annual global mean surface ocean pH from 1985 to 2025. The dark line represents the central estimate, while the shaded area indicates the uncertainty range (WMO, 2026)

Regional patterns in surface ocean pH change are uneven. The strongest declines in surface pH have been observed in the Indian Ocean, Southern Ocean, eastern equatorial Pacific, northern tropical Pacific, and parts of the Atlantic Ocean. Collectively, these regions represent approximately 47% of the sampled global ocean and exhibit rates of surface ocean acidification that exceed the global mean (WMO, 2026).

F.6 Biodiversity

Biodiversity is the variety of life on Earth and the natural systems that support it. It is essential as it underpins the fundamental biological and ecological processes that sustain life. Biodiversity is the essential foundation and regulator that enables ecosystem services, supporting clean air and water, food production, climate regulation, pollination, disease control, and other critical processes essential to human survival and wellbeing.

Habitat loss and fragmentation are the leading causes in all global regions of biodiversity decline, driven primarily by the conversion of natural ecosystems such as forests, wetlands, and grasslands into agricultural land, urban areas, and infrastructure. This is followed by pressures from overexploitation, invasive species, and disease. Additional threats include climate change, which is most frequently highlighted in Latin America and the Caribbean, and pollution, which is particularly prominent in North America and the Asia–Pacific region (WWF, 2024).

A diverse ecosystem is more resilient to environmental changes like climate change. However, climate change has caused widespread and detectable changes across marine, terrestrial and freshwater ecosystems worldwide. Figure F-9 shows the confidence levels associated with climate change impacts on changes to ecosystem structure, species range shifts and changes in seasonal timing in terrestrial, freshwater and ocean ecosystems globally (IPCC, 2022a).

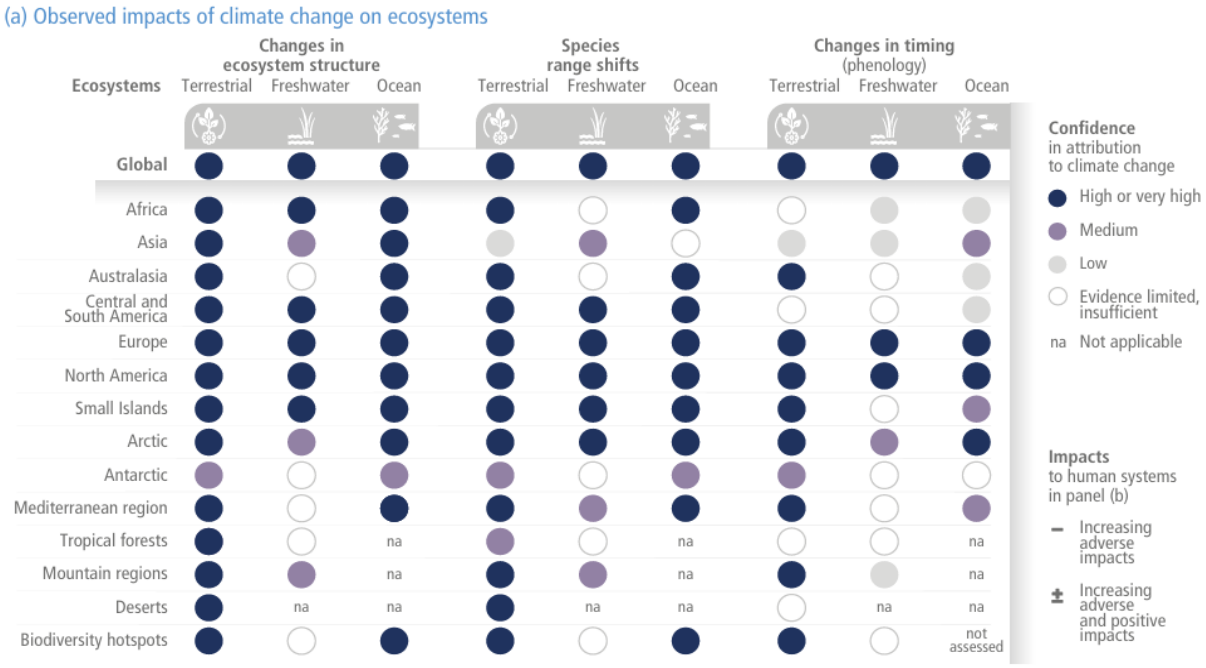


Figure F-9: Observed global and regional impacts on ecosystems (Pörtner et al., 2022a)

These impacts have occurred earlier than previously projected, and over broader geographic areas with more severe consequences. Many organisms show biological responses such as altered physiology, growth rates, population size, geographic range shifts, and changes in seasonal timing. These responses are often insufficient to keep pace with the rapid rate of recent climate change. As an example, Figure F-10 illustrates the observed shifts in the latitudinal geographic ranges of different marine species from 1955 to 2015 and shows a decline in marine species richness around the equator and in the Arctic (IPCC, 2022a).

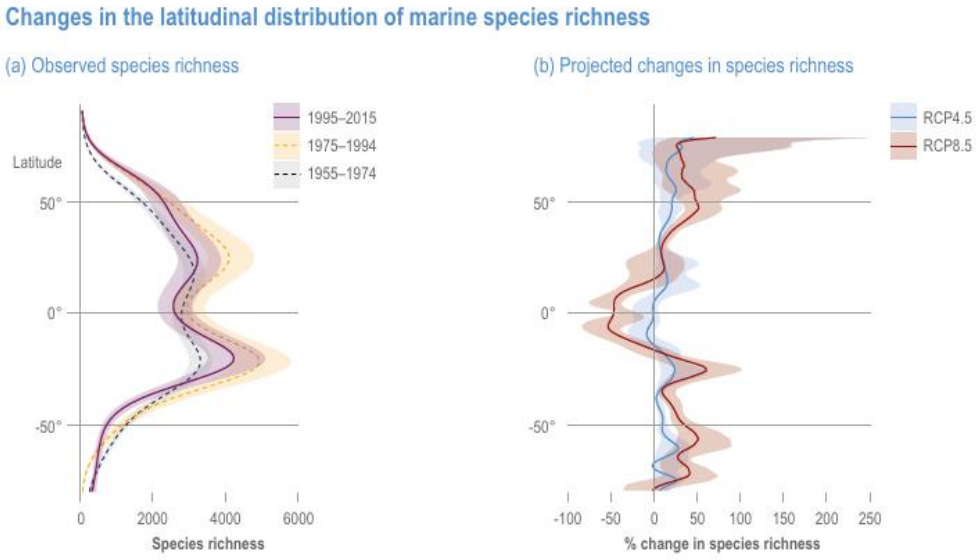


Figure F-10: Changes in the latitudinal distribution of observed marine species richness (based on 48,661 marine species) for three historical periods (1955-1974, 1975-1994, 1995-2015) (Cooley et al., 2022)

As a result, climate change has driven local species losses and increased the prevalence of disease. In some cases, these pressures have contributed to climate-driven extinctions. One such example is the Bramble Cay melomys *(Melomys rubicola)*, a small rodent formerly endemic to a single low-lying island off northern Australia. The species is now officially recognised as extinct, following habitat loss caused by flooding during

severe weather events, impacts that have been exacerbated by climate change-driven sea level rise (National Geographic, 2019).

In addition, ecosystems are being structurally reorganised, alongside intensified wildfire activity and increases in burned areas, with climate change driving an estimated 15.8% increase in global burned area between 2003 and 2019 (Burton, 2024). The capacity of ecosystems to deliver key services, such as food production, water regulation, and climate buffering, has declined.

The most comprehensive global indicators show sustained and widespread losses. For example, the Living Planet Index reported that monitored vertebrate wildlife populations declined on average by 73% between 1970 and 2020, as shown in Figure F-11 (WWF, 2024).

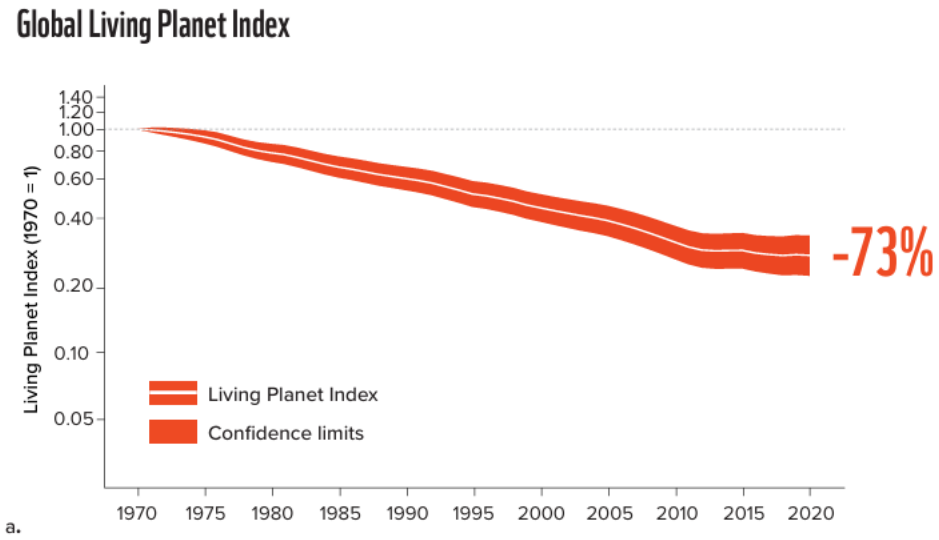


Figure F-11: The global Living Planet Index (1970 to 2020) based on 34,836 monitored populations representing 5,495 vertebrate species. The index is shown by the white line, with shaded areas illustrating statistical uncertainty (WWF, 2024)

Figure F-12 shows the steepest declines have occurred in freshwater ecosystems (85%), followed by terrestrial (69%) and marine systems (56%) (WWF, 2024). These trends reflect changes in population abundance rather than absolute species extinctions, but they signal ecosystem stress.

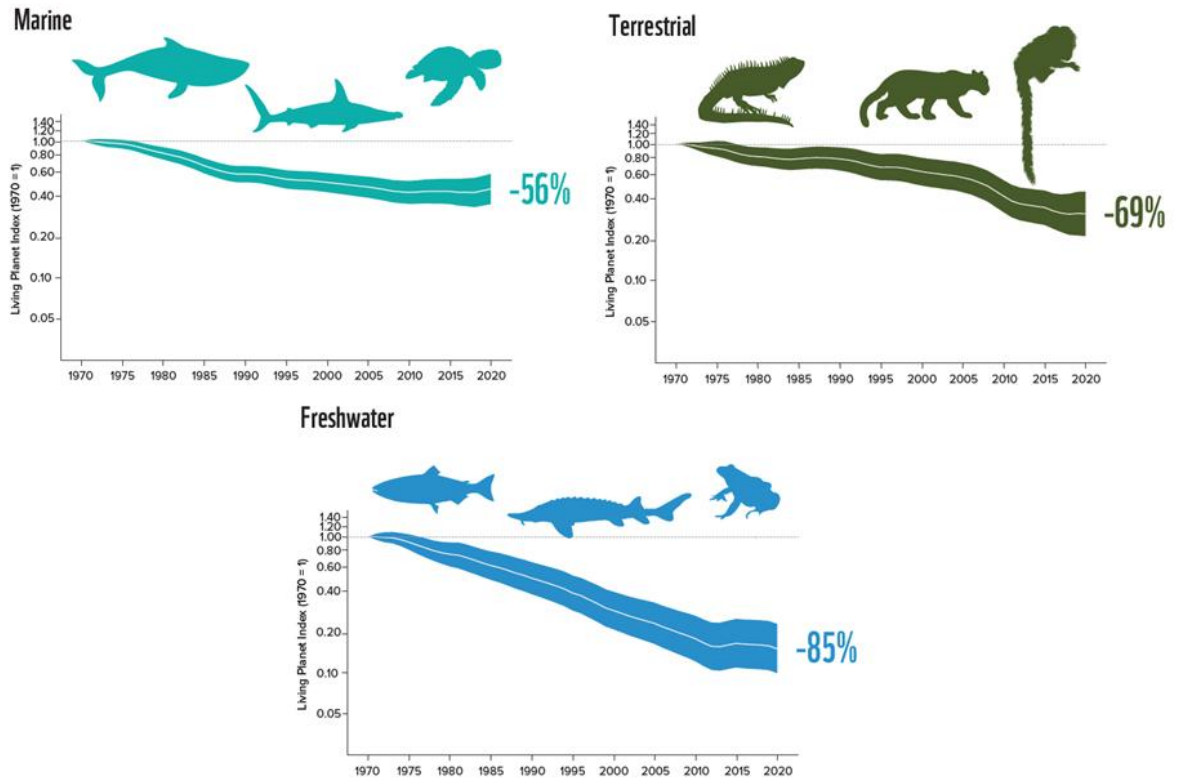


Figure F-12: The Living Planet Index trends by ecosystem type (1970-2020), incorporating data from 16,909 populations of 1,816 marine species, 11,318 populations of 2,519 terrestrial species and 6,609 populations of 1,472 freshwater species (NOAA, 2025)

F.6.1 Coral Reefs

Coral reefs are a key example of highly biodiverse ecosystems, supporting around 25% of all marine species while occupying just 0.2% of the ocean (IPCC, 2019). However, coral reefs are currently undergoing rapid global biodiversity loss, with mass coral bleaching primarily driven by ocean warming and further exacerbated by ocean acidification (IPCC, 2022a).

The ongoing fourth global coral bleaching event (January 2023 - present), as confirmed by NOAA and shown in Figure F-13, has affected the majority of the world's reefs. Approximately 84.4% of the world's coral reefs have experienced bleaching level heat stress, with mass bleaching documented in at least 83 countries and territories, making this the largest global bleaching event to date. The previous record was set during the third global coral bleaching event (2014–2017), which affected 68.2% of the world's reef area, with earlier events in 1998 and 2010 (NOAA, 2025).

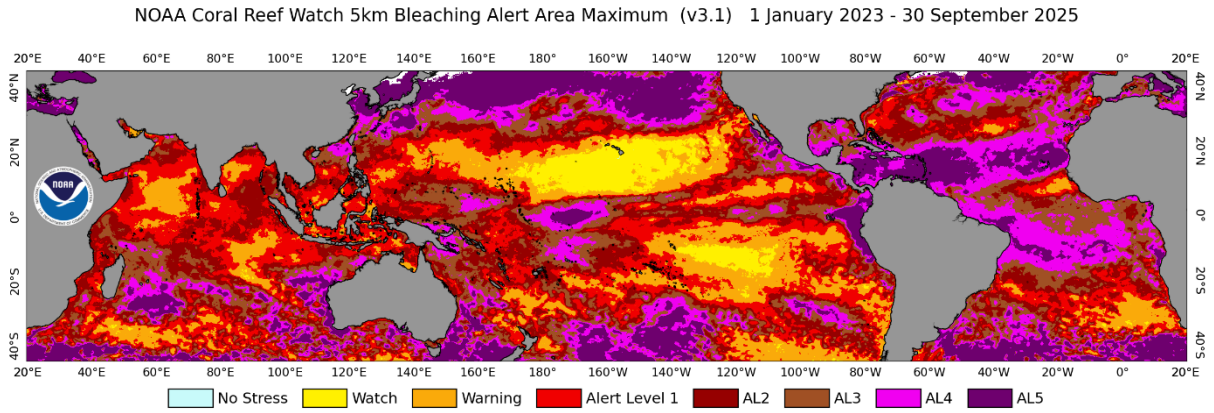


Figure F-13: NOAA Coral Reef Watch's 5 km Bleaching Alert Area Maximum product (January 2023–September 2025) showing the highest accumulated heat stress experienced by coral reefs globally, with darker colours indicating conditions capable of causing reef-wide bleaching and severe coral loss (NOAA, 2025).

As live coral declines, the complex habitats that sustain diverse fish, invertebrates, and microbial communities are lost, leading to reductions in species richness, shifts in community composition, and diminished ecosystem functioning. Repeated bleaching, combined with ocean acidification, overfishing, and pollution, is reducing reef resilience and increasing the risk of local extinctions.

F.7 Human Health

Climate-related health risks are increasing, affecting physical health, nutrition, longevity, and mental well-being, while also placing increasing pressure on healthcare systems (IPCC, 2022a).

Figure F-14 summarises the observed global and regional impacts of climate change on human systems, highlighting the levels of confidence associated with these impacts and indicating whether they are increasing adverse and/or positive outcomes. Figure F-14 also focuses on impacts related to water scarcity and food production, human health and well-being, and cities, settlements, and infrastructure (IPCC, 2022a). Selected observed global health impacts are summarised below.

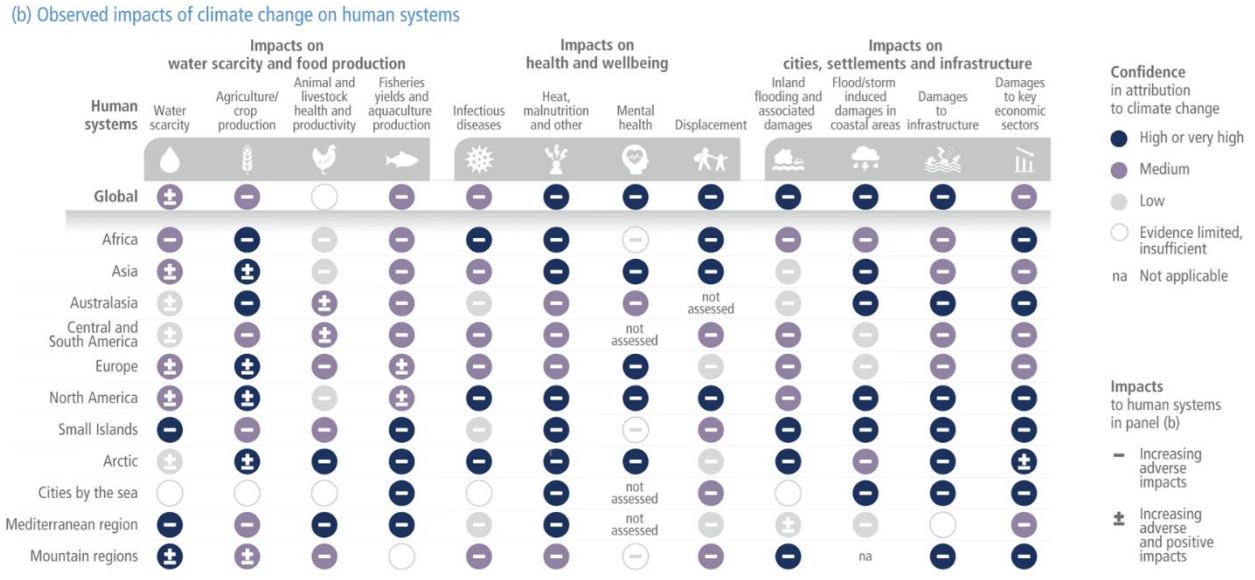


Figure F-14: Observed global and regional impacts of climate change on human systems (IPCC, 2022b)

F.7.1 Climate-Sensitive Diseases and Health Outcomes

Although malaria cases have declined globally due to improvements in healthcare and socioeconomic conditions, warming temperatures have contributed to the disease spreading to higher altitudes. Observed changes in temperature, rainfall, humidity, and human mobility are also strongly associated with increases in dengue worldwide, chikungunya across multiple regions, and tick-borne diseases such as Lyme disease in North America and Europe. Higher temperatures, heavy rainfall, and flooding have been linked to increased incidence of diarrhoeal diseases, including cholera, other gastrointestinal infections, and food-borne illnesses, while flooding events have also disrupted public health services and increased exposure to water- and vector-borne diseases.

In addition, climate extremes such as wildfires, storms, and floods are associated with elevated risks of respiratory infections and higher rates of adverse mental health outcomes in affected populations (IPCC, 2022).

F.7.2 Heat-Related Health Impacts

Heat is becoming a growing health risk due to expanding urban areas, more frequent and intense high-temperature events, and aging populations. Over the past two decades, the number of working hours lost because of heat has increased considerably, and some regions are already experiencing heat levels that reduce people's ability to work safely and effectively.

Some recent heatwave-related health impacts can be partly attributed to climate change; however, other factors including age, pre-existing health conditions, housing quality, socioeconomic status, and the capacity of public health systems also play an important role. Extreme heat events have also negatively affected mental health, well-being, cognitive performance, and can increase irritability and aggression. Evidence indicates a consistent association between elevated temperatures and adverse mental health outcomes. (IPCC, 2022a).

F.7.3 Food and Nutrition Security

Observed climate variability and change have been associated with increased food insecurity in many regions, particularly in low and middle-income countries. These conditions have been linked to multiple forms of malnutrition, including undernutrition and obesity. Climate change affects all four aspects of food security: availability, stability, access, and utilisation. Impacts extend beyond insufficient calorie intake to include poor diet quality and diet-related chronic diseases (IPCC, 2022a).

Globally, the scale of malnutrition remains severe: more than 690 million people are undernourished, 144 million children are stunted (chronic undernutrition), 47 million are wasted (acute undernutrition), and over 2 billion people suffer from micronutrient deficiencies. In 2019, 135 million people across 55 countries experienced acute hunger requiring urgent assistance (IPCC, 2022a).

Climate change contributes to malnutrition by reducing crop yields, increasing food price volatility, disrupting food supply chains, and limiting access to nutrient-dense foods. Studies across multiple global regions show that higher temperatures are associated with reduced dietary diversity, while areas exposed to higher precipitation tends to improve diet diversity (IPCC, 2022a).

At the same time, climate change is also linked to rising rates of obesity, particularly in low and middle-income countries. Heat exposure can reduce physical activity, increase reliance on processed and calorie-dense foods, and raise the cost of fresh produce. As a result, food insecurity increasingly coexists with obesity and diet-related chronic diseases, including diabetes and cardiovascular disease. Globally, 38.3 million children under five are overweight, 2.1 billion adults are overweight or obese, and diabetes prevalence has nearly doubled over the past 30 years (IPCC, 2022a).

Populations exposed to extreme weather events such as droughts, floods, and storms have experienced reduced access to sufficient and nutritious food, contributing to higher risks of malnutrition and illness (IPCC, 2022a).

F.7.4 Material Assets, Cultural Heritage and the Landscape

F.7.4.1 Material Assets

Material assets, including buildings, infrastructure, and other physical resources, are increasingly affected by climate change and wider environmental pressures. Many assets were designed for past climatic conditions and are therefore vulnerable to more frequent and intense extreme weather events such as flooding, heatwaves, storms, and coastal erosion. Rising temperatures can accelerate material degradation and reduce the performance and lifespan of buildings and infrastructure, while flooding and erosion can cause direct damage, disruption, or loss of assets (IPCC, 2022a).

These physical risks to material assets do not occur in isolation but interact with broader socio-economic conditions. Rising global temperatures, increasing frequency and intensity of extreme weather events, and long-term environmental degradation are interacting with existing socio-economic vulnerabilities such as inequality, population growth, urbanisation, and resource dependence. These interactions are amplifying risks to livelihoods, food and water security, public health, infrastructure, and economic stability, with disproportionate impacts on the poorest populations, particularly in low-income countries and climate-sensitive regions (IPCC, 2022a).

Economic losses from climate change result from negative impacts on key inputs, including reduced crop yields, reduced water availability, and decreased outdoor work productivity due to heat stress. The largest losses occur in sectors that are directly exposed to climate conditions, such as agriculture, forestry, fisheries, energy, and tourism, with impacts varying by region (IPCC,2022a).

Energy and Industrial Water Use

Water availability is a critical determinant of the performance, reliability, and longevity of energy sector material assets, particularly hydropower and thermoelectric power plants, which together account for 94.7% of global electricity generation (IPCC, 2022a). Climate change is already undermining these assets through altered precipitation patterns, reduced river flows, rising water temperatures, and an increasing frequency of extreme events such as droughts, floods, and storms. These pressures reduce power plant efficiency, constrain cooling systems, accelerate wear and degradation of infrastructure, and can cause direct physical damage to generation facilities, transmission networks, and associated assets. At the same time, rising ambient temperatures increase electricity demand for cooling, placing further stress on existing energy infrastructure (IPCC, 2022a).

Hydropower assets are particularly sensitive to changes in water availability and flow regimes. Evidence from multiple regions shows that droughts and altered runoff patterns have significantly reduced hydropower output, lowering utilisation rates and reducing the economic value of installed infrastructure (IPCC, 2022b). As an example, in Brazil's São Francisco River basin, drought conditions in 2016 and 2017 reduced average hydropower plant capacity factors to approximately 23% and 17%, respectively (IPCC, 2022b).

Thermoelectric power generation infrastructure is more consistently affected by water scarcity and elevated temperatures. Insufficient cooling water availability during droughts and heatwaves leads to widespread reductions in operational capacity, forced shutdowns and long-term efficiency losses. For example, an estimated 50% of freshwater thermal capacity is lost on extreme high-temperature days in the UK. On a global scale, drought years during the 1981–2010 period led to an average 3.8% reduction in thermoelectric power output compared to long-term average values (IPCC, 2022b). These impacts increase operating costs, shorten asset lifespans, and expose energy systems to heightened risks of disruption and reduced energy security (IPCC, 2022b).

Overall, there is high confidence that climate change has already reduced the performance and utilisation of hydroelectric and thermoelectric energy assets globally, primarily due to drought, altered river flows, and rising water temperatures (IPCC, 2022b).

Extreme Weather and Climate Events

Extreme weather and climate-related events have led to growing losses through damage to material assets, including buildings, transport networks, utilities, and other critical infrastructure, as well as through disruption of supply chains and essential services (IPCC, 2022b). Damage to these physical assets increases recovery and rebuilding costs, reduces asset lifespans, and undermines the reliability of economic and social systems. Consequently, these impacts caused by extreme weather and climate events have slowed economic growth, particularly in developing countries, and have disproportionately affected vulnerable populations and livelihoods (IPCC, 2022b).

Economic losses from climate-related disasters continue to rise, placing increasing pressure on public finances, insurance systems, and long-term development pathways, while climate risks remain insufficiently integrated into investment, planning, and adaptation decisions (IPCC, 2022b). Severe climate disasters reduce regional GDP by up to 2.2%, with long lasting losses of around 1.7% persisting for at least 5 years after an event (OECD, 2025). Material asset damage is particularly evident in highly exposed regions and sectors. Examples include the substantial economic losses and widespread damage experienced by Small Island Developing States as a result of tropical cyclones and rising sea levels, as well as major economic damage caused in recent years by wildfires partly driven by climate change in regions such as North America, Australia, and the Arctic (IPCC, 2022b). It is estimated that the 2025 Los Angeles wildfires resulted in total economic losses of around US$ 53 billion, including approximately US$ 40 billion in insured losses (Munich RE, 2026).

Food and Natural Resource Production Systems

Climate change is increasingly affecting the material assets that underpin food and natural resource production systems, including agricultural land and soils, irrigation and drainage infrastructure, forestry and fisheries assets, storage facilities, and processing equipment. Damage to, or reduced performance of, these assets is limiting the capacity of agriculture, forestry, fisheries, and aquaculture to meet growing demand from an increasing human population, while also driving economic losses through lower productivity, asset degradation, repair and replacement costs, and operational disruptions across these sectors (IPCC, 2022b).

Over the past 50 years, human-driven warming has slowed improvements in agricultural productivity, particularly in mid- and low-latitude regions. Trends in agricultural total factor productivity (TFP), defined as the ratio of aggregate agricultural outputs (crops and livestock) to aggregate inputs (land, labour, fertiliser, machinery, etc.), show that although global TFP increased between 1961 and 2015, long-term climate change substantially constrained this growth. Specifically, climate trends reduced global TFP growth by an estimated cumulative 21% over the 55-year period compared with a counterfactual scenario without climate change (IPCC, 2022b). The negative impacts were more pronounced in Africa, Latin America, and the Caribbean, where reductions in TFP growth of approximately 26–34% were observed (Ortiz-Bobea et al., 2021).

Rising temperatures have also degraded crop and grassland quality and increased annual variability in harvests. Figure F-15 presents the increase in food production loss events since the 1960s experienced by aquaculture, fisheries, livestock and crops. The observed direction of impact and confidence in attribution from climate change to crop yield productivity across four major crop types globally: maize, rice, soybean and wheat, with predominately negative impacts (IPCC, 2022b).

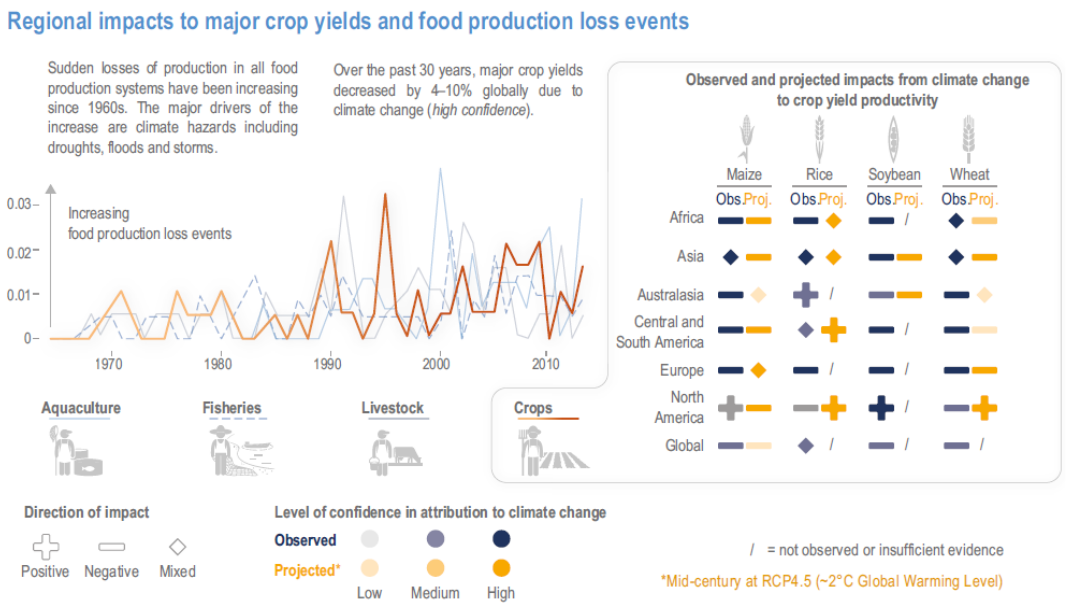


Figure F-15: Food production loss events affecting aquaculture, fisheries, livestock and crops (left panel) and regional impacts on crop yield productivity (right panel) (Pörtner et al., 2022b)

In marine and freshwater systems, warming waters and ocean acidification have already had measurable negative effects on farmed aquatic species. In wild fish populations, sustainable yields have decreased by 4.1% between 1930 and 2010 due to ocean warming (IPCC, 2022b).

Figure F-16 presents the global frequency of food production loss events between 1961 and 2013 across crops, fisheries, livestock, and aquaculture (IPCC, 2022b).

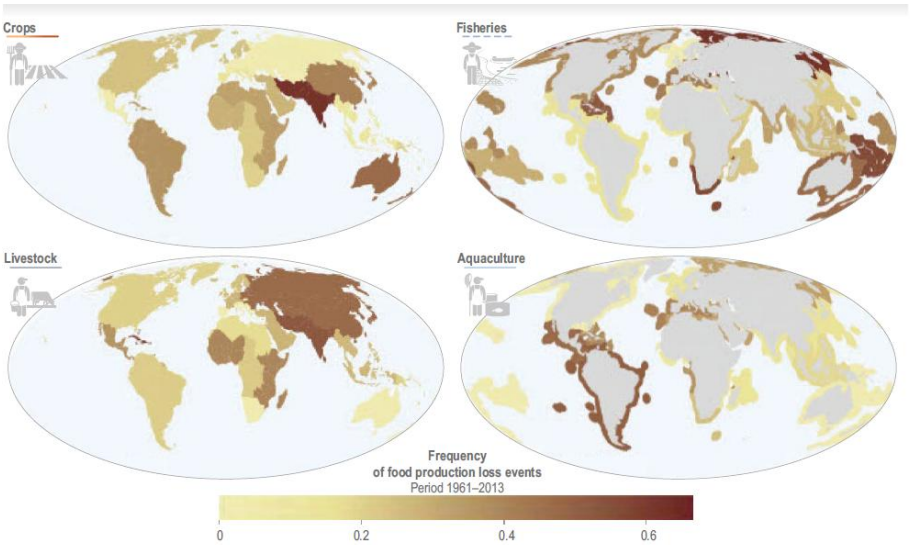


Figure F-16: Frequency of food production loss events from 1961 to 2013 for crops, fisheries, livestock, and aquaculture (Pörtner et al., 2022b)

Extreme weather and climate events, such as droughts, floods, wildfires, and marine heatwaves, reduce food production and raise food prices, putting food security, nutrition, and livelihoods at risk. Figure F-17 below shows that the frequency of climate-related food production loss events has increased globally over recent decades, including a rise in large-scale losses exceeding 20 million tonnes (IPCC, 2022b).

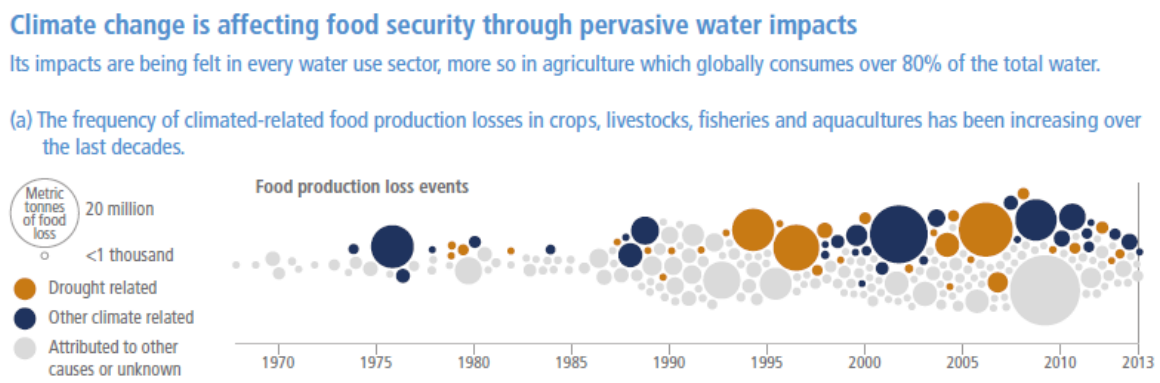


Figure F-17: Frequency of climate-related food production losses in crops, livestock, fisheries and aquacultures (Pörtner et al., 2022c)

In Europe, the impacts of extreme heat and drought have increased in severity over the past 50 years. These events have caused significant economic losses across livestock, forests and crop systems, including repeated reductions in wheat production in 2012, 2016 and 2018. Heat and drought have also damaged forests, leading to reduced timber production and sales (IPCC, 2022b).

Marine heatwaves have resulted in major losses in fisheries and aquaculture, including well-documented events along the west coast of North America (2013–2016) and the east coast of Australia (2015–2016, 2016–2017, and 2020) (IPCC, 2022b).

F.7.4.2 Cultural Heritage

Cultural heritage is increasingly recognised as vulnerable to environmental change and climate-related pressures, particularly where heritage assets are closely connected to natural processes, landscapes and long-established patterns of settlement (UNESCO, n.d.). Rising temperatures, sea-level rise, coastal erosion, flooding, wildfires and changes in soil moisture are contributing to the deterioration or loss of tangible cultural heritage (physical products of human creativity such as historic buildings, archaeological sites and cultural landscapes) and intangible cultural heritage (living traditions including practices, expressions, knowledge and skills passed down through generations) (European Parliamentary Research Service, 2024; IPCC, 2022b). These risks are often exacerbated by the age and design of historic structures, which were not developed to withstand current or projected climate conditions (European Parliamentary Research Service, 2024; Historic England, 2026), and by the concentration of heritage assets in environmentally sensitive locations such as coastal and riverside areas (IPCC, 2022b).

While the physical impacts of climate change on the environment are increasingly well documented, the effects on cultural heritage are less consistently monitored (IPCC, 2022b).

Traditional farming practices are an example of cultural traditions that are being affected by environmental change. Indigenous and small-scale farmers often rely on local knowledge and farming methods that promote biodiversity, maintain soil health, and use natural pest control. These approaches support the cultivation of a diverse range of crops, increasing genetic diversity and helping crops withstand climate-related stresses (IPCC, 2022b). However, most agricultural research, funding and support are focused on a small number of major crop species, with limited research and innovation directed towards smaller or “minor” crops. As a result, many Indigenous and small-scale farmers are shifting away from diverse cropping systems towards a narrower range of major crops. This trend can reduce the resilience of food systems, making them more vulnerable to pests, disease, and drought, and can also lead to the loss of Indigenous and local knowledge (IPCC, 2022b). For example, in the Andean Altiplano of Bolivia, Indigenous farmers have traditionally cultivated a wide variety of native crops that are tolerant of drought and frost, using long-established practices of seed selection and sharing. These farming systems are now under increasing pressure from

climate-related stresses, rising pest and disease problems, migration away from rural areas, and more intensive farming, resulting in a decline in traditional crops (IPCC, 2022b).

F.7.4.3 The Landscape

Globally, the landscape is undergoing rapid and interconnected change as climate change and other environmental pressures intensify and interact. Rising temperatures, shifting precipitation patterns, sea-level rise, and more frequent and severe extreme weather events are altering terrestrial, freshwater, coastal, and marine environments, accelerating the degradation of natural systems and the transformation of human-managed landscapes (IPCC, 2021a; IPCC, 2023).

River Landscapes and Connectivity

Global analysis of river flows shows spatially complex patterns, with reduced flows in regions such as the Mediterranean, southern Australia, and northeastern Brazil, and increased flows in northern Europe. More than half of global rivers currently experience periodic drying, reducing river connectivity and altering river corridor landscapes (IPCC, 2022b).

In high-latitude and high-altitude streams, shrinking glaciers, reduced snow cover, earlier snowmelt and altered precipitation patterns are increasing flow intermittency, resulting in streams drying up more often. This is changing source stream landscapes, reducing their reliability as permanent features and affecting how water moves through downstream landscapes (IPCC, 2022b).

Lake Landscapes

Changes to the global water cycle is altering how water is stored in lakes, leading to lake levels rising, falling, or remaining stable depending on local conditions. Although it is difficult to attribute changes at individual lakes directly to climate change, consistent patterns observed across large regions and over long time periods provide stronger evidence of a climate change influence. There is also growing evidence that climate change is leading to the loss of small, temporary ponds, which collectively cover a greater global area than permanent lakes. This is resulting in a widespread but often overlooked, simplification of freshwater landscapes (IPCC, 2022b).

In mountain regions, lakes fed by melting glaciers are increasing in size as glaciers retreat. On the Tibetan Plateau, higher water storage is linked to glacier melt, thawing permafrost, and changes in rainfall and runoff. These processes are reshaping high-altitude landscapes by forming new lakes, changing drainage patterns, and increasing the risk of landscape instability (IPCC, 2022b).

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Appendix G Expected Trajectory of Climate Conditions and the Environment

G.1 Global Surface Temperature

Across every emissions pathway assessed, global average surface temperatures are projected to keep rising until at least the middle of the century, as shown in Figure G-1. Without substantial and rapid cuts to CO_2 and other GHG emissions in the coming decades, warming levels of 1.5°C and 2°C are projected to be surpassed at some point during the 21st century.

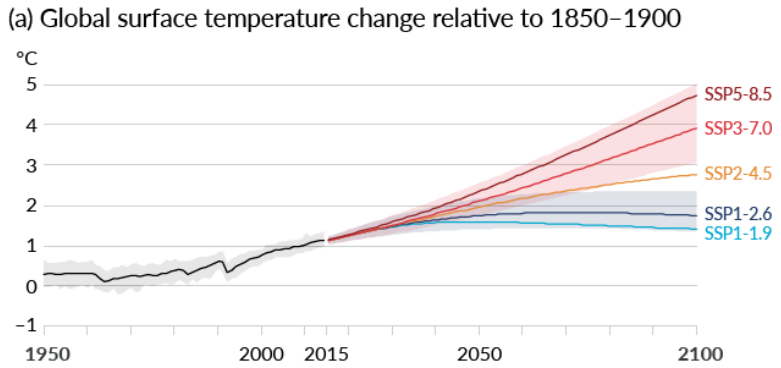


Figure G-1: Global surface temperature change projections (relative to pre-industrial 1850-1900 baseline) (IPCC, 2021c).

Projected global surface temperatures for three periods (2021-2040, 2041-2060 and 2081-2100) are shown in Table G-1. Relative to the 1850–1900 baseline, mean global surface temperatures during 2081–2100 are very likely to increase by between:

- 1.0°C and 1.8°C under the very low GHG emissions pathway (SSP1-1.9)
- 2.1°C to 3.5°C under the intermediate GHG emissions pathway (SSP2-4.5)
- 3.3°C to 5.7°C under the very high GHG emissions pathway (SSP5-8.5).

Table G-1: Projected changes in global surface temperature (relative to the 1850-1900 baseline) for selected 20-year periods across the five illustrative emissions scenarios (IPCC, 2021a).

Scenario	Near Term (2021-2040)		Mid Term (2041-2060)		Long Term (2081-2100)	
	BEST ESTIMATE	VERY LIKELY RANGE (°C)	BEST ESTIMATE	VERY LIKELY RANGE (°C)	BEST ESTIMATE	VERY LIKELY RANGE (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

G.2 Extreme Weather and Climate Events

Figure G-1 shows that as global temperatures rise, extreme weather and climate events are projected to become more widespread, more intense, and affect more regions of the world. Table G-2 summarises the projected increase in frequency and intensity of hot temperature extremes, heavy precipitation and agricultural and ecological droughts under over 1.5°C, 2°C and 4°C warming scenarios.

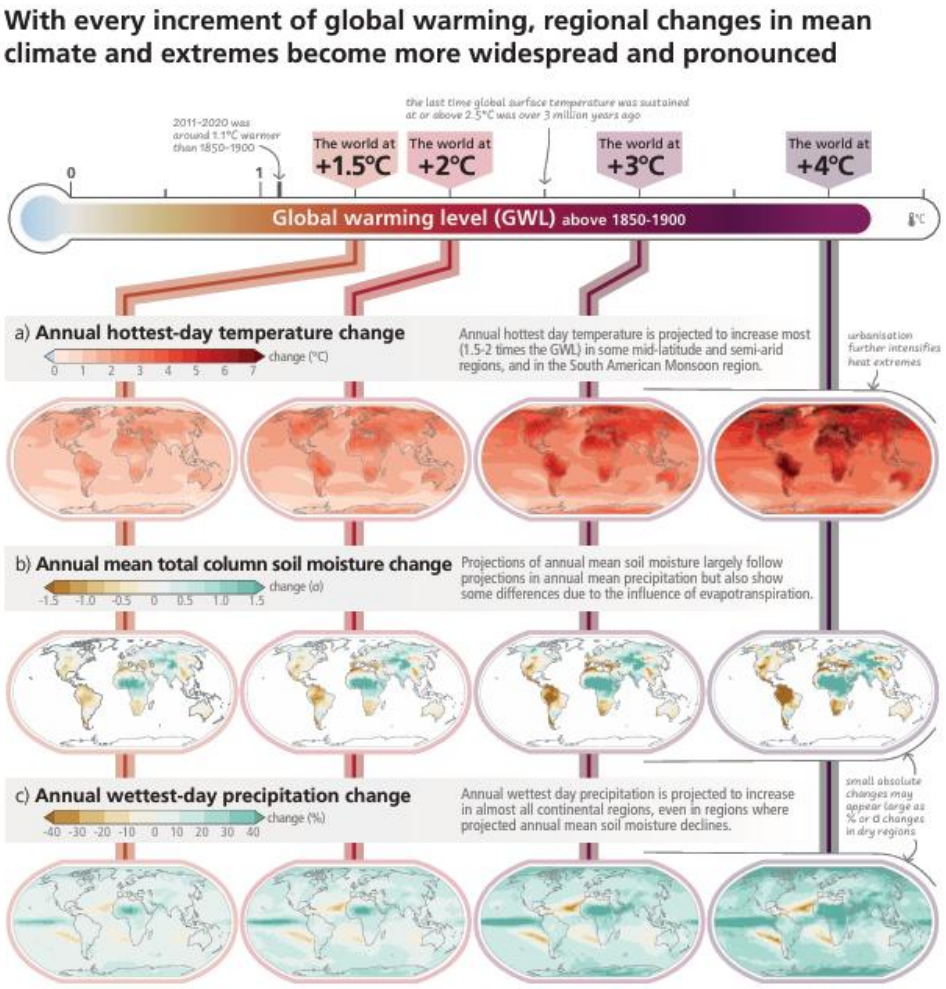


Figure G-2: Projected global changes relative to the 1850–1900 baseline at warming levels of 1.5°C, 2°C, 3°C and 4°C, showing changes in (a) annual hottest-day temperature change, (b) annual mean total column soil moisture change, and (c) annual wettest-day precipitation change (IPCC, 2023a).

Table G-2: Projected changes in the intensity and frequency of hot temperature extremes over land, extreme precipitation over land, and agricultural and ecological droughts in drying regions (IPCC, 2021a).

	1850-1900 Baseline*	Current Observations (1°C)	Future Global Temperature Increase		
			1.5°C	2°C	4°C
Hot temperature extremes over land**					
Frequency per 10 years	Once	Now likely occurs 2.8 times (1.8 – 3.2)	Will likely occur 4.1 times (2.8 – 4.7)	Will likely occur 5.6 times (3.8 – 6.0)	Will likely occur 9.4 times (8.3 – 9.6)
Intensity Increase	-	+1.2°C warmer	+1.9°C warmer	+2.6°C warmer	+5.1°C warmer
Frequency per 50 years	Once	Now likely occurs 4.8 times (2.3 – 6.4)	Will likely occur 8.6 times (4.3 – 10.7)	Will likely occur 13.9 times (6.9 – 16.6)	Will likely occur 39.2 times (27.0 – 41.4)
Intensity Increase	-	+1.2°C warmer	+2.0°C warmer	+2.7°C warmer	+5.3°C warmer
Heavy precipitation over land***					
Frequency per 10 years	Once	Now likely occurs 1.3 times (1.2 – 1.4)	Will likely occur 1.5 times (1.4 – 1.7)	Will likely occur 1.7 times (1.6 – 2.0)	Will likely occur 2.7 times (2.3 – 3.6)
Intensity Increase	-	+6.7% wetter	+10.5% wetter	+14.0% wetter	+30.2% wetter
Agricultural & ecological droughts in drying regions******					
Frequency per 10 years	Once	Now likely occurs 1.7 times (0.7 – 4.1)	Now likely occurs 2.0 times (1.0 – 5.1)	Now likely occurs 2.4 times (1.3 – 5.8)	Now likely occurs 4.1 times (1.7 – 7.2)
Intensity Increase	-	+0.3 standard deviations drier	+0.5 standard deviations drier	+0.6 standard deviations drier	+1.0 standard deviations drier

*Projected changes are shown at global warming levels of 1°C, 1.5°C, 2°C, and 4°C and are relative to a baseline of 1850–1900 which represents a climate without human influence.
**Hot temperature extremes are defined as the daily maximum temperatures over land that were exceeded on average once in a decade (10-year event) or once in 50 years (50-year event) during the 1850–1900 baseline.
***Extreme precipitation events are defined as the daily precipitation amount over land that was exceeded on average once in a decade during the 1850–1900 baseline.
****Agricultural and ecological drought events are defined as the annual average of total column soil moisture below the 10th percentile of the 1850–1900 baseline. Intensity changes are expressed as fractions of standard deviation of annual soil moisture.

G.3 Global Mean Sea Level

Figure G-3 shows how sea level rise is projected to continue, and how the projected speed and total amount of rise depends on future GHG emissions.

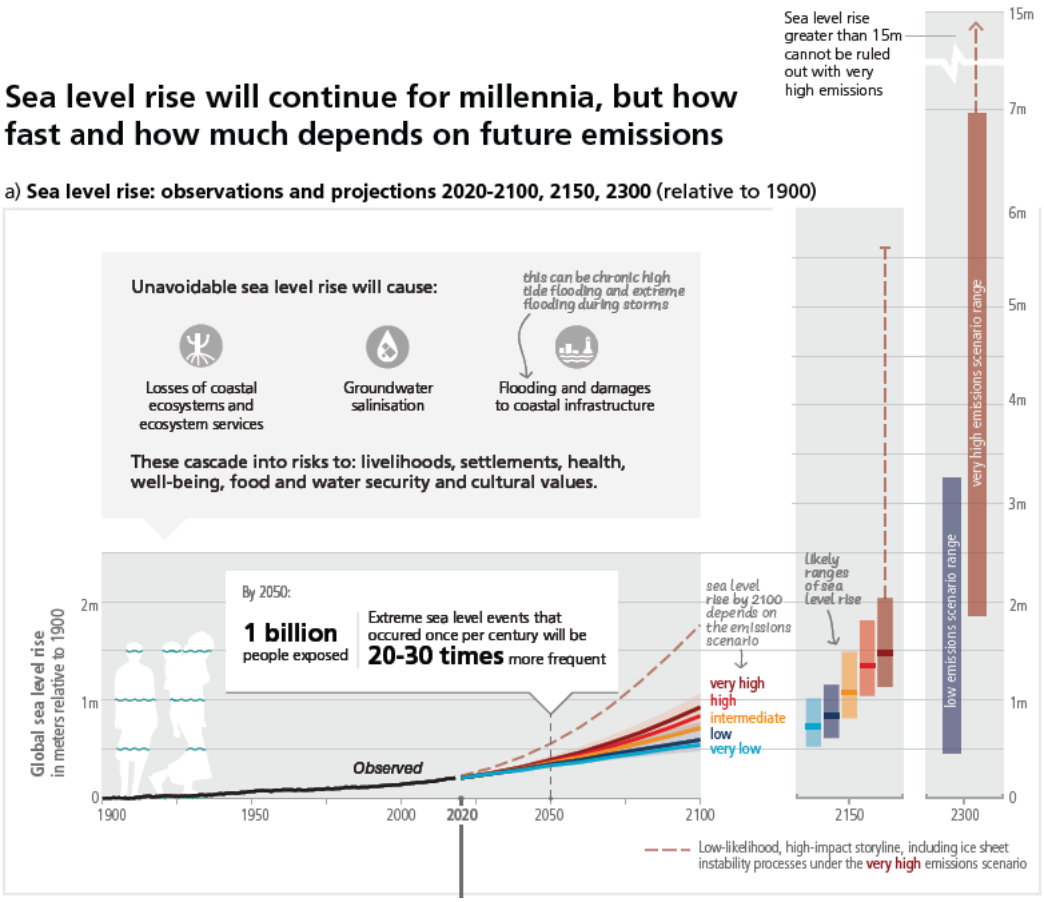


Figure G-3: Projected global sea level rise under different emissions scenarios. (IPCC, 2023b)

G.4 Carbon Sequestration Capacity

Figure G-4 shows how the Earth's land and ocean carbon sinks are projected to absorb a smaller proportion of CO_2 emissions as total emissions increase, leaving more CO_2 accumulating in the atmosphere by 2100 under higher-emissions scenarios. In the lower emissions scenarios, most emitted CO_2 is projected to be absorbed by land and ocean sinks, while in the higher emissions scenarios, more than half of emitted CO_2 is projected to remain in the atmosphere.

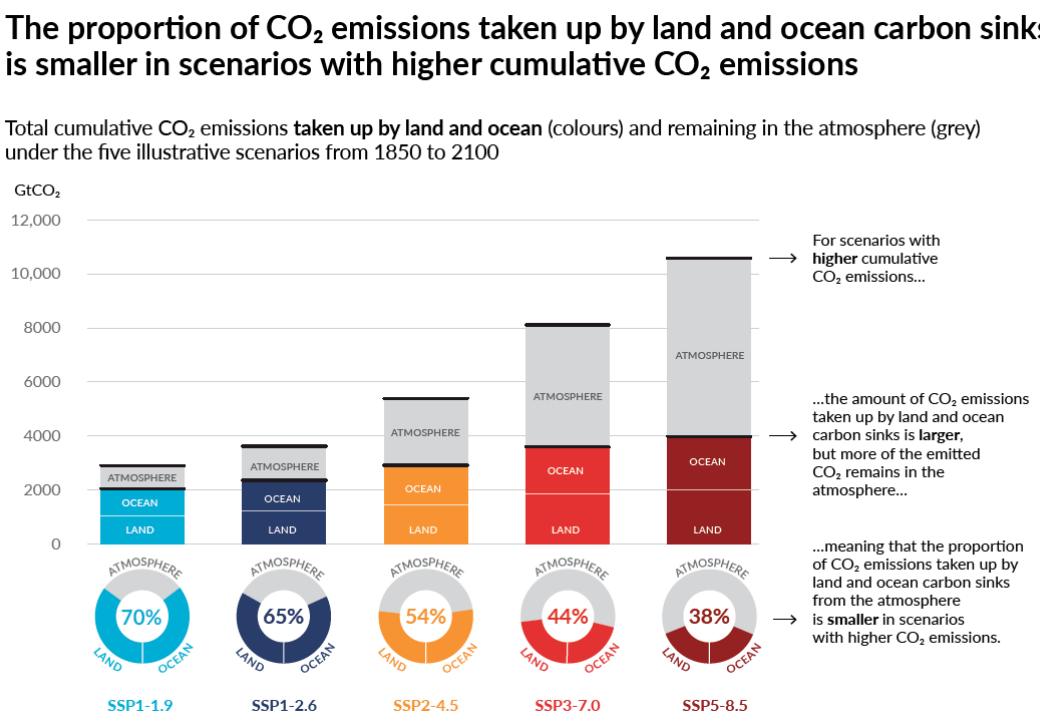


Figure G-4: Cumulative anthropogenic CO_2 emissions taken up by land and ocean sinks by 2100 under the five SSPs. (IPCC, 2021d)

G.5 Cryosphere Changes

G.5.1 Sea Ice

The Arctic is projected to become virtually sea-ice-free in September at least once before 2050 under all five illustrative scenarios considered (as shown in Figure G-5), with higher levels of warming leading to more frequent occurrences. By contrast, there is low confidence in projections of Antarctic Sea-ice decline.

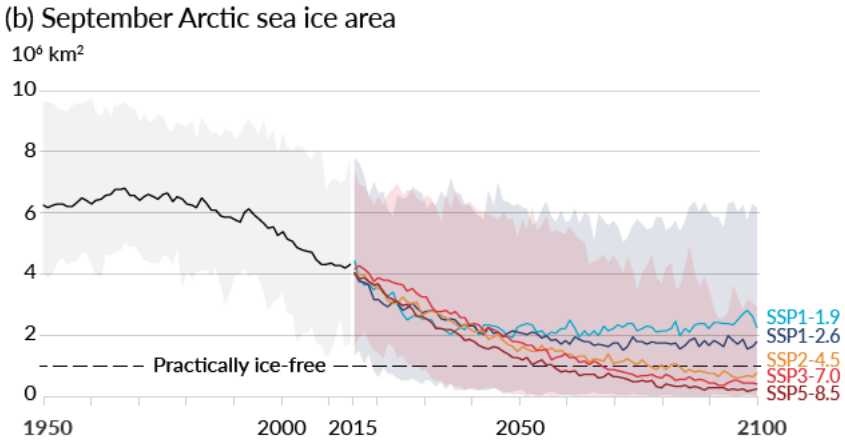


Figure G-5: Projected changes in September Arctic sea-ice area under different future emissions pathways (IPCC, 2021e).

G.5.2 Glaciers

As shown in Figure G-6, glaciers are projected to continue to lose mass under all emissions scenarios for several decades, even if global temperatures stabilise, due to delayed response.

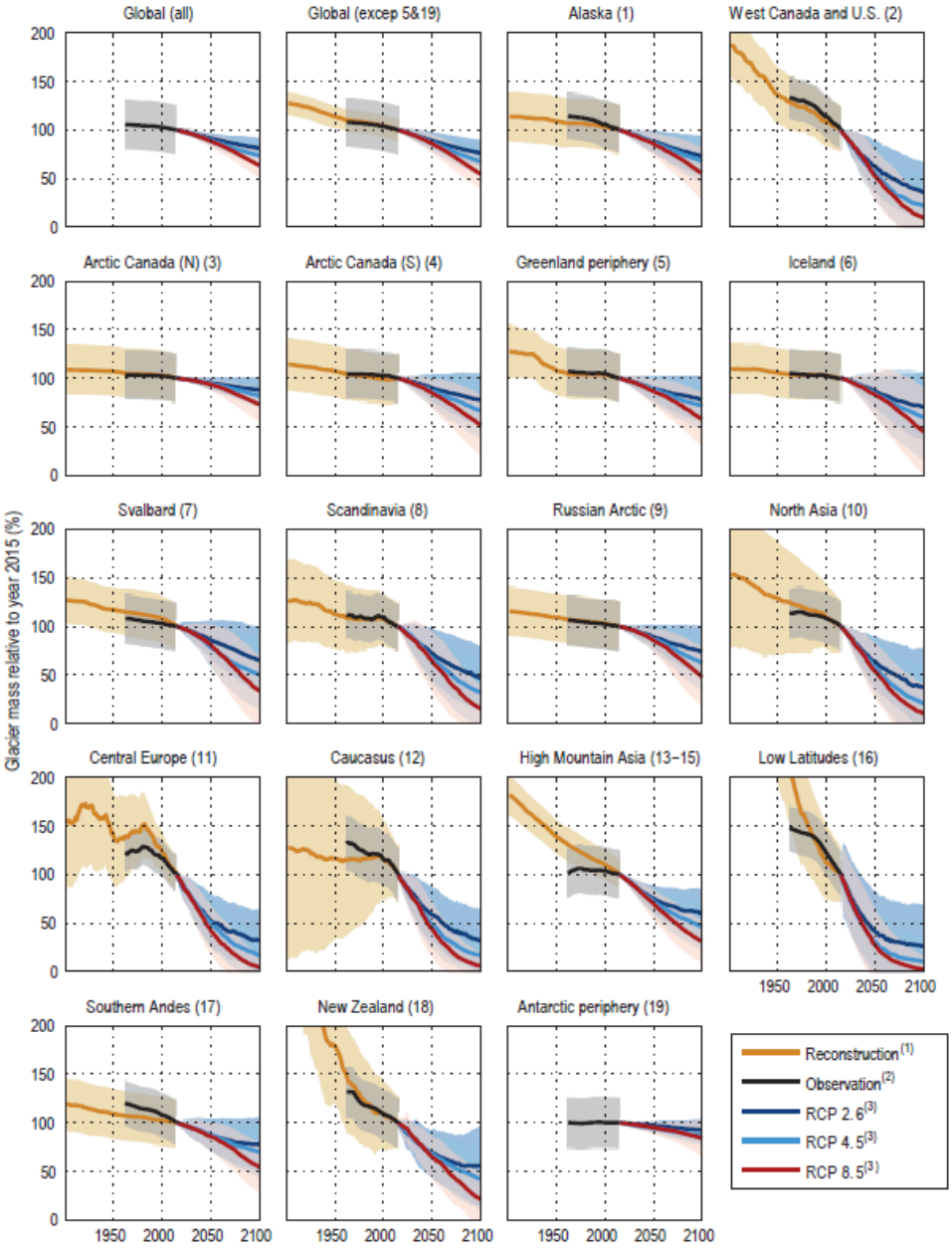


Figure G-7: Projected global and regional glacier mass changes under different emissions scenarios (IPCC, 2021f).

G.6Oceanic Changes

G.6.1 Ocean Warming

At least 83% of the global ocean surface is projected to warm over the 21st century. Warming is projected to continue until at least 2300, even under low-emissions scenarios, due to slow deep-ocean circulation. Figure G-8 displays the probability ratio of marine heatwaves (i.e. how much more likely marine heatwaves are compared with pre-industrial conditions) under two emissions scenarios for 1985-2014 and 2081-2100.

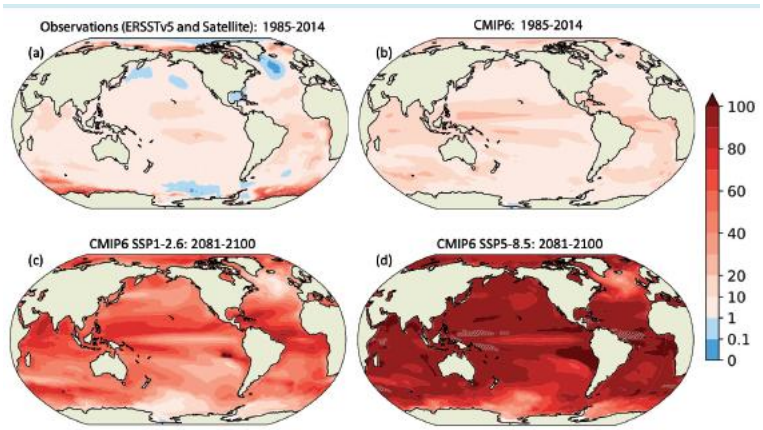


Figure G-9: The probability ratio of marine heatwaves under low and high emissions scenarios for the 1985-2014 and 2081-2100, relative to pre-industrial conditions (IPCC, 2021g).

G.7 Biodiversity

Figure G- 10 shows the projected percentage loss of terrestrial and freshwater biodiversity at global warming levels of 1.5°C, 2°C, 3°C and 4°C, relative to the pre-industrial period.

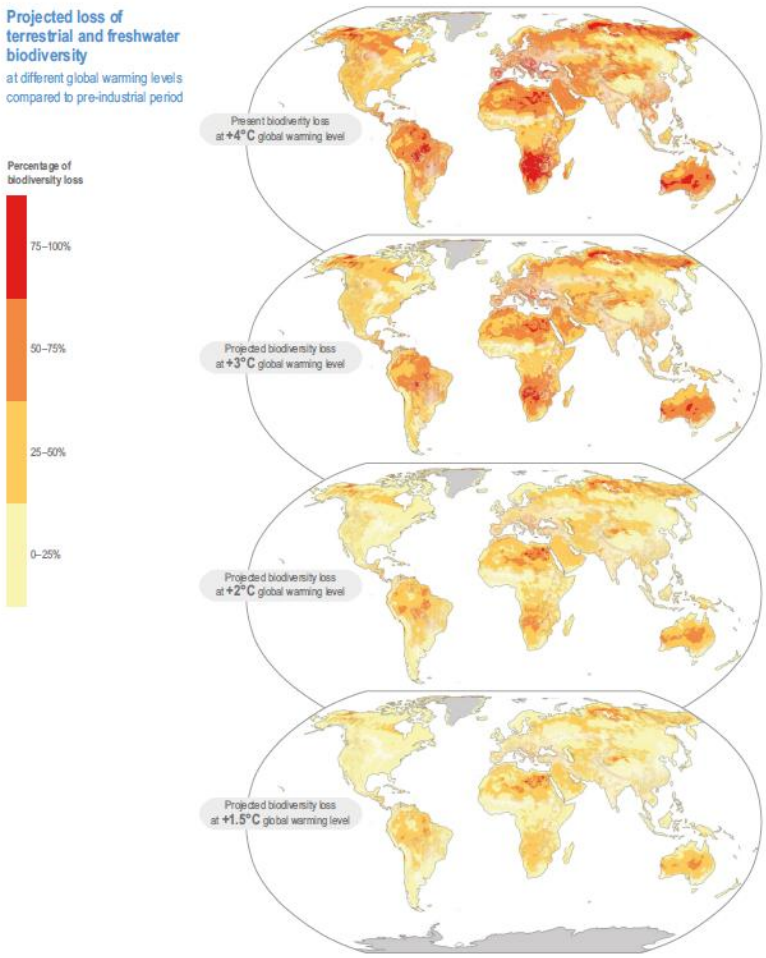


Figure G- 10: Projected loss of terrestrial and freshwater biodiversity at global warming levels of 1.5°C, 2°C, 3°C and 4°C (Parmesan et al., 2022a).

Figure G-11 illustrates how the impacts of climate change on natural and human systems are projected to become more severe and more widespread as global temperatures increase, assuming no additional

adaptation measures are taken. Panel (a) shows the projected increase in biodiversity loss as global temperatures increase. Panel (b) illustrates the projected number of days per year with dangerous heat-humidity conditions affecting human health. Panel (c) presents projected changes in food production, including impacts on maize yields and fisheries, under higher warming levels.

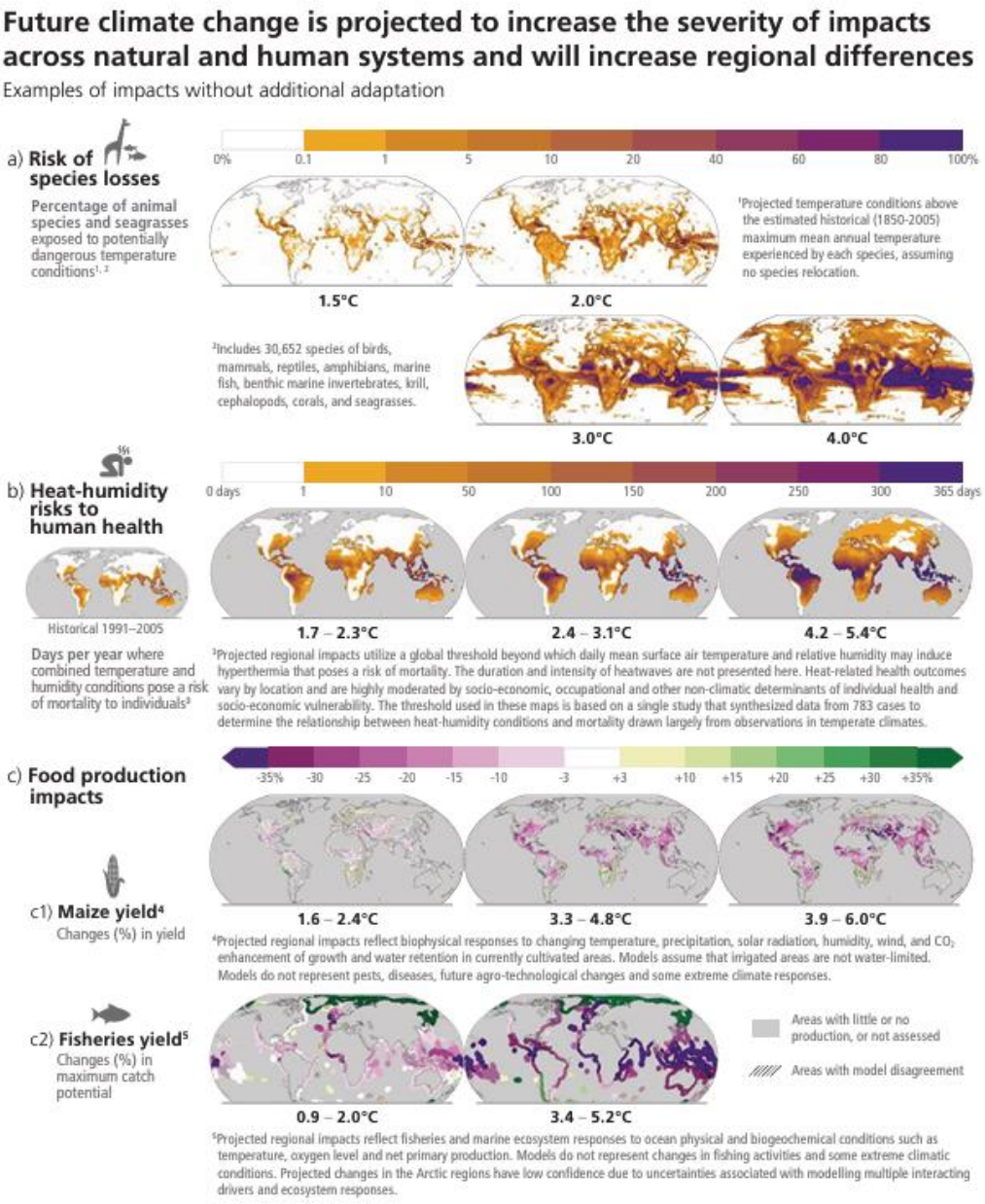


Figure G-11: Projected impacts of climate change on natural and human systems at increasing levels of global warming, showing changes relative to historical conditions and assuming no additional adaptation. Panel (a) shows the risks of species loss due to exposure to higher temperature conditions, panel (b) shows the heat-humidity risks to human health, including increases in days with dangerous conditions, and panel (c) shows the impacts on food production, including changes in maize yields and marine fisheries productivity, at global warming levels of approximately 1.5°C, 2°C, 3°C and 4°C above pre-industrial levels (IPCC, 2023c).

G.8Human Health

G.8.1 Climate-Sensitive Diseases

Figure G-12 shows the projected changes in the potential abundance of *Aedes aegypti* (the primary vector of Dengue fever, Zika virus, Chikungunya, Yellow fever) under low and high emissions scenarios for 2090-2099 (related to a 1987-2016 baseline). The red regions on the map indicate areas where abundance is projected to increase, while the blue regions indicate areas where abundance is projected to decrease.

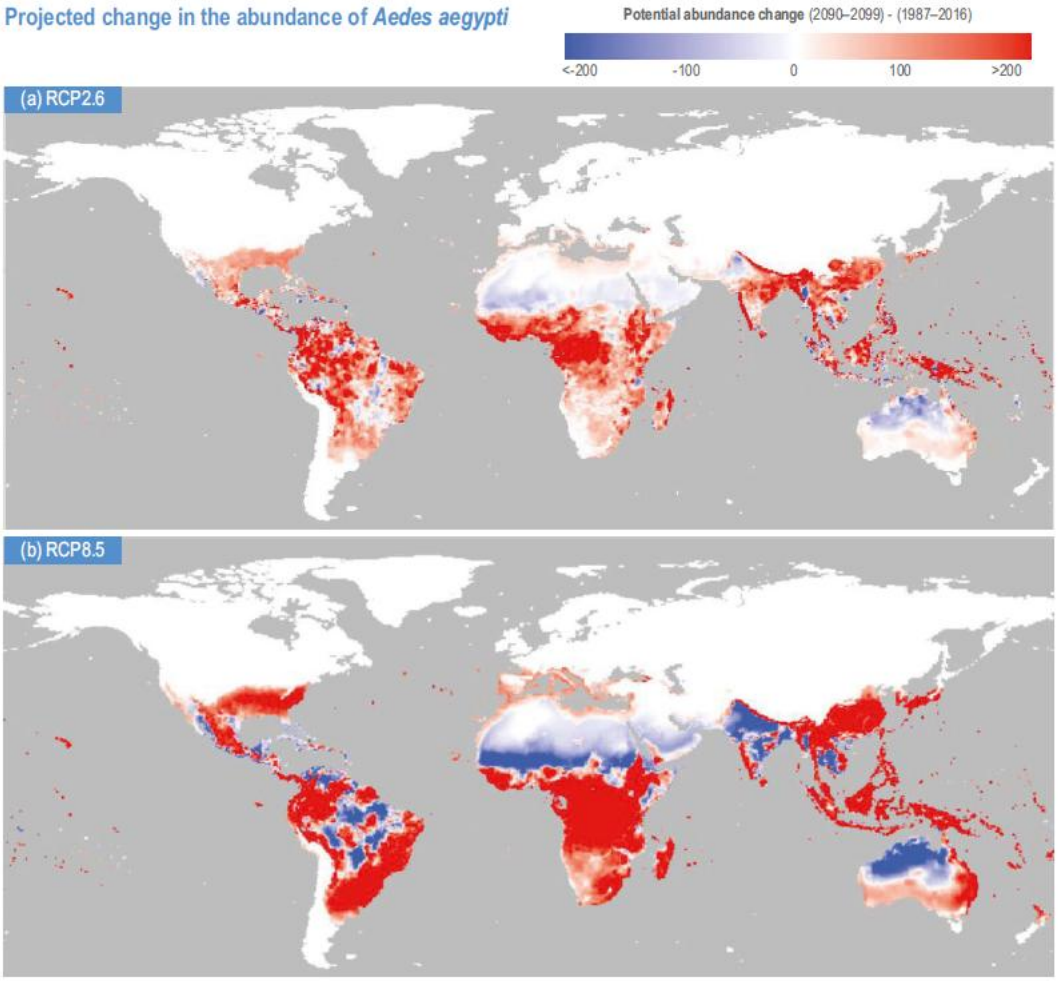


Figure G-12: Projected changes in the potential abundance of Aedes aegypti (the primary vector of Dengue fever, Zika virus, Chikungunya, Yellow fever) under low and high emissions scenarios for 2090-2099 (related to 1987-2016) (Cissé et al., 2022).

G.9 Material Assets, Cultural Heritage and the Landscape

G.9.1 Material Assets

G.9.1.1 Water Scarcity

Figure G-13 describes the level of policy effort needed to address water scarcity by 2050, based on both projected water stress (using the Water Scarcity Index, WSI) and the uncertainty in those projections drawing on five climate models, three hydrological models and three future SSPs. Policy challenges are classified as low (monitoring and review), medium (moderate changes to water systems), or high (major, transformative changes). Low challenges occur where projected water scarcity remains low (WSI < 0.4) and uncertainty is stable; medium challenges occur where either water scarcity remains low but uncertainty increases, or water scarcity increases (WSI > 0.4) with stable uncertainty; and high challenges occur where both water scarcity

and uncertainty increase. Areas shown in white represent locations with very low water scarcity (WSI < 0.1) or very low water demand (IPCC, 2022a).

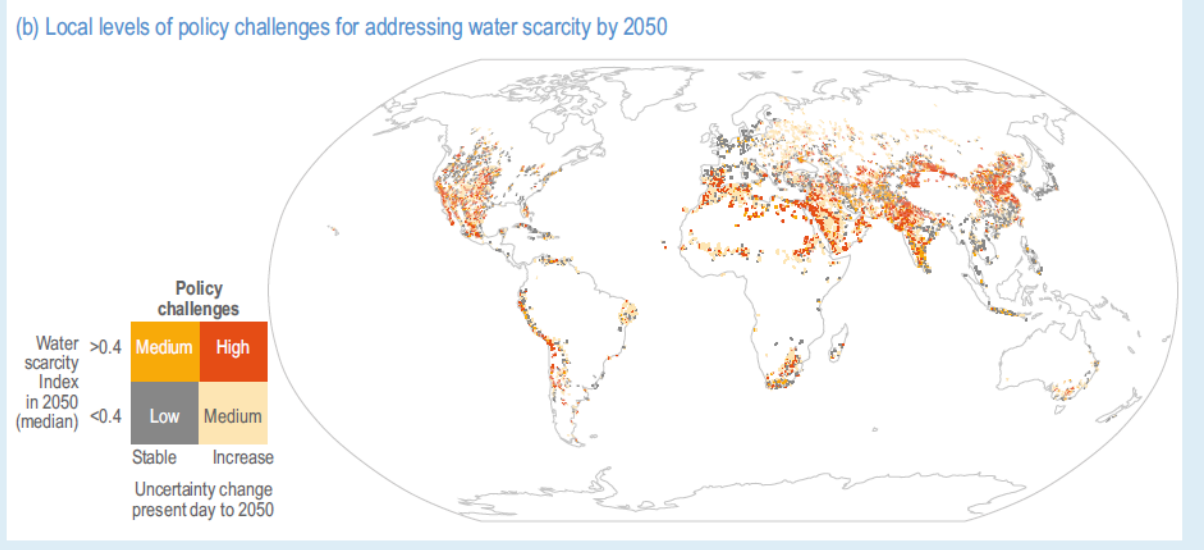


Figure G-14: Level of policy effort needed to address water scarcity by 2050, based on both the expected level of water stress (using the Water Scarcity Index, WSI) and their level of uncertainty. The projections combine five climate models, three global hydrological models and three SSPs (Caretta et al., 2022a)

G.9.1.2 Key Infrastructure Risks

Figure G-15 presents examples of key regional risks and impacts, along with their associated confidence levels, under warming scenarios of up to 4°C. Examples relevant to material assets project the increasing risk of coastal flooding to infrastructure in Europe with rising global temperatures, and the growing costs and damages affecting key infrastructure in the Arctic (IPCC, 2022a).

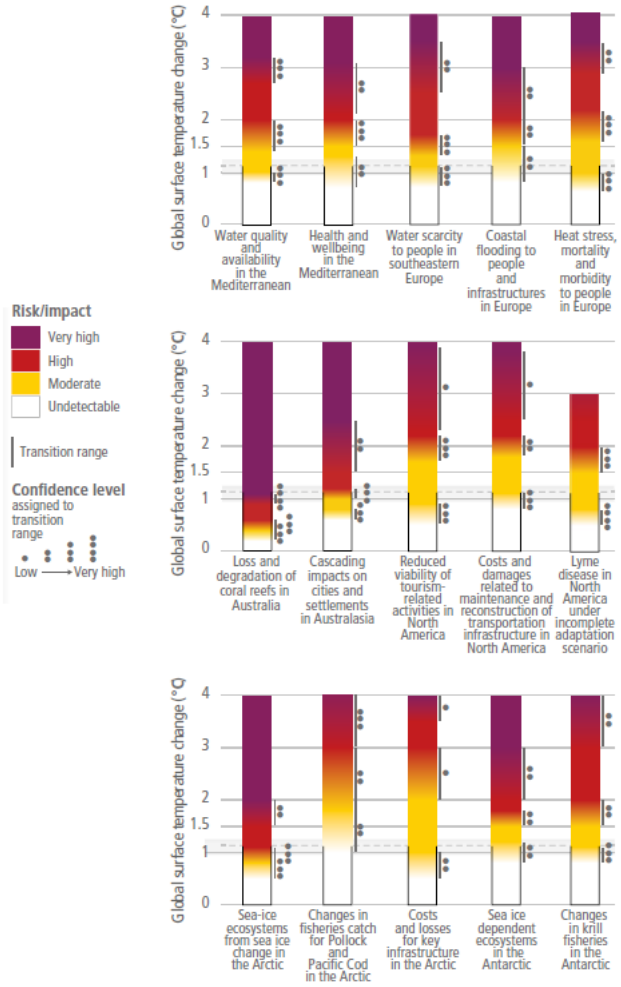


Figure G-15: Examples of regional key risks/impacts and their associated confidence levels under warming scenarios up to 4°C (IPCC, 2022b)

G.9.1.3 Agriculture

Figure G-16 shows where wheat production is projected to increase or decrease globally, and how total global wheat production is projected to change through the 21st century, relative to a historical baseline (1983-2013).

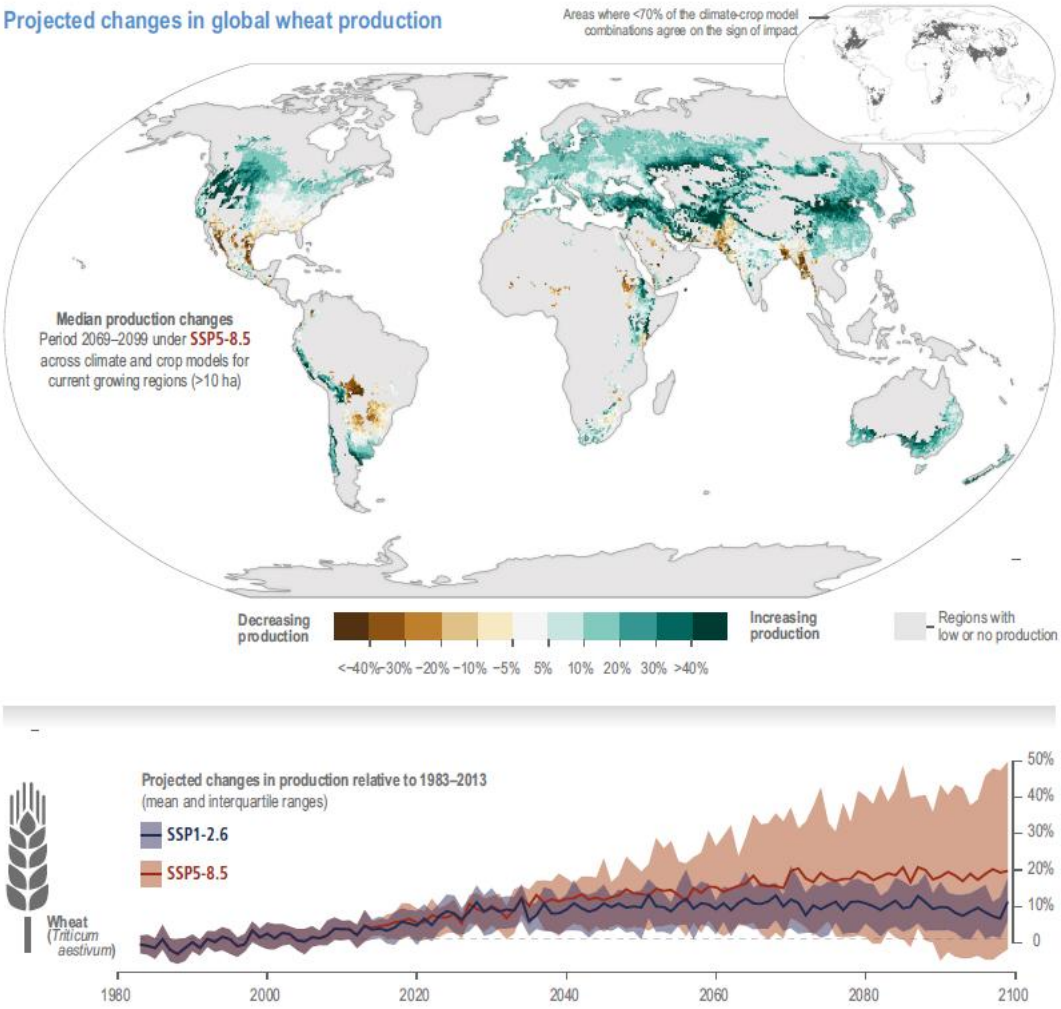


Figure G-16: Projected changes in global wheat production. The upper panel shows projected production changes for 2069-2099 under a high emissions scenario, while the lower panel shows the projected changes for a low and high emissions scenario relative to a 1983-2013 baseline (IPCC, 2022c).

Figure G-17 illustrates the projected number of days per year when cattle are exposed to extreme heat stress, relating to a combination of high temperature and humidity under different emissions scenarios. Extreme heat stress conditions could reduce animal welfare, productivity, fertility, and survival.

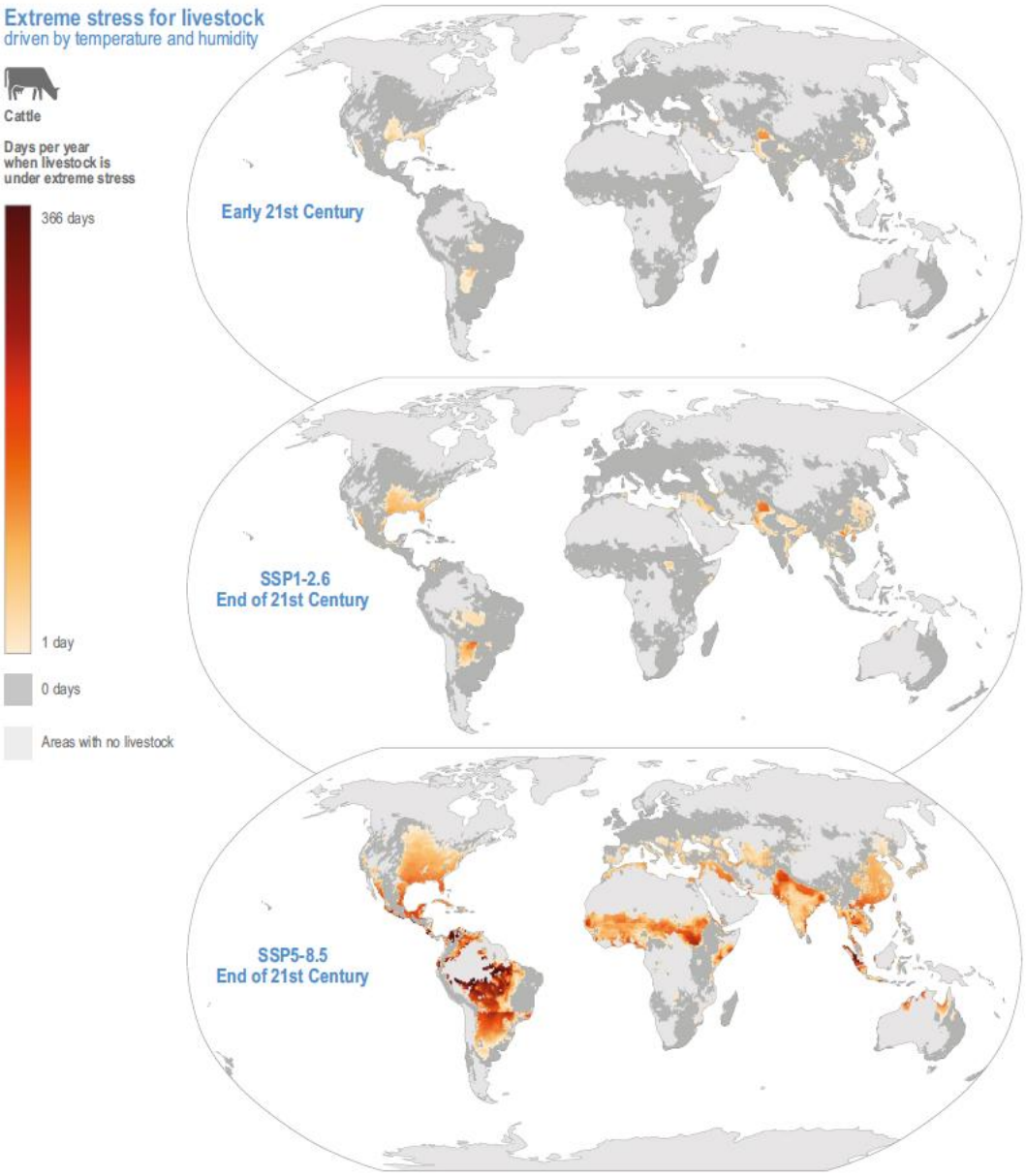


Figure G-17: Projected changes in extreme heat stress for livestock (cattle) related to increasing temperature and humidity under a low emissions scenario and a high emissions scenario (IPCC, 2022c).

G.9.1.4 Productivity

Figure G-18 illustrates how rising temperature and humidity are projected to reduce human physical work capacity for outdoor labour, particularly under higher future warming scenarios.

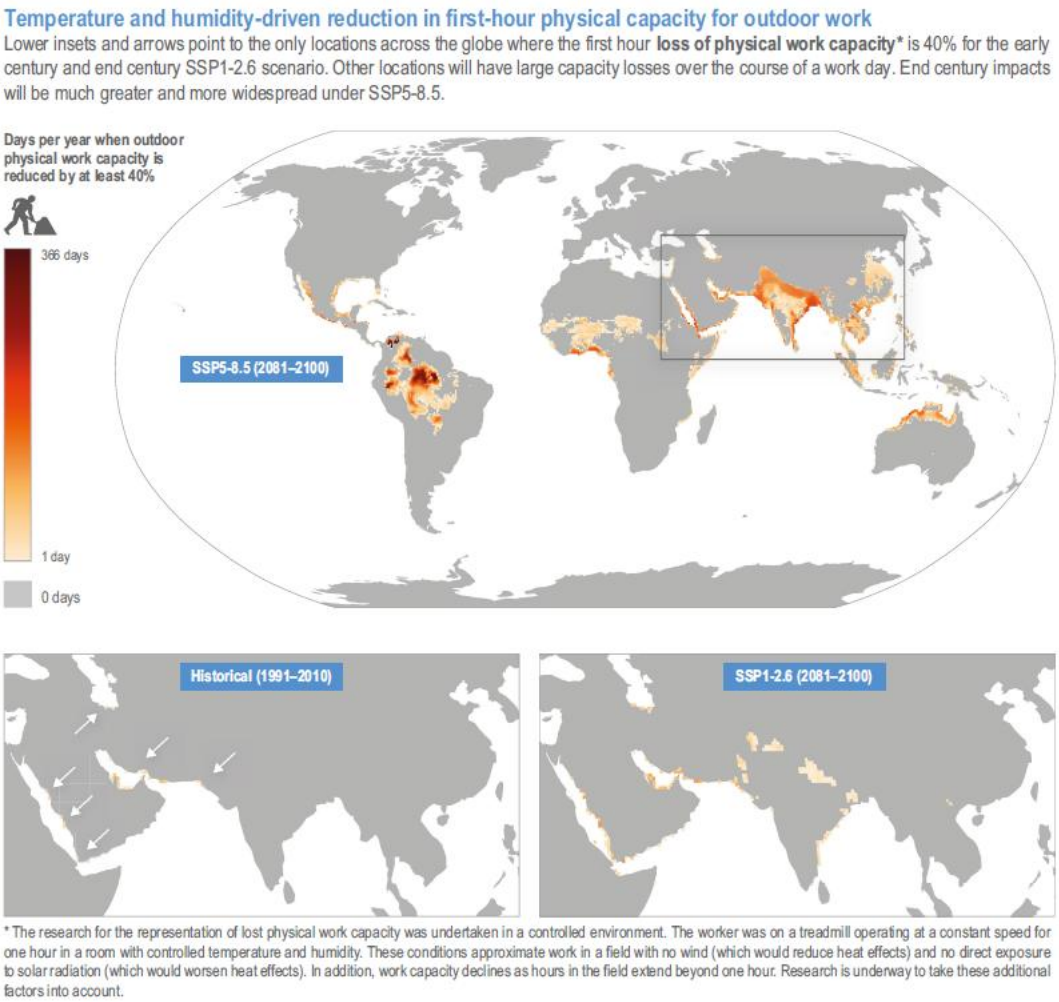


Figure G-18: Temperature and humidity-driven reduction in physical work capacity for humans working outdoors for a low emissions scenario and a high emissions scenario (relative to a 1991-2010 baseline) (IPCC, 2022e).

G.9.2 Cultural Heritage

Projecting changes to cultural heritage is inherently challenging due to its intangible, place-specific, and context-dependent nature, which is difficult to quantify or model (Richards and Brimblecombe, 2025). In addition, there is a general lack of consistent, long-term data on cultural heritage and their vulnerability, further limiting the ability to make robust predictions (Crowley *et al.,* 2022). Figure G-19 presents water-related adaptation responses, including current benefits, co-benefits with mitigation, potential negative effects, and their future effectiveness and remaining risks projected under different levels of global warming. As shown in Figure G-19, there is low confidence in evidence on Indigenous knowledge and local knowledge-based adaptations on water-related adaptation responses.

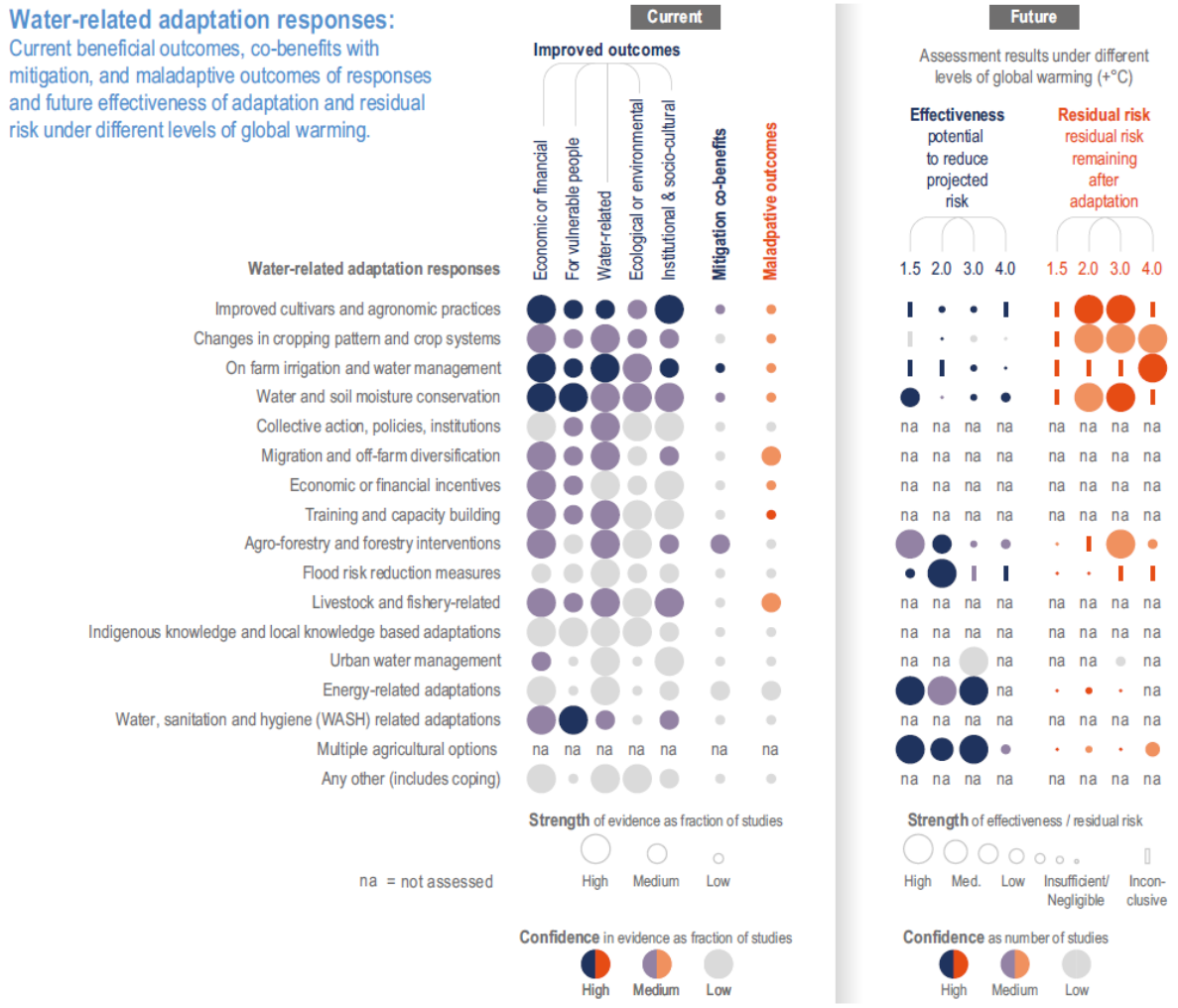


Figure G-19: Water-related adaptation responses, including current benefits, co-benefits with mitigation, potential negative effects, and their future effectiveness and remaining risks under different levels of global warming (Caretta et al., 2022b).

Sea-level rise and related coastal hazards are projected to pose increasing climate risks to African heritage over the coming decades. Figure G-20 illustrates the coastal cultural and natural heritage sites across Africa that are at risk from sea-level rise and erosion by 2100 under a high emissions scenario (IPCC, 2022a).

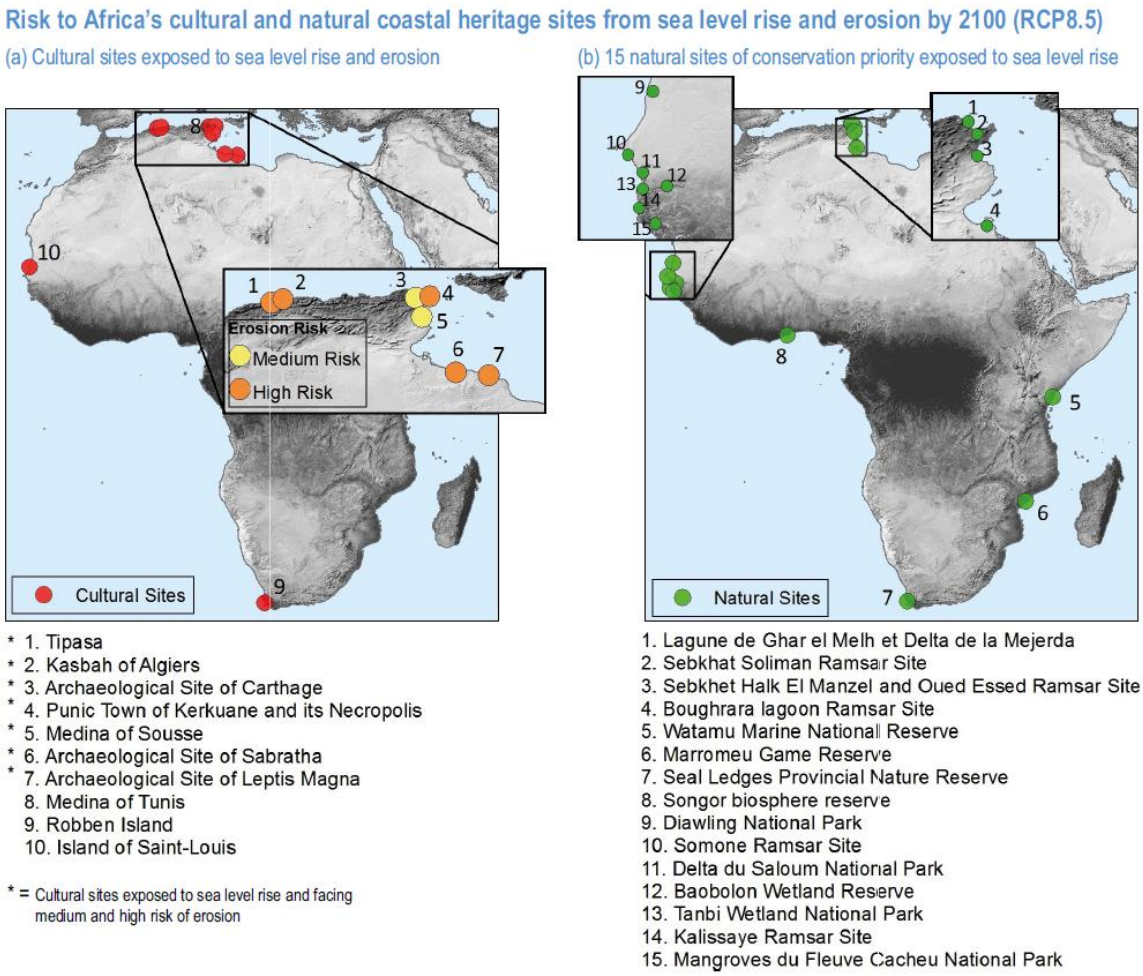


Figure G-20: Risk to Africa's cultural and natural coastal heritage sites from sea level rise and erosion by 2100 under a high emissions scenario (RCP8.5) (Trisos et al., 2022)

Figure G-21 illustrates the projected increase in risk to World Cultural Heritage sites across the Mediterranean from flooding and erosion associated with sea-level rise by 2100 under a high emissions scenario.

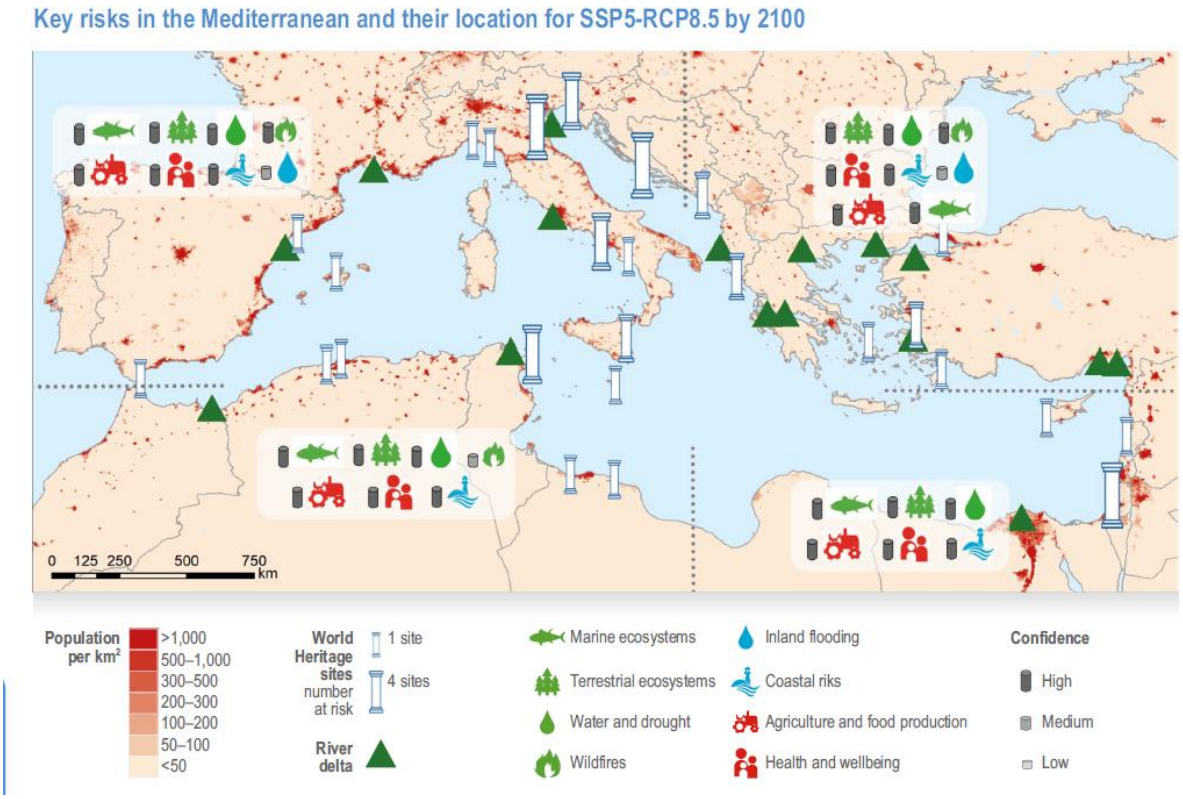


Figure G-21: Key risks in the Mediterranean and their location across the Mediterranean region under a high emissions scenario (SSP5-RCP8.5) by 2100 (Ali et al., 2022)

G.9.3 The Landscape

Figure G-22 and Figure G-23 shows the projected future global ice cover trends of lakes and rivers across the Northern Hemisphere under different temperature scenarios.

Figure G-22 presents the spatial distribution of current and future Northern Hemisphere lakes that may experience intermittent winter ice cover under climate warming, with light grey areas indicating current conditions and coloured areas showing projected future changes. The figure indicates that lakes, which currently experience intermittent winter ice cover are projected to see a progressive reduction in ice cover duration as global temperatures increase from 2°C to 3.2°C, 4.5°C and 8°C above the 1970–2010 baseline. Under higher warming scenarios, the extent and duration of lake ice cover decline further, with some locations projected to lose seasonal ice cover entirely.

Figure G-23 shows the forecasted changes in river ice duration across the Northern Hemisphere under the RCP4.5 scenario, approximately equivalent to a 2°C increase, for the period 2080-2100 compared with 2009-2029. The black reference lines indicate ice duration during the period of 2009-2029, while blue shading indicates increases in ice duration, and grey areas represent land where rivers cannot be observed using the available data. The figure shows that ice duration for rivers is expected to decline across much of the Northern Hemisphere, with the largest changes occurring in areas where rivers currently experience seasonal ice cover. In these regions, the ice season becomes shorter in the future, with deeper pink-to-red shading showing greater decreases in ice duration, compared with the baseline period, showing a broad reduction in the persistence of river ice under warming conditions. Overall, the figure demonstrates a widespread spatial reduction in river ice duration under a moderate warming scenario, consistent with a warming-driven decline in seasonal ice cover.

Overall, both figures show a pattern of decreasing ice cover in lakes and rivers respectively under warming conditions, with greater reductions associated with higher temperature increases.

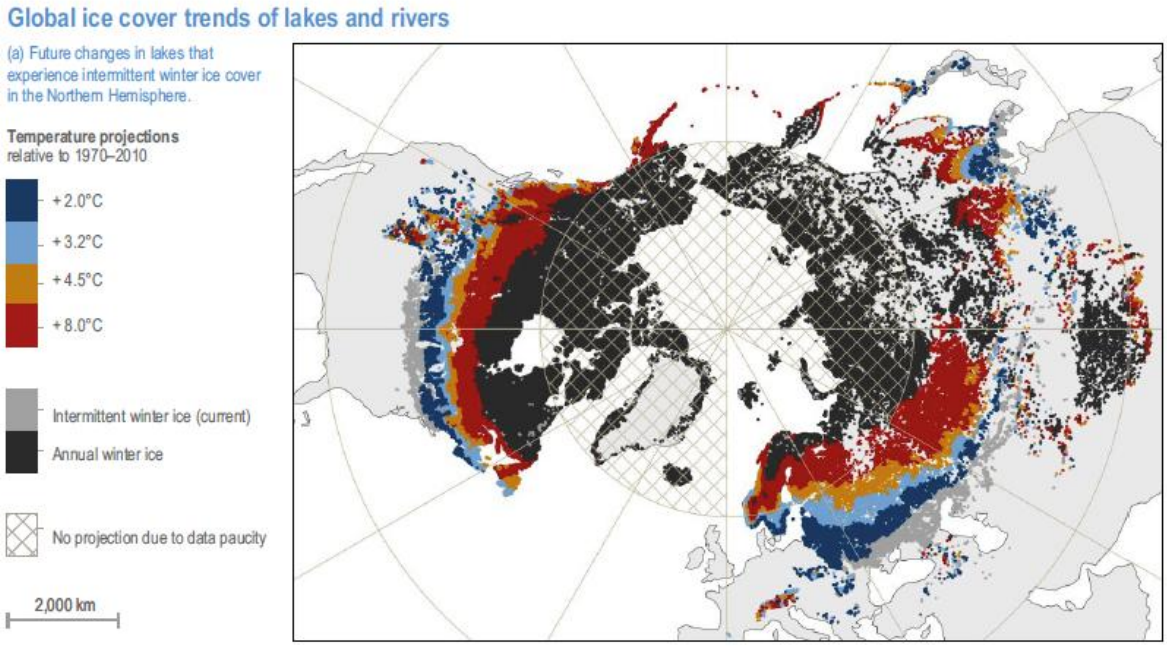


Figure G-22: Projected changes in lakes that experience intermittent winter ice cover in the Northern Hemisphere under warming scenarios of 2°C, 3.2°C, 4.5°C and 8°C relative to a 1970-2010 baseline (Parmesan et al., 2022b)

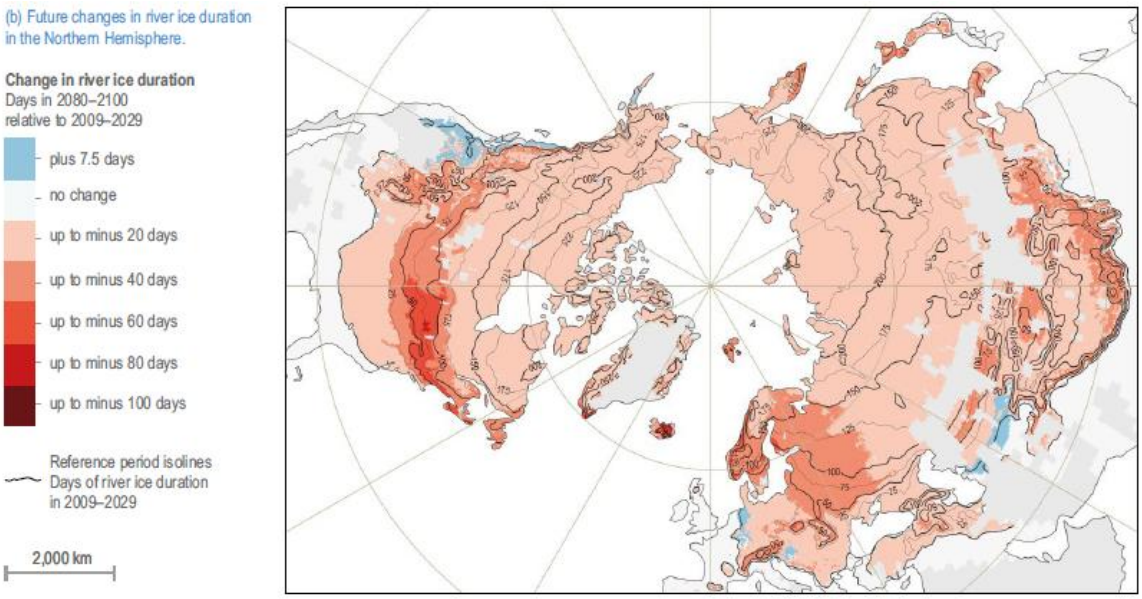


Figure G-23: Projected changes in river ice duration across the Northern Hemisphere under the RCP4.5 scenario (around 2°C increase) for 2080–2100, compared to 2009–2029. White areas show rivers with no ice in the baseline period (zero days). Reference lines indicate ice duration during 2009–2029. Colours show changes in ice duration (in days), with blue indicating increases. Grey areas represent land where rivers cannot be observed using available data (Parmesan et al., 2022c).

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Appendix H Greenhouse Gas Baseline Model Assumptions and Limitations

Table H-1: Assumptions, uncertainties and limitations of selected pathways and scenarios.

Scenario / Pathway Group	Key Assumptions	Uncertainties	Limitations
IPCC Shared Socioeconomic Pathways (SSPs)	• SSPs are defined as baseline socio-economic narratives or storylines used to frame climate futures; they vary across population, income, inequality, technological change, trade, and lifestyle patterns, rather than prescribing a single emissions outcome (IPCC, 2019). • The socio-economic drivers are exogenous narrative pathways used to generate emissions baselines (Ministry for the Environment, 2024a) and Integrated Assessment Models (IAMs) link these drivers to energy demand, emissions, and mitigation outcomes (IPCC, 2022b). • Baseline scenarios typically assume no additional climate policies beyond those already in place, allowing comparison with stronger mitigation scenarios (IPCC, 2022a).	• Wide range of possible outcomes due to uncertain socio-economic development, technological change, and policy responses across pathways (Pirani et al., 2024; IPCC, 2022f). • Uncertainty is structural: the SSPs encode different futures for socioeconomic development rather than probabilistic forecasts. The main uncertainty lies in future demographic, economic, institutional, and technological trajectories (IPCC, 2019). • The SSPs do not determine climate outcomes on their own; actual warming depends on the emissions pathway paired with the socioeconomic storyline (IPCC, 2021). • Wide uncertainty in socioeconomic drivers (GDP growth 2.7–4.1%/yr; population ~8.5–9.7bn by 2050) (IPCC, 2022a). • The speed and cost of technological innovation, such as clean energy deployment, are uncertain and vary across scenarios (IPCC, 2022b). • Even if emissions pathways are known, there remains uncertainty in how the	• The SSPs are narrative frameworks, not forecasts; used in models to explore a range of plausible futures rather than assign probabilities (IPCC, 2019). • They rely on integrated assessment models and simplified representations of complex socio-economic systems.to explore different futures (Ministry for the Environment, 2024a). • Limited representation of feedback from climate impacts to socioeconomic development (one-directional framework) (IPCC, 2024). • Human factors such as behaviour change, lifestyle shifts, and political dynamics are simplified or only partially represented in the models (IPCC, 2022b). • Structural differences across IAMs (e.g. sector coverage, technology representation) reduce comparability (Kikstra et al., 2022a). • Different models use different methods and assumptions, which means results for the same SSP can

Scenario / Pathway Group	Key Assumptions	Uncertainties	Limitations
		climate system will respond, meaning similar SSPs can lead to different temperature outcomes (IPCC, 2024; Kikstra et al., 2022b).	vary significantly depending on the model used (IPCC, 2022b).
IPCC AR6 Mitigation Pathway Categories (C1-C8)	• Emission scenarios grouped into categories (C1–C8) based on temperature outcomes (e.g. 1.5°C, 2°C, >3°C) derived from modelled emissions pathways and IAM results (IPCC, 2024). • The categories group emission scenarios based on the level of global warming they achieve by 2100, ranging from pathways consistent with limiting warming to around 1.5°C (C1) to those with much higher temperature increases (IPCC, 2024). • Many of the lower-temperature pathways assume rapid reductions in emissions increasing use of carbon dioxide removal technologies (IPCC, 2022b).	• There is high uncertainty about whether carbon dioxide removal technologies can be deployed at the scale and speed assumed in many scenarios (IPCC, 2022b). • Climate system uncertainty (e.g., transient climate response i.e. how sensitive temperatures are to emissions) affect how pathways map to warming levels (IPCC, 2024).	• Many scenarios rely heavily on large-scale carbon dioxide removal technologies, which are not yet proven at the required scale in the real world (IPCC, 2022b). • Categories aggregate heterogeneous pathways into single groups, masking differences in underlying assumptions or policy choices and intra-category variability (IPCC, 2022c; IIASA, 2023). • Differences in how models represent sectors (such as agriculture or industry) require harmonisation, which introduces simplifications (IPCC, 2022b).
IPCC CurPol and ModAct Pathways	• Current Policies (CurPol) and Moderate Action (ModAct) are illustrative pathways in AR6 WGIII, positioned alongside higher-emissions and mitigation pathways (IPCC, 2022d). • They are intended to show the effect of gradual policy strengthening versus stronger action, rather than represent a single policy forecast (IPCC, 2022d). • They are used as reference cases to compare current-policy outcomes with stronger mitigation cases (IPCC, 2022e).	• Uncertainty is driven by how quickly current policies tighten, whether announced measures/policies are implemented, whether pledges are translated into enforceable measures and how sectoral transitions unfold (IPCC, 2022d). • These scenarios typically lead to a wide range of emission outcomes (e.g., ~2.2–3.5°C median warming for policy-based pathways), reflecting uncertainty in	• These pathways do not represent what would be required to meet international climate goals such as limiting warming to 1.5°C, so they are not suitable for assessing Paris-aligned futures (IPCC, 2022a). • They assume that policies are implemented as planned, which may not reflect real-world delays or failures (IPCC, 2022c).

Scenario / Pathway Group	Key Assumptions	Uncertainties	Limitations
	• CurPol: assumes continuation of existing implemented policies by the end of 2020 (≈ policy baseline) (IPCC, 2022a; IPCC, 2022c). • ModAct: assumes moderate strengthening of policies, often aligned with NDCs or incremental mitigation efforts (partial implementation of climate goals) inferred from AR6 comparisons (IPCC, 2022c). • Both reflect near- to medium-term policy real-world policy decisions and commitments rather than scenarios that are deliberately constructed to achieve a specific outcome or targets (IPCC, 2022b).	policy ambition and effectiveness (IPCC, 2022g). • Political, economic and social changes (such as elections or economic crises) are not captured in baseline policy continuation assumptions and could significantly alter policy trajectories (IPCC, 2022b).	
IEA World Energy Outlook Scenarios (NZE, APS, CPS, STEPS)	This scenario set reflects different policy ambition levels: • **CPS**: Includes only policies already enacted into law, excluding announced intentions (IEA, 2025c). • **STEPS**: Based on current stated and announced policies (including planned policies), reflecting today's policy trajectory (IEA, 2025d). • **APS**: Assumes full and timely implementation of announced pledges (e.g., NDCs, net-zero targets) (IEA, 2025a). • **NZE**: a normative pathway assuming rapid global decarbonisation, net-zero CO_2 by 2050, and strong policy + technology deployment (IEA, 2023).	• Policy delivery risk (gap between announcements and implementation central in APS) (IEA, 2025a). • Future technology costs and adoption rates (such as renewables, hydrogen, or carbon capture) remain uncertain (IEA, 2024). • Energy demand projections depend on uncertain factors such as economic growth and electrification trends (IEA, 2024). • For APS and STEPS, outcomes are especially sensitive to whether stated pledges become implemented policy and whether current policies are strengthened (Ministry for the Environment, 2024b).	• Some emerging technologies or behavioural changes may not be fully represented due to modelling constraints (IEA, 2024). • The scenarios depend heavily on assumptions about policy implementation, especially in APS and NZE, which may not be realistic. (IEA, 2025a). • The modelling focuses primarily on the energy system and does not fully capture broader socioeconomic dynamics compared to IPCC frameworks (IEA, 2024).

Scenario / Pathway Group	Key Assumptions	Uncertainties	Limitations
IEA APS - Edition Change (WEO-2024 vs WEO-2025)	• **WEO-2024 APS**: assumes full implementation of all announced pledges (NDCs + net-zero) (IEA, 2025a). • **WEO-2025**: APS removed pending updated NDC clarity; scenario set emphasises CPS/STEPS/NZE (IEA, 2025a; IEA, 2025b).	• There is uncertainty about how countries will update their climate commitments (NDCs) in future policy cycles (post-2025) (IEA, 2025a). • Increased uncertainty in policy ambition tracking without APS benchmark scenario (IEA, 2025b).	• Discontinuity reduces comparability across editions (APS no longer a consistent benchmark) (IEA, 2025a). • Reflects dependence on evolving policy datasets rather than stable methodological framework (IEA, 2025b).

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Appendix I: Production Profiles

This appendix presents the estimated production forecasted for the Cleeton Hub both with and without Platypus, as well as for the Platypus field alone.

Forecasts for gas, condensate and water production are presented for the Low, Mid and High production cases. Note, the High case production estimates are also presented in Section 4.

Production estimates are presented in metric units of standard cubic metres for gas and metric tonnes for condensate and water.

The ES makes use of many metrics for comparison with national and internation benchmarks. By way of convention, some of the metrics used are relative to production expressed in alternative units.

To aid transparency for understanding how Platypus would perform relative to certain benchmark metrics, this appendix also presents production estimates for Platypus in selected units other than those of the Système International d'unités (SI). These are million standard cubic feet per day (MMscf/d) for gas and barrels per day for condensate and water. Additionally total production (gas plus condensate) is expressed in barrels of oil equivalent per day (boe/d).

I.1. High Case Production Profiles

Table I-1 Baseline Gas Production for Cleeton Hub with and without High Case Platypus Gas Production in m^3/d.

Year	Gas Production		
	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	m^3/d		
2026	1,807,028	1,807,028	
2027	1,602,762	1,602,762	
2028	1,390,490	1,390,490	
2029	1,227,278	1,699,152	471,874
2030	1,117,079	2,424,681	1,307,602
2031	1,020,475	1,969,731	949,255
2032	932,283	1,656,585	724,302
2033	858,728	1,443,750	585,022
2034	790,595	1,283,105	492,511
2035	729,178	1,156,699	427,521
2036	671,685	1,049,605	377,920
2037	623,116	962,831	339,715
2038	577,248	886,195	308,947
2039	535,413	832,262	296,849
2040	495,691	790,767	295,076
2041	461,938	726,524	264,586
2042	429,748	670,055	240,307
2043	400,166	620,726	220,559
2044	371,812	575,634	203,822
2045	347,697	536,947	189,250

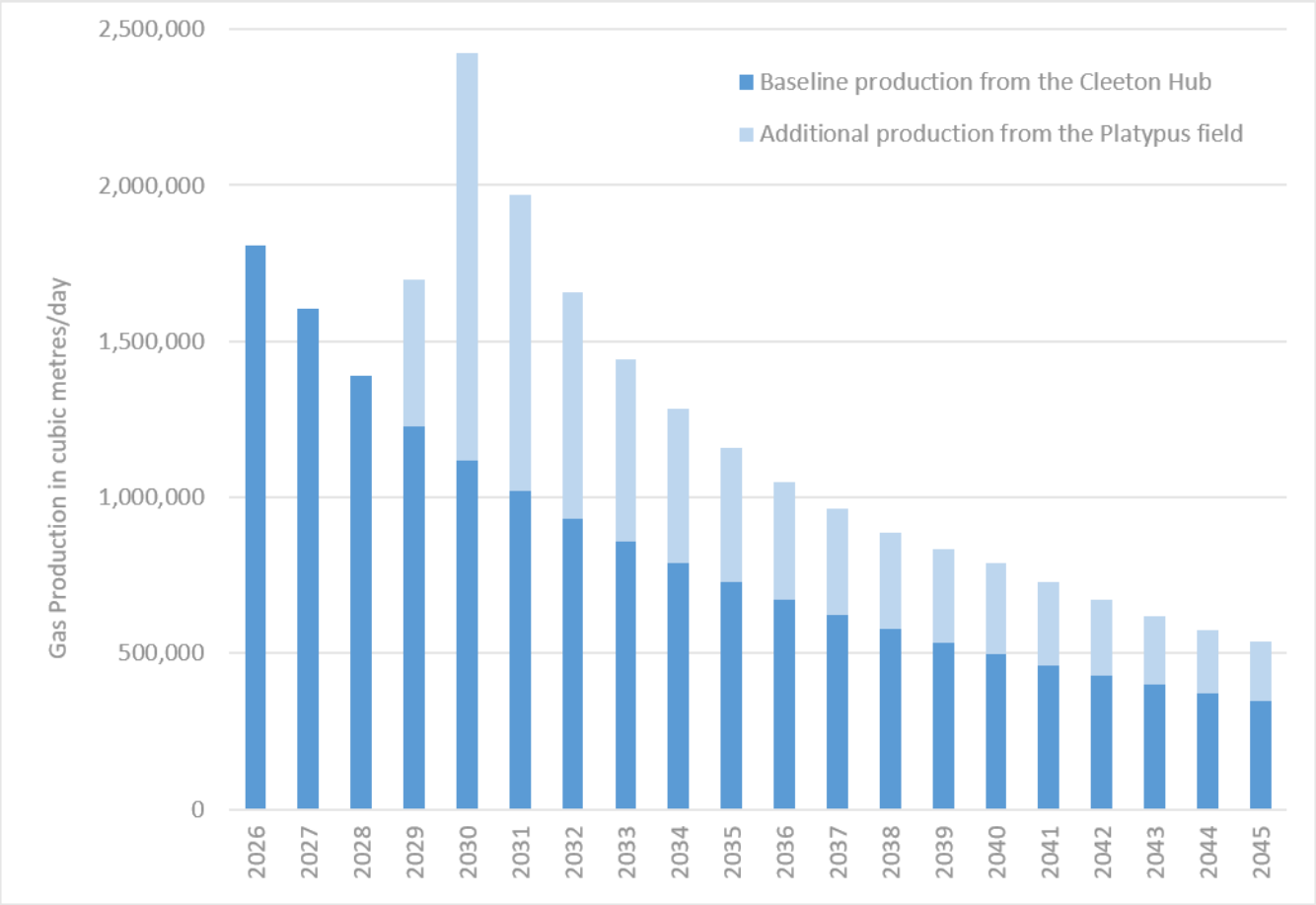


Figure I-1 High Case Average Gas Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in m^3/d.

Table I-2 Baseline Condensate Production for Cleeton Hub with and without High Case Platypus Condensate Production in te/d.

Year	Condensate Production		
	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	te/d		
2026	11.9	11.9	
2027	10.0	10.0	
2028	7.9	7.9	
2029	6.3	12.9	6.6
2030	5.6	23.8	18.2
2031	5.0	18.2	13.2
2032	4.5	14.5	10.1
2033	4.0	12.2	8.1
2034	3.7	10.5	6.8
2035	3.3	9.3	5.9
2036	3.0	8.3	5.3
2037	2.8	7.5	4.7
2038	2.5	6.8	4.3
2039	2.3	6.5	4.1
2040	2.1	6.2	4.1
2041	2.0	5.6	3.7
2042	1.8	5.1	3.3
2043	1.7	4.7	3.1
2044	1.5	4.4	2.8
2045	1.4	4.0	2.6

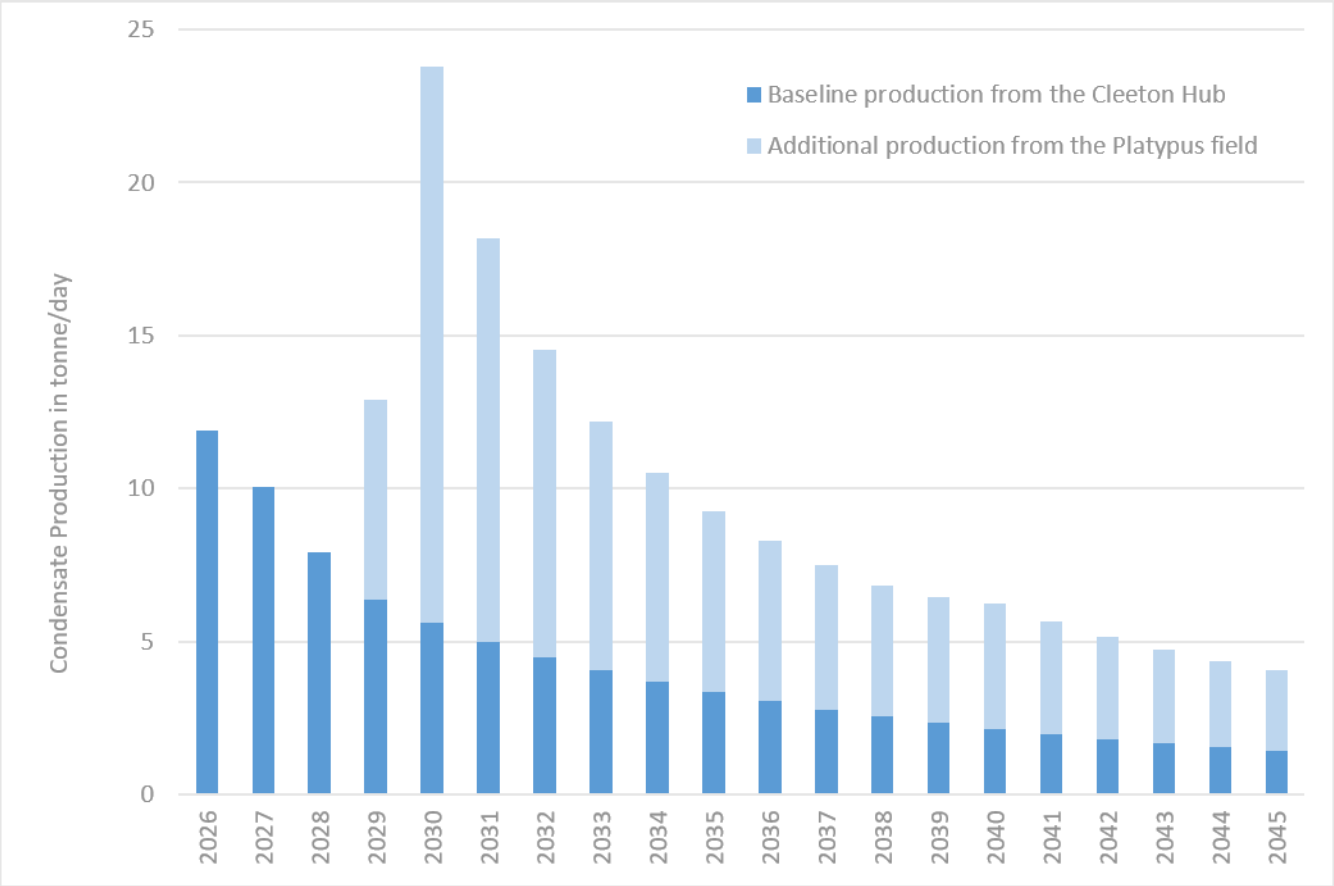


Figure I-2 High Case Average Condensate Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in te/d.

Table I-3 Baseline Water Production for Cleeton Hub with and without High Case Platypus Water Production in te/d.

Year	Water Production		
	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	te/d		
2026	271.1	271.1	
2027	222.3	222.3	
2028	192.1	192.1	
2029	167.3	175.1	7.8
2030	146.8	168.5	21.7
2031	129.5	145.3	15.8
2032	114.9	127.0	12.0
2033	102.4	112.1	9.7
2034	91.5	99.7	8.2
2035	82.1	89.2	7.1
2036	73.8	80.0	6.3
2037	66.4	72.1	5.6
2038	59.9	65.1	5.1
2039	54.2	59.1	4.9
2040	49.0	53.9	4.9
2041	44.4	48.8	4.4
2042	40.3	44.3	4.0
2043	36.6	40.3	3.7
2044	33.3	36.7	3.4
2045	30.3	33.4	3.1

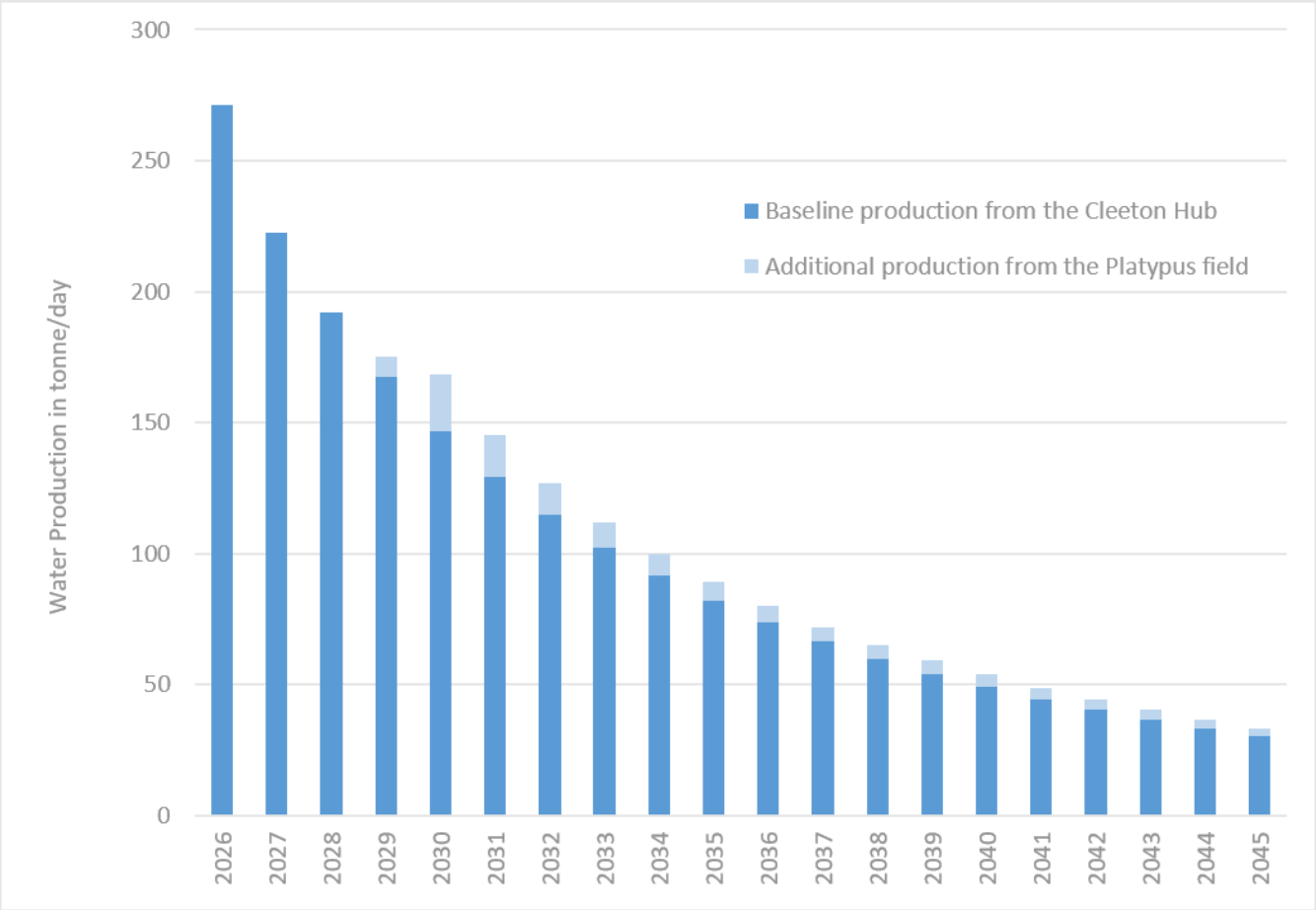


Figure I-3 High Case Average Water Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in te/d.

Table I-4: Baseline Total Production for Cleeton Hub with and without High Case Platypus Total Production in boe/d.

Total Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	boe/d		
2026	10,734	10,734	
2027	9,516	9,516	
2028	8,249	8,249	
2029	7,276	10,105	2,829
2030	6,621	14,461	7,839
2031	6,047	11,738	5,691
2032	5,524	9,867	4,342
2033	5,088	8,595	3,507
2034	4,683	7,636	2,953
2035	4,319	6,882	2,563
2036	3,978	6,244	2,266
2037	3,690	5,727	2,037
2038	3,418	5,271	1,852
2039	3,170	4,950	1,780
2040	2,935	4,704	1,769
2041	2,735	4,321	1,586
2042	2,544	3,985	1,441
2043	2,369	3,691	1,322
2044	2,201	3,423	1,222
2045	2,058	3,193	1,135

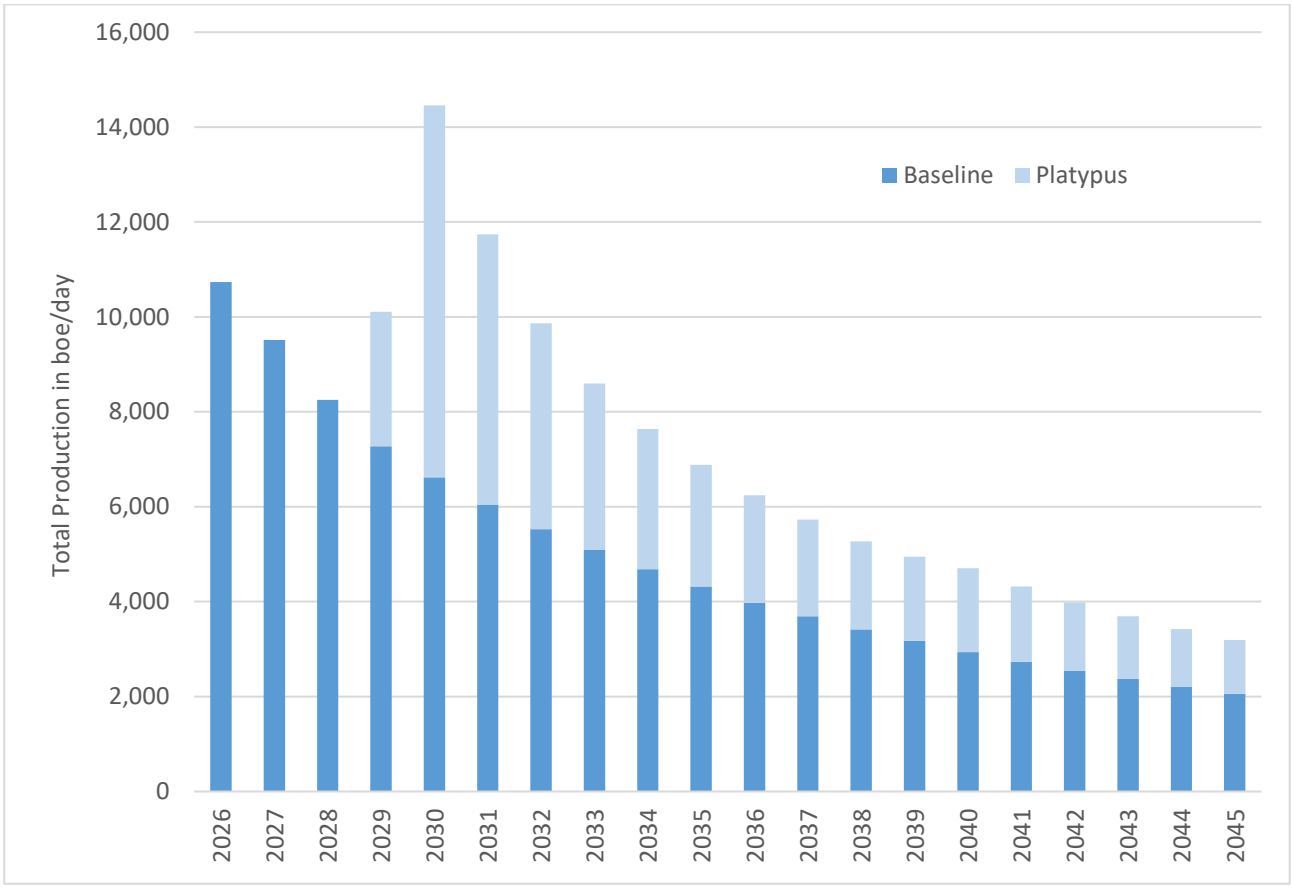


Figure I-4: High Case Total Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in boe/d.

I.2. Mid Production Profiles

Table I-5: Baseline Gas Production for Cleeton Hub with and without Mid Case Platypus Gas Production in m^3/d.

Gas Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	m^3/d		
2026	1,807,028	1,807,028	
2027	1,602,762	1,602,762	
2028	1,390,490	1,390,490	
2029	1,227,278	1,623,006	395,728
2030	1,117,079	1,989,460	872,381
2031	1,020,475	1,618,693	598,217
2032	932,283	1,410,060	477,777
2033	858,728	1,273,021	414,292
2034	790,595	1,164,635	374,040
2035	729,178	1,073,093	343,915
2036	671,685	990,054	318,369
2037	623,116	919,975	296,859
2038	577,248	855,125	277,876
2039	535,413	805,761	270,348
2040	495,691	761,406	265,715
2041	461,938	705,715	243,777
2042	429,748	656,959	227,211
2043	400,166	613,482	213,316
2044	371,812	572,797	200,985
2045	347,697	537,487	189,790

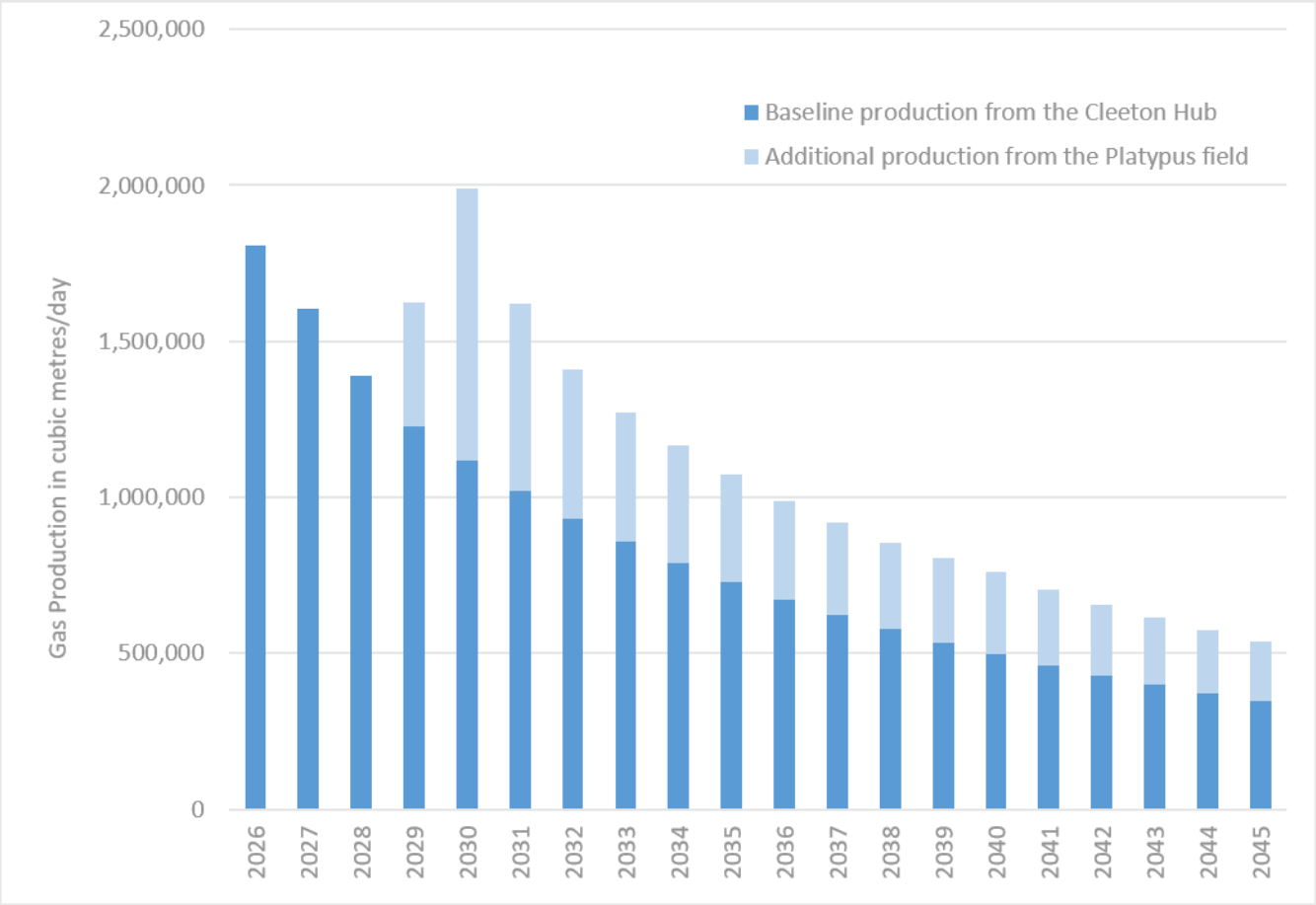


Figure I-5: Mid Case Average Gas Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in m^3/d.

Table I-6: Baseline Condensate Production for Cleeton Hub with and without Mid Case Platypus Condensate Production in te/d.

Condensate Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	te/d		
2026	11.9	11.9	
2027	10.0	10.0	
2028	7.9	7.9	
2029	6.3	11.8	5.5
2030	5.6	17.7	12.1
2031	5.0	13.3	8.3
2032	4.5	11.1	6.6
2033	4.0	9.8	5.8
2034	3.7	8.9	5.2
2035	3.3	8.1	4.8
2036	3.0	7.5	4.4
2037	2.8	6.9	4.1
2038	2.5	6.4	3.9
2039	2.3	6.1	3.8
2040	2.1	5.8	3.7
2041	2.0	5.3	3.4
2042	1.8	5.0	3.2
2043	1.7	4.6	3.0
2044	1.5	4.3	2.8
2045	1.4	4.0	2.6

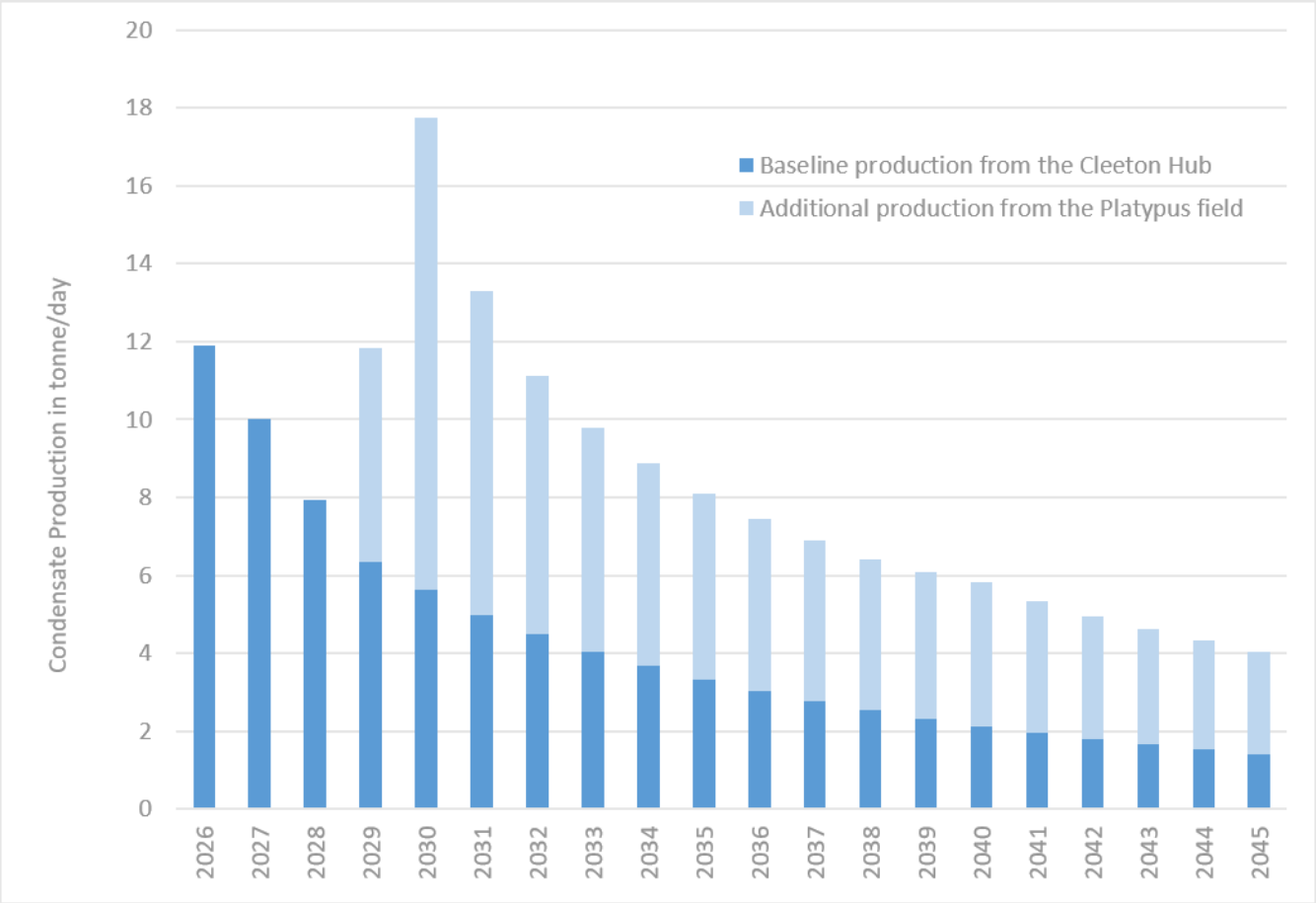


Figure I-6: Mid Case Average Condensate Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in te/d.

Table I-7: Baseline Water Production for Cleeton Hub with and without Mid Case Platypus Water Production in te/d.

Water Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	te/d		
2026	271.1	271.1	
2027	222.3	222.3	
2028	192.1	192.1	
2029	167.3	173.9	6.6
2030	146.8	161.3	14.5
2031	129.5	139.5	9.9
2032	114.9	122.9	7.9
2033	102.4	109.3	6.9
2034	91.5	97.8	6.2
2035	82.1	87.8	5.7
2036	73.8	79.1	5.3
2037	66.4	71.4	4.9
2038	59.9	64.6	4.6
2039	54.2	58.7	4.5
2040	49.0	53.5	4.4
2041	44.4	48.5	4.1
2042	40.3	44.1	3.8
2043	36.6	40.2	3.5
2044	33.3	36.6	3.3
2045	30.3	33.4	3.2

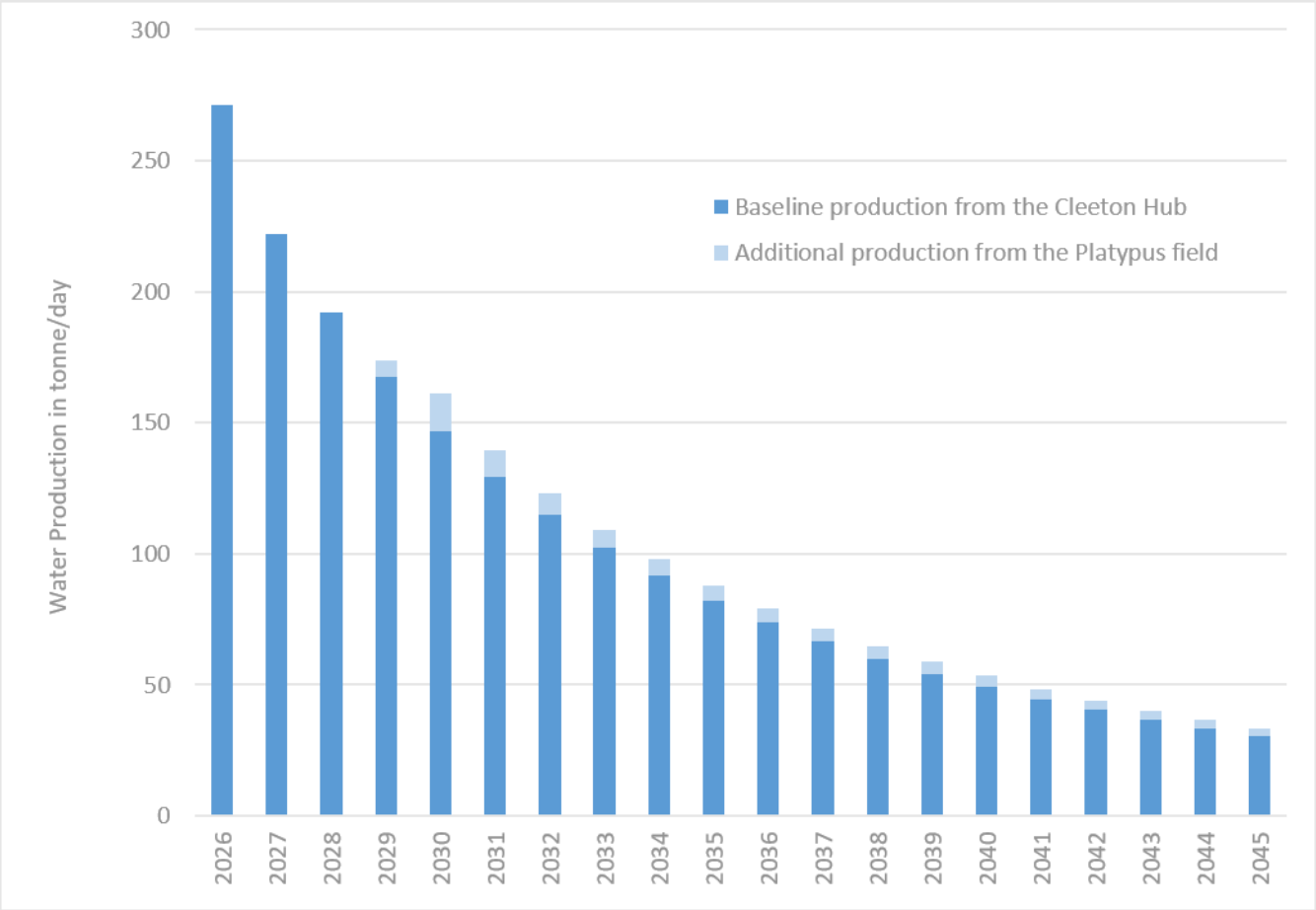


Figure I-7: Mid Case Average Water Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in te/d.

Table I-8: Baseline Total Production for Cleeton Hub with and without Mid Case Platypus Total Production in boe/d.

Total Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	boe/d		
2026	10,734	10,734	
2027	9,516	9,516	
2028	8,249	8,249	
2029	7,276	9,648	2,372
2030	6,621	11,851	5,230
2031	6,047	9,634	3,586
2032	5,524	8,389	2,864
2033	5,088	7,571	2,484
2034	4,683	6,926	2,242
2035	4,319	6,381	2,062
2036	3,978	5,887	1,909
2037	3,690	5,470	1,780
2038	3,418	5,084	1,666
2039	3,170	4,791	1,621
2040	2,935	4,528	1,593
2041	2,735	4,197	1,461
2042	2,544	3,906	1,362
2043	2,369	3,648	1,279
2044	2,201	3,406	1,205
2045	2,058	3,196	1,138

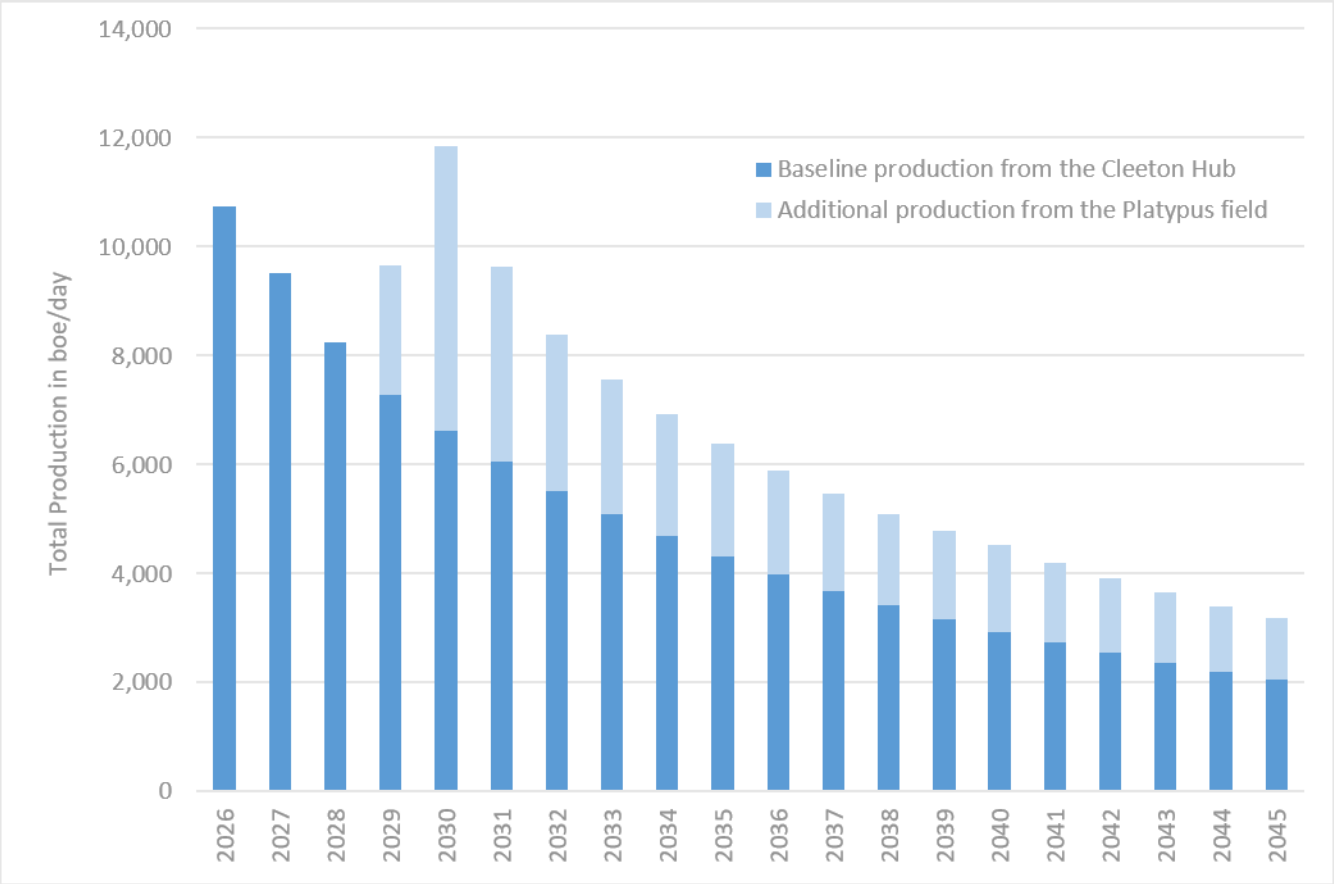


Figure I-8: Mid Case Total Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in boe/d.

I.3. Low Production Profiles

Table I-9: Baseline Gas Production for Cleeton Hub with and without Low Case Platypus Gas Production in m^3/d.

Gas Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	m^3/d	m^3/d	m^3/d
2026	1,807,028	1,807,028	
2027	1,602,762	1,602,762	
2028	1,390,490	1,390,490	
2029	1,227,278	1,448,404	221,126
2030	1,117,079	1,606,840	489,761
2031	1,020,475	1,327,058	306,582
2032	932,283	1,164,847	232,564
2033	858,728	1,055,898	197,169
2034	790,595	969,491	178,897
2035	729,178	893,670	164,492
2036	671,685	823,393	151,708
2037	623,116	759,275	136,158
2038	577,248	699,521	122,272
2039	535,413	672,449	137,036
2040	495,691	647,127	151,436
2041	461,938	588,905	126,967
2042	429,748	544,694	114,946
2043	400,166	506,929	106,762
2044	371,812	471,811	99,999
2045	347,697	440,260	92,563

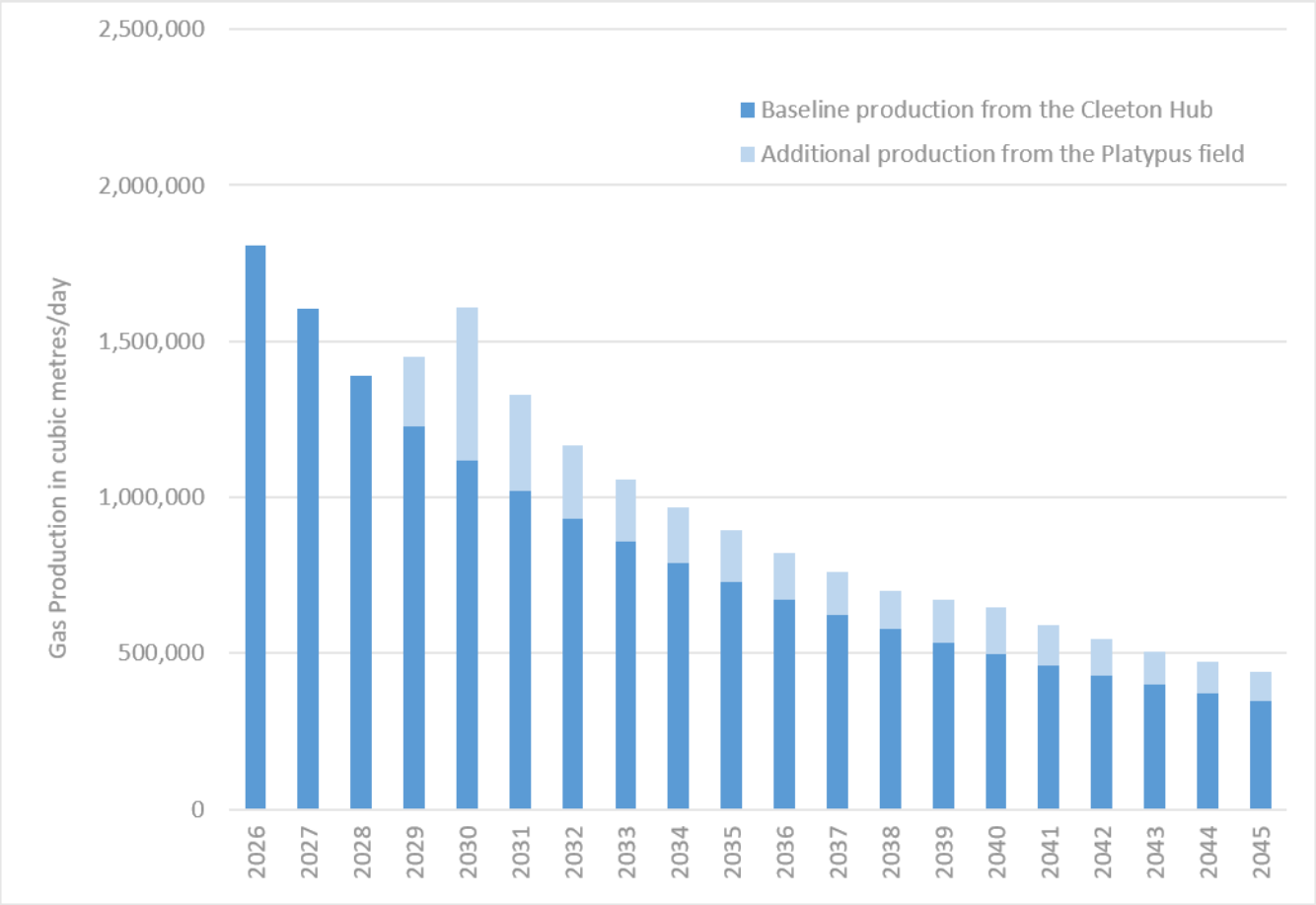


Figure I-9: Low Case Average Gas Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in m^3/d.

Table I-10: Baseline Condensate Production for Cleeton Hub with and without Low Case Platypus Condensate Production in te/d.

Condensate Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	te/d		
2026	11.9	11.9	
2027	10.0	10.0	
2028	7.9	7.9	
2029	6.3	9.4	3.1
2030	5.6	12.4	6.8
2031	5.0	9.3	4.3
2032	4.5	7.7	3.2
2033	4.0	6.8	2.7
2034	3.7	6.2	2.5
2035	3.3	5.6	2.3
2036	3.0	5.1	2.1
2037	2.8	4.7	1.9
2038	2.5	4.2	1.7
2039	2.3	4.2	1.9
2040	2.1	4.2	2.1
2041	2.0	3.7	1.8
2042	1.8	3.4	1.6
2043	1.7	3.1	1.5
2044	1.5	2.9	1.4
2045	1.4	2.7	1.3

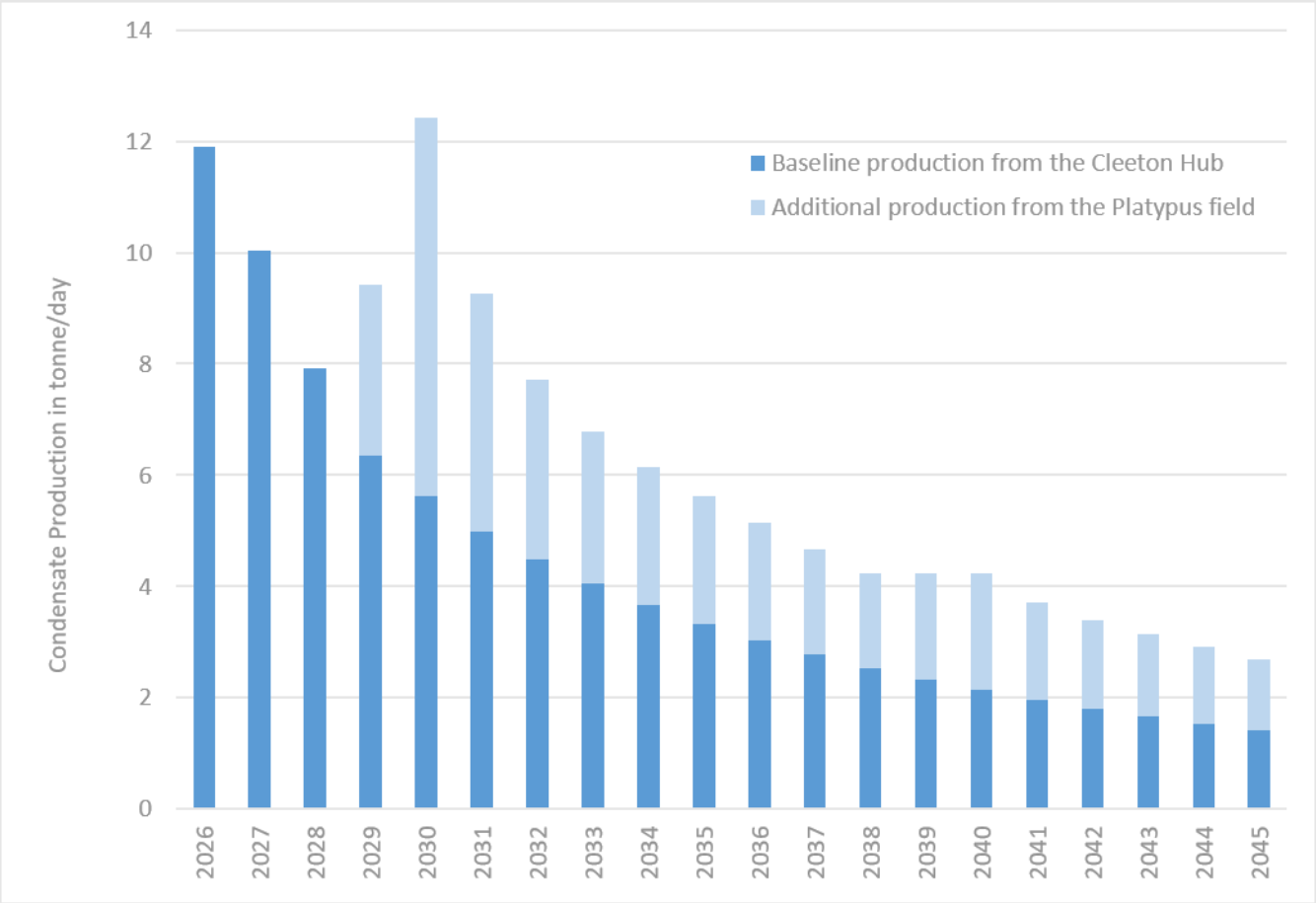


Figure I-10: Low Case Average Condensate Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in te/d.

Table I-11: Baseline Water Production for Cleeton Hub with and without Low Case Platypus Water Production in te/d.

Water Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	te/d		
2026	271.1	271.1	
2027	222.3	222.3	
2028	192.1	192.1	
2029	167.3	171.0	3.7
2030	146.8	155.0	8.1
2031	129.5	134.6	5.1
2032	114.9	118.8	3.9
2033	102.4	105.7	3.3
2034	91.5	94.5	3.0
2035	82.1	84.8	2.7
2036	73.8	76.3	2.5
2037	66.4	68.7	2.3
2038	59.9	62.0	2.0
2039	54.2	56.5	2.3
2040	49.0	51.5	2.5
2041	44.4	46.5	2.1
2042	40.3	42.2	1.9
2043	36.6	38.4	1.8
2044	33.3	34.9	1.7
2045	30.3	31.8	1.5

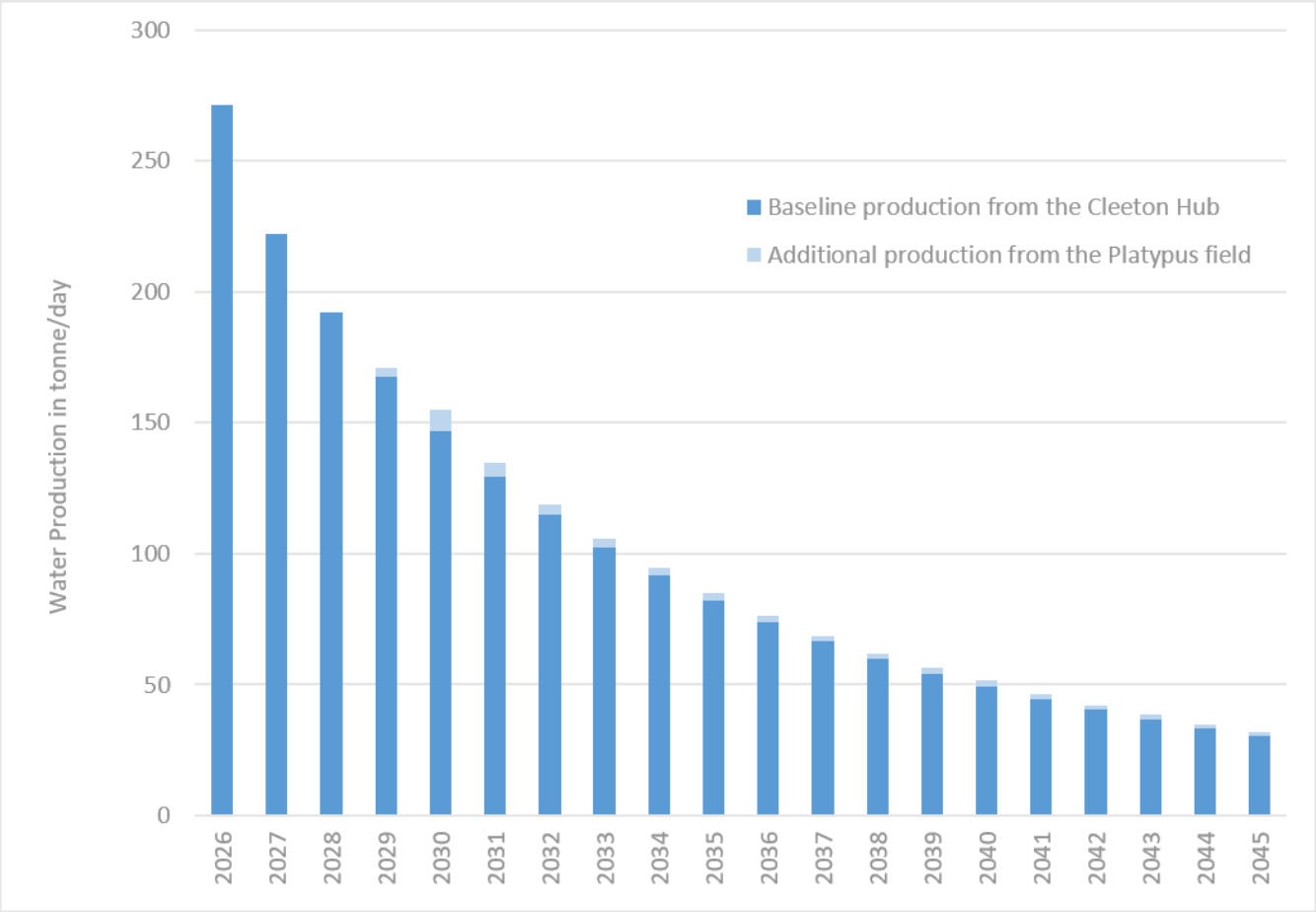


Figure I-11: Low Case Average Water Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in te/d.

Table I-12: Baseline Total Production for Cleeton Hub with and without Low Case Platypus Total Production in boe/d.

Total Production			
Year	Cleeton Hub Without Platypus	Cleeton Hub With Platypus	Platypus Alone
	boe/d		
2026	10,734	10,734	
2027	9,516	9,516	
2028	8,249	8,249	
2029	7,276	8,602	1,326
2030	6,621	9,557	2,936
2031	6,047	7,885	1,838
2032	5,524	6,918	1,394
2033	5,088	6,270	1,182
2034	4,683	5,756	1,073
2035	4,319	5,305	986
2036	3,978	4,888	910
2037	3,690	4,507	816
2038	3,418	4,152	733
2039	3,170	3,992	822
2040	2,935	3,843	908
2041	2,735	3,496	761
2042	2,544	3,233	689
2043	2,369	3,009	640
2044	2,201	2,801	600
2045	2,058	2,613	555

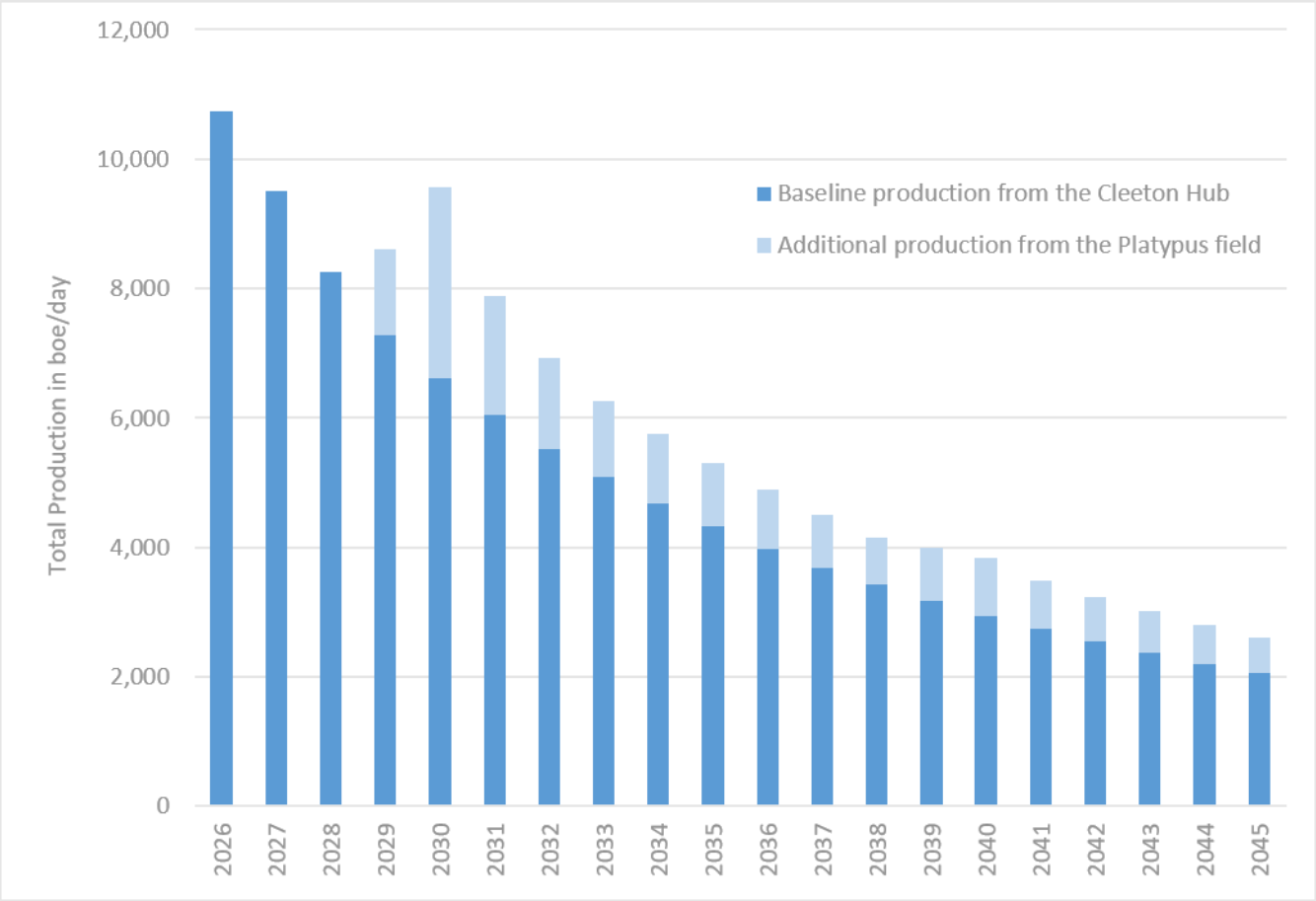


Figure I-12: Low Case Total Production Rates from the Platypus Field superimposed on baseline rates from the Cleeton Hub in boe/d.

I.4. Platypus Profiles Presented in Non-SI Units

Table I-13 Daily gas production at Platypus only for the low, mid and high production cases.

Platypus Gas Production			
Year	Low Case	Mid Case	High Case
	MMscf/d		
2029	7.8	14.0	16.7
2030	17.3	30.8	46.2
2031	10.8	21.1	33.5
2032	8.2	16.9	25.6
2033	7.0	14.6	20.7
2034	6.3	13.2	17.4
2035	5.8	12.1	15.1
2036	5.4	11.2	13.3
2037	4.8	10.5	12.0
2038	4.3	9.8	10.9
2039	4.8	9.5	10.5
2040	5.3	9.4	10.4
2041	4.5	8.6	9.3
2042	4.1	8.0	8.5
2043	3.8	7.5	7.8
2044	3.5	7.1	7.2
2045	3.3	6.7	6.7
Total	107.0	211.2	271.8

Table I-14 Daily condensate production at Platypus only for the low, mid and high production cases.

Condensate Production			
Year	Platypus Low Case	Platypus Mid Case	Platypus High Case
	bpd		
2029	24.2	43.3	51.7
2030	53.6	95.5	143.1
2031	33.6	65.5	103.9
2032	25.4	52.3	79.3
2033	21.6	45.3	64.1
2034	19.6	41.0	53.9
2035	18.0	37.6	46.8
2036	16.6	34.9	41.4
2037	14.9	32.5	37.2
2038	13.4	30.4	33.8
2039	15.0	29.6	32.5
2040	16.6	29.1	32.3
2041	13.9	26.7	29.0
2042	12.6	24.9	26.3
2043	11.7	23.3	24.1
2044	10.9	22.0	22.3
2045	10.1	20.8	20.7
Total	331.8	654.8	842.4

Table I-15 Daily water production at Platypus only for the low, mid and high production cases.

Produced Water			
Year	Platypus Low Case	Platypus Mid Case	Platypus High Case
	bpd		
2029	19.5	34.9	41.6
2030	43.2	77.0	115.4
2031	27.1	52.8	83.8
2032	20.5	42.2	63.9
2033	17.4	36.6	51.7
2034	15.8	33.0	43.5
2035	14.5	30.3	37.8
2036	13.4	28.1	33.3
2037	12.0	26.2	30.0
2038	10.8	24.5	27.3
2039	12.1	23.8	26.2
2040	13.3	23.5	26.1
2041	11.2	21.5	23.3
2042	10.2	20.0	21.2
2043	9.4	18.8	19.5
2044	8.8	17.7	18.0
2045	8.2	16.8	16.7
Total	267.4	528.1	679.3