Montrose Infill Project Environmental Statement

NEO NEXT+ Document No.: RP-MO0786-HS-0404

OPRED Document No.: ES/2023/006

Environmental Statement Details

Section A: Administrative information

A1 – Project Reference Number

Please confirm the unique ES identification number for the project.

Number: ES/2023/006

A2 - Developer Contact Details

Company name: NEO NEXT+ Energy Resources UK Limited

Contact name: [redacted]

Contact title: [redacted]

A3 - ES Contact Details (if different from above)

Company name: As above

Contact name: As above

Contact title: 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]	NEO NEXT+	[redacted]	26 years' oil and gas experience, 3 years as an Environmental Advisor with NEO NEXT+.
[redacted]	NEO NEXT+	[redacted]	24 years' experience in environmental management within the oil and gas industry.
[redacted]	NEO NEXT+	[redacted]	24 years' project management and engineering experience within the oil and gas industry.
[redacted]	Genesis	[redacted]	19 years' experience in environmental consultancy.
[redacted]	Genesis	[redacted]	6 years' experience in environmental consultancy.
[redacted]	Genesis	[redacted]	28 years' experience (15 years' experience in environmental consultancy).
[redacted]	Genesis	[redacted]	25 years' experience in environmental consultancy.
[redacted]	Genesis	[redacted]	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:	**P019**
Licensee	**Percentage Equity**
NEO NEXT+ Energy Delta Limited	58.974360 %
Ithaca MA Limited	41.025640 %
Licence Number:	**P020**
Licensee	**Percentage Equity**
NEO NEXT+ Energy Delta Limited	58.974360 %
Ithaca MA Limited	41.025640 %

Section B: Project information

B1 – Nature of project

a) Please specify the name of the project.

Name: Montrose Infill 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.

NEO NEXT+ Energy Resources UK Limited (hereafter referred to as NEO NEXT+), operator on behalf of owners NEO NEXT+ Energy Delta Limited and Ithaca MA Limited (hereafter referred to as Ithaca Energy), propose to further develop the Montrose field to extend its field life. The Montrose field is located in United Kingdom (UK) Blocks 22/17 and 22/18 in the central North Sea, *c.*190 km from Peterhead and *c.* 46 km from the UK/Norway median line. The proposed Project involves the drilling of five subsea infill wells, installation of associated subsea infrastructure and modifications to the existing Montrose Bridge Linked Platform (BLP). These new wells will be tied back to the existing Montrose BLP, where the hydrocarbons will be processed. Oil will be exported via the Forties Pipeline System (FPS) and gas via the Central Area Transmission Systems (CATS). The five proposed infill wells are production wells.

The project can be summarised as follows:

- The drilling of five subsea production wells at a new drill centre within the Montrose field.
- Installation of subsea infrastructure to support the tie-back of the wells to the Montrose BLP.
- Modification of the existing Montrose BLP to accommodate the additional wells.

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): 22.

Block number(s): 17 and 18.

Locations	Latitude (ED50)	Longitude (ED50)
Montrose Bridge-Linked Platform:	57°27'6.429" N	1°23'18.453" E
Well 1 MRH	57°27’30.053” N	01°23’15.503” E
Well 2 MRI	57°27’30.506” N	01°23’15.483” E
Well 3 MRG	57°27’30.063” N	01°23’16.282” E
Well 4 MRC	57°27’30.483” N	01°23’16.264” E
Well 5 MRS	57°27’30.903” N	01°23’16.245” E

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

Distance to nearest UK coastline (km): 190 km.

Which coast? Scotland

Distance to nearest international median line (km) 46 km.

Which line? UK / Norway

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: Montrose Bridge Linked Platform Environmental Statement (submitted by Talisman Energy)

Date of submission of ES: January 2012

Identification number of ES: D/4124/2011

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Acronyms

Acronyms	
“	Inches
<	Less than
≥	Greater than or equal to
>	Greater than
°	Degrees
°C	Degrees Celsius
%	Percentage
µg/g	Microgram per Gram
µg/kg	Microgram per Kilogram
µg/l	Microgram per litre
µm	Micrometre
2D	Two-Dimensional
A	Activity factor
ADMS	Atmospheric Dispersion Modelling System
AEL	Associated Emission Level
AHV	Anchor Handling Vessel
AI	Artificial Intelligence
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
BAT	Best Available Technique
Bcf	Billion Cubic Feet
BEIS	Department for Business, Energy & Industrial Strategy (now DESNZ)
BLP	Bridge Linked Platform
BOP	Blowout Preventer
BSL	Benthic solutions Limited
CA	Comparative Assessment
CAPEX	Capital Expenditure
CATS	Central Area Transmission Systems
CCC	Climate Change Committee
CCS	Carbon Capture and Storage
CCUS	Carbon Capture Utilisation and Storage
CERC	Cambridge Environmental Research Consultant
CH4	Methane
CHARM	Chemical Hazard Assessment and Risk Management
CIP	Communication and Interface Plan
cm	Centimetre
CMID	Common Marine Inspection Documents

Acronyms	
CNS	Central North Sea
CNSe	Central North Sea Electrification
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COLREGS	International Regulations for the Prevention of Collisions at Sea
CoP	Cessation of Production
COSHH	Control of Substances Hazardous to Health
CP	Chemical Permit
CPT	Cone Penetration Test
CR	Critically Endangered
CRA	Corrosion Resistant Alloy
CSIP	Cetacean Stranding Investigation Programme
CSV	Construction Support Vessel
CtL	Consent to Locate
D	Depth
dB	Decibel
dB re 1 µPa	Decibels relative to one micropascal
dB re 1 μPa^2s	Decibels relative to one micropascal square second
DCA	Decommissioning Operations
DD	Data Deficient
DepCon	Deposit Consent
DESNZ	Department for Energy Security and Net Zero (formerly BEIS)
DHSV	Down Hole Safety Valve
DR	Drilling Screening Direction
DRA	Drilling Operations
DREAM	Dose-related Risk and Effect Assessment Model
DSV	Dive Support Vessel
ED50	European Datum 50
EEMS	Environmental and Emissions Monitoring System
EF	Emission Factor
EHC	Electro-Hydraulic Control
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EMS	Environmental Management System
EMT	Environmental Management Team
EN	Endangered
ENVID	ENVironmental and socio-economic Impact IDentification
EPS	European Protected Species

Acronyms	
ERAP	Emission Reduction Action Plan
ERL	Effects Range Low
ERM	Effects Range Medium
ERRV	Emergency Response and Rescue Vessel
ES	Environmental Statement
ESAS	European Seabirds at Sea
ESDV	Emergency Shutdown Valve
ESG	Environmental, Social, Governance
ESIA	Environmental and Socio-Economic Impact Assessment
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
FDP	Field Development Plan
FeAST	Feature Activity Sensitivity Tool
FGR	Flare Gas Recovery
FOCI	Features of Conservation Importance
FPS	Forties Pipeline System
ft	Feet
g/m^2	Grams per square metre
GHG	Greenhouse Gas
GOR	Gas Oil Ratio
GTG	Gas Turbine Generator
GWP	Global Warming Potential
H	Height
HAS	Habitat Assessment Survey
HDJU	Heavy Duty Jack-up
HF	High Frequency
HP	High Pressure
HQ	Hazard Quotient
HSE	Health and Safety Executive
HUC	Hook Up and Commissioning
Hz	Hertz
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Seas
IMO	International Maritime Organisation
INTOG	Innovation and Targeted Oil & Gas

Acronyms	
IOGP	International Association of Oil & Gas Producers
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standards Organisation
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
kHz	Kilohertz
kJ	Kilojoule
kg/m^2	Kilogram per square metre
km	Kilometre
km^2	Square kilometre
km^3	Cubic kilometre
ksi	Kilopound per square inch
kW/m	Kilowatt per metre
L	Length
LAT	Lowest Astronomical Tide
LC	Least Concern
LCP	Large Combustion Plant
LF	Low Frequency
LoF	Life of Field
LSA	Low Specific Activity
LTOBM	Low Toxicity Oil Based Mud
m	Metre
M	Emitted Mass
m^2	Square metre
m^3	Cubic metre
m^3/d	Cubic meters per day
m/s	Metres per second
MAH	Major Accident Hazard
MAR	Montrose Area Redevelopment
MarESA	Marine Evidence-based Sensitivity Assessment
MarLIN	Marine Life Information Network
MARPOL	International Convention for the Prevention of Pollution from Ships
MAT	Master Application Template
MBES	Multibeam Echo-Sounder
Mbopd	Thousand barrels of oil per day
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCP	Medium Combustion Plant

Acronyms	
MCZ	Marine Conservation Zone
mD	Millidarcy
MEI	Major Environmental Incident
mg/kg	Milligrams per Kilogram
mg/l	Milligrams per Litre
MJ	Megajoules
MMMP	Marine Mammal Mitigation Protocol
mm	Millimetres
MMbbl	Million barrels of oil
MMO	Marine Mammal Observer
mmscfd	Million standard cubic feet per day
MoD	Ministry of Defence
MPA	Marine Protected Area
MPFM	Multi-phase flowmeter
ms	Milliseconds
MSFD	Marine Strategy Framework Directive
MTe	Mega Tonnes
MU	Management Units
MW(th)	Megawatts (thermal)
N2O	Nitrogen Oxide
NA	Not Assessed
NCMPA	Nature Conservation Marine Protected Area
NDC	Nationally Determined Contributions
NE	Not Exposed
NLB	Northern Lighthouse Board
nm	Nautical miles
NMFS	National Marine Fisheries Service
NMP	National Marine Plan
NMPi	National Marine Plan Maps interactive
nmVOC	non-methane Volatile Organic Compounds
NORM	Naturally Occurring Radioactive Material
NOx	Nitrous Oxide
NO2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NPI	Non-Production Installation
NR	Not Relevant
NS	Not Sensitive
NSS	North Sea Standard
NSTA	North Sea Transition Authority (formerly OGA)

Acronyms	
NSTD	North Sea Transition Deal
NT	Near Threatened
NTS	National Transmission System
OCGT	Open Cycle Gas Turbines
OCR	Offshore Chemicals Regulations
OESEA	Offshore Energy Strategic Environmental Assessment
OEUK	Offshore Energies UK (formerly OGUK)
OGA	Oil and Gas Authority (now NSTA)
OGMP	Oil and Gas Methane Partnership
OGUK	Oil and Gas UK (now OEUK)
OiW	Oil in Water
OMF	Outer Moray Firth
OLP	Operations Life Permit
OPEP	Oil Pollution Emergency Plan
OPEX	Operating Expense
OPOL	Offshore Pollution Liability Association
OPPC	Oil Pollution Prevention and Control
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response
OSD	Offshore Safety Directive
OSPAR	Oslo and Paris Conventions
OSRF	Oil Spill Response Forum
OSRL	Oil Spill Response Limited
OTP	Oil Discharge Permit
PAH	Polyaromatic Hydrocarbon
PAM	Passive Acoustic Monitoring
PEMS	Predictive Emissions Monitoring system
PETS	Portal Environmental Tracking System
PLA	Production Operations
PLONOR	Pose Little or No Risk
PMF	Priority Marine Feature
PNEC	Predicted No Effect Concentration
PPA	Power Purchase Agreement
ppb	Parts per billion
PPC	Pollution Prevention and Control
ppg	Pounds per Gallon
ppm	Parts per million
PR	Production Screening Direction
PTS	Permanent Threshold Shift

Acronyms	
PVA	Particularly Valuable Area
PW	Produced Water
PWA	Pipeline/Flowline Works Authorisation
RBA	Risk-Based Approach
ROV	Remotely Operated Vehicle
RQ	Risk Quotient
S	Sensitive
SA	Standalone application
SAC	Special Areas of Conservation
SAT	Subsidiary Application Template
SBES	Single-Beam Echo-Sounder
SCANS	Small Cetacean Abundance in the North Sea
SCR	Safety Case Regulations
SDS	Safety Data Sheet
SECEs	Safety and Environment Critical Elements
SEEMP	Shipboard Energy Efficiency Management Plan
SEL	Sound Exposure Level
SFF	Scottish Fishermen's Federation
SGMD	Scottish Government Marine Directorate
SIMOPs	Simultaneous operations
SINTEF	Stiftelsen for industriell og teknisk forskning (modelling software)
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index
SOx	Sulphur oxides
SO2	Sulphur dioxide
SPA	Special Protection Areas
SPL	Sound Pressure Level
SSS	Side Scan Sonar
stb	Standard barrels
TCC	Thermo-Mechanical Cuttings Cleaner
te	Tonne
Te	Thousand Tonnes
te/d	Tonnes per day
te/hr	Tonnes per hour
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TOM	Total Organic Matter
TOOPEP	Temporary Operations Oil Pollution Emergency Plan and Emergency
tugs	Tow Vessels

Acronyms	
TVDss	True Vertical Depth Subsea
UHB	Upheaval Buckling
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
UKOOA	United Kingdom Offshore Operators Association
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UPS	Uninterrupted Power Supply
UTM	Universal Transverse Mercator
VHF	Very High Frequency
VOCs	Volatile Organic Compounds
VMS	Vessel Monitoring System
VTS	Vessel Traffic Survey
VU	Vulnerable
W	Width
WBM	Water-based Mud
WIA	Well Intervention Operations
WMP	Waste Management Plan
WONS	Well Operations Notifications
WtT	Well to Tank

Non-Technical Summary

Background

The Montrose field is located in Blocks 22/17 and 22/18 in the Central North Sea (CNS) approximately 190 km from the Scottish coastline and *c.* 46 km from the UK/ Norwegian median line (Figure i). The Montrose Field is one of nine fields: Montrose, Arbroath, Carnoustie, Arkwright, Brechin, Wood, Godwin, Cayley and Shaw, which combined are referred to as the MonArb Area. Owners of the MonArb hub are NEO NEXT+ Energy Delta Limited (58.97%) and Ithaca Energy (41.03%).

It is proposed that the Montrose Infill wells be developed as a subsea tie-back to the Montrose Bridge Linked Platform (BLP). Montrose BLP is located to the north of Montrose Alpha, which was installed as part of the Montrose Area Redevelopment (MAR) BLP Project, together with the Cayley and Shaw subsea tie-backs to BLP.

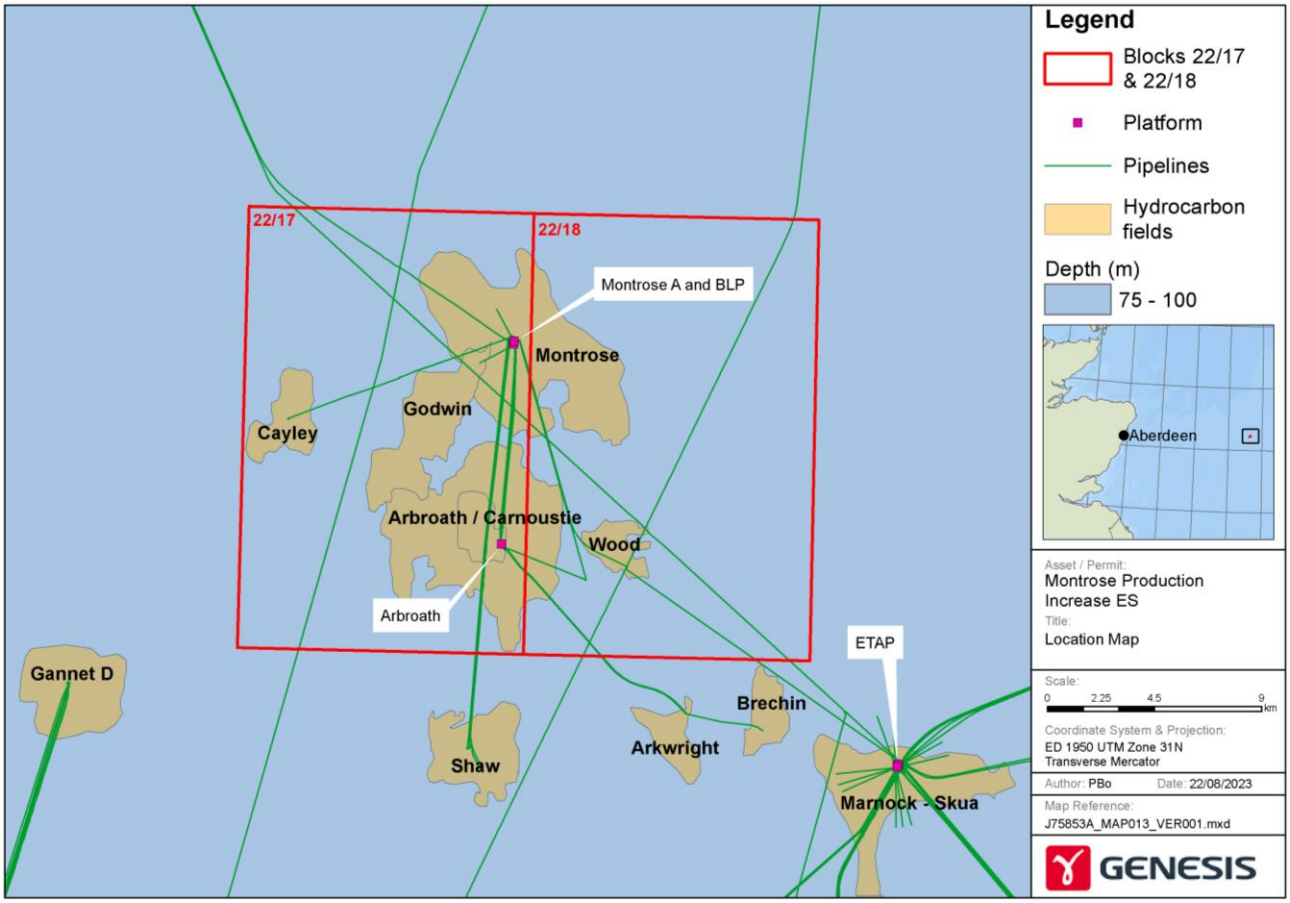


Figure i: Location of Montrose Field.

Overview of the Montrose Field

The Montrose Field is one of nine fields: Montrose, Arbroath, Carnoustie, Arkwright, Brechin, Wood, Godwin, Cayley and Shaw, which combined are referred to as the MonArb Area.

There are three platforms in the MonArb Area operated by NEO NEXT+ including Montrose Alpha commissioned in 1976, the Arbroath platform commissioned in 1990, and the Montrose Alpha Bridge Linked Platform (BLP)

commissioned in 2017. The Montrose Alpha and Montrose BLP combined are referred to as the Montrose Complex.

The Arbroath platform located 11 km south of the Montrose Complex receives fluids from the Arbroath, Carnoustie, Arkwright, Brechin and Godwin fields. These fluids go through a primary separation process on Arbroath before being piped to the Montrose Alpha platform for final processing and export. The Shaw and Cayley Fields are subsea wells tied back to the Montrose BLP whilst the Montrose Field is currently producing via production wells drilled from the Montrose Alpha platform.

The Wood Field also ties directly back to the Montrose Alpha platform. Oil from all fields is exported from Montrose Alpha via the Forties Pipeline System (FPS). Gas is exported from Montrose BLP to the Central Area Transmission System (CATS), which transports gas to the Teesside gas terminal for processing and entry into the UK National Transmission System (NTS).

Environmental Statement Scope

The scope of the Environmental Impact Assessment (EIA) and resultant Environmental Statement (ES) includes the following activities:

- The drilling of up to five production wells from a single subsea drill centre located *c*. 0.7 km north-west of the Montrose BLP, outside the existing 500 m exclusion zone;
- Installation of subsea infrastructure to support tie-back of the wells to the existing Montrose BLP;
- Modifications to the existing Montrose BLP; and,
- Production at the Montrose BLP platform.

In line with the 2020 Offshore EIA Regulations and supporting OPRED guidance (OPRED 2021 and OPRED 2025), the EIA sets out to describe and evaluate the impacts of any emissions to air, discharges to sea, seabed disturbance, noise, waste production and resource use resulting from the proposed development on a range of receptors including flora, fauna, water, air, climate (including Scope 3 emissions) and material assets. In addition, the potential interactions with other users of the sea are considered. These aspects are considered for planned activities and unplanned (i.e. accidental) events.

Consideration of Alternatives

The ES describes the socio-economic benefits of the proposed Project when compared to the 'Do Nothing' scenario. Aspects considered include security of energy supply, job security and contribution to the wider economy and meeting climate obligations.

Decision to Drill More Wells

The addition of the infill wells maintains the economic viability of the Montrose installation and allows maximised recovery of the reserves in line with the North Sea Transition Authority (NSTA) guidance.

Location of Wells

Due to the cost and complexity of re-instating full drilling capability on Montrose Alpha, it was considered uneconomic to drill platform wells therefore; subsea wells were selected as the only viable development alternative.

Installation Method for Manifold

The underlying sediments, combined with the requirement to make the manifold fishing friendly due to the potential for fishing gear interaction, determined that a piled manifold would be required. Other installation methods such as suction anchors and gravity based were therefore ruled out. it is acknowledged that as of 16th October 2025, the East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA) has a restriction on dredging and beam trawling within the full site, as well as a restriction on demersal gear (other than demersal seine nets) within one zoned area (Scottish Government, 2025). Whilst fishing restrictions may currently be enforced, future changes are outside the control of NEO NEXT+ and it is prudent to ensure the design caters for this possibility as far as practicable.

Pipeline Installation Options

A number of installation methods for the pipelines and control line between the production manifold and the Montrose BLP have been investigated, taking into account a number of factors including the sediment type, location within a protected area, and engineering requirements. Studies undertaken by NEO NEXT+ determined that the most suitable installation method for the pipeline would be surface laid with mattress protection as the preferred option, with surface laid with rock placement protection as an alternative option. Both of these options have been carried through in the ES, considering the worst case scenario in the impact assessment for each receptor. No trenching options have been carried through in the ES as it was considered that this method of installation would not be practical given the short length of line.

Montrose Infill Project

The proposed Montrose Infill Project involves the installation of new subsea production infrastructure tied back to the existing Montrose BLP, which will be subject to brownfield modifications and a modular extension.

Final well design has yet to be determined, however the base case is for up to five wells to be drilled at one drill centre located within a single 500 m safety zone. The drill centre will be located *c*. 0.7 km from the Montrose BLP. At the time of writing, it had yet to be determined if a semi-submersible drilling rig or a heavy-duty jack-up (HDJU) drilling rig will be used to drill the proposed Montrose Infill Project wells. The water depth, weather conditions and seabed conditions in the area are such that either drilling rig could be used. The ES therefore takes into consideration both options, and for each environmental aspect considered, the drilling rig resulting in the worst-case environmental impact will be assessed.

Infrastructure to be installed as part of the proposed Montrose Infill Project includes:

- A production flowline, gas lift flowline, and an Electro-Hydraulic Control (EHC) umbilical for well control between the BLP and the manifold;
- Manifold, drilling template (if used), Xmas trees and wellhead protection structures.

As noted above in terms of installation method of the infield lines; the ES assesses the impacts associated with the worst-case scenario for each receptor, between surface laid with mattress protection as the preferred option and surface laid with rock placement protection as an alternative option.

Stabilisation and protection materials such as grout bags and mattresses will be required on the approaches to the BLP riser and the manifold. A contingency volume of rock cover (11,100 te) has been presented in the ES as a worst case to mitigate upheaval buckling if the placement of concrete mattresses is insufficient, such that the full length of the flowlines would be rock covered in the alternative option. Prior to production, the integrity of the flowlines and gas export pipeline will be confirmed via testing such as leak detection.

Spare caisson risers on Montrose BLP will be utilised, with production fluids received into the existing Shaw separator on Montrose BLP. Utilities and services will be provided from the Montrose BLP. Processed oil and gas will continue to be exported via the existing Forties Pipeline System and CATs respectively.

Taking account of the anticipated High Case production profiles, daily oil and gas production rates from the Montrose Infill wells are anticipated during the first full year of production (in 2029) at an approximate rate of 2,061 te/d (tonnes per day) and 263,433 m^3/d (cubic metres per day), respectively. Note that these figures include some back-out of the existing fields being produced at MonArb to adjust the overall production rates. After 2029, production rates for both oil and gas subsequently decrease every year to end of field life. The reservoir will not require water injection to maintain the pressure required during production, produced water profiles increase over field life with maximum produced water rates associated with the final years of production.

At Cessation of Production (CoP) the Montrose Infill Project infrastructure will be decommissioned in line with legislation in force at that time. It is expected that the subsea structures (mattresses, grout bags, spools and umbilical jumpers) will be removed from the seabed and returned to shore for reuse / recycling / disposal and a seabed clearance campaign conducted, however, this would be subject to future legislative requirements and guidance. In line with current legislation, if mattresses are used to mitigate UHB along the full length of lines (base case), then the lines and associated mattresses would be recovered to shore. However, if it is necessary to rock cover the lines for UHB mitigation, the decommissioning of the lines under the rock would be subject to a Comparative Assessment. Should Comparative Assessment determine that the pipelines / umbilical should be decommissioned *in situ* (in the alternative case scenario), NEO NEXT+ will agree an ongoing monitoring plan with the relevant authority (currently this is OPRED).

Schedule of Activities

The activities associated with the drilling, installation, and commissioning of the Montrose Infill Project are currently scheduled to take place between Q3 2027 and Q4 2028 with first oil expected in Q4 2028 (Table i). It should be noted that the schedule presented is indicative and is liable to change as the project develops.

Table i: Indicative schedule of activities for the proposed Montrose Infill Project.

Activity	2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Drilling								
Installation of subsea infrastructure								
Well tie-ins and commissioning								
First oil								

Baseline Environment

A high-level summary of the environment at the Montrose Field is provided in Table ii.

Table ii: Summary of the Environment at the Montrose Field.

Summary Description of the Baseline Environment.
Bathymetry and Metocean Characteristics
The seabed in the Montrose area is relatively flat. Water depth at the Montrose platform is approximately 91 m. General gradients recorded throughout the survey area are less than 0.5°, although there are some localised maximum gradients of up to 7.5° at existing wells and pipelines. Wind direction and speed is changeable throughout the year. The area experiences rough

Summary Description of the Baseline Environment.
seas, particularly from October to March. Currents in the area originate from the vertically well-mixed coastal water and the inflow of Atlantic water from the Fair Isle and Dooley current.
Sediment and Seabed Features
The seabed gradient is generally < 0.5˚ with the seabed gently shoaling to the west-north-west. A modelled distribution of seabed sediments in the North Sea revealed that the predominant habitat in Blocks 22/17 and 22/18 is 'offshore circalittoral sand'. Levels of contaminants in the Montrose field area are generally at the background levels reported for the CNS. The 2022 surveys showed an increase in some concentrations of heavy metal compared to those of the 2011 surveys whereby metals were all consistent with background concentrations for the sediment type and region. There was minor elevation in the concentration of cadmium 17 km south of the Montrose platform, but this was not sufficient to result in any toxicological effect on the faunal community. A contaminated drill cuttings pile is present directly below the Montrose A platform, which will not be disturbed by the Montrose Infill project.
Plankton
Plankton form the basis of the food chain in the marine ecosystem and are a crucial source of food for multiple species. 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. The zooplankton community is dominated by calanoid copepods such as the cold-water copepod *Calanus finmarchicus* and the temperate copepod *Calanus helgolandicus*. Between 1960 and 2015, *C. finmarchicus* abundance declined significantly in Regional Sea 1, whilst *C. helgolandicus* increased. Other important components of the zooplankton assemblage include *Paracalanus*, *Pseudocalanus* and larval stages of *Calanus*, euphausiids, *Acartia*, and decapods.
Seabed Habitat and Communities
A veneer of very loose to very dense silty shelly sand, less than 1 m thick, is present over the MAR Project survey area, with the exception of occasional clay outcrops close to the Shaw field (more than 10 km south of the Montrose platform). The seabed is relatively flat across the survey area, with sparse fauna. The seabed across the site was characterised by muddy sands and gravelly muddy sands, primarily represented by consistent low reflectivity sonar data, with the exception of a large high reflectivity patch to the east of the area, ground-truthed as a higher density of shell fragments overlaying silty sands, with some agglomerations of white sea urchin (*Gracilechinus acutus norvegicus*). The seabed within the area includes one main level four European Nature Information System (EUNIS) habitat type: MD52 'Offshore circalittoral sand' (JNCC: SS.SSa.OSa). This habitat is characterised by muddy sand with variable proportions of shell. Smaller areas consisting of a greater accumulation of shells have been classified as MC42 'Offshore circalittoral mixed sediment' (JNCC: SS.SMx.OMx). Areas where a high density of sea urchins, thought to be *Gracilechinus acutus*, were present were classified as ME6212 '*Gracilechinus acutus norvegicus* assemblage on Atlantic mid bathyal mud' (JNCC: M.AtLB.Mu.UrcCom.GraAcu).
Fish and Shellfish
A variety of fish species inhabit the shelf seas in the project area some identified as priority marine features and others of commercial importance. Cod, lemon sole, mackerel, *Nephrops*, Norway pout, plaice and sandeel all may use the area for spawning. Several species may use the area as nursery grounds including anglerfish, blue whiting, cod, European hake, haddock, herring, ling, mackerel, *Nephrops*, plaice, sandeels, spotted ray, spurdog and whiting.
Seabirds
A number of seabird species are likely to occur in the area over the summer breeding season and winter months. Many species, e.g., terns, overwinter out with the area, whilst other seabirds e.g., little auks, move to the area from more northerly breeding grounds to overwinter. For all species combined, a maximum of 17 seabirds are predicted to occur per km^2 during the breeding season (April to September), this number increased to 171 seabirds per km^2 during summer months (July to August) and 65 seabirds per km^2 during the winter months (November to March). A large variety of seabirds use the area including guillemot, European storm petrel, northern fulmar and Atlantic puffin. The nearby coastlines of North East Scotland support a number of seabird colonies for various species.
Marine Mammals
Harbour seals are unlikely to occur in the area, however there have been sightings from a number of North Sea platforms. Telemetry data revealed that 0 to 0.001% of UK and Ireland at-sea grey seal population may be present. Several whales and

Summary Description of the Baseline Environment.
dolphin species have been sighted in the area including, harbour porpoise, bottlenose dolphin, white-beaked dolphin, Atlantic white-sided dolphin, minke whale, killer whale and Risso's dolphin. Distribution and abundance of these dolphin and whale species varies throughout the year, with an increase in abundance of species over the summer months for all species.
Conservation
Blocks 22/17 and 22/18 lie within the East of Gannet and Montrose Fields NCMPA. There are no other protected areas within 40 km of these blocks. The East of Gannet and Montrose Fields NCMPA was designated in 2014 to protect the 'offshore deep sea muds' habitat and the low or limited mobility species 'ocean quahog aggregations (including sands and gravels as their supporting habitat)'. Ocean quahog (*Arctica islandica*) is considered as threatened and/or declining across the northeast Atlantic (OSPAR 2008) and is a Scottish Priority Marine Feature (PMF). The next closest site is the Norwegian Boundary Sediment Plain NCMPA 55 km to the northeast. Loch of Strathbeg Special Protection Areas (SPA) and the Buchan Ness to Collieston Coast SPA are some of the closest coastal sites to the Project area. A number of species identified in the area are afforded protection under European, UK and Scottish conservation regulations.
Other Sea Users
The area is fished by local and international vessels, with fishing effort tending to be higher in spring and summer. Otter trawls targeting demersal and shellfish species have been used the most intensely in the area while pelagic trawls and seine nets have been used second most. When fishing effort in the Project area (ICES 43F1) is compared against effort across all ICES rectangles in the UKCS, fishing effort within 43F1 accounted for 0.1% between 2019 and 2023 (Scottish Government, 2024). Fishing effort within this rectangle is therefore considered relatively Low. The proposed Project lies within a well-developed oil and gas production area with a number of installations, pipelines and umbilicals present. The proposed Montrose Infill Project is located within the vicinity of six confirmed Innovation and Targeted Oil and Gas (INTOG) application sites, the closest awarded INTOG site is located *c*. 23 km south of the proposed Montrose drill centre. The closest operational wind farm is the Hywind Scotland wind farm located off the coast of Peterhead, over 100 km west of the Montrose area. The closest Scotwind lease area is E2, which is located *c*. 65 km west of the Montrose platform.

Environmental Impact Assessment

In order to determine the impact that the proposed Montrose Infill Project may have on the environment, an ENVironmental and socio-economic impact IDentification (ENVID) was undertaken using a structured methodology. The purpose of the ENVID was to identify the significance of the environmental and socio-economic risks associated with the planned activities and any possible unplanned events and to identify appropriate mitigation measures, controls and safeguards to minimise this risk.

For each of the planned activities an environmental and/or socio-economic Impact Significance is assigned for the relevant aspects (e.g. emissions to air, discharges to sea, underwater noise etc.) by taking into account the Receptor Sensitivity and the Magnitude of Effect.

For unplanned events the environmental and/or socio-economic significance of risk ranking also takes into account the Likelihood of the event occurring. A summary of the key findings of the impact assessment is presented in Table iii.

Table iii: Environmental Impact Assessment Key Findings.

Aspect
Physical Presence
The physical presence of project vessels, the drilling rig, and subsea infrastructure associated with the proposed Project has the potential to be a navigational hazard, restrict fishing operations in the area and to cause disturbance to marine fauna. Mitigation measures include early consultation with the Scottish Fishermen's Federation (SFF) for all operations, notification to other users of the sea regarding the project's activities, a safety exclusion zone in place around the drill centre, and use of the ERRV at Montrose to warn of anchor location prior to semi-submersible rig coming on location (if used). The physical presence of the project related aspects listed above is considered a **Low** socio-economic impact significance. In addition, the environmental impact significance in relation to marine mammals, birds and fish is considered **Low**. The environmental and

Aspect
socio-economic impacts are therefore considered acceptable when managed within the additional controls and mitigation measures outlined in Table iv.
Emissions to Air
Activities associated with the proposed Montrose Infill Project including drilling, subsea installation, production start-up, modifications to the existing Montrose BLP, operations and decommissioning will all result in emissions to air which can contribute to global atmospheric concentrations of greenhouse gases (GHGs) and regional acid loads. NEO NEXT+ has assessed the impact associated with atmospheric emissions from the proposed Project. In the drive to towards supporting the UK's Net Zero target and meeting the company's GHG commitments, the identification, assessment, and minimisation of emissions have been embedded in all stages of the project management process. A number of integrated measures across drilling, installation, commissioning and production will be adopted to ensure emissions are minimised to as low as reasonably practicable. Emission of atmospheric pollutants that affect air quality, such as NO_x, SO_2 and carbon monoxide, from combustion equipment at the Montrose Complex currently have low impact on the environment. Air dispersion modelling shows that neither short-term nor long-term air quality standards or objectives are at risk of being breached. Potential for impact at all external human receptors is insignificant. Release of atmospheric air quality pollutants at and around the Montrose Complex would increase during the period of construction, drilling and installation before returning to levels similar, or slightly lower than, present for the duration of production. Air dispersion modelling shows that air quality standards are at low risk of being exceeded anywhere during either the drilling or production periods. Baseline greenhouse gas intensity of production in 2023 was 29.0 kilograms of carbon dioxide equivalent per barrel of oil equivalent ($kgCO_2e$/boe) as compared to the average for all facilities in the UK sector of the North Sea of 24.5 $kgCO_2e$/boe and the average for large platforms of over 25 years age of 50.3 $kgCO_2e$/boe. Production from the existing fields served by the Montrose Complex will decline over the next five years up to the planned date for cessation of production and, as such, the baseline greenhouse gas intensity is projected to increase in the absence of the proposed Project. During production of the proposed Infill Project, greenhouse gas intensity of production will decrease relative to the baseline, with a project life-of field intensity of 29.7 $kgCO_2e$/boe. The flaring intensity of production at the Montrose Complex will reduce as a result of the proposed Project due to the installation of flare gas recovery to ensure no routine flaring. Greenhouse gas emissions have been estimated for all phases of the project, including indirect downstream emissions associated with the end use of exported hydrocarbons. The proposed Project has been determined to be fully compatible with the UK meeting its climate obligations, including legally binding greenhouse gas emissions reductions, and helping to meet the projected demand for oil and gas to affect the transition to a Net Zero economy by 2050. Greenhouse gas emissions from the proposed Project are identified as minor adverse magnitude and insignificant impact severity at the project level and, in combination with other plans and projects, at a UK national level. In combination with all projects at a global level, the proposed Project would also be consistent with scenarios for achieving the objectives of the Paris Agreement, such as the International Energy Association Net Zero by 2050 scenario and low emission Shared Socio-economic Pathways scenarios of the UN Intergovernmental Panel on Climate Change, if governments and organisations across the globe implement policies and actions for cutting demand accordingly. In such scenarios, indirect downstream greenhouse gas emissions from the proposed Project would have a minor adverse magnitude of impact and would not be significant. In other, higher emissions, scenarios the baseline future impact magnitude on climate change from global activities could be of moderate adverse or major adverse magnitude. The proposed Project will have negligible effect on the future baseline magnitude of global emissions and on the significance of the impact.
Discharges to Sea
Activities that result in planned discharges to sea will occur from the drilling, installation, commissioning, and production phases of the proposed Montrose Infill Project. Discharges from drilling will include drilling fluids and cuttings, cement and well bore clean-up fluids. Installation discharges will include water containing a mix of chemicals used for testing the integrity of pipelines. Impacts associated with these drilling and installation related discharges may arise from the suspension of particulate matter in the water column and the presence of chemicals within the discharge. Modelling of drill cuttings discharges was carried out to support the impact assessment. Discharges to sea from the existing Montrose platforms during production will include drainage water discharges and treated produced water discharges (as per existing practices on the Montrose platforms). Impacts from production related discharges may arise from a decrease in water quality, which in turn could affect plankton which drift in the water column and therefore cannot avoid discharges in the same way that fish and marine mammal can. Assessment of planned discharges on the water column and its associated receptors concluded that the

Aspect
overall Impact Significance of the environmental impacts of all planned discharges is **Low** and therefore considered acceptable when managed within the additional controls and mitigation measures identified in Table iv.
Seabed Disturbance
There will be disturbance of the seabed during the drilling and installation phases of the proposed Project. It is not known if a semi-submersible drilling rig or a HDJU drilling rig will be used to drill the proposed wells; the assessment considers the worst-case seabed impact associated with anchoring of a semi-submersible drilling rig as this would result in a greater impact than the positioning of the HDJU drilling rig. However, the potential for spud can depressions remaining is also considered should a HDJU drilling rig be selected. Having been towed to the site, the semi-submersible drilling rig will be held on location using eight drag anchors connected to the drilling rig via anchor lines measuring *c*. 1,500 m in length. The ES assumes that the semi-submersible drilling rig and associated anchor system would only need to be positioned once to reach all well locations. Drill cuttings and associated drilling fluids are expected to be discharged at the seabed during drilling of the tophole sections of each well. The lower well sections will be drilled using low toxicity oil based muds (LTOBM). It is not known if the LTOBM contaminated cuttings from the lower sections will be skipped and shipped to shore or if they will be thermally treated offshore and discharged from the drilling rig. The ES assumes a worst case whereby these cuttings are treated offshore and discharged. Modelling of the discharge of the drill cuttings has been carried out to support the assessment of cuttings. Drill cuttings discharge simulations using the Dose-related Risk and Effects Assessment Model (DREAM) estimated a maximum thickness of cuttings of 373 mm in the immediate vicinity of the wells, reducing rapidly with distance. The area with a thickness of greater than 6.5 mm is predicted to be *c*. 0.17 km^2 at the end of drilling but reduces over time. 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. The maximum area where there is a combined risk (takes account of depth of burial, change in grain size, oxygen depletion and toxicity due to chemicals) to more than 5 % of the most sensitive species in the sediment following drilling is predicted to be approximately 2.64 km^2 after drilling ends. The area reduces to 1.30 km^2 after two years due to re-colonisation by opportunistic species. Seabed recovery then slows down, and after 5 years and 10 years the potentially impacted area is estimated to be 0.87 km^2 and 0.56 km^2 respectively. There will be an area of permanent disturbance associated with any surface laid infrastructure, mattresses, grout bags, and contingency rock cover. Impacts resulting from the proposed activities have the potential to impact on areas of potential OSPAR habitat 'sea pens and burrowing megafauna communities' however given the widespread distribution of the habitat across the surveyed areas in the vicinity of the project, the impact is not considered significant. The Montrose Field is located within the East of Gannet and Montrose Fields NCMPA. As noted in Table ii, the NCMPA is protected for 'offshore deep-sea muds' habitat, and *A.islandica* aggregations (including sands and gravels as their supporting habitat). Given the location of the proposed wells within the 'offshore circalittoral sand' area of the NCMPA, there will be no impacts to the 'offshore deep-sea mud' habitats. Although no adult *A.islandica* specimens were identified in the Montrose survey area, juveniles were present within the survey area. The impact significance of seabed disturbance on *A.islandica* and sands and gravels as their supporting habitats is therefore considered to be Moderate. The impacts are 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. Decommissioning activities will result in temporary disturbance to the seabed. It is anticipated that the area disturbed by the decommissioning activities will be less than that disturbed by the drilling and installation activities and will mostly be within the same footprint disturbed by the installation activities. Overall, the worst-case analysis of the proposed Montrose Infill Project activities that require interaction with the seabed shows that most of disturbance will be temporary whilst the drilling rig is on station and during installation of the flowlines, EHC umbilical, and other subsea structures. Approximately 3.20 km^2 may be subject to temporary disturbance by drilling and installation activities, and 0.57 km^2 will have a permanent or long-term footprint from the subsea structures, stabilisation and protection materials, and residual drill cuttings accumulation. The temporary and permanent disturbance represents 0.045 % and 0.25 %, respectively, of the sands and gravels area within the NCMPA. Therefore, the area impacted by the proposed Montrose Infill Project is relatively small (and is also noted to be an overestimate as the area covered by drill cuttings and other disturbances will overlap). Though recovery is expected to begin immediately after some of the activities are completed, taking account of the total area that could be impacted either permanently or temporarily, the overall Impact Significance associated with disturbing the seabed is considered **Moderate**, such that some of the environmental impacts will be discernible after the activities are

Aspect
completed or through to the time of decommissioning. The Project will continue to work towards minimising the potential impact e.g. surface laying rather than burying the lines.
Underwater Noise
The main sources of underwater noise associated with the proposed Montrose Infill Project will result from drilling operations, placement of contingency rock cover, vessel use, and the piling of the manifold. Many marine organisms use sound for navigation, communication, and prey detection. Therefore, the introduction of man-made sources of underwater noise has the potential to impact marine animals if it interferes with their ability to receive and use sound. Types of impact include temporary avoidance or behavioural changes, the masking of biological sounds, as well as auditory and other injuries. Underwater noise modelling was carried out to assess the impacts of piling noise. Although the sound from the proposed project does have the potential to cause disturbance to marine animals, it is not expected to have a significant impact on any cetacean or fish species. Taking this into account, and considering the mitigation measures outlined in Table iv, the Impact Significance of the environmental impact of the underwater noise associated with the proposed activities is considered **Low**. The impacts are therefore considered acceptable when managed within the controls and mitigation measures identified.
Waste
NEO NEXT+ is committed to reducing waste generation and to managing all generated waste, by applying approved and practical methods and by adhering to the waste hierarchy. Waste will only be disposed of if it cannot be prevented, reclaimed or recovered. All waste will be managed in accordance with NEO NEXT+/ vessel Waste Management Plans, including existing waste management procedures on the Montrose platforms. 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. The overall Impact Significance of waste generation is therefore considered to be **Low** and is therefore acceptable when managed within the mitigation measures described. With the application of the control and mitigation measures identified, the Impact Significance of waste generation is considered **Low** such that any environmental impacts associated with waste production are thought to be negligible.
Accidental Events
The ES presents a detailed evaluation of a low probability well blowout. Small scale accidental events, ranked Minor or Moderate, have also been reviewed in this ES. The potential hydrocarbon spill scenario was modelled using the Oil Spill Contingency and Response (OSCAR) model. The likelihood of the hydrocarbon release modelled occurring is considered remote owing to the procedural and operational controls that will be applied during the Montrose Infill Project. Given the Likelihood of such a release, 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 is considered to range from **Low** to **Moderate** depending on the environmental receptor. The well blowout scenario is considered a Major Accidental Hazard (MAH). MAH's must be assessed to determine if they may result in significant adverse effects on the environment and constitute a Major Environmental Incident (MEI). Based on the criteria outlined in the Safety Case Regulations (SCR, 2015) and the oil spill simulation results, it was established that the blowout scenario could lead to impacts in relation to seabirds, marine mammals, offshore protected areas, coastal protected areas and fisheries/aquaculture/shellfish water protected areas, that would qualify as an MEI as defined in the SCR (2015).

Overall Conclusion

In summary, the ES concludes that the proposed Montrose Infill Project will not result in any significant environmental effects provided that all identified mitigation measures are implemented. Environmental and social impacts identified through the impact identification process, as well as all mitigation measures, will be inputted to the Project Risk Register. NEO NEXT+'s Environmental Management System (EMS) will be used to ensure that the on-going process of identification, assessment and control of environmental risks will continue throughout planning and operations of the Montrose Infill Project. In addition, no significant cumulative or transboundary effects are considered likely to arise from the proposed Montrose Infill Project.

Risks and impacts can be readily mitigated and controlled through robust design, effective operating practices and systems implemented by a highly trained workforce. NEO NEXT+ has a 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.

Project commitments to be inputted to the Project Risk Register are summarised in Table iv.

Table iv: Montrose Infill Project commitments.

Aspect	Commitments
Physical Presence	❯ Operations Notice 6 notification will be submitted prior to rig mobilisation; ❯ A Vessel Traffic Survey (VTS) will inform a Consent to Locate (CtL) application for the drilling rig; ❯ A Collision Risk Management Plan will be produced, if determined to be required; ❯ All vessels will adhere to International Regulations for preventing Collisions at Sea (COLREGS) and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.; ❯ The drilling rig will have a 500 m safety zone to mitigate any collision risk; ❯ An Emergency Response and Rescue Vessel (ERRV) will patrol the area during the drilling operations; ❯ The drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations; ❯ Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site; and ❯ All infrastructure will be laid within one of two 500 m exclusion/safety zones.
Emissions to Air	**Proposed Pre-Start Up Mitigation Measures** ❯ Inclusion of optimised energy efficiency and GHG emissions reduction in the rig selection and tendering process. ❯ Batch drilling and completion opportunities will be evaluated. These would reduce emissions through reduced logistical requirements and fluid handling efficiencies. ❯ The information gained from each well test will be assessed with a view to reducing the volumes of hydrocarbons to be flared during well testing for each subsequent production well. ❯ During flaring from well clean-up and testing operations, environmental conditions will be monitored, and a dedicated person will be assigned for full-time fire watch duty. ❯ The drilling rig and other project vessels will be subject to audits ensuring compliance with UK legislation. ❯ Vessel use will be optimised where possible by minimising the number of vessels required, and their length of time on site. ❯ Vessels will be operated where possible in modes that allow for economical fuel use.
	Proposed Production Mitigation Measures In accordance with the revised NSTA strategy, and associated Stewardship Expectation 11, as well as with the industry commitments within the North Sea Transition Deal (NSTD), NEO NEXT+ will incorporate the following controls: ❯ Select, plan and execute NEO NEXT+'s emissions reduction and monitoring initiatives over a reasonable timescale in line with the Montrose Complex's Emissions Reduction Action Plan (ERAP). ❯ Where it is not considered reasonable to electrify, NEO NEXT+ is committed to pursue other power emissions reductions.

Aspect	Commitments
	› With the proposed Montrose Infill Project and planned production post-2030, the goal of no routine flaring and venting through the provision of a new flare gas recovery system onboard the Montrose Complex is anticipated. › Diesel use by the gas turbine generators (GTGs) onboard the BLP is limited to turnarounds and shutdowns and for plant re-start when fuel gas is unavailable. › With the proposed Montrose Infill Project, continual monitoring and reviewing of emissions and carbon intensity of the Montrose Complex. The Montrose Complex's ERAP will continue to be reviewed for potential opportunities to further reduce emissions against the sector targets outlined in the NSTD. These measures will help to ensure that opportunities for efficiency and reduction of atmospheric emissions, where not in conflict with safe operations, are identified, actioned as appropriate and reviewed.
Discharges to Sea	› Minimise use of vessels, through efficient journey planning; › The drilling rig used will be audited under NEO NEXT+'s Marine Operations and Vessel Assurance Standards and subject to rig recertification audits; › All vessels used will be International Convention for the Prevention of Pollution from Ships (MARPOL) compliant; › Where technically feasible NEO NEXT+ will prioritise the selection of chemicals which are Pose Little or No Risk (PLONOR), or chemicals with a lower Risk Quotient (RQ); › Preference will be given to skipping and shipping produced sand; › Produced water will be treated to reduce Oil in Water (OiW) content to below 30 mg/l; and › The discharges of any water based hydraulic fluids, sand or chemicals are regulated by the Oil Pollution Prevention and Control (OPPC) and/or Offshore Chemicals Regulations (OCR) regulations and reported through the Environmental and Emissions Monitoring System (EEMS). As such, NEO NEXT+ will confirm that sampling, analysis, and reporting are undertaken in line with the regulations and permit conditions.
Seabed Disturbance	› Pre-deployment surveys will be undertaken to identify suitable locations for the anchors (if required); › Pipeline and umbilical route surveys will be undertaken; › The use of mattresses, grout bags, and contingency rock cover, will be minimised through optimal project design. › Anchors of the drill rig (if used) will be maintained under tension to minimise chain contact on seabed; › Cement volumes required will be planned and optimised; › Use of ROV for visual monitoring and pH monitoring during cementing jobs that allows stopping when cement is either observed or detected at seabed (to minimise excess cement); › Sea dye will be used to indicate when cement is approaching the surface; › The use of dynamically positioned vessels where possible will minimise anchor use; › Use of low toxicity chemicals in Water-based Mud (WBM) sweeps; › Use of specialist contractors to minimise dropped objects; and › Lifting plans in place.
Underwater Noise	› A qualified, trained and equipped marine mammal observer (MMO) will be present during piling. The MMO will carry out a pre-piling survey of a 500 m mitigation zone and, if an animal 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;

Aspect	Commitments
	› Passive Acoustic Monitoring (PAM) will be employed during periods of low visibility and at night to detect marine mammal presence; and › Avoiding commencing piling at night or in poor visibility when marine mammals cannot reliably be detected. If this cannot be avoided, then PAM will be used; › Commitment to preparing a Marine Management Mitigation Protocol (MMMP) to summarise all mitigation measures.
Waste	› NEO NEXT+ will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle; › Existing asset and vessel WMPs will be followed; and › Only suitably permitted and licensed disposal yards / landfill sites will be used, in compliance with relevant legislation.
Accidental Events	› Activities will be carried out by trained and competent offshore crews and supervisory teams; › An approved Oil Pollution Emergency Plan (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; › A co-ordinated industry oil spill response capability will be available; and › Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue.
	Wells specific control measures
	› A robust Blowout Preventer (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; › 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
	› A mandatory 500 m safety zone will be in place for the drilling rig and for the wells following completion; › Operational restrictions will be in place for visiting vessels in bad weather; › Simultaneous operations (SIMOPS) procedures will be in place; › Pipelines will have pressure monitoring and low pressure alarms; and › Oil spill control measures will be followed as outlined in the OPEP.

1 Introduction

This Environmental Statement (ES) presents the Environmental Impact Assessment (EIA) carried out in support of the proposed Montrose Infill Project.

1.1 Background

The Montrose Field is located on the United Kingdom Continental Shelf (UKCS), *c*. 190 km from the Scottish coastline at Peterhead and *c*. 46 km from the UK/Norway median line, in Blocks 22/17 and 22/18 of the Central North Sea (CNS) (Figure 1-1). Water depth at the Montrose Field is *c*. 91 m. The Field currently produces via one platform well drilled from the Montrose Alpha platform. NEO NEXT+ Energy Resources UK Limited (hereafter referred to as NEO NEXT+[1]) are proposing to further develop the Montrose Field by drilling up to five additional subsea infill wells. This further development of the Field is hereafter referred to as the proposed Montrose Infill Project.

The Montrose Field is one of nine fields: Montrose, Arbroath, Carnoustie, Arkwright, Brechin, Wood, Godwin, Cayley and Shaw, which combined are referred to as the MonArb Area.

There are three platforms in the MonArb Area operated by NEO NEXT+, including Montrose Alpha commissioned in 1976, the Arbroath platform commissioned in 1990, and the Montrose Alpha Bridge Linked Platform (BLP) commissioned in 2017. The Montrose Alpha and Montrose BLP combined are referred to as the Montrose Complex.

The Arbroath platform located *c*. 11 km south of the Montrose Complex receives fluids from the Arbroath, Carnoustie, Arkwright, Brechin and Godwin fields. These fluids go through a primary separation process on Arbroath before being piped to the Montrose Alpha platform for final processing and export.

The Shaw and Cayley Fields are subsea wells tied back to the Montrose BLP whilst the Montrose Field is currently producing via production wells drilled from the Montrose Alpha platform. The Wood Field also ties directly back to the Montrose Alpha platform.

Oil from all fields is exported from Montrose Alpha via the Forties Pipeline System (FPS). Gas is exported from the Montrose BLP to the Central Area Transmission System (CATS), which transports gas to the Teesside gas terminal for processing and entry into the UK National Transmission System (NTS).

In 2012 an Environmental Statement (ES) was submitted by Talisman (The Montrose Bridge Linked Platform ES; DECC Ref D/4124/2011) to support the MonArb Area Redevelopment (MAR) Project. The ES included the installation of the Montrose BLP, the development of the Cayley and Shaw Fields as subsea tie-backs to the BLP and the drilling and completion of six additional platform production wells at Montrose. The BLP was installed and the Cayley and Shaw fields were developed, however the proposed six Montrose platform infill wells were never drilled.

In order to extend the field life, NEO NEXT+ are proposing to drill five subsea wells as part of the proposed Montrose Infill Project. As a result of the proposed Project, life of field for the Montrose Complex as a host is expected to extend from December 2030 (anticipated Cessation of Production (CoP) without the proposed Montrose Infill Project) to December 2035 (anticipated CoP with the proposed Montrose Infill Project).

The licence interests are summarised in Table 1-1.

[1] NEO NEXT+ was formed from the merger of NEO Energy, Repsol Resources UK, and TotalEnergies UK.

Table 1-1: License interests of the MonArb Hub.

Equity Holder	% Holding
NEO NEXT+ Energy Delta Limited	58.974360 %
Ithaca MA Limited	41.025640 %

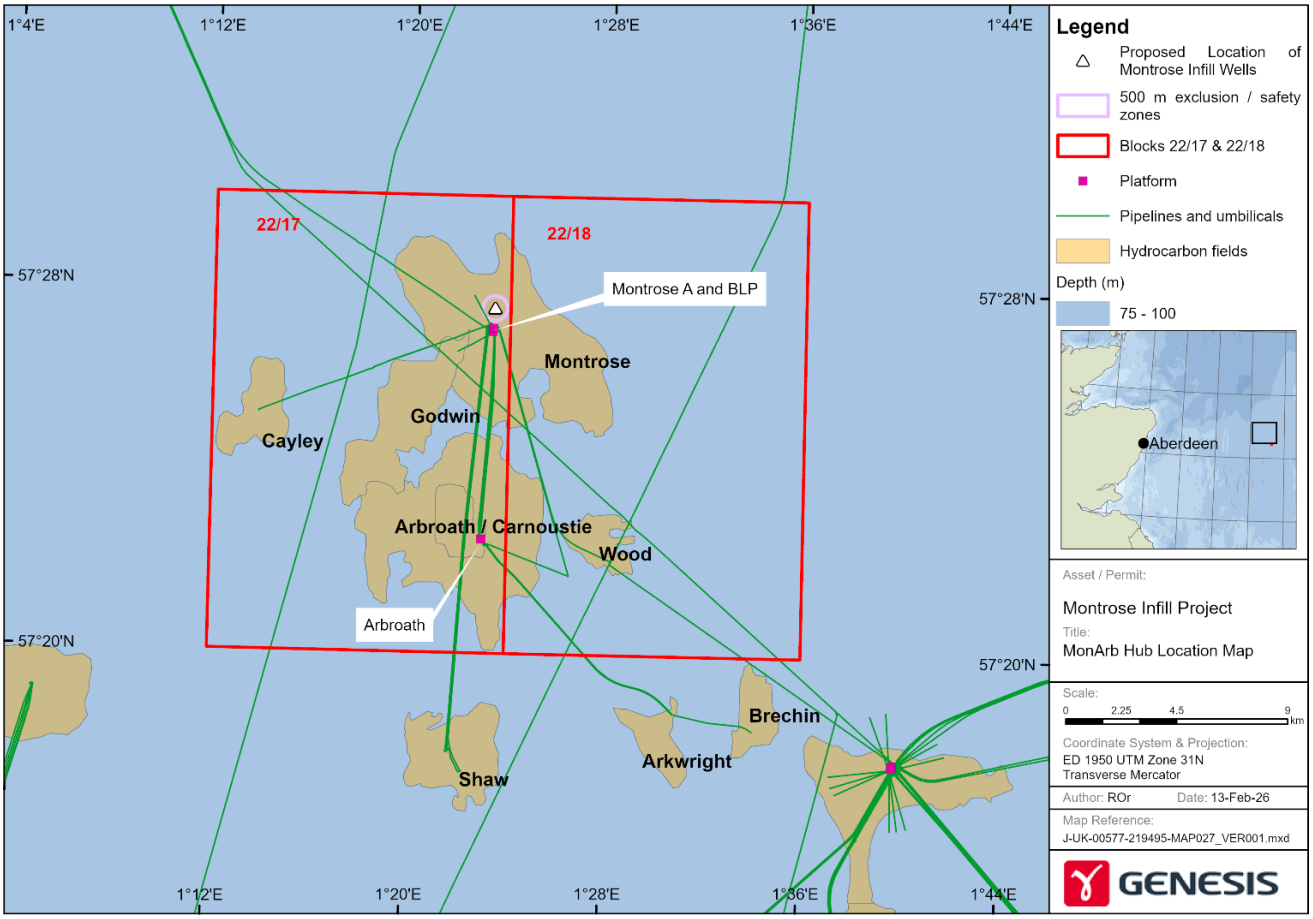


Figure 1-1: Location of the proposed Montrose Infill Project.

1.2 Overview of the proposed Montrose Infill Project

The proposed Montrose Infill Project comprises:

- Drilling of five production wells from a single subsea drill centre located *c*. 0.7 km north of the Montrose BLP, i.e. *c*. 200 m outside the existing 500 m exclusion zone;
- Installation of subsea infrastructure to support tie-back of the wells to the Montrose BLP;
- Modifications to the existing Montrose BLP; and,
- Production at the Montrose BLP platform.

Utilities and services will be provided from the Montrose BLP. Processed oil and gas will continue to be exported via the existing FPS and CATS respectively. The location of the proposed wells in relation to the existing BLP, are shown in Figure 1-2.

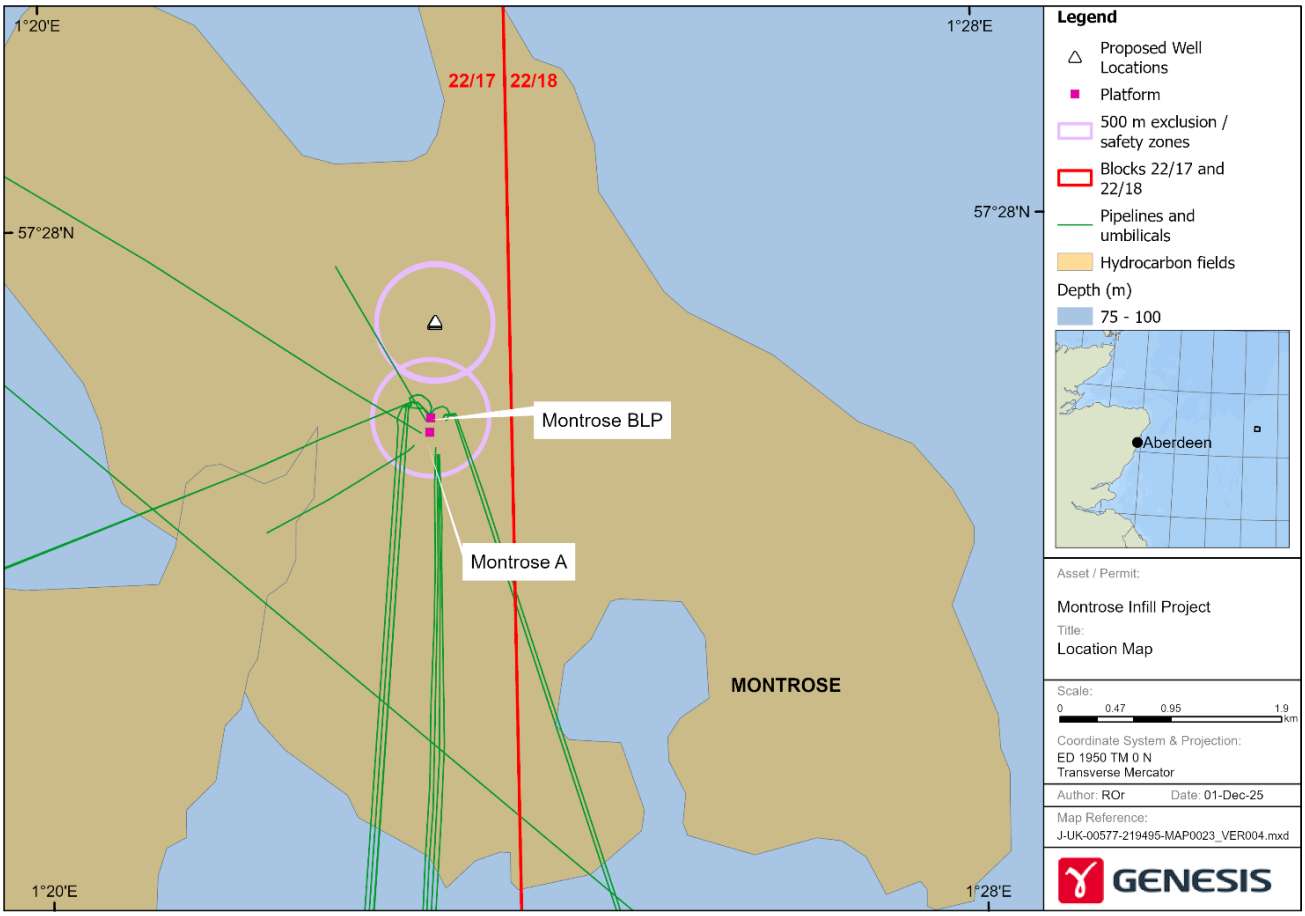


Figure 1-2: Location of the proposed Montrose infill wells in relation to the existing BLP.

1.3 Purpose of the Proposed Montrose Infill Project

The purpose of the proposed Montrose Infill Project is to maximise economic recovery from the Montrose Field and extend production life at the Montrose Complex.

The UK Government's Energy White Paper explicitly recognises that the UK's domestic oil and gas industry has a critical role in maintaining the country's energy security and is a major contributor to the UK economy. The proposed Project supports the UK Government's statutory objective to maximise the value of economically recoverable hydrocarbons. The Project will support increased longevity of its host, the Montrose BLP, and in doing so, sustain key existing infrastructure which could support the future development of oil and gas discoveries in the CNS.

1.4 Purpose of the Environmental Statement

Under the 'Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020' (hereafter referred to as the 2020 Offshore EIA Regulations), the proposed Montrose Infill Project requires an Environmental Impact Assessment (EIA) and ES to be submitted to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) for approval. This requirement is due to the anticipated increased volumes of hydrocarbons to be produced such that consent is being sought for the

'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 this ES is to report on the EIA process undertaken to meet statutory 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 NEO NEXT+ 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.

This ES has been prepared in accordance with the 2020 Offshore EIA Regulations and supporting guidance from OPRED (DESNZ, 2021), including recently published guidance for assessment of GHG emissions resulting from the end use of the hydrocarbons produced (OPRED, 2025).

1.5 Scope of the Environmental Statement

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

- The drilling of the proposed subsea Montrose Infill wells;
- The installation and commissioning of the required subsea infrastructure;
- Brownfield modifications to Montrose BLP;
- Production of Montrose Infill hydrocarbons to the existing BLP; and
- Following the Finch ruling, the assessment also covers atmospheric emissions associated with the end use of produced hydrocarbons.

The ES sets out to describe and evaluate the impacts of any emissions to air, discharges to sea, seabed disturbance, underwater noise, waste production and resource use resulting from the proposed Project on a range of receptors including flora, fauna, water, air, climate and material assets. The potential interactions with other users of the sea are considered. These aspects are considered for planned activities and unplanned (i.e. accidental) events. In addition, an assessment of the impacts of atmospheric emissions associated with the end use of the produced oil and gas is provided.

1.6 Document Layout

To determine the environmental and socio-economic impacts of the proposed Montrose Infill Project, an understanding of the regulatory context, stakeholder concerns, the proposed activities and the environmental and socio-economic baseline is required. Table 1-2 details the structure of the ES report.

Table 1-2: Structure of ES.

Chapter No.	Title	Contents
0	Non-Technical Summary	A summary of the ES.
1	Introduction	Introduction to the proposed Project and scope of the ES. This chapter also includes a summary of applicable legislation, NEO NEXT+'s Environmental Management System, areas of uncertainty, societal benefits of the Project, and the consultation process to date.
2	Pathway to Net Zero	NEO NEXT+'s approach to reducing greenhouse gas emissions across their portfolio and outlining their plans to become a Net Zero company by 2050. This chapter also details initiatives to decarbonise the MonArb Hub Area (including the Montrose Complex) and the proposed Montrose Infill Project.
3	Project Alternatives and Project Description	A description of the project alternatives considered is provided. In addition, in relation to the proposed Project details of the drilling and subsea installation operations are provided, an overview of the Montrose Complex and proposed brownfield modifications, and the anticipated production profiles.
4	Environmental and Socio-Economic Baseline	A description of the environmental and socio-economic receptors in the area.
5	Impact Assessment Methodology	Description of the methodology used to determine the significance of the environmental and social risk of the proposed activities.
6 to 11	Assessment of Aspects	Detailed assessment of Physical Presence (Section 6); Emissions to Air (Section 7); Discharges to Sea (Section 8); Seabed Disturbance (Section 9); Underwater Noise (Section 10); and Waste Management (Section 11) aspects of the development.
12	Accidental Events	Details of accidental events identified during the ENVironmental and socio-economic Impact IDentification (ENVID) workshop.
13	Conclusions	Key findings including a register of commitments.
14	References	Lists sources of information used throughout the ES.
Appendix A	Scotland's National Marine Plan and Marine Strategy Framework Directive	Assessment of the project against Scotland's National Marine Plan General Polices and Oil and Gas Specific Policies, as well as Marine Strategy Framework Directive.
Appendix B	ENVID Results	Results of the ENVID workshop.
Appendix C	Oil Spill Modelling	Modelling of the impacts of a hydrocarbon release in the event of a well blowout during drilling.
Appendix D	Underwater Noise Modelling	Modelling of impacts of piling activities associated with the new manifold.

Chapter No.	Title	Contents
Appendix E	Drill Cuttings Modelling	Modelling of impacts of drill cuttings discharges associated with the new wells.
Appendix F	Production Profiles	Production Profiles (Low case, Mid case, High case).
Appendix G	Atmospheric Dispersion Modelling (ADMS)	Modelling to predict the dispersion of atmospheric pollutants.

1.7 Societal Benefits of the Proposed Project

Wider benefits to the interests of the nation and contribution to the Government's objectives for the North Sea have been considered in relation to the proposed Montrose Infill Project. 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 oil and gas". 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 licenses while ensuring existing fields are supported and managed through their lifespan.

SUPPORTING EXISTING OIL AND GAS SUPPLY CHAIN / SECURITY OF ENERGY SUPPLY

The proposed Project would extend the Montrose Complex economic life to at least 2035, which is five years longer than the current CoP date of 2030. As well as production from the Infill wells, the life of field extension will also enable continued production from the Wood, Cayley and Shaw fields and the existing Montrose well.

Extending the field life of Montrose supports the UK Government's goal of moving away from issuing new oil and gas exploration licenses and instead providing a managed transition for existing oil and gas fields, supporting their continued operation for their full lifetime. The objective of the proposed Montrose Infill Project is to optimise production from the existing Montrose field through development of new infill wells. This aligns with the remit of the 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.

The UK is projected to use at least of 13 billion barrels of oil equivalent (bboe) by 2050 (OEUK, 2025b). The resources in the North Sea will not meet this demand in full, such that the remaining requirement will be met by imports. Any oil and gas that is not recovered will increase the anticipated volume of imports with no wider benefits to UK jobs or the UK economy (OEUK, 2025b). Therefore, developing the Montrose field will support the UKs drive for energy security, the UK economy and will help retain jobs across the UK.

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 Montrose, 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).

Extending the field life of the Montrose Complex will protect jobs in the North Sea energy sector given that work will be involved throughout the duration of project construction, installation and extended production to 2035. NEO NEXT+ have a business strategy which can be summarised as "Resilience, Yield and Growth", focusing on operational synergies and potential future acquisitions to create strong value and cash flow, supporting job resilience and potential growth in the energy sector.

MEETING CLIMATE OBLIGATIONS

Chapter 2 of this ES summarises how NEO NEXT+, as a UK operating company, supports the UK Government's Net Zero target and how the proposed Montrose Infill Project aligns with the North Sea Transition Deal (NSTD) Policies and Commitments, and NEO NEXT+'s Net Zero commitments (NSTA, 2021a).

In addition, Project Alternatives in the context of GHG emissions, and consequentially the Project's contribution to Climate Obligations are discussed in detail in Section 7.5.8. Following development of the proposed Montrose Infill Project, all parameters that the NSTA uses for benchmarking performance across the UKCS will be favourable for the Montrose Complex, including Green House Gas Intensity (GHGI), flaring intensity, venting intensity and operating with zero routine flaring.

1.8 Legislative Overview

This section provides a summary of the current environmental legislation applicable to the proposed Project. Note that Energy Transition and Net Zero are discussed in detail in Section 2 and therefore not described in this subsection.

1.8.1 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 supplementary OPRED Guidance on assessing the effects of downstream Scope 3 emissions on the climate (DESNZ, 2025).

The EIA Regulations require an ES to be prepared and submitted for:

i. New developments, or an increase in production which will produce 500 te or more per day of oil, or 500,000 m^3 or more per day of gas;
ii. Pipelines of 800 mm diameter and 40 km or more in length;
iii. Storage sites pursuant to Directive 2009/31/EC on the geological storage of Carbon Dioxide (CO_2);
iv. Installations for the capture of CO_2 for the purpose of storage; and
v. Any change to, or extension of, projects listed in parts (i) to (iii) above where such a change or extension in itself meets the thresholds specified above.

In addition to the mandatory ES conditions, a discretionary ES may be required for an oil and gas project if, for example, the new development is less than 40 km from the UK coast. Such projects will be considered on a case-by-case basis. Further details are contained in the Guidance Notes for Industry (DESNZ, 2021).

As described previously, the proposed Montrose Infill Project requires an ES due to the anticipated production profiles.

The EIA needs to consider the impact on the surrounding environment including any protected areas. Protected areas have been designated as a result of European Directives, in particular the European Union (EU) Habitats Directive 92/43/EEC and the EU Wild Birds Directive 2009/147/EC (previously 79/409/EEC), and have been enacted in the UK by the following legislation:

- The Conservation of Offshore Marine Habitats and Species Regulations 2017: These regulations are the principal means by which the Birds and Habitats Directives are transposed in the UK offshore marine area (i.e. outside the 12 nm territorial limit); and
- The Offshore Petroleum (Conservation of Habitats) Regulations 2001 (as amended), similar to the Conservation of Offshore Marine Habitats and Species Regulations 2017, transpose the Habitats Directive and the Birds Directive into UK law in relation to oil, gas and, under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, Carbon Capture and Storage (CCS) plans and projects. These regulations apply to projects wholly or partially on the UKCS and adjacent waters outside territorial waters.

1.8.2 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 or injure EPS” either alone or in combination with other plans and projects.

The MonArb Area is located within the East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA), and the proposed Project will include drilling and laying of subsea infrastructure within the NCMPA. The Project Team are cognisant of the requirements under the Habitats Directive at all phases.

1.8.3 Discharges to Sea

OIL DISCHARGES

In accordance with the Oslo/Paris Convention (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 below 30 mg/l. OSPAR Recommendation 2001/1 also required contracting parties to reduce the total discharge of oil in produced water 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).

Produced water at the Montrose Complex is treated and discharged. It is proposed that produced water from the proposed Project is also treated and discharged. A description of the existing produced water system is provided in Sections 3.7 and 3.9.3.

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 2011). The regulations require offshore Operators to apply for permits for the use and / or discharge of chemicals in the course of 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 produced water 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. The RBA for Management of Produced Water for the Montrose Asset (NOV Wellstream UK, 2025) has been referred to in Chapter 8 (Discharges to Sea).

1.8.4 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 ETS system on 1 January 2021. The EU ETS is based on Directive 2003/87EC establishing a scheme for greenhouse gas 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 Greenhouse Gas 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.

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 (NOx), oxides of sulphur (SOx), methane (CH_4) and volatile organic compounds (VOCs) and the demonstration of the use of Best Available Technique (BAT).

Given the combustion equipment at the Montrose Complex, compliance with both the UK ETS and the PPC regulations is required.

The revised North Sea Transition Authority (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 greenhouse gas emissions and assist in meeting the UK Net Zero target. The Strategy is supported by Stewardship Expectations (SE). The OGA '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 CCS 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 (OPRED, 2025).

1.8.5 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 (FEPA) Part II (environment) and the Coastal Protection Act (navigation). The MCAA has enabled:

- Establishment of the Marine Management Organisation (MMO) to operate as the competent marine planning authority in English territorial waters and UK 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 adjacent to England and Wales and UK offshore waters.

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 or under the OPRED environmental regime, require an MCAA licence.

1.8.6 National Marine Plan

The Scottish National Marine Plan (NMP) comprises plans for Scotland's inshore (out to 12 nm) and offshore waters (12 to 200 miles) as set out under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009. The NMP represents a framework of Scottish Government policies for the sustainable development of marine resources. The NMP is underpinned by the following strategic objectives:

- Achieving a sustainable marine economy;
- Ensuring a strong, healthy and just society;
- Living within environmental limits;

- Promoting good governance; and
- Using sound science responsibly.

These objectives are to be achieved through the application of 21 'General Planning Principles'. Development projects should take these principles into account in order to support the overall NMP objectives for sustainable development of Scotland's marine environment. The NMP sets out specific key issues for oil and gas sector in supporting the objectives of the plan:

- Maximise extraction;
- Re-use infrastructure;
- Transfer of skills to renewables and CCS;
- Co-operation with the fishing industry;
- Noise impacts to sensitive species;
- Chemical and oil contamination of water, sediments and fauna;
- Habitat changes.

The NMP also sets out general policies and objectives as part of the UK's shared framework for sustainable development. The proposed operations as described in this ES have been assessed against all NMP objectives (Appendix A) and policies. The objectives and policies are described in Appendix A.

1.9 NEO NEXT+ Management System

NEO NEXT+ is committed to conducting activities in compliance with all applicable legislation and in a manner that will minimise impacts on the environment. Environmental and social impacts identified through the impact identification process will be inputted to the Project Risk Register. A summary of key environmental and social impacts and risks shall be included within the Project's decision documentation throughout all phases of the proposed Project.

NEO NEXT+ has established a clear framework for the effective management of Health, Safety and Environmental (HSE) issues involving their activities in the UK. The Company regards environmental management as being an integral part of its overall management responsibility, the fundamental aims being to support environmental protection, prevent pollution, and comply with legislation and regulations.

The proposed Montrose Infill Project will be delivered in compliance with NEO NEXT+'s Environmental Management System (EMS). NEO NEXT+'s HSE Policy is a public declaration of the Company's commitment to create a safe working environment such that no harm is caused to people, and where environmental impacts are minimised. The Company's HSE policy is provided in Figure 1-3.

Health, Safety & Environment Policy

Our Vision

Our HSE vision is to create a workplace where harm to people and the environment is prevented through responsible operations, visible leadership and a culture of care where we look out for one another.

Our Commitments

To meet our commitments, NEO NEXT+ shall ensure that:

- All personnel are aware of their responsibility to never compromise on safety as safety is a NEO NEXT+ Company Value
- Effective leadership is in place and all employees and contractors promote a positive HSE culture
- Robust systems and processes are implemented to ensure that all applicable HSE legislation, standards and other requirements are met
- All personnel are empowered to take responsibility for their own health and safety, observe company values and are trained and competent for their roles
- All personnel are aware of their duty to intervene and will use their "Stop Work Authority" if they see or suspect an unsafe condition or behaviour
- All operated assets adopt a set of key safety guidelines or rules to support our existing management systems and help prevent injuries to personnel
- We safeguard our people's health and well-being through health surveillance and well-being programmes
- We minimise our environmental impact and prevent pollution by managing our energy consumption, reducing carbon emissions and reducing the impact on the natural environment (water, air and soils)
- All risks are identified, assessed, and managed to levels that are as low as reasonably practicable
- Integrity of our assets is maintained over their lifecycle from design and construction to decommissioning
- All changes are identified and managed to ensure they are implemented correctly
- Incidents and near misses are reported in a timely manner and are fully investigated
- Appropriate plans for emergency situations and incidents are in place and regularly tested
- HSE management and performance is regularly assessed, reviewed, and audited to achieve continuous improvements
- We integrate human and organisational factors into all our business activities to ensure the interaction between people, the environment, equipment, and procedures are considered in all aspects of our activities

Our approach to health, safety and the environment is based on transparency and open, constructive dialogue with all stakeholders both inside and outside our business.

30th March 2026

Ferdinando Rigardo
CEO

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Figure 1-3: NEO NEXT+ HSE Policy.

1.10 Areas of Uncertainty

This ES was prepared during the Concept Select and Front-End Engineering Design phases of the proposed Project. As a result, some assumptions have been made in order to undertake the EIA. Where assumptions have been made, the option considered to have greater potential environmental impacts was assessed. Assumptions and uncertainties are outlined below.

1.10.1 Drilling Rig

The type of drilling rig to be used is not known at this time, such that either a semi-submersible or a heavy-duty jack-up (HDJU) may be selected. The ES carries both options and presents whichever option is deemed to be the worst case environmentally. For example, anchoring of a semi-submersible will have a larger footprint of impact on the seabed relative to the HDJU footprint, however the HDJU would likely result in deeper impressions on the seabed.

1.10.2 Well Locations and Separate Wells vs Drilling Template

Indicative well locations are provided in the ES. It is possible that at the time of drilling the final well locations may differ slightly, however they are expected to be within a few meters of the locations provided and all will be located within a single drill centre. The well locations provided in the ES allow for inclusion of maximum length of lines (including the flowlines, spools, umbilical and umbilical jumpers) and the maximum anticipated quantities of stabilisation materials.

At the time of writing the ES, it had yet to be determined if the wells would be drilled on a drilling template or off template. Therefore, the ES has considered the impacts associated with both options:

(1) five wells drilled on a template; and,

(2) five wells drilled off template.

For each environmental aspect being considered, the option resulting in the worst-case environmental impact will be assessed. The Project recognises the smaller area of impact from a template (compared to an off-template scenario). The project will endeavour to minimise impacts to the seabed by minimising the area of disturbance where possible.

1.10.3 Stabilisation and Protection Materials

The two pipelines (production and gas lift) and umbilical to be laid between the drill centre and Montrose BLP will be surface laid, however, it is not yet known which pipeline protection method will be selected. The preferred method (and most likely solution) is protection using mattresses, as this will allow recovery of the mattresses and lines at the end of field life. However, rock placement is always being considered in the event that mattresses do not provide suitable mitigation against Upheaval buckling (UHB). The ES will therefore consider both options and the worst-case scenario will be assessed for each receptor.

Maximum anticipated quantities of rock cover (if used), mattresses and grout bags are presented in the ES to assess the worst-case scenario in terms of impacts on the seabed. The requirements for stabilisation/protection material will be further assessed and confirmed in later Pipeline Work Authorisation (PWA) submissions and associated environmental permit applications.

1.10.4 Production Profiles

Production profiles based on models have a certain degree of uncertainty associated with them. The production profiles presented in this ES are aligned with those in the Field Development Plan (FDP).The profiles are an annualised average of the projected production from the Montrose field. Production profiles in Low, Mid, and High case are presented in Appendix F. The High case represents an optimistic scenario with maximum expected hydrocarbon output, assuming favourable technical and operational conditions and reflects the best-case projection of production volumes. The Mid case profile represents a most probably scenario based on current data and assumptions and serves as a reference case for planning and analysis. The Low case profile accounts for potential technical and operational challenges and represents a conservative, or worst-case, scenario with lower-than-expected hydrocarbon output.

1.11 Consultation Process

Consulting with stakeholders is an important part of the impact assessment process as it allows any concerns or issues which stakeholders may have, to be communicated and addressed. In September 2023, as part of the informal stakeholder engagement process, NEO NEXT+ issued a Scoping Report to stakeholders. The Scoping Report provided an overview of the proposed Project and the impacts to be assessed in the ES Report. Stakeholders were invited to comment on the Scoping Report with respect to any concerns they may have.

The Scoping Report was issued to the following in September 2023:

- Joint Natural Conservation Committee (JNCC) – written response received (Table 1-3);
- Maritime and Coastguard Agency (MCA) – written response received (Table 1-4);
- Northern Lighthouse Board (NLB) – written response received (Table 1-5);
- OPRED Environmental Management Team (EMT) – written response received (Table 1-6);
- Scottish Fishermen's Federation (SFF) – written response received (Table 1-7);
- Scottish Government Marine Directorate (SGMD) – written response received (Table 1-8); and,
- The Ministry of Defence (MoD) – responded with no comments.

Comments received on the Scoping Report are summarised in Table 1-3 to Table 1-8.

In addition, a Stakeholder Engagement meeting with JNCC and OPRED was held on 10th October 2025, during which additional feedback was provided to NEO NEXT+ and this feedback has also been added to Table 1-3 (JNCC feedback) and Table 1-6 (OPRED feedback). This meeting was set up as a discussion on existing survey data to inform the ES. The aims of the meeting were to:

- Inform JNCC and OPRED on the proposed project, the existing survey data, and the mitigation measures for minimising impact on the seabed;
- Discuss JNCCs response to the Scoping Letter (received October 2023); and
- Discuss any further concerns that JNCC / OPRED may have.

As required by the 2020 Offshore EIA Regulations, a copy of the ES and the public notice will be made publicly available on the Company's website at the time of submission. In addition, NEO NEXT+ will continue the process of consultation will continue throughout the project.

Table 1-3: JNCC Comments on Scoping Report / During Stakeholder Consultation Meeting.

JNCC Comment	Response
Comments on the Scoping Report (2023)	
JNCC recommend the use of the Site Information Centre for the East of Gannet and Montrose Fields NCMPA for further information on site features, our most recent conservation advice, and advice on operations.	The Site Information Centre for the East of Gannet and Montrose Fields NCMPA has been used to inform Chapter 4 (Environmental Baseline).
JNCC noted that site-specific environmental surveys have been undertaken and will provide a more detailed environmental baseline to inform the EIA and ES. JNCC requested that results are contextualised and related back to proposed operations and their specific locations. This should be done by providing detailed maps of the area, highlighting where surveys and proposed operations will be taking place.	A map of the area, highlighting where environmental surveys and the proposed operations will be taking place is provided in Chapter 4 (Environmental Baseline). Where relevant the impact assessment Chapters (Chapters 6 to 12) take account the results of the survey in the impact assessment.
JNCC noted that the operator has taken the NCMPA into account regarding protective materials and has opted to use mattresses wherever possible rather than rock/gravel. Should any additional protective material be required (even as a contingency), JNCC encourage the operator to minimise the amount of hard substrate used as much as possible. JNCC would welcome detailed commentary on protective materials to allow for further understanding of their nature conservation impacts. This would include specifics such as: › Location of any rock dump sites › Size / grade of any rock to be used › Tonnage / volume / quantity to be used › Contingency tonnage / volume / quantity to be used › Method of delivery to the seabed › Seabed footprint of protective material › Assessment of impact Where protective material cannot be avoided, JNCC recommended using a more targeted placement e.g. fall pipe vessel rather than using vessel-side discharge methods, and to avoid known aggregations of features of conservation interest as much as practically possible.	Addressed within Chapter 3 (Project Description) and Chapter 9 (Seabed Disturbance).

JNCC Comment	Response
The assessment of the cumulative effects of a project is required under EIA regulations. JNCC suggested 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 significant appropriate development for which some realistic figures are available. Due to the substantial offshore activities planned and/or taking place within the East of Gannet and Montrose NCMPA, this section will be of substantial importance at the ES stage.	A qualitative cumulative impact assessment has been undertaken in each of the impact chapters. Within the NCMPA, there will be ongoing activities at the Gannet Platform as part of oil and gas production, as well as activity at the awarded Innovation and Targeted Oil & Gas (INTOG) site within the NCMPA; this has been taken into consideration within the cumulative assessment in Chapter 9 (Seabed Disturbance).
Comments received during Stakeholder Consultation Meeting (2025)	
JNCC emphasised that juvenile *A. islandica* are protected as well as adults. The presence of juveniles should be treated as presence of *A. islandica*.	The ES assumes presence of *A. islandica* in Chapter 4 (Environmental Baseline) and Chapter 9 (Seabed Disturbance).
Discussions on data sources resulted in the following data sources being recommended by OPRED/JNCC for consideration in the ES: › Feature Activity Sensitivity Tool (FeAST) tool (https://www.nature.scot/professional-advice/protected-areas-andspecies/priority-marine-features-scotlands-seas/feature-activity-sensitivity-tool-feast); › JNCC Advice on Operations (AOps) tool, which shows which activities features of protected areas are sensitive to. JNCC strongly recommended that NEO NEXT+ refer to the JNCC Advice on Operations tool within the ES; › MarLIN (Marine Life Information Network); and › MarESA (Marine Evidence based Sensitivity Assessment) (Note OPRED/JNCC advised that FeAST is currently being updated in terms of advice on *A. islandica* and that the JNCC AOps tool is preferred)	The ES has included these data sources in Chapter 4 (Environmental Baseline) and they have been considered throughout Impact Assessment Chapters, particularly Chapter 9 (Seabed Disturbance).
JNCC acknowledged that Montrose is not in the muddy area of the NCMPA and requested that the ES demonstrates why there is a high confidence that rock pads won't be required for stabilisation of the HDJU.	Detailed in Chapter 3 (Project Description) of the ES.

Table 1-4: MCA Comments on Scoping Report.

Comments on the Scoping Report - MCA	Response
The MCA expected the EIA to consider the impact of the works on shipping and safe navigation with an appropriate risk assessment to mitigate the risk to As Low As Reasonably Practicable (ALARP). A traffic assessment (Shipping and Navigation) and a Collision Risk Management assessment must be in place in order to minimize the risk of ship collision and to define the guarding role of the ERRV whilst on location.	The impact to the shipping industry is assessed and discussion in Chapter 6 (Physical Presence). Note that no new shipping, navigation or collision risk assessment was undertaken to support the ES. However, this would be undertaken to support the drilling permit application. An ERRV will remain present during drilling phase and throughout field life extension.
Subject to the risk assessment, the MCA expected the standard conditions as set out below for this development. The conditions used may vary but should be based on the Navigational Risk Assessment, along with any other mitigation measures in respect of trenching, mattressing and over-trawlability protection where required. 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. Communications with other bodies in relation to the consent conditions should be addressed to: › UKHO › MCA › General Lighthouse Authorities › Kingfisher Information Services › Local Notice to Mariners. Local operators are defined as operators of vessels who regularly use the vessel routes identified within the Vessel Traffic Survey Report which is required to be produced, and submitted, as part of the Consent to Locate application process.	The impact to the shipping industry is assessed and discussion in Chapter 6 (Physical Presence). NEO NEXT+ commit to: a) Notify the UKHO and MCA at least 48 hours in advance of commencement of the works. b) To inform Kingfisher Information Services and local operators at least two weeks in advance of works commencing. Additionally, NEO NEXT+ commit to immediately notify the relevant parties if determination of the application occurs within the two weeks prior to works commencement.
MCA requested that an Oil Pollution Emergency Plan and Emergency Response Procedure is put in place.	The Montrose field has an approved OPEP in place, as detailed in Chapter 12 (Accidental Events). The OPEP will be updated to include the new Montrose

Comments on the Scoping Report - MCA	Response
	Infill wells, and a Temporary Operations OPEP (TOOPEP) would be in place during drilling.

Table 1-5: Northern Lighthouse Board (NLB) Comments on Scoping Report.

Comments on the Scoping Report - NLB	Response
NLB requested clarification on the positioning of the new module.	The positioning of the new module, which will be placed on the Montrose BLP, is detailed in Chapter 3 (Project Description).
If the new module extrudes beyond the existing structure, NLB requested that an assessment is completed on the impact that the module will have upon the arcs of visibility of marine navigation lighting on the BLP platform. This is to ensure that compliance with the Standard Marking Schedule for Offshore Installations is maintained.	The new module is discussed in Chapter 3 (Project Description). NEO NEXT+ commits to preserving arcs of visibility and as such will ensure that lighting on the BLP will continue to comply with the Standard Marking Schedule for Offshore Installations.
In addition, NLB requested that 'as-built' plans are provided to the UK Hydrographic Office on completion of the works, to enable the update of appropriate navigational publications.	NEO NEXT+ commit to providing as built plans to the UKHO on completion of works.

Table 1-6: OPRED Comments on Scoping Report.

Comments on the Scoping Report - OPRED	Response
OPRED requested that a non-technical summary is included in the ES as detailed in Schedule 6 of the EIA Regulations	A non-technical summary has been included.
OPRED requested that the anticipated field life is discussed in the ES.	Field life is discussed in Chapters 1 (Introduction) and 3 (Project Description).
The ES should provide production figures in tonnes per day of oil in addition to m^3. Production figures of gas should also be shown in m^3 in addition to standard cubic feet.	Production Profiles are provided in the requested units in Appendix F.
For hydrocarbons and produced water, production to end of field life should be forecasted (to align with the associated FDP) and the high, medium and low case production values should be included for each (P10, P50 and P90).	The low, medium and high case production forecasts for hydrocarbons and produced water are listed in Appendix F. The production profiles presented in the ES mirror the profiles added to the FDP.
OPRED requested that clarity is provided as to why the Montrose Infill Project is considered a Schedule 1 project under the EIA regulations.	Clarification is provided in Section 1.3.
A section should be provided in the ES which considers alternative options for the development. Areas to consider include; › Rig selection – emissions minimisation;	This is partly covered in the section on the Project Alternatives within the Project Description chapter (Section 3.2) and partly covered in the Net Zero Chapter (Chapter 2) as follows:

Comments on the Scoping Report - OPRED	Response
› Vessels – MARPOL/IMO GHG objectives and optimisation; › Well design – minimise interventions, any future potential uses as Carbon Capture Utilisation and Storage (CCUS) injection wells; › Pipelines – minimised resources associated with length and associated deposits. › Manifold - can it be suction installed or gravity based, rather than piled? › Future-proofing - for example capability to convert easily to electrification in future.	› Rig selection – Discussed in Section 1.9.1 generally, and Section 2.3.1 in the context of emissions minimisation. › Vessels – All vessels will be MARPOL compliant and NEO NEXT+ are committed to auditing their contractors (which would include assessment of their combustion equipment). Discussed in Section 2.3.1. › Well design – Discussed in Section 2.3.1. › Pipelines – Discussed in Section 3.2.4. › Manifold – Discussed in Section 3.2.3. › Future proofing – Discussed in Sections 2.2.2 and 2.3.2 (Electrification Readiness).
The option selection should detail how environmental considerations and emissions influenced the chosen option. How emissions are being reduced and/ or offset elsewhere should be discussed. The associated carbon intensity of the project should be discussed when comparing alternatives. Carbon intensity values should also be compared with average figures for the central North Sea.	This is partly covered in the Project Alternatives within the Project Description chapter (Section 3.2) and partly covered in the Net Zero Chapter (Chapter 2), enclosed in Section 2.1 and 2.3.1.
OPRED requested that long term plans to power the Montrose platform are discussed. For example, consideration could be given to electrification, renewable energy sources and bio-fuels.	This is covered in the Net Zero Chapter (Chapter 2) enclosed in Sections 2.2 (Decarbonisation of MonArb Hub) and 2.3.2 (Montrose Infill Project Electrification Readiness).
Atmospheric emissions should be determined for all phases of the development (installation, operation and decommissioning). Emissions from the project should be compared with UK Carbon Budgets (going up to 2037) that will apply in the period of production. These should be compared to the North Sea Transition Deal target emission levels for 2025, 2027 and 2030 (according to the lifespan of the proposal).	Covered in Chapter 7 (Emissions to Air). Note, emissions associated with the decommissioning phase are not estimated in the ES because of the uncertainty associated with the decommissioning basis / philosophy at this stage. However, the emissions associated with the plug and abandonment of the wells and the decommissioning of the subsea infrastructure to be installed are expected to be less than the emissions associated with the drilling and installation phases.
The ES should consider opportunities for future use of the infrastructure, for example CCUS / hydrogen production. Areas to consider are; reservoir suitability for storage, wells and pipeline suitability for transport of these products.	This is included in the Net Zero Chapter enclosed in Section 2.3.3 (Potential for Repurposing / Re-use of Montrose Infill Infrastructures). Also mentioned in Section 3.11 (Decommissioning).
The existing Montrose PPC permit has a derogation to exceed the 350 mg/Nm3 emissions limit (currently permitted at 585 mg/Nm3). These are time limited exceedances of the emissions limit until 17th August	Montrose Complex has a single Large Combustion Plant (LCP) qualifying plant type: 2 of Open Cycle Gas Turbines (OCGTs) LM2500+ on BLP run on a duty/standby arrangement. Whilst running. they

Comments on the Scoping Report - OPRED	Response
2025 (supported by a cost benefit analysis). The ES should refer to guidance on Large Combustion Plant (LCP) Best Available Technology (BAT) Associated Emission Levels (AEL's) and assess the likely impact on the LCP from the development.	currently operate below the 70% threshold where BAT-AEL (350 mg/Nm^3) for NOx applies: at 18.9MW (<65%). To ensure permit compliance where plant operation necessitates load level above 70 %, (19.96MW) a derogation is in place permitting an emission limit of 500mg/Nm^3. The derogation application modelling included an additional 1MW load potential associated with Montrose infill which may cause load to exceed the 70 % threshold (the assumption being current operating load + 1MW for Montrose Infill). Supporting the derogations application, a Cost Benefit Analysis (CBA) presented Best Available Technique (BAT) evaluation in the form of a benefit analysis of emission improvement technologies available. Together with the Assessment of NOx emissions in Chapter 7 of the ES, it is concluded that the Montrose NOx emissions are (i) minimally increased by Montrose Infill and (ii) upper modelled NOx emissions are minimal and as low as reasonably practicable.
The ES should take into account recently announced changes concerning Medium Combustion Plant (MCP) permitting.	As there is no requirement for installation of new combustion equipment with the Montrose Infill Project, this is not applicable.
The ES should consider all relevant general policies (Chapter 4) and the oil and gas sector specific policies and objectives (Chapter 9) of Scotland's National Marine Plan.	The ES considers the relevant general policies and the oil and gas sector specific policies of Scotland's National Marine Plan in Appendix A.
The Department welcome that decommissioning will be considered in the ES. The ability to decommission should also be considered in the option selection process.	The base case solution of flexible flowlines and umbilicals on seabed with concrete mattresses offers the opportunity for the facilities to be recovered and disposed as part of the decommissioning process. In event that the flowlines and umbilicals are covered by rock placement, should current guidelines still be in place, a comparative assessment would be carried out to determine the optimal approach to decommissioning the lines Decommissioning is discussed in Section 3.11.
A high level overview of chemical use should be provided in the ES. Compatibility of production fluids with those already being produced at Montrose should also be considered.	Chemical use is discussed in Chapter 8 (Discharges to Sea).
The ES should provide an overview of the designated features, conservation objectives and current status of the East of Gannet and Montrose Nature Conservation Marine Protected Area (NCMPA). The ES should also	The ES provides an overview of the designated features of the East of Gannet and Montrose Fields NCMPA in Section 4.4 and addresses potential

Comments on the Scoping Report - OPRED	Response
consider any potential impacts on Annex I habitats or priority species in the vicinity. The impact assessment should consider impacts of the project alone and cumulatively on these species, designated features and conservation objectives. Impact areas associated with the project should be expressed as a percentage of the NCMPA area for context. Use of the Feature Activity Sensitivity Tool is advised when considering the likely impacts of a project on habitats and species of conservation concern.	impacts on these features in Chapters 8 (Discharges to Sea) and 9 (Seabed Disturbance).
The ES (and supporting modelling) should consider the potential impact of likely drilling scenarios including contingencies. The worst case cuttings discharge situation should be presented in the ES.	Details of the contingencies included in the modelling are provided in Appendix E (Drill Cuttings Modelling), which was agreed following additional OPRED consultation.
Aggregated Vessel Monitoring System (VMS) fishing effort data sets for 2010 - 2020 from the National Marine Plan Maps interactive web site NMPi) should be used. EMODnet average annual fishing effort (mW fishing hours) in the Greater North Sea Ecoregion during 2015–2018 should also be used.	This information is detailed in Section 4.6.1 of Chapter 4 (Environmental Baseline).
A visual representation of the recently added nine new spatial layers to the National Marine Plan interactive (NMPi) is also advised, showing changes over the last five years of published statistics for: › tonnage for demersal, pelagic and shellfish species; › value (£) for demersal, pelagic and shellfish species; effort (days) (by UK vessels >10m length) for demersal active (bottom trawls, dredges etc.); pelagic active (pelagic trawls, purse seines etc.); and passive (pots/creels, gillnets etc.).	This information is detailed in Section 4.6.1 of Chapter 4 (Environmental Baseline).
The EMODNET Human Activities data portal now contains recent vessel density information based on the Automatic Identification System (AIS) and OPRED advised that this should be included.	This information is detailed in Section 4.6.2 of Chapter 4 (Environmental Baseline).
OPRED requested that detail on whether the proposed infrastructure is designed to be over-trawlable is included.	Detail on whether the proposed infrastructure is over-trawlable is included in Section 3.2.4 and Section 3.2.5 of Chapter 3 (Project Description). In addition, given the close proximity of the drill centre to the Montrose Complex, all infrastructure will be located within either the existing 500 m safety zone associated with the Montrose Complex or the proposed 500 m zone around the new drill centre. It is also acknowledged that as of October 2025, there are restrictions on commercial fishing

Comments on the Scoping Report - OPRED	Response
	within the East of Gannet and Montrose Fields NCMPA.
The seabed disturbance chapter should consider the potential for disturbance and remobilisation of any contaminated sediments in the vicinity of the Montrose platform.	Assessment of disturbance and remobilisation of the contaminated sediments in the vicinity of the Montrose Complex has been presented in Section 9.5.1 of Chapter 9 (Seabed Disturbance).
The permanent and temporary impacts of seabed disturbance should also be assessed.	A summary of temporary and permanent impacts is provided in Table 9-1 and impacts are assessed in Section 9.5 of Chapter 9 (Seabed Disturbance).
The Offshore Installations (Offshore Safety Directive) Regulations 2015 (SCR 2015) transposed the requirements of the Offshore Safety Directive (OSD) and came into force on 19 July 2015. The SCR 2015 also aims to increase the protection of the marine environment and coastal economies against pollution and to ensure appropriate response mechanisms are in place in the event of such an incident. The ES should give due consideration to the potential for operations to result in Major Environmental Incidents (MEI) as defined under OSDR. In most cases, the worst-case scenario relating to the identified major accident hazards will equate to the worst-case potential release assessed under the EIA process. The assessment in the EIA will therefore be relevant and will additionally confirm whether there is likely to be a significant impact that would constitute a MEI.	The worst-case release has been detailed and assessed. Activities that could result in an MAH and those which could be an MEI have been identified. This assessment is presented in Chapter 12 (Accidental Events). Oil Spill Modelling is included in Appendix C.
Where there is potential for shoreline oiling on the Scottish coastline as a result of an accidental event scenario, OPRED advised that impacts on aquaculture and Shellfish Water Protected Areas should be considered.	Potential impacts on aquaculture and Shellfish Water Protected Areas are discussed in Chapter 12 (Accidental Events). The closest aquaculture sites are 176 km away, as discussed in Chapter 4 (Environmental Baseline) and are therefore not assessed further.

Table 1-7: Scottish Fishermen's Federation (SFF) Comments on Scoping Report.

Comments on the Scoping Report - SFF	Response
SFF regard the safety of fishing vessels all the time and therefore proposed that sufficient safety measures be in place during surveys, construction, operation, and decommissioning activities of the project. Moreover, post-decommissioning, SFF would like to see that the seabed is returned to its natural state and is safe for fishing vessels to resume in the area.	During all phases, safety measures and notifications will be in place to mitigate effects on the fishing industry. At the time of decommissioning, an Environmental Appraisal will be produced with appropriate measures detailed. NEO NEXT+ are committed to ensuring a safe seabed following decommissioning. Details of decommissioning are provided in Section 3.11. Section 3.2.4. details the safety of fishing vessels being a reason in selecting a piled manifold over other manifold installation options (although it is

	acknowledged that as of October 2025, there are restrictions on commercial fishing within the East of Gannet and Montrose Fields NCMPA).

Table 1-8: Scottish Government Marine Directorate (SGMD) Comments on Scoping Report.

Comments on the Scoping Report - SGMD	Response
SGMD advise the application should meet the requirements and recommendations of the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020, The Petroleum Act 1998 and associated guidance documents. SGMD also advise the application should consider how the proposed works comply with Scotland's National Marine Plan, which was published in March 2015, in accordance with the Marine (Scotland) Act 2010.	The ES was completed in line with the requirements of the 2020 Regulations, the Petroleum Act 1998, and associated guidance notes. An assessment against the Scottish NMP has also been completed (Appendix A).
SGMD advise the site-specific modelling should provide the best understanding of the potential fate and impact of discharges / emissions.	Modelling for the fate of drilling discharges is provided in Appendix E. Modelling for the fate of an oil spill is provided in Appendix C. These site-specific modelling studies have informed the assessments provided in Chapter 8, Chapter 9, and Chapter 12.
SGMD advise that OPRED ensure such deposits will not pose a future hazard to other sea users or impact the ability to decommission adjacent infrastructure.	The impacts of the physical presence of project infrastructure on other sea users are discussed in Section 6.2.1 of Chapter 6 (Physical Presence).
SGMD recommend the timing of the operation is moved out-with the spawning period for that species or that OPRED satisfy themselves the operator has demonstrated that spawning stock level impacts are not likely, taking account of associated cumulative impacts.	Spawning periods for fish are included in Section 4.3.3. Cumulative impacts to commercial fisheries are addressed in Chapter 6 (Physical Presence). NEO NEXT+ recognise that the drilling and installation schedule overlaps with spawning and nursery periods for some fish species in the area. Where possible scheduling of the offshore activities will limit the working period and minimise the impact on spawning and nursery periods.
SGMD advise operators should demonstrate that the installation or removal of infrastructure will not significantly impact commercial fishing operations or pose a hazard to other sea users.	The impacts from installation and removal of infrastructure on other sea users are discussed in Chapter 6 (Physical Presence).
SGMD advise that OPRED ensure impacts on aquaculture and Shellfish Water Protected Areas are considered.	The closest aquaculture sites are 176 km away, as discussed in Chapter 4 (Environmental Baseline). The probability of aquaculture and Shellfish Water Protected Areas being impacted by a well blowout is discussed in Chapter 12 (Accidental Events).

2 Pathway to Net Zero

In 2019, following the ratification of the Paris Agreement by the UK, the government introduced a legally binding commitment (through the Climate Change Act 2008 (2050 Target Amendment) Order 2019) setting the UK on a firm pathway to Net Zero greenhouse gas (GHG) emissions; in other words, targeting at least 100% GHG emissions reduction by 2050 compared to 1990 levels (UK Government, 2019). Through the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, 2045 is designated as the goal year in Scotland for achieving 100% emission reduction. To ensure the UK and all devolving governments remain on track with their commitments, an independent committee, the Climate Change Committee (CCC), is tasked with monitoring developments and the legally mandated five-year Carbon Budget system that supports the Net Zero targets. The UK's Carbon Budgets determine the legal limit on GHG emissions during a given period of time. The UK's first Carbon Budget under the new Net Zero objective was the 6th carbon budget released by the CCC in 2020. The 6th Carbon budget was enacted in 2021 following government review.

The UK Government's main climate change policy document is the Net Zero Strategy (Build Back Greener) (HM Government, 2021) which sets out policies and proposals for decarbonising all sectors of the UK economy to meet the Government's Net Zero target by 2050, and builds on the Government's Ten-point plan for a green industrial revolution (HM Government, 2020b). The offshore oil and gas industry and the UK government entered into a sector agreement known as the North Sea Transition Deal (NSTD) (UK Government, 2021). The NSTD recognises the key role the UKCS offshore oil and gas sector plays in meeting the UK government's Net Zero commitments and supports the sector's transition to clean, green energy and a secure future for high-skilled oil and gas workers and the supply chain. It also includes a commitment to reductions in offshore production emissions of 10% by 2025; 25% by 2027; and 50% by 2030, against a 2018 baseline (UK Government, 2021).

The North Sea Transition Authority's (NSTA) (formerly known as the Oil and Gas Authority (OGA)) revised Strategy (OGA, 2021) places an obligation on UKCS oil and gas operators and licensees to take appropriate steps to assist the UK Government in meeting the Net Zero target in line with the NSTD and whilst maintaining the UK's energy security in this transition, to consider their social licence to operate, and to develop good Environmental, Social and Governance (ESG) practices in their plans and daily operations.

This chapter summarises how NEO NEXT+, as a UK operating company, supports the UK Government's Net Zero target and how the Montrose Infill Project aligns with the NSTD policies and commitments, and NEO NEXT+'s Net Zero commitments (NSTA, 2021a).

2.1 Decarbonisation of NEO NEXT+ Operations

NEO NEXT+ is placing a strategic focus on emission management and managing the carbon intensity of its operations through supporting the industry's transition as mandated by the NSTD to clean, green energy whilst ensuring a secure future for skilled oil and gas workers in the Northeast of Scotland and across the UK (UK Government, 2021). The Company recognises the importance of emissions management and managing the carbon intensity of its operation in line with its wider corporate strategy.

2.1.1 NEO NEXT+ Emissions Management Overview

It is the Company's target that all operations are conducted in a manner that strives for good emissions management, seeking emissions reductions in line with or better than the 2050 Net Zero emissions goal. Furthermore, NEO NEXT+ are committed to taking the lead in the energy transition in line with the objectives of the Paris Agreement and the Sustainable Development Goals of the United Nations.

NEO NEXT+ has developed its own road map to meet the UK government's 2050 Net Zero emissions goal. Whilst this is aligned to the NSTA's Net Zero targets as set out in the NSTD, it details the key steps the Company believes it will need to take to achieve Net Zero.

A key aspect of the emission road map are the phased opportunities which NEO NEXT+ continues to explore across its portfolio. NEO NEXT+ has already executed several emission reduction initiatives and continues to explore new opportunities for emissions reductions, with these opportunities falling into four broad improvement categories:

- Phase 1 – Operational Improvements: Delivering emissions reductions by changing the way it operates its existing plant and equipment.
- Phase 2 – Plant Improvements: Delivering emissions reductions by plant upgrades and operational philosophies.
- Phase 3 – Step Change Improvements: Delivering emissions reductions by larger scale changes such as platform electrification, deployment of renewable power sources, CCS and hydrogen.
- Phase 4 – Business Diversification: Delivering emissions reductions by diversifying from oil and gas production.

2.1.2 Improving Operation Efficiencies

EMISSION REDUCTION ACTION PLANS (ERAP)

Central to the 'license to operate' obligations set out in the NSTA Revised Strategy is the requirement for UK operators to undertake their upstream operations in line with the NSTA Stewardship Expectations (SE) including Stewardship Expectation 11 – Net Zero (SE11) (NSTA, 2021a). SE11 states that for each UK offshore operated asset or hub a GHG Emissions Reduction Action Plan (ERAP) must be developed, implemented, and maintained. UKCS assets operated by NEO NEXT+ have established ERAPs to target emission reductions and improve operational efficiency through a variety of projects, focusing notably on power generation, flaring, and venting.

The ERAPs are site specific and have been agreed with the Executive Leadership. The ERAPs include:

- a costed implementation plan with dates;
- anticipated CO_2e saving, cost to implement, net present value and payback period for each opportunity identified from present day to CoP;
- identification of more complex line items to be studied and confirmed to offer the expected emissions savings before enactment; and
- integration of the OEUK's Methane Action Plan requirements (OEUK, 2025).

A key element of the management of the ERAPs is that they are reviewed with both onshore support and offshore asset personnel on a monthly basis.

FLARING

In accordance with the World Bank Zero Routine Initiative, the NSTA aims for zero routine flaring by 2030 for the UCKS basin (NSTA, 2021a). As set out in the Company's Net Zero roadmap (Section 2.1.1), flaring strategies across operated assets are continuously reviewed with an aim of continuous improvement to target zero routine flaring by 2030.

NEO NEXT+ has conducted a review of all flare and vent arrangements across its assets to identify all sources of flaring and venting and identify flare and vent gas recovery opportunities where feasible. Recommendations from the study have been integrated into individual asset ERAPs for further engineering investigation.

Acoustic valve surveys are also regularly conducted on offshore assets to determine where valves are passing unnecessarily to flare or releasing fugitive emissions. Once identified, the valve is either maintained *in situ* to stop the valve from passing or changed out at the next shutdown opportunity. Another area of focus for reduced flaring is instrumentation control loop tuning. Surveys are regularly undertaken to identify underperforming control loops leading to gas unnecessarily routed to flare and where possible, identifying adjustments to reduce this.

METHANE

Offshore methane emissions are predominantly generated from venting, gas turbine and flare system combustion inefficiencies and fugitive emissions from processing plants. Improving the Company's monitoring of methane emissions is an area of continuous improvement. NEO NEXT+ is committed to meeting EU Methane Regulation requirements, which are equivalent to the Oil and Gas Methane Partnership (OGMP) 2.0 level 5, for all relevant assets which export to the EU. NEO NEXT+ is committed to managing its methane emissions by adhering to OEUK Methane Action Plan requirements (OEUK, 2025), and by minimising routine flaring and venting as per the NSTA's SE11 (NSTA, 2021a).

ELECTRIFICATION

The need to electrify offshore oil and gas installations forms a key part of the NSTD, where it is considered as a step-change abatement option for emissions reduction. NEO NEXT+ recognises that offshore electrification provides a mechanism to significantly reduce at-site emissions involved in the production of oil and gas. NEO NEXT+ is fully committed to actively engaging with the NSTA and other operators to understand what is required to electrify an oil and gas installation. NEO NEXT+ continues to evaluate the viability of electrification across its UKCS operated assets where appropriate, either through cables from shore or through a dedicated windfarm option.

2.2 Decarbonisation of the MonArb Hub

As part of NEO NEXT+'s strategic focus on emission management and decarbonisation of its assets, it has undertaken various initiatives in line with the approaches defined in Section 2.1.2 to manage the decarbonisation of its assets within the MonArb Hub area, which includes the Montrose Complex.

2.2.1 Montrose ERAP

NEO NEXT+ has ERAPs in place for each of its producing assets. The Montrose ERAP has been developed from a hopper of emissions reduction ideas which was compiled using existing reports, new ideas generated by Emission Reduction Focal points, site specific decarbonisation studies, as well as suggestions from the general work force.

The plans are site specific and have been agreed with the Executive Leadership Team.

The reduction opportunities being considered are broad reaching and incorporate low Capital Expenditure (CAPEX) operational changes, as well as high CAPEX engineering changes.

2.2.2 MonArb Hub Electrification Readiness

In the OGA Plan to reduce UKCS greenhouse gas emissions, the NSTA (2024) have stated that all assets intending to produce oil or gas beyond 2030 must have ERAPs that include a comprehensive technical and economic assessment of both full and partial electrification options. This must include a full assessment of potential emissions savings from relevant regional electrification schemes (based on the societal cost of emissions). That assessment must identify all reserves and resources that may be developed through that asset. These requirements build on, and are consistent with, the NSTA's Net Zero expectations set out in the Field Development

Plan guidance (NSTA, 2021c). NEO NEXT+ will continue to engage with the NSTA and government in identifying and addressing barriers where appropriate.

Considering the location of the Montrose Complex installation and the likely modification required to be made to the Montrose Complex, it has been identified that electrification of the Montrose Complex would have to be achieved within the bounds of the following:

- Part of a multi-asset scheme rather than a Montrose specific scheme.
- The source of power must be a (green emission free source) wind farm with the ability to import power from the grid, or grid only providing a reliable and stable power source with high levels of availability.
- Remaining field life is limited, first power must be early to provide suitable benefits.
- First power for the Montrose Infill project should be one year after first power is generated from the wind farm / made available via a grid connection.
- NEO NEXT+ will bear the costs of the platform modifications and the cable connection to a hub.
- A 3rd party will bear the costs of the wind farm and connections to the grid between the wind farm and grid which would be reflected in a Power Purchase Agreement (PPA) on the price of power.

Study work has indicated that electrification of the Montrose Complex poses significant challenges due to the life of the field and expected first power dates which are likely to be beyond 2030, as well as uncertainties around the availability of cables, a grid supply, and wind turbines. Given these uncertainties, for the purpose of assessing the environmental impacts; this ES is based upon no electrification of the Montrose Complex. This study work is further detailed in Section 2.2.3.

2.2.3 Montrose and Electrification

Several studies have considered the electrification of the Montrose Complex, including:

- Integration of the Complex into the Central North Sea Electrification (CNSE) Project;
- Montrose Electrification Appraisal Study; and
- Electrification of Montrose via an isolated (islanded) wind farm.

A summary of the findings of each of these studies is presented here.

CENTRAL NORTH SEA ELECTRIFICATION (CNSE) PROJECT

Within the North Sea, the CNSE Project is a collaborative project between several operators which aims to contribute to the decarbonisation of the offshore energy sector through electrification of existing oil and gas infrastructure in the CNS. In 2021 a confidential Concept Screening Report was completed which included consideration of the Montrose Complex. This report covered a number of electrical power supply concepts which included (but not limited to):

1. A cabling system from the UK to an offshore convertor station;
2. A cabling system from Norway to an offshore convertor station; and
3. Power to an offshore convertor station from a local offshore windfarm.

Cabling would then be laid from the offshore convertor station to each participating CNSE asset. An EIA Scoping Report was subsequent submitted considering the first of the three options listed (Xodus, 2023).

In addition to considering different power supply concepts the Concept Screening Report also estimated the abatement cost for every tonne of CO_2 at site. The report estimated that the abatement cost for Montrose would

be >£350 / te CO_2, which is significantly higher than both the cost of CO_2 under the UK ETS (including forecasted costs) and the societal cost of CO_2[1].

It was concluded that the Montrose Complex would not proceed further beyond the CNSE Screening Report. This was principally due to the relatively small potential emissions saving at the Montrose installation when compared to other UKCS sites being considered for electrification. It should also be noted that the gas power generation turbines installed on the Montrose installation are relatively modern and operate at a high efficiency.

2023 MONTROSE ELECTRIFICATION APPRAISAL STUDY

In 2023 a study was commissioned to identify the brownfield modifications which would be required at Montrose in order to achieve electrification. The study concluded that there is insufficient space within the existing Montrose BLP switch room to accommodate the new equipment required to electrify Montrose. An option screening assessment was carried out considering alternative locations on the Montrose BLP for the necessary equipment. One potentially suitable location was identified, however, it presented significant size restrictions[2]. The report concluded on a modular solution that would require a cantilever support.

In addition to requiring a new module with cantilever support there is insufficient J-tubes to accommodate a power cable, such that a new J-tube would need to be installed.

The expectation at the time of writing the ES is that earliest first power from grid connection will be around 2031. When it is considered that the Montrose CoP is mid 2030s. This means that the period in which Montrose would benefit from emissions reductions from electrification is relatively short.

ISLANDED WIND FARM SUPPORTING MONTROSE

In 2022, a study was commissioned to explore the feasibility of installing an islanded wind farm which would provide dedicated electrical power to the Montrose Complex. The study explored two options, a single wind turbine option and a dual wind turbine option.

An islanded windfarm is expected to reduce requirements for large cabling lengths, and additional requirements for large transformers located on one of the Montrose platforms. However, unlike a grid connected windfarm there is no opportunity to provide back-up power during periods where the wind conditions are outside the operating limits of the wind turbines.

The report concluded that in both scenarios the gas turbines would need to be retained at the Montrose Complex, thereby eroding the emissions benefit. Operating two wind turbines could deliver the required power on Montrose if they were running at 100% capacity 100% of the time. Wind intermittency would mean that these requirements are not expected to be met for significant periods. As oil and gas installations typically operate at steady state power generation (with slight load variances due to equipment being started / stopped), the variability of offshore wind means that at least one gas turbine must continue to run at a low load whilst the wind turbines are in use so that it could provide power generation quickly to combat the intermittency of the wind turbines. Running the gas

[1] UK Government derives GHG emissions values to represent the societal cost of emissions due to e.g. health impacts, flooding, the cost of climate change mitigations etc. These values are used across government for valuing impacts on GHG emissions resulting from policy interventions. In 2020 prices the central value for GHG emissions values projected between 2025 and 2035 (the date for Montrose cessation of production) ranges between £260 and £302 /teCO_{2e}. Further information can be found at: Valuation of greenhouse gas emissions: for policy appraisal and evaluation - GOV.UK

[2] Note other options considered were ruled out due to locations being earmarked for other requirements, or the locations being found to be in contradiction to the design philosophy of having all utilities at the south end of the BLP behind the blast wall.

turbine(s) at low loads results in lower efficiency of the turbine, as well as potentially damaging the unit. This could be offset against load banks which would allow a period of Uninterrupted Power Supply (UPS) back-up until the turbine can be started and brought online. However, at 22 MW load and a typical 30-minute start-up time, this would oblige the use of a significantly large battery storage solution which would take up a lot of space on the platform as well as the associated increase in weight. This could not be fully negated by deploying more wind turbines as the intermittency would remain. Furthermore there would be additional challenges concerning the use / storage of excess power, particularly with the lack of an import / export connection from the onshore power grid.

CONCLUSION

As outlined above several options have been considered for future use, including power from shore. Studies have been undertaken to understand modifications required to accept these sources of low carbon power. Depending on the extent of the electrification and existing operations, these modifications can include both electrical system changes and modifications to processing facilities. The studies have shown that electrification of the Montrose Complex would require significant brownfield modifications. In addition, Montrose would benefit from emissions reductions over a relatively short period before CoP. Given these uncertainties, for the purpose of assessing the environmental impacts; this ES is based upon no electrification of the Montrose Complex.

2.2.4 Montrose Platform Flare Gas Recovery

NEO NEXT+ commissioned a study to assess the feasibility of implementing Flare Gas Recovery (FGR) on the Montrose Complex (Stage 1). The study investigated the suitability of different technologies that can be used for recovery of the flare gas, such as gas-gas eductor, gas liquid eductor, or a stand-alone compression package. While the gas-gas and gas-liquid eductor options were identified as being smaller, less costly, and operationally simpler than the stand-alone compression packages, it was found that they were unsuitable for this application due to insufficient availability of motive fluid. Consequently, a stand-alone compression package was selected as the most appropriate solution, with the technology assessment concluding that a liquid-ring compressor represents the preferred option. The study also highlighted the challenges associated with installing a relatively large equipment package on the Montrose asset. These considerations were carried forward for resolution during the next phase of engineering.

Stage 2 comprised a Front-End Engineering Design (FEED) study focused on the option selected during Stage 1. This phase was commissioned to further develop the design, confirm the technical and operational viability of the solution, and address the issues identified in the Stage 1 recommendations. The Stage 2 report establishes the most suitable location for the compression package, verifies the feasibility of the proposed pipework routing, and confirms the availability of adequate utility supplies. In addition, the study demonstrates that the project will deliver a net daily reduction in CO_2 emissions, thereby validating the environmental benefit of implementing the selected FGR solution.

NEO NEXT+ will continue to assess and manage the installation of a flare gas recovery unit on the Montrose Complex through its Integrated Project Management System. This will be done on the context of the NSTA's Zero Routine Flaring by 2030 goal. If the proposed Project moves forward, NEO NEXT + anticipate having the FGR system operational by 2030.

2.3 Montrose Infill Project Net Zero Evaluation

To ensure that the proposed Montrose Infill Project aligns with NEO NEXT+'s Net Zero road map, optimisation measures will be taken to minimise the emissions during the construction and operating phases of the Project life cycle. The design, construction and operation will all be conducted using the emissions management and efficiency saving approaches detailed in Section 2.1 and with consideration to ongoing decarbonisation initiatives

within the MonArb area. This will ensure alignment with NEO NEXT+'s broader decarbonisation initiatives and targets within the MonArb area, and across the organisation.

2.3.1 Minimising GHG Emissions and Flaring Through Design

VESSEL USE

All vessels used in the construction and operation on the proposed Project will be MARPOL compliant, with NEO NEXT+ being committed to auditing any contractors and their combustion equipment to ensure compliance with MARPOL and IMO GHG and Net Zero objectives. Optimisation will be carried out where possible to minimise the number of vessels required, time in transit and length of time on site during construction. The proposed Project will not increase the number of supply and support vessels required on site at the complex during production or their rate of fuel consumption, but by extending the CoP of the Complex through the Montrose Infill Project, these vessels will be required on site until 2035 as detailed in Chapter 7 (Emissions to Air). Through optimised vessel use and associated fuel use, GHG emissions from vessels will be minimised wherever possible.

CONCEPT DESIGN

The selected design concept for the Montrose Infill production is to route the fluids through existing processing equipment, co-mingled with production from the existing Shaw field, and to operate within the existing processing capacity constraints (specifically by cutting back production of high water cut Arbroath production due to limitations in gas compression capacity). This approach ensures that no additional equipment is required and that there is no increase in compression or pumping loads (the oil export rate will not be increased above the existing pumps' minimum flow recycle setting). Increasing the oil and gas production will reduce the overall Montrose Complex energy intensity and emissions intensity – in full alignment with NEO NEXT+'s emissions strategy (Section 2.1.1)

DRILLING AND WELL DESIGN

Logistics and transport requirements will be optimised in the design, procurement and execution phases of the well construction process to minimise durations and generation of GHG emissions. The potential to batch drill and complete sections of the wells is being evaluated. This could bring significant optimisation of transportation and emissions by reducing operations such as fluid system changes, equipment load outs and rig-up and down of temporary equipment.

On each well, following clean-up, a main well flow test will be undertaken via the rig where possible to obtain reservoir information and fluid samples. The well test will be designed to provide an optimal duration and reduce flaring to minimise the GHG emissions produced. Modern 'green' burners will be utilised to ensure all hydrocarbons are burnt completely.

Opportunities to utilise multi-skilled field personnel and remote operations support to reduce helicopter transits and offshore rig personnel will be evaluated. The logistics personnel onshore and offshore will operate in accordance with all relevant procedures and will strive to optimise vessel and helicopter utilisation.

A core objective of the well delivery process from well design through to development of programmes and procedures, risk management, vendor selection, quality management, competency assurance, management of change and operational supervision will be performance management including minimisation of non-productive time.

The drilling rig selection criteria will include the technical capacity for logistical and operational efficiencies which have the potential to reduce emissions through improved performance, reduced operational time and reduced logistical requirements. The GHG management and reduction plans of vendors will form part of the technical

evaluation phase of the procurement process. All mitigation measures identified will be captured in a Project Risk Register.

FLARING

Flaring associated with the proposed Montrose Infill Project will be limited to safety reasons and will occur during plant blowdown and start-up of the Montrose Complex, for planned turn arounds and potentially from unplanned controlled shutdowns, for example following compressor trips. Introduction of Montrose Infill production will not change the current operating conditions at the Montrose Complex with respect to flaring because no additional processing equipment is required. The operating philosophy at the Montrose Complex is to keep the frequency of these events to an absolute minimum, both for environmental reasons and to optimise production.

2.3.2 Montrose Infill Project Electrification Readiness

The proposed Montrose Infill Project does not involve installation of any combustion equipment. There will be an additional electrical demand of approximately 1 MW for process heating. The only other additional electrical loads will be for area lighting, fire and gas detectors, electrically actuated valves and the like along with the negligible additional indirect electrical load associated with providing instrument air to control and shutdown valves. As such, the project imposes no impediment to electrification readiness of Montrose. The work regarding electrification assumed a mid-2030s CoP date, so any life of field extension caused by the proposed Montrose Infill Project has already been accounted for in the electrification work.

2.3.3 Potential for Repurposing / Re-use of Montrose Infill Infrastructures

A Carbon Capture Utilisation and Storage (CCUS) Review of the MonArb Area was conducted in 2022 to explore opportunities for CO_2 storage, Hydrogen (H_2) storage (and recovery) and Enhanced Oil Recovery (EOR) potential (through CO_2 injection). Well data was collected to evaluate the reservoir for potential repurposing of the reservoir (and wells) in the future. It was concluded that the configuration and structure of the reservoirs at Montrose would not be suitable for CCUS or Hydrogen, or EOR. A Repsol Resources UK Repurposing Taskforce Report confirms that Montrose has no near-time potential for CCUS or Hydrogen.

In addition to the reservoir not being suitable the infrastructure at the Montrose Complex was not designed for the injection of CO_2 such that significant brownfield modifications would be required.

2.3.4 Climate Change Impact Assessment

The evaluation of GHG emissions impacts on selected host infrastructure is presented in Chapter 7 of this ES. The purpose of this assessment is to determine the potential effects on the climate from GHG emissions arising from the proposed Montrose Infill Project, including how it would affect the ability of the UK Government to deliver carbon reduction targets.

3 Project Description

3.1 Development Overview

As described in Chapter 1, the proposed Montrose Infill Project can be summarised as follows:

- Drilling of five additional production wells from a single subsea drill centre located *c*. 0.7 km north-west of the Montrose BLP, outside the existing 500 m exclusion zone;
- Installation of subsea infrastructure to support tie-back of the wells to the Montrose BLP;
- Modifications to the existing Montrose BLP; and,
- Production at the Montrose BLP platform.

This chapter describes the activities associated with the proposed drilling, installation and production phases. An overview of the expected decommissioning activities is also provided. In addition to providing an overview of the selected option, the first section of this chapter provides a description of the different options considered for the proposed Project.

Figure 3-1 illustrates the approximate location of the proposed Infill drill centre relative to the Montrose BLP.

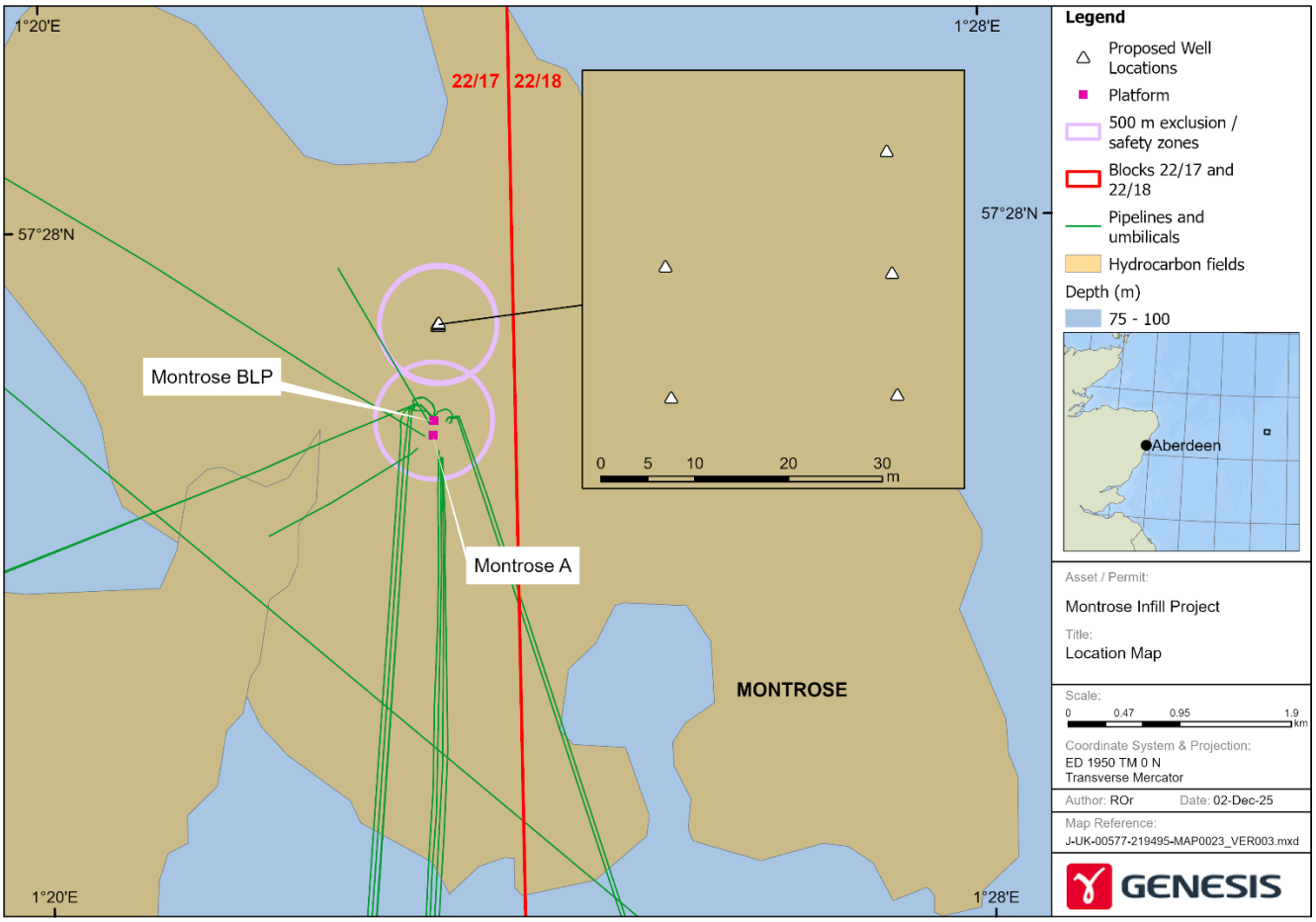


Figure 3-1: Approximate location of the proposed Montrose Infill wells (should the wells be drilled off template- see Section 3.5.1).

3.2 Analysis of Alternatives

An evaluation of the proposed Montrose Infill Project when compared to the 'Do Nothing' scenario is provided in Section 1.7. This section therefore focuses on the feasible development alternatives considered for progressing the proposed wells.

The Montrose Infill Project considered a number of development concepts for the additional wells at the Montrose Field. This section presents a summary of the development concepts and the screening process that was undertaken to identify the preferred development concept. Project Alternatives in the context of GHG emissions are described in Section 7.5.8.

3.2.1 Decision to Drill More Wells in the Montrose Field

In the absence of the proposed Project production at the MonArb host installations would cease at the end of 2030. As previously described in Section 1.7, the decision to drill additional wells at the Montrose Field would extend the MonArb Hub economic life to at least 2035 and maximises returns from the reservoir. The addition of the Infill wells allows production for Cayley, Shaw, Wood and the existing Montrose wells to continue and therefore helps maintain the economic viability of the Montrose Complex and allows the recovery of the reserves to be maximised, in line with North Sea Transition Authority (NSTA) guidance.

3.2.2 Subsea vs Platform Wells

Previously it was expected that the Infill wells would be drilled from the Montrose Alpha platform (Talisman, 2012). However, technical issues associated with the Montrose Alpha drilling and the cost and complexity of the brownfield works associated with installing a new drilling unit meant that replacing the drilling unit on Montrose Alpha was not considered feasible.

Following a review of the infill scope, and the expected end of field life of the Montrose Field, it was determined that the cost of re-instating a full drilling capability on Montrose Alpha would prohibit the project therefore, platform wells were discounted, and subsea wells selected as the only viable development alternative. Subsea tie-back options were also identified to carry less risk of project cost and/or schedule escalation.

3.2.3 Installation Method for Manifold

Studies undertaken by NEO NEXT+ determined that the most suitable installation method for the manifold would be the use of hammer piles.

As the combined manifold assembly would have a significant on bottom weight, a gravity-based foundation was considered. However, the seabed comprises a sand layer that extends to around a depth of 1.2 m which is underlain by soft clay. Preliminary analysis indicated that even plating the entire base of the foundation would mean that the 'Factors of Safety' would not be met due to the soft underlying clay layer which would result in a bearing failure. Additionally, it was identified that there would be a significant long-term settlement of the manifold (predicted to be in the order of 100 to 150 mm) which would have the potential to lead to overstress of the tie-in spools and adjacent manifold piping, resulting in an increased potential for stress cracking failure. Plating the entire underside of the manifold foundation structure was also identified to present issues during installation and deployment through the splash zone. In addition, in water depths of *c*. 91 m at the Project location, considerable ballast would need to be included to make the manifold stable on the seabed.

As a result of the above, a gravity-based solution was discounted over a piled foundation.

Suction piles were also ruled out as a suction anchor requires uniformly soft/ ultra soft soil conditions for effective use. Given that there is a sand layer above the soft clay layer in this area, the sediment type is not conducive to the use of suction anchors.

In addition, although vessels are not allowed within a 500 m safety zone, fishing gear interaction with subsea infrastructure within a 500 m safety zone is known to have occurred previously in the UKCS. It is also acknowledged that as of October 2025, there are restrictions on the use of demersal mobile gear within the East of Gannet and Montrose Fields NCMPA (Scottish Government, 2025). Despite this, it is noted that whilst fishing restrictions are currently enforced, future changes are outside the control of NEO NEXT+ and thus it is prudent to ensure the manifold design caters for this possibility as far as practicable. A cautious approach to make the manifold 'fishing friendly' was preferred, which would necessitate the use of hammer piles.

3.2.4 Pipeline Installation Options

A number of pipeline installation options for the lines between the manifold and the Montrose BLP were investigated, taking account of three criteria; (1) safety, (2) engineering requirements / practicality, and (3) environmental factors such as sediment type and location within a protected area. Options that were initially considered include:

- Option 1: Trench and mechanically backfill;
- Option 2: Jet trench and backfill;
- Option 3: Surface laid with entire length protected by concrete mattresses or rock placement; and
- Option 4: Surface laid with pipeline ends protected by mattresses or rock placement.

Studies undertaken by NEO NEXT+ determined that the most suitable installation method for the flowlines (gas lift and production) and the EHC umbilical would be surface laid on the seabed, given that the proposed wells are located within a protected area and wholly within the drill centre 500 m safety zone or the Montrose BLP 500 m exclusion zone and therefore burial is not required for protection purposes. In addition, seabed stability requirements met the use of intermittent placement of concrete mattresses. No trenching options have been carried through in the ES as it was considered that this method of installation would not be practical given the short length of line (drill centre located 0.7 km from BLP).

Mattresses, grout bags and rock cover are typically added for one or more of the following three purposes:

- Protection against dropped objects;
- Stabilisation to maintain the lines on the seabed; and
- Mitigation of UHB.

To mitigate dropped object impacts, continuous concrete mattresses will be laid at the BLP end (out to *c*. 100 m) and on the approach to the manifold (out to *c*. 200 m). Studies have shown that the 3" gas lift line and the EHC umbilical will both require mitigation to retain the lines on the seabed (i.e. for stabilisation) given their small diameters and the currents in the area. In addition, the production flowline may require UHB mitigation. At the time of writing it is expected that mattresses laid at 12 m intervals along the two flowlines and the EHC umbilical will provide the necessary stabilisation and UHB mitigation. Note the three lines (i.e. production, gas lift and EHC umbilical) will be laid *c*. 1 m apart such that the same mattresses will mitigate the three lines at each interval. Should ongoing engineering studies indicate that the laying of mattresses at intervals does not provide the necessary mitigation for UHB, it is possible that rock cover will be laid along the lines in a single berm with an approximate width of 7 m.

The ES therefore considers both options and the worst-case scenario will be assessed for each receptor.

It should be noted that NEO NEXT+ are giving consideration to UHB mitigation up front during pipeline material selection. To provide life of field corrosion resistance against the constituents of the produced hydrocarbons, a corrosion resistant alloy (CRA) is required for the pipeline material. All flexible flowline contractors in consideration during FEED have proposed a pipeline of flexible construction with a CRA inner layer rather than a

rigid CRA solution. Assessment of the flexible flowline design will be made during the procurement process and evaluation.

3.3 Field and Reservoir Characteristics

The Montrose field is an oil reservoir of Palaeocene Forties turbidite sandstone, deposited in two channels commonly referred to as the East and West lobes of the field. The reservoir interval is approximately 200 feet thick with around 150 feet net oil column. The permeability range is from 0-1200 Millidarcy (mD), averaging around 40 mD. The large Forties aquifer provides some pressure support to the field.

The field was discovered in 1971 and started production in June 1976, peaking at 35 thousand barrels of oil per day (Mbopd) by mid-1976. In 1990, when production had declined to approximately 12 Mbopd, the field was shut-in whilst the neighbouring Arbroath field was tied-in to the Montrose production facilities. The lack of significant offtake since the early 1990's has resulted in aquifer recharge and a significant potential for infill drilling into the Montrose reservoir.

Montrose Reservoir characteristics are summarised in Table 3-1.

Table 3-1: Montrose reservoir properties.

Property	Value
Reservoir type	Oil and Gas
Reservoir depth (ft, True Vertical Depth subsea [TVDss])	8,150
Recoverable Oil Reserves to year end 2035 (Million barrels of oil [MMbbl])	14.26
Recoverable Gas Reserves to year end 2035 (Billion Cubic Feet [Bcf])	8.42
Solution GOR (SCF/stb)	615
Oil gravity (°API)	41.06
Reservoir temperature at Datum (°F)	255
Reservoir pressure at Datum (psia)	3,300 (likely) 3,650 (maximum)

3.4 Schedule of Activities

The activities associated with the drilling, installation, and commissioning of the Montrose Infill Project are currently scheduled to take place between Q3 2027 and Q4 2028 with first oil expected in Q4 2028 (Table 3-2). It should be noted that the schedule presented is indicative and is liable to change as the project develops.

Table 3-2: Indicative schedule of activities for the proposed Montrose Infill Project.

Activity	2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Drilling								
Installation of subsea infrastructure								
Well tie-ins and commissioning								
First oil								

3.5 Drilling Phase

A maximum of five wells will be drilled as part of the Montrose Infill Project. This section describes the proposed drilling activities.

3.5.1 Drilling Location

Table 3-3 provides indicative locations for the drilling template (if used) and the individual well locations (if the off-template option is selected). The wells will be located *c*. 0.7 km from the existing Montrose BLP and if drilled off template will be spaced *c*. 13 m – 25 m apart as "worst case", which will allow all five wells to be drilled from one placement of the drilling rig (whether it is a semi-submersible drilling rig or HDJU drilling rig that is selected) (Section 3.5.2).

Table 3-3: Indicative location of the drilling template (if used) and wells should they be drilled off template.

Drilling Scenario	Infill Well Name	Montrose Well Locations	
		Latitude	Longitude
Wells drilled at a template	Drill template location (approximate location)	57°27'30.053" N	01°23'15.503" E
Wells drilled off-template	Well 1 MRH	57°27'30.053" N	01°23'15.503" E
	Well 2 MRI	57°27'30.506" N	01°23'15.483" E
	Well 3 MRG	57°27'30.063" N	01°23'16.282" E
	Well 4 MRC	57°27'30.483" N	01°23'16.264" E
	Well 5 MRS	57°27'30.903" N	01°23'16.245" E
Datum is European Datum 50 (ED50) Transverse Mercator: Universal Transverse Mercator (UTM)-N Zone 31			

3.5.2 Drilling Rig

At the time of writing, it had yet to be determined if a semi-submersible drilling rig or a HDJU drilling rig will be used to drill the Montrose Infill wells. The water depth, weather conditions and seabed conditions in the area are such that either drilling rig type could be used. The ES therefore takes into consideration both options, and for each environmental aspect being considered, the drilling rig resulting in the worst-case environmental impact will be assessed. For example, anchoring of a semi-submersible drilling rig would result in a greater seabed impact than the positioning of the HDJU drilling rig, however the HDJU drilling rig would likely result in deeper impressions on the seabed.

Whilst on site, the drilling rig (HDJU or semi-submersible) will have a 500 m exclusion zone such that unauthorised vessels, including fishing vessels, are not permitted to enter this 500 m zone. Further to this, as of October 2025, there are restrictions on demersal mobile gear within the East of Gannet and Montrose Fields NCMPA (Section 4.6.1; Scottish Government, 2025).

The drilling rig will be equipped with navigation lights, radar and radio communications. Given the proximity to the Montrose Complex (*c*. 700 m), the Emergency Response and Rescue Vessel (ERRV) supporting the Montrose Complex will provide support to the drilling rig whilst on location.

For the semi-submersible drilling rig, the anchors will be located out with the 500 m exclusion zone. If anchors were to be pre-laid, a Kingfisher warning would be posted to provide advice to users of the sea that these were about to be placed, giving their exact location. Typically, a guard vessel would be present to warn other sea users of the anchor location. This would also apply if the contingency anchors were deployed to assist with the positioning of the HDJU rig. However, given the restrictions on demersal mobile gear within the East of Gannet and

Montrose NCMPA as of October 2025 (Section 4.6.1; Scottish Government, 2025), NEO NEXT+ will discuss with OPRED the necessity for guard vessels if the anchors are pre-laid. Once the drilling rig is on site the ERRV at the Montrose Complex will also support the drilling rig and if necessary will take the role of the guard vessel.

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.

HDJU DRILLING RIG

If used, the HDJU drilling rig would be towed to site using up to three tow vessels (tugs). The HDJU 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 HDJU drilling rig legs will be jacked down onto the seabed with the hull raised above the water providing a stable platform. Excessive penetration by the legs into the seabed will be prevented by three spud cans at the bottom of the legs, each with a diameter of *c*.18 m. The HDJU spud can penetration into the seabed will be approximately 12 m (40 ft) deep and 18 m (59 ft) in diameter.

It is expected that all five wells will be drilled from one placement of the HDJU rig, regardless of the template or off-template option being selected and hence a maximum of three spudcan depressions would remain. The close proximity of the wells also allows the wells to be batch drilled and batch completed for maximum efficiency and therefore minimising the duration of the drilling campaign. As a worst-case scenario, two contingency anchors may be used to assist with the positing of the HDJU rig over the location of the wells. Anchor lines of *c*. 800 m – 1,000 m will connect each anchor to the HDJU rig and up to 200 – 400 m of each anchor line will be in contact with the seabed. If used, the two contingency anchors will be deployed using the tugs. Once the HDJU is on site, the anchors (if used) will be recovered. Details of the placement of the potential anchors will be provided in the Consent to Locate (CtL) permit applications which will be submitted before the drilling rig is mobilised to the drill centre.

A support pad (rock or mud mat) beneath the spud cans of the HDJU would be unlikely to be required due to the expected strength of the near-seabed sediments. This will be confirmed when the site is surveyed with a Cone Penetration Test and boreholes, however, recent HDJU placements within the area (both at Montrose and Arbroath platforms) have not found a requirement to provide additional support below the spud cans. The shallow sediments below the seabed in this area are characterised by channels caused by the scraping action of ancient ice movement, meaning the sub-seabed geology at the depth of interest can be somewhat variable. It is not possible to confirm with absolute certainty that there will be no requirement to place additional support below the HDJU footprints, however, historic placements provide a high level of confidence that this is unlikely and therefore this has not been accounted for within the impact assessment of the ES.

SEMI-SUBMERSIBLE DRILLING RIG

If used, the semi-submersible drilling rig will be towed to the drill centre using up to three tugs and will be held in position using eight anchors (maximum dimensions 6.7 m (Length [L]) x 6 m (Width [W]) each). Anchor lines of *c*. 1,500 m will connect each anchor to the semi-submersible drilling rig and up to 600 m of each anchor line will be in contact with the seabed. If, after all anchors are in place, it is found that insufficient tension is generated, up to four “piggyback” anchors may be deployed[1]. These anchors will be of the same type and dimensions as the primary anchors. The anchors will be connected via 150 m piggyback lines. It is assumed that all 150 m of the piggyback lines will be in contact with the seabed.

A CtL permit application will be submitted before the drilling rig is mobilised to the drill centre.

[1] "piggyback" describes a configuration where one anchor is attached to (or mounted onto) another, effectively "piggybacking" on the primary anchor.

If a semi-submersible drilling rig is used, all five wells will be drilled from one positioning of the rig and the associated anchor system.

3.5.3 Blowout Preventer and Well Control Equipment

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

The function of the BOP will be to prevent uncontrolled flow from the well to the surface during drilling by positively closing in the well in the event of an uncontrolled release from the reservoir into the well bore. The BOP is made up of a series of hydraulically operated rams 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, NEO NEXT+ procedures and UK legislation and industry standards.

3.5.4 Well Design

All five of the wells will be of a similar design and will be between 4,074 m and 6,564 m in length. Each well is expected to comprise five hole sections as summarised in Table 3-4. 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 Well 5 MRS well, which is the 'longest' wellbore with the maximum lengths and thus the worst-case cuttings generated) is shown in Figure 3-2.

Table 3-4: Indicative Well Design (Well 5 MRS well as an example).

Section Diameter (“)	Casing (“)	Section Length (m)
42 x 36	36 x 30	85
26	20	402
17 ½	13.375	722
12 ¼	10.75 x 9.625	4,030
8 ½	7 x 5.5	1,325
Total drilled length (from seabed) (m)		**6,564**

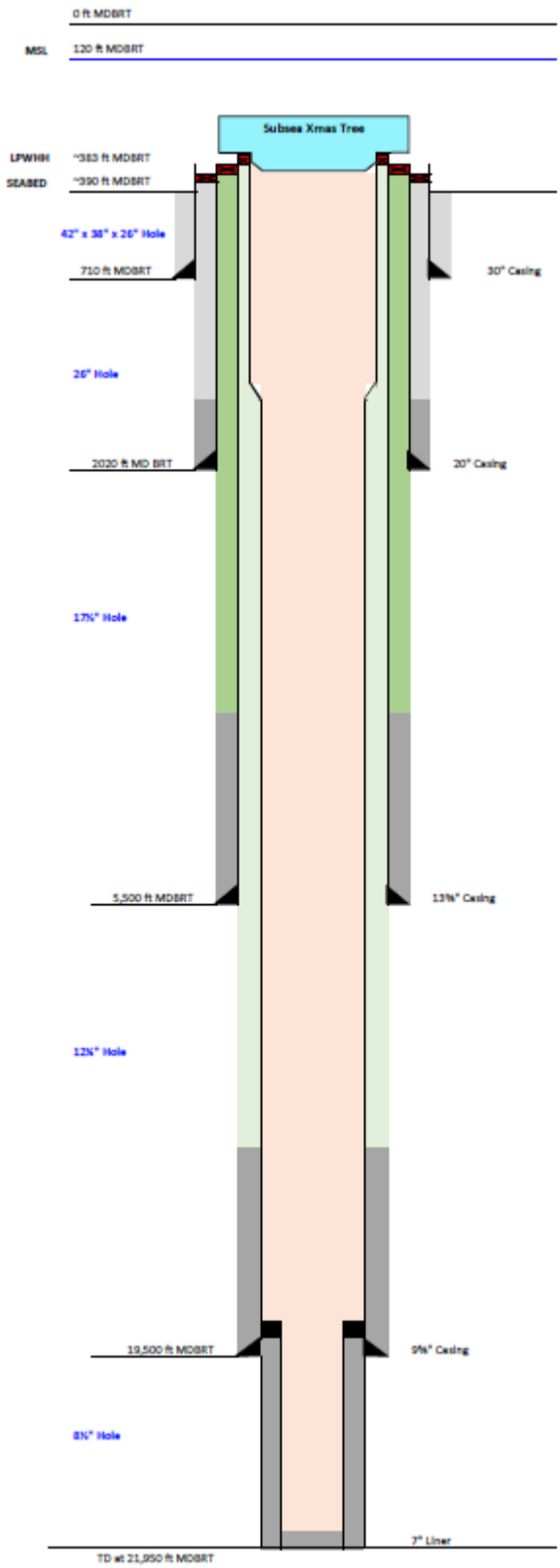


Figure 3-2: Well 5 (MRS) proposed completion schematic.

3.5.5 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 first two sections (42" and 26") will be drilled with seawater and water-based mud (WBM) sweeps to help clean up cuttings, then discharged directly to the seabed *c*. 1 m above seabed. Low toxicity oil-based mud (LTOBM) will be used for the three lower sections of the well and the cuttings will be treated at the drill rig using a thermo-mechanical cuttings cleaner (TCC). Following treatment, the cuttings will be discharged at the sea surface via a cuttings discharge hose below the rig. A summary description of the thermal desorption process using a TCC, also known as a hammermill (RotoMill™) system is provided in the shaded area below and illustrated in Figure 3-3.

Should RotoMill™ be unavailable, the LTOBM cuttings will be skipped and shipped to shore for treatment and disposal.

Drill Cuttings Modelling has been carried out to support the impact assessment, presented in Appendix E, and assumes the same design for all wells. Drilling off-template represents a worst-case scenario with regards to the area impacted by drill cuttings and hence this has been assumed for the modelling.

The anticipated drilling fluid type, the cuttings mass and the discharge location of cuttings for each well section is summarised in Table 3-5. Full details of the mud volumes to be used will be provided in subsequent drilling Subsidiary Application Template (SAT) permit applications.

Table 3-5: Anticipated cuttings mass associated with the proposed Montrose Infill wells.

Section diameter (“)	Drilling fluid	Quantity of cuttings (te)			Discharge Location
		For 1 well	For 5 wells	With additional contingency re-spuds and side tracks*	
42	WBM sweeps	237.04	1,185.2	2,370.4	Discharged directly to the seabed.
26		429.62	2,148.1	4,296.2	
17 ½	LTOBM	295.78	1,478.9	1,478.9	Thermally treated offshore and discharged at sea surface or skipped and shipped to shore for treatment and disposal.
12¼		808.98	4,044.9	8,089.8	
8½		128.06	640.3	1,280.6	
Total for cuttings contaminated with WBM sweeps		**666.66**	**3,333.3**	**6,666.6**	
Total for LTOBM contaminated cuttings		**1,232.82**	**6,164.1**	**10,849.3**	

Notes:
* drill cuttings modelling within the ES assumes a worst case whereby a re-spud of the 42” and 26” sections and a contingency side track of the 12¼” and 8½” sections is required across all five wells.

Thermal Treatment of Cuttings – Summary Description of the TCC RotoMill™ Technology

During thermal desorption cuttings are heated to the distillation temperature of the base oil and this temperature is maintained until all the oil is vapourised. Thermal desorption units typically use a TCC, also known as a hammermill (RotoMill™) system, which uses a series of hammer arms mounted on a central drive shaft rotating at high speed in a process chamber. Friction from the hammers and cuttings generates enough heat (240°C to 260°C) to evaporate the water and then the oil from the cuttings. The oil can then be condensed and separated for recovery/recycling.

In accordance with RotoMill™ performance data, the processed powder typically contains 0.1 % or less of hydrocarbon (i.e. either LTOBM or a combination of LTOBM and reservoir oil) content by weight (Kirkness *et al.*, 2008) and can be discharged. A value of 1 % oil on cuttings (OOC) has been used for the Montrose Drill Cuttings Modelling in line with the regulatory requirements of 1 % OOC and is considered a worst-case based on previous wells. Only part of the 8½'' section will encounter reservoir oil.

The recovered water has a hydrocarbon content of less than 30 mg/l and can also be discharged (the water is sampled and discharged separately from the cuttings and is not part of the Drill Cuttings Modelling).

An overview of the RotoMill™ process is shown in Figure 3-3. The RotoMill™ can process cuttings at speeds of up to 10 t/hr (TWMA, 2019), though rates of 8 t/hr are more typical.

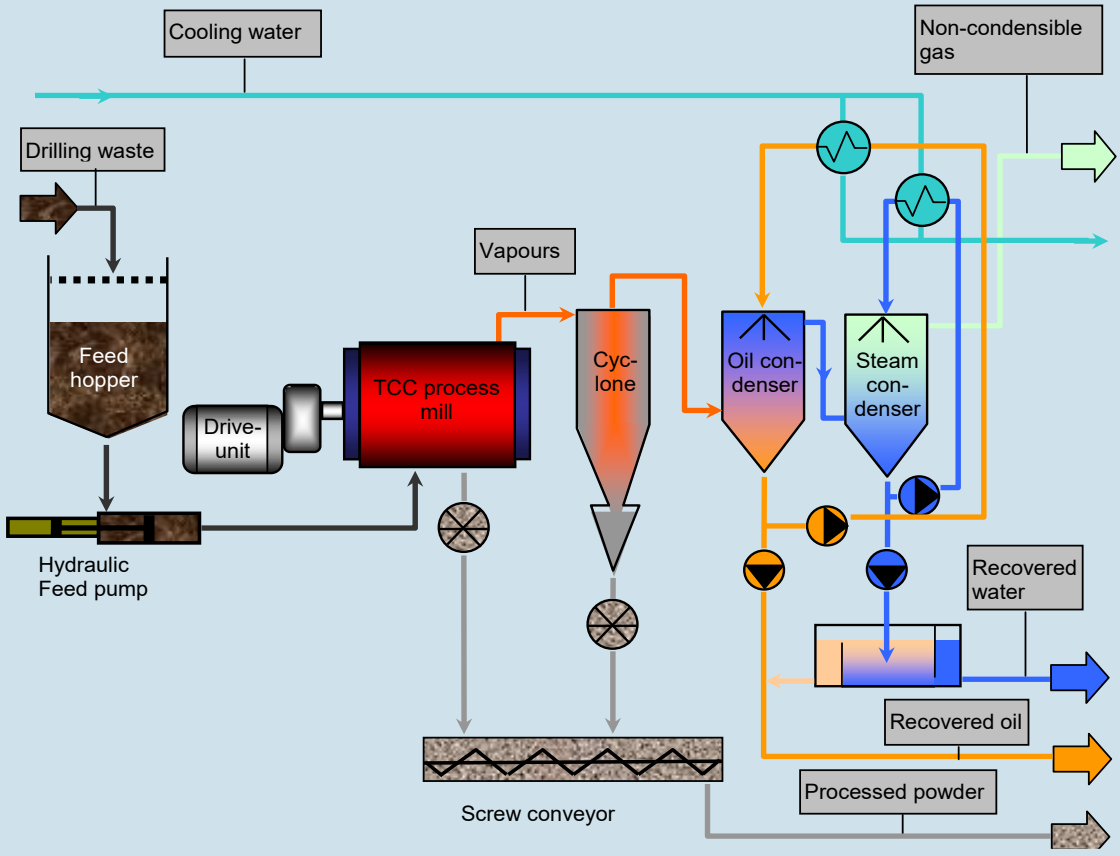


Figure 3-3: Schematic showing RotoMill™ process.

3.5.6 Cementing Chemicals

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.

During cementing operations, the majority of these chemicals are left downhole, but a quantity of cement may be discharged onto the seabed around the top of the conductor while filling the annulus between conductor and the host rock formation with cement. 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 secured. It is estimated that *c*. 25 tonne (te) (assuming 50 % is returned to the surface) of cement could be discharged on the seabed immediately adjacent to each well location. The ES assumes that at each well location the resultant cement patio will have a radius of 7.5 m, however it should be noted that the cement patios will overlap given the wells are located in close proximity. 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 3-6. All five wells will have similar cement and spacer volumes.

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 technically 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 3-6: Estimated cement requirements per well (similar quantities for all five wells).

Section (“)	Spacer (m^3)	Class G cement (m^3)	Will excess cement be disposed of on the seabed?
42	None - seawater is used	94	Yes
26	32	160	
17 ½	19	54	No
12¼	13	20	
8½	13	24	

3.5.7 Well Clean-Up

Upon completion of the production wells, they will be cleaned-up which will requiring flaring of some oil and gas. As the new Montrose wells will be drilled before the tie-back to the existing Montrose BLP will be installed, there will be a requirement for all hydrocarbons produced during the well clean-up to be flared at the drilling rig. Well testing and clean-up will involve flaring of a maximum of 369 te of gas and 3,152 te of oil over a 28-hour period for all five wells.

3.5.8 Relief Well Location

A plan will be put in place for the drilling of a relief well to intersect the Montrose wells in the event of a well blowout and will include a proposed drilling rig location from which a relief well could be drilled.

3.5.9 Drill Rig Support Activity

Various support vessels will be associated with the drilling operations such as supply vessels. Table 3-7 summarises the estimated duration each vessel will be on site and their estimated fuel use. Estimates provided are based on an indicative worst-case drilling duration.

As noted in Section 3.5.2, the wells will be drilled from a single rig positioning (for both HDJU and semi-submersible drill rig types). The close proximity of the wells also allows the wells to be batch drilled and batch completed for maximum efficiency and therefore minimising the duration of the drilling campaign.

Table 3-7: Fuel consumption of vessels associated with the drilling of the Montrose infill wells should (a) a semi-submersible or (b) a HDJU be used.

Vessel type	Active days	Fuel consumption (te/d)[2]	Total fuel use (te)
(A) Semi-Submersible Drilling Rig			
Semi-submersible: mobilisation/demobilisation/in transit	7	24	168
Semi-submersible – on location	455	24	10,920
Tugs: 3 tugs to bring the rig on location. 7 days allowed for Rig mobilisation/demobilisation/in transit.	21	17	357
AHVs – assumes one AHV for pre-lay and anchor recovery, and two AHVs for hook up and unhook (therefore, 6 AHV deployments and 8 days allowed for each vessel including transit)	48	17	816
Supply Vessels (dedicated supply boats) (including transit)	447.5	7	3,133
Supply Vessels (skip & ship operations) (including transit)*	185	7	1,295
Helicopter (te/hr): 4.5 flights per week and 3 hr round trip. Therefore, 233 flights x 3 hr per flight.	37	12	444
Total fuel use associated with drilling using a semi-submersible drilling rig			**17,133**
(B) HDJU Drilling Rig			
HDJU: mobilisation/ demobilisation/ in transit	7	12	84
HDJU: on location	485	12	5,820
Tugs: 3 tugs to bring the rig on location. Allows for 12 days per vessel for initial mobilisation for each tug.	36	17	612
Supply Vessels (dedicated supply boats) (including transit)	447.5	7	3,133
Supply Vessels (skip & ship operations) (including transit)[1]	185	7	1,295

Vessel type	Active days	Fuel consumption (te/d)[2]	Total fuel use (te)
Helicopter (te/hr): 4.5 flights per week and 3 hr round trip. Therefore, 233 flights x 3 hr per flight.	39	12	468
Total fuel use associated with drilling using a HDJU drilling rig			**11,412**
Note: Days on site indicates the maximum possible number of days as worst case scenarios. [1] Required in the event that the cuttings from the lower well sections cannot be treated and discharged at sea.			

3.6 Subsea Installation Phase

3.6.1 Overview

This section describes the pipelines and subsea infrastructure to be laid as part of the proposed Montrose Infill Project, as summarised in Table 3-8. It includes the drilling template, if that option is selected. Note that this has been based on the lines being surface laid given that is the selected pipeline installation method. Existing spare risers are available on the Montrose BLP and the lines will be tied into the base of the existing risers.

Table 3-8: Subsea infrastructure associated with the Montrose Infill Project.

Item	Description
One 8" production flowline between the new manifold and the BLP	700 m x 8" production flowline laid between the new manifold and the Montrose BLP. The 700 m comprises the spools at the manifold, the flowline, spools at the base of the riser and the connection to the riser. The full length of the production flowline will be surface laid.
One 3" gas lift flowline between the BLP and the new manifold	700 m x 3" gas-lift flowline, laid between the Montrose BLP and the new manifold. The 700 m comprises connection at the riser, spools at the base of the existing riser, the flowline, and spools at the manifold. The full length of the gas lift flowline will be surface laid.
One EHC flowline between the BLP and manifold	700 m EHC umbilical The 700 m comprises: static umbilical on the seabed, umbilical jumper at the base of existing riser and at the manifold. The full length of the static umbilical will be surface laid.
Manifold	18 m (L) x 11 m (W) x 6 m (H) Piled - four piles measuring 26 m (L) x 0.61 m (D).
Drilling template and Xmas trees (template option)	Drilling template dimensions: 6 m (L) x 10 m (W) x 5.5 m (H). It is assumed that (if used) the drilling template will be piled. Each well will have a horizontal Xmas tree and wellhead protection structure associated with it, which will be located on top of the drilling template. Approximate dimensions of each Xmas tree/protection structure are 8 m (L) x 8 m (W).
Xmas trees (off-template option)	Each well will have a horizontal Xmas tree and wellhead protection structure associated with it. Approximate dimensions of each Xmas tree/protection structure are 8 m (L) x 8 m (W).

Item	Description
Spools and umbilical jumpers between each of the production wells and the manifold	Two spools (production and gas lift) and an umbilical jumper each with a maximum length of 50 m will be laid between each production well and the manifold. All lines will be surface laid and will be protected with mattresses and grout bags.

3.6.2 Installation of Subsea Structures

As summarised in Table 3-8, the following structures will be installed as part of the proposed Montrose Infill Project:

- Template option: Drilling template with Xmas trees on top (with associated protective wellhead structures); or
- Off-template option: Xmas trees with associated protective wellhead structures; and
- Manifold.

Each of these structures are expected to be lowered through the water column using a vessel crane and winch.

DRILLING TEMPLATE AND XMAS TREES

The drilling template (if used) would be lowered to the seabed from a construction vessel (or similar); it is assumed that the drilling template would be piled. Following completion of drilling, a horizontal Xmas tree with protective structures will be installed on each well. If the drilling template option is selected, the Xmas trees will be located within the template. The Xmas trees will have an arrangement of hydraulically operated valves, with manual back-up valves, to provide integrity barriers from the reservoir. The production wells will also feature a Downhole Safety Valve (DHSV) which is a hydraulically operated isolation device.

MANIFOLD INSTALLATION

The manifold will be lowered to the seabed from a construction vessel (or similar). Once in position, four driven piles will be used to maintain its position. Manifold dimensions, pile lengths and pile diameters are provided in Table 3-8. The manifold will be located within the drill centre 500 m safety zone.

3.6.3 Installation of Flowlines, EHC Umbilical, Spools and Umbilical Jumpers

LINES BETWEEN MONTROSE BLP AND MANIFOLD

The ES assumes that the lines (1 x production flowline, 1 x gas lift flowline, 1 x EHC umbilical) to be laid between the Montrose BLP and the manifold will be laid on seabed surface. Requirements for dropped object protection, stabilisation and UHB mitigation are discussed in Section 3.6.4.

SPOOLS AND UMBILICAL JUMPERS

All the production and gas lift spools and all the umbilical jumpers will be laid on seabed surface and protected using mattresses and grout bags. Lines laid between the drilling template (for the template option) / wells (for the off-template option) and the manifold will be laid in as close a proximity as possible to minimise mattress use.

3.6.4 Protection, Stabilisation and UHB Mitigation Materials

Table 3-9 outlines the anticipated maximum number of mattresses and grout bags required to provide protection, stabilisation and UHB mitigation for the proposed Project (with contingency volumes). The quantities provided

also include those required at the crossing of the existing Montrose Gas Export SSIV control umbilical, which is laid on the seabed and covered by concrete mattresses.

Mattresses and grout bags will be used to provide dropped object protection at the BLP platform (out to *c.* 100 m from the platform) and at the drill centre (out to *c.* 200 m from the manifold and along the spools and umbilical jumpers between the wells and the manifold) (Figure 3-4 and Figure 3-5). Note detailed engineering/assessment has not yet been undertaken on what protection will be required on approach to the BLP, e.g., a drop cone may be required around the entry point at the surface. Therefore, a greater allowance of stabilisation features has been assumed for this area.

Studies have shown that due to the seabed currents in the area and the small diameters of the gas lift and EHC umbilical, stabilisation material will be required for these lines to ensure they remain on the seabed. In addition, UHB mitigation is also expected to be required for the production flowline. In addition to providing dropped object protection, the mattresses laid within 100 m and 200 m of the BLP and the drill centre manifold respectively will also provide the necessary stabilisation and UHB mitigation. For the remaining 400 m of the lines it is proposed to lay mattresses at 12 m intervals to provide the required stabilisation/UHB mitigation. The placement of mattresses at 12 m spacings is expected to satisfy the download requirements for UHB, thereby negating the requirement for rock. It should be noted that away from the BLP and the drill centre manifold, the lines will be laid in proximity such that mattresses will be 'shared' between the lines.

The base case is to not use rock cover; however, should ongoing engineering determine that mattresses will not provide sufficient mitigation for UHB, rock cover may be selected. The ES assumes that *c.* 400 m of the production flowline would be rock covered. At the time of writing it is not possible to exclude the potential requirement for rock to address UHB, however the Project is progressing with the aim to not use rock.

Table 3-9: Anticipated stabilisation and protection requirements.

Location	Mass of Contingency Rock (te)[1]	Number of Mattresses[2] 6 m (L) x 3 m (W) x 0.15 m (H)	Number of 25 kg Grout Bags[3]
Base Case where no rock cover required			
Within the Montrose BLP 500 m exclusion zone.	N/A	82 Concrete mattresses used continuously to protect the production, gas lift and EHC umbilical lines out to 100 m. Beyond 100 m, concrete mattresses laid at 12 m intervals to provide stabilisation of the gas lift and EHC umbilical and UHB mitigation for the production line.	492 Within 100 m of the platform and at the crossing.
Within the infill drill centre 500 m safety zone.	N/A	154 Concrete mattresses used continuously to protect the production, gas lift and EHC umbilical lines out to 200 m, equivalent to the edge of the Montrose BLP 500 m zone. Concrete mattresses will be used to protect the spools and umbilical jumpers between each well and the manifold.	924 Within 200 m of the manifold.
Total for Base Case	**N/A**	**236**	**1,416**
Alternative Case where contingency rock cover required to mitigate UHB			
Within the Montrose BLP 500 m exclusion zone.	11,100 te Assumes 400 m of lines are rock covered. This is the length from boundary of the existing BLP 500 m exclusion zone to 100 m from the BLP.	52 Concrete mattresses used continuously to protect the production, gas lift and EHC umbilical lines out to 100 m. *Less than the base case as does not include mattresses laid at intervals between 100 m and 500 m from the BLP as rock used instead.*	492 Within 100 m of the platform and at the crossing.
Within the infill drill centre 500 m safety zone.		154 Concrete mattresses used continuously to protect the production, gas lift and EHC umbilical lines out to 200 m. Concrete mattresses used to protect the spools and umbilical jumpers between each well and the manifold.	924 Within 200 m of the manifold.
Total for Alternative Case	**11,100**	**206**	**1,416**

[1]Rock volumes outlined in this table are considered contingency rock.
[2]The mattress quantities include a 20 % contingency.
[3]The grout bag quantities include a 10 % contingency.

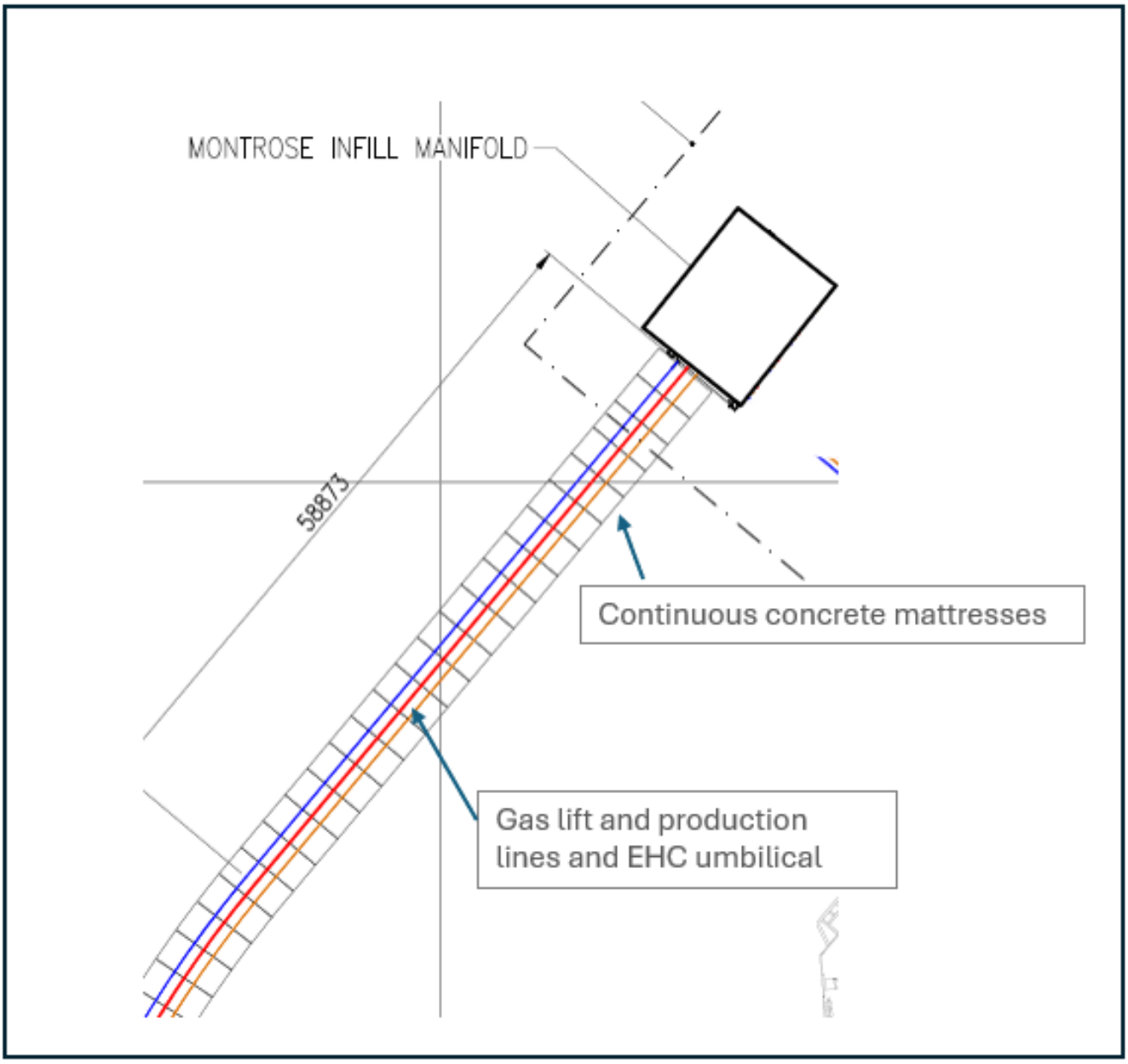


Figure 3-4: Indicative illustration of continuous concrete mattresses on approach to Montrose Infill manifold.

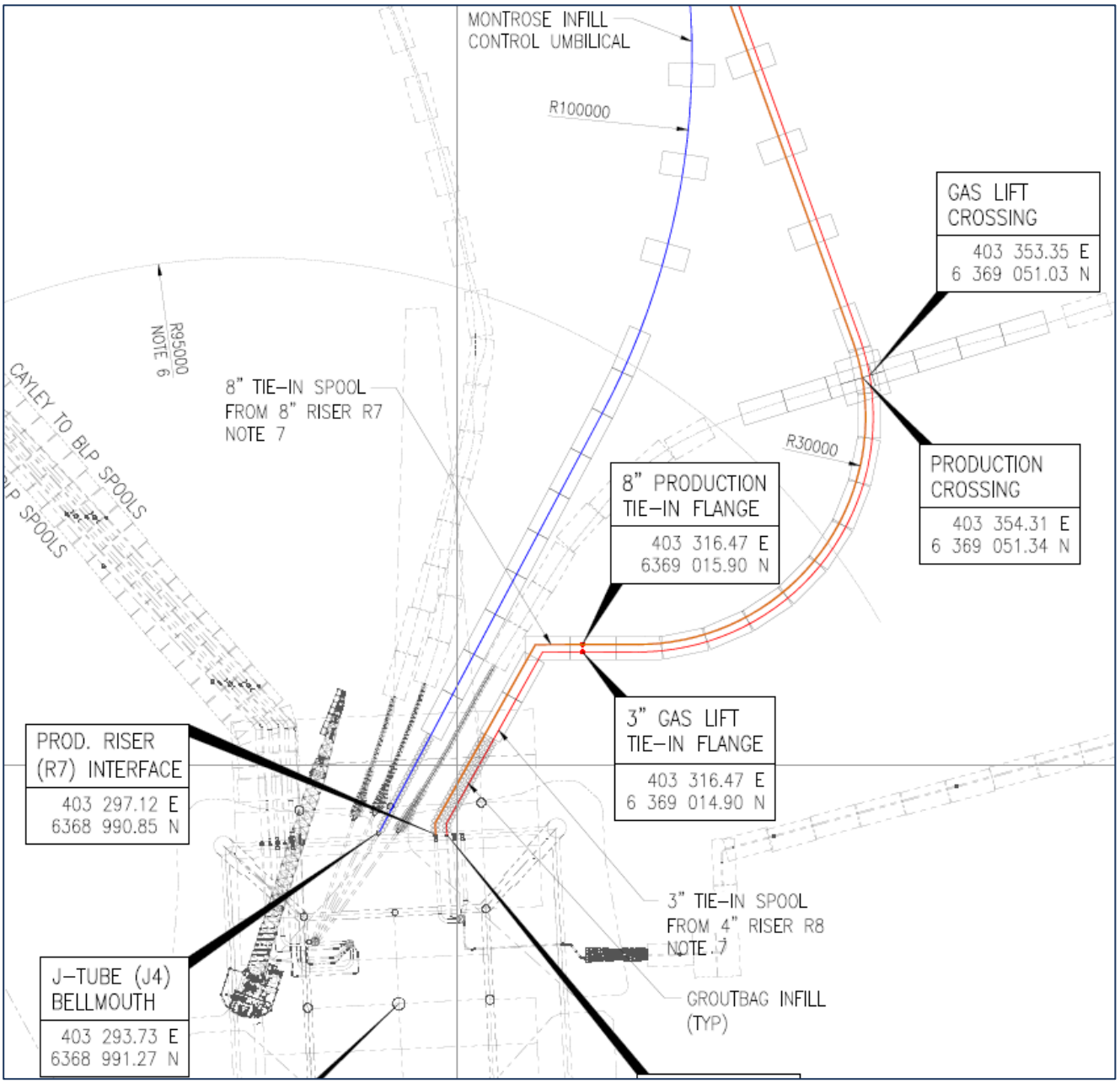


Figure 3-5: Indicative illustration of lines and mattresses on approach to the Montrose BLP.

3.6.5 Pipeline Commissioning

Following installation of the flowlines, umbilical, spools and umbilical jumpers, various commissioning activities will be required, such as, testing for leaks, displacement of the inhibited seawater in the production and gas lift flowlines to the topsides process, and preparation of the system for the introduction of hydrocarbons. It is anticipated the flowlines will be pre-flooded with inhibited water prior to installation. The spools are also likely to contain inhibited seawater (e.g., containing biocides). It is expected that some of the cores within the umbilical and umbilical jumpers will be filled with water based hydraulic fluids and others with mono-ethylene glycol. Testing and commissioning operations may either be performed from the BLP or the installation vessel.

The flowlines will be pressurised in accordance with design codes to pressures above the maximum operating pressure. 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 Offshore Chemicals Regulations (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 testing and commissioning activities, and all the systems are deemed fit for operation.

3.6.6 Subsea Installation Support Vessels

Various support vessels will be required to support the installation of the subsea infrastructure. Typical vessel use, duration, and fuel usage are provided in Table 3-10. Note that the working times include a waiting on weather allowance.

Table 3-10: Fuel consumption of subsea installation support vessels associated with the Montrose Infill Project.

Vessel type	Days on site	Fuel consumption (te/d)[2]	Total fuel use (te)
Construction Support Vessel (CSV) – Port	7	4	28
CSV – Transit	6	20	120
CSV – Working	24	17	408
Dive Support Vessel (DSV) – Port	4	3	12
DSV – Transit	4	18	72
DSV – Working	35	15	525
Rock dumping – Port	2	2	4
Rock dumping – Transit	4	10	40
Rock dumping – Working	4	15	60
		Total fuel use	**1,269**

3.7 Overview of Montrose BLP

The Montrose BLP is bridge-linked to the Montrose Alpha platform and processes fluids from subsea tiebacks from the Cayley and Shaw fields, which came onstream in 2017.

The BLP comprises an integrated module containing oil and gas processing facilities together with power generation, supporting utilities, switchgear, dedicated flare and crane, and local equipment rooms. The BLP does not have any drilling facilities.

Reservoir fluids received at the Montrose Complex undergo separation and treatment at either Montrose Alpha or the BLP depending on the source of the fluid.

Reservoir fluids from the Arbroath, Arkwright, Brechin, Wood, Carnoustie, and Godwin Fields as well as one active well in the Montrose Field are processed on the Montrose Alpha platform. There are two separation and treatment trains active on Montrose Alpha (Train 1 and Train 2), and both have the same process, a simplified diagram is shown in Figure 3-6. Reservoir fluids enter the 1st stage separators and produced water is then routed from the 1st stage separators to the hydrocyclone units and then onwards to the CETCO (Induced Gas Flotation) Units, which provides efficient oil recovery. Produced water then passes from the CETCO Units for disposal to sea.

Separated oil from the hydrocyclones and CETCO Units is pumped to the 2nd stage separators (not shown on figure). Following separation in the 2nd stage separators, produced water is routed from the dehydrators directly to the CETCO units where, after treatment, it is pumped overboard to sea.

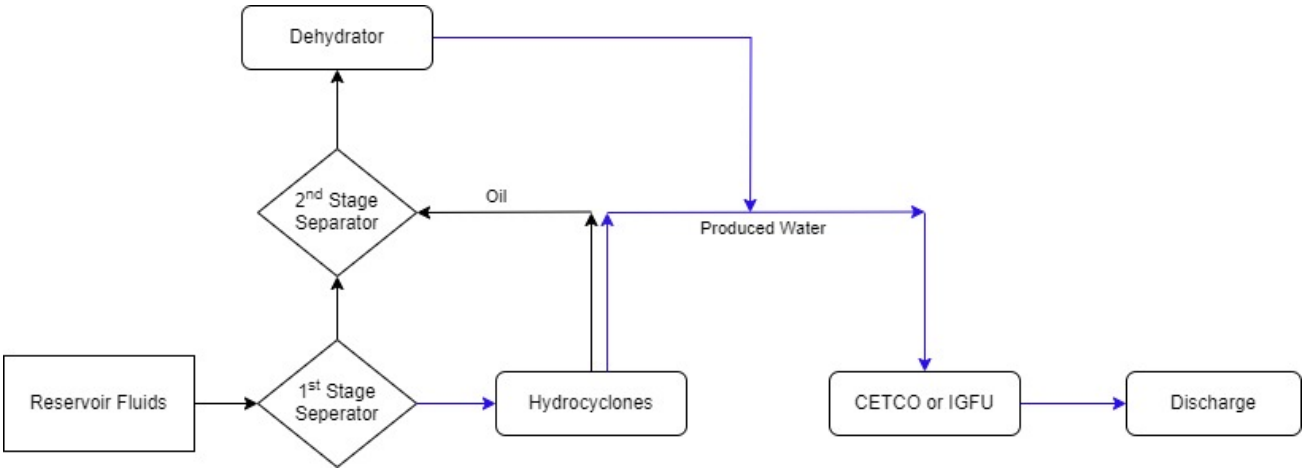


Figure 3-6: Separation and Treatment Trains on Montrose Alpha.

Reservoir fluids from the Cayley and Shaw fields are processed on the BLP (Figure 3-7). Reservoir fluid from the Cayley and Shaw fields are individually separated before produced water flows to a set of hydrocyclones individual to that field. Produced water from the 2nd stage separator is treated by the 2nd stage Hydrocyclone. Produced water then passes from all hydrocyclones on the BLP to the secondary water treatment package (Induced Gas Flotation Unit, Micro Bubble Pumps and Reject Oil Return Pumps). The oil separated out during this stage is sent to the 2nd stage separator, where the process will follow that previously detailed. The treated water is routed to the Produced Water Disposal Caisson for discharge to sea.

Reservoir fluids from the five new Montrose infill wells will be processed through the existing infrastructure used for the Shaw field on the BLP. Produced water is currently discharged overboard at the Montrose BLP after being treated and sampled for compliance with below 30 mg/l oil in water content (monthly average). The produced water profiles tend to increase over the field life with the maximum produced water rate associated with the final years of production.

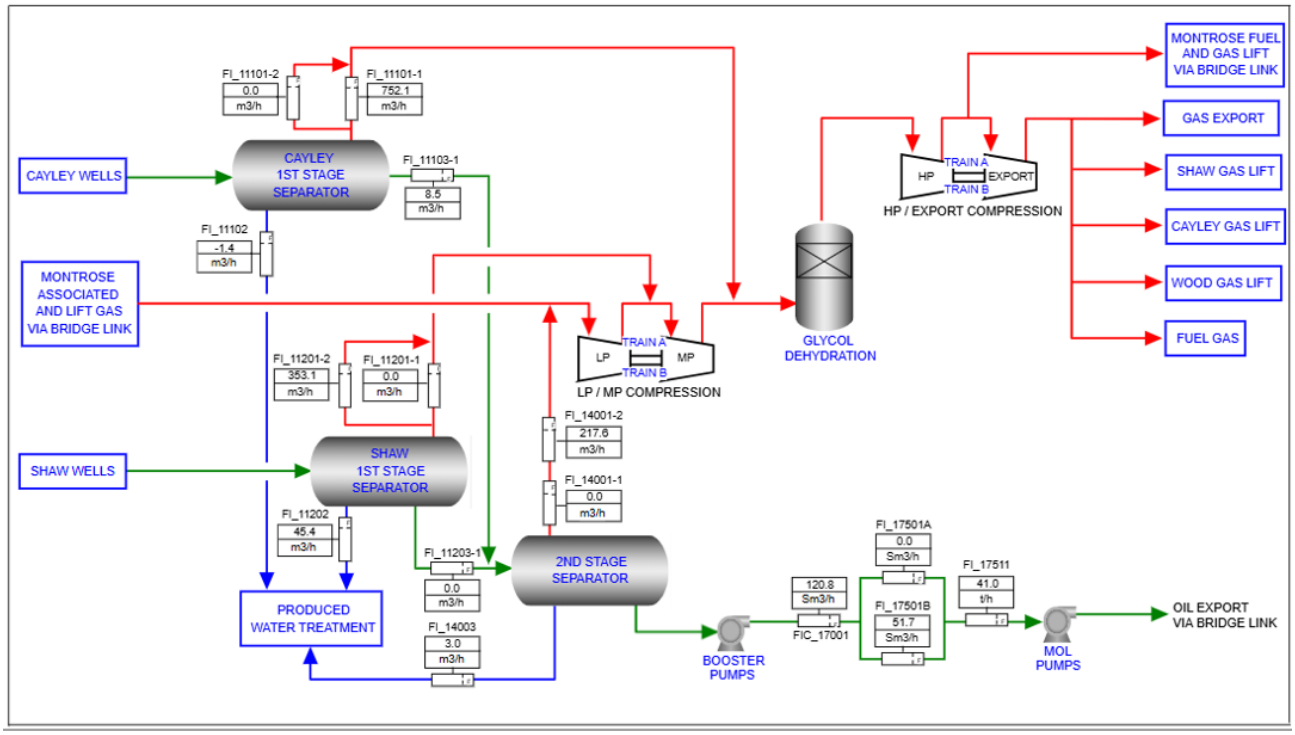


Figure 3-7: Separation and Treatment Trains on Montrose BLP.

The Risk Based Approach (RBA) assessment carried out in 2025 (NOV Wellstream UK, 2025) states that at present it is considered that the existing produced water treatment equipment on Montrose represents Best Available Technique (BAT). NEO NEXT+ remains committed to ensuring that the principles of BAT and Best Environmental Practice (BEP) continue to be applied to the treatment and discharge of produced water.

3.8 Montrose BLP Modifications

Primary separation will be on Montrose BLP in the Shaw separator, where the hydrocarbons from the proposed infill wells will comingle with Shaw fluids, and thereafter follow the Shaw fluids respective (oil / gas / water) processing routes. Gas compression and treatment will be via the existing system on Montrose BLP. Oil and water separation efficiency will be improved on the BLP by running the crude oil start-up heater continuously to ensure produced water discharged overboard are below 30 mg/L.

The base case for the proposed Montrose Infill Project will be to install a new purpose-built extension on the east face of the existing Montrose BLP. The extension will comprise four individual modular structures with an additional upper structural frame connecting into the weather deck, all of which will be vertically supported by welded cellar deck extensions which will be installed as pre-works.

The module will extend from the sub cellar deck to the weather deck. The overall size of the module extension will be 11 m (W) x 4.5 m (Depth [D]) x 15 m (H), and the approximate total gross weight is 137 te.

The installation of the pre-assembled units will be by platform crane, so individual module lifts will be restricted to within crane capacity of 40 te. A dropped object protection frame will be provided over pre-assembled units to allow flexibility of schedule by mitigating restrictions associated with lifting over live plant. The protection frame will comprise a series of five welded portal frames and six pallets installed via the platform crane during shutdown.

It will be ensured that the arcs of visibility for marine navigation lighting on the BLP platform will be maintained, to ensure compliance with the Standard Marking Schedule for Offshore Installations.

The reception pipework (including provision of temporary pigging infrastructure tie-in) and equipment required to support the new wells will be largely contained within the new pre-assembled modules with relatively short brownfield routings being required for the production, gas lift, flare and drains pipework.

A schematic of the proposed module configuration is shown in Figure 3-8.

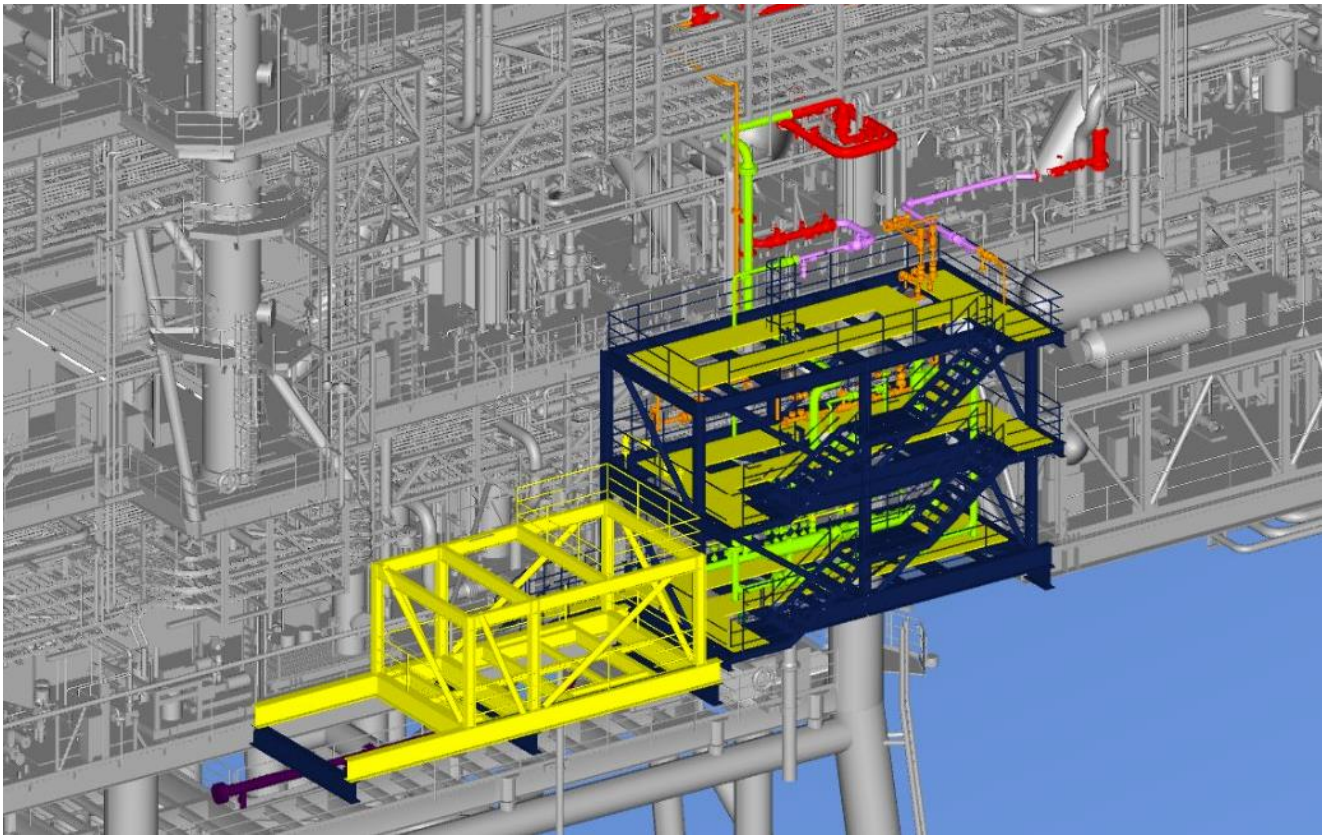


Figure 3-8: Proposed module configuration.

3.9 Production from the Existing Montrose BLP

Chemical use during production is anticipated to be the same as what is being used currently on the Montrose Complex and will include, for example, methanol and scale chemicals. Methanol injection will be required at each well-head (both upstream and downstream of production choke valve) for well start-up or shut-down, with injection at the subsea manifold as contingency. Scale treatment will be required to protect the downhole tubing and the subsea/topsides production system against scaling. Direct scale inhibitor injection will be provided to all wells downhole, and at the flowline inlet (i.e. subsea manifold) as top-up. Topsides flowline scale inhibitor injection is already available for top-up scale inhibitor.

One subsea gas-lift flowmeter per infill well will be located in the subsea manifold for the purpose of gas allocation. A subsea multi-phase flowmeter (MPFM) will also be located within the manifold structure for the purpose of reservoir management, and a topsides MPFM for field measurement and allocation. The subsea MPFM should have the capacity to flow all wells, to allow calibration with the topsides meter, and potentially to act as a back-up (but note that the subsea MPFM is primarily for well management). No meter will be installed on the other Shaw separator inlet line(s). Shaw will be allocated by subtraction of the Infill MPFM from the Shaw separator outlet single phase meters.

There is no allowance for sparing of the subsea or topsides flowmeters. On topsides, a bypass will be included as contingency.

3.9.1 Artificial Lift

The proposed new Infill wells will require artificial lift from first start-up. Artificial lift will be by gas lift as is standard across the MonArb facilities and is available on both the Montrose Alpha and the Montrose BLP. The proposed new Infill wells will require continuous gas lift at an estimated rate of 3 mmscfd per well at 1,500 psig (downstream of the wellhead choke); this will be provided from the Montrose BLP High Pressure (HP) compressor discharge. A bypass will be provided around the inboard valve for pressurisation of the subsea flowline. A route to flare will be provided for emergency relief and blow down.

There is evidence of adequate aquifer support from historical production/pressure data indicating that reservoir support by water injection is not required for the proposed new Infill wells.

3.9.2 Flaring and Venting

The existing Montrose BLP has stable operations, therefore trips or shutdowns longer than 12 hours (which would require a subsea depressurisation and cold, low-pressure restart to flare) are rare.

Flaring is anticipated during the following activities:

- Start-up flaring;
- Subsequent start-ups; and
- Process flaring and blowdown.

For the proposed Montrose Infill Project, it has been assumed that there would be two cold start-ups with associated flaring. Current venting rates on Montrose BLP will remain unchanged following the addition of the Montrose Infill Project wells.

As discussed in Chapter 2 a flare gas recovery system will be installed at Montrose to reduce emissions due to flaring. Further details are provided in Chapter 7.

3.9.3 Produced Water

As noted in Section 3.7, produced water from the proposed Montrose Infill wells will tie into the existing produced water treatment system on the Montrose BLP. As such, the produced water will be treated to reduce oil in water concentrations to below 30 mg/l and discharged overboard. Note at any time the produced water treatment system may be down (e.g. for maintenance), production would be shut-in.

Once the infill wells are brought online, production from other fields will be optimised in order to maintain the produced water rate within the design envelope of the Montrose BLP. The produced water rates tend to increase over the field life with the maximum produced water rate associated with the final years of production. The worst case average produced water rate forecast associated with the introduction of the infill wells is shown in Section 3.9.4, Table 3-13 and Figure 3-11.

3.9.4 Production Profiles

OIL PRODUCTION PROFILES

Table 3-11 and Figure 3-9 demonstrate the High Case average oil production rates from the Montrose field with and without the proposed Montrose infill Project. In Table 3-11, Baseline (Business as Usual (BAU)) oil production from existing wells at the Cayley, Wood, Shaw and Montrose fields between 2026 and 2030 is distinguished from additional production from these wells due to the life of field extension that would result from the proposed

Montrose Infill Project proceeding. Project oil production includes projected production from the Montrose Infill wells plus the life extension production from the existing wells. The final column in the table represents the total oil production at the Montrose Complex if the Project goes ahead.

Maximum oil production from the Montrose infill wells is anticipated in 2029 during the first full year of production and then is expected to decline until end of field life in 2035. The production rate from the Montrose Infill Wells ranges from 2,061 te/d in 2029 to 791 te/d in 2035.

Mid Case and Low Case production profiles are presented in addition to the High Case production profiles in Appendix F, along with Oil production profiles provided in m^3/d units.

Table 3-11: Montrose High Case average oil production rates (te/d).

Year	High Case Oil Production Rate (te/d)				
	Baseline from Existing Wells (BAU)	Life Extension of Existing Wells	Montrose Infill Wells	Montrose Infill Project	Total Production with Addition of Montrose Infill Project
2026	738				738
2027	694				694
2028	619		243	243	862
2029	525		2,061	2,061	2,585
2030	453		1,495	1,495	1,948
2031		389	1,196	1,584	1,584
2032		361	1,090	1,450	1,450
2033		310	974	1,284	1,284
2034		280	843	1,123	1,123
2035		277	791	1,068	1,068

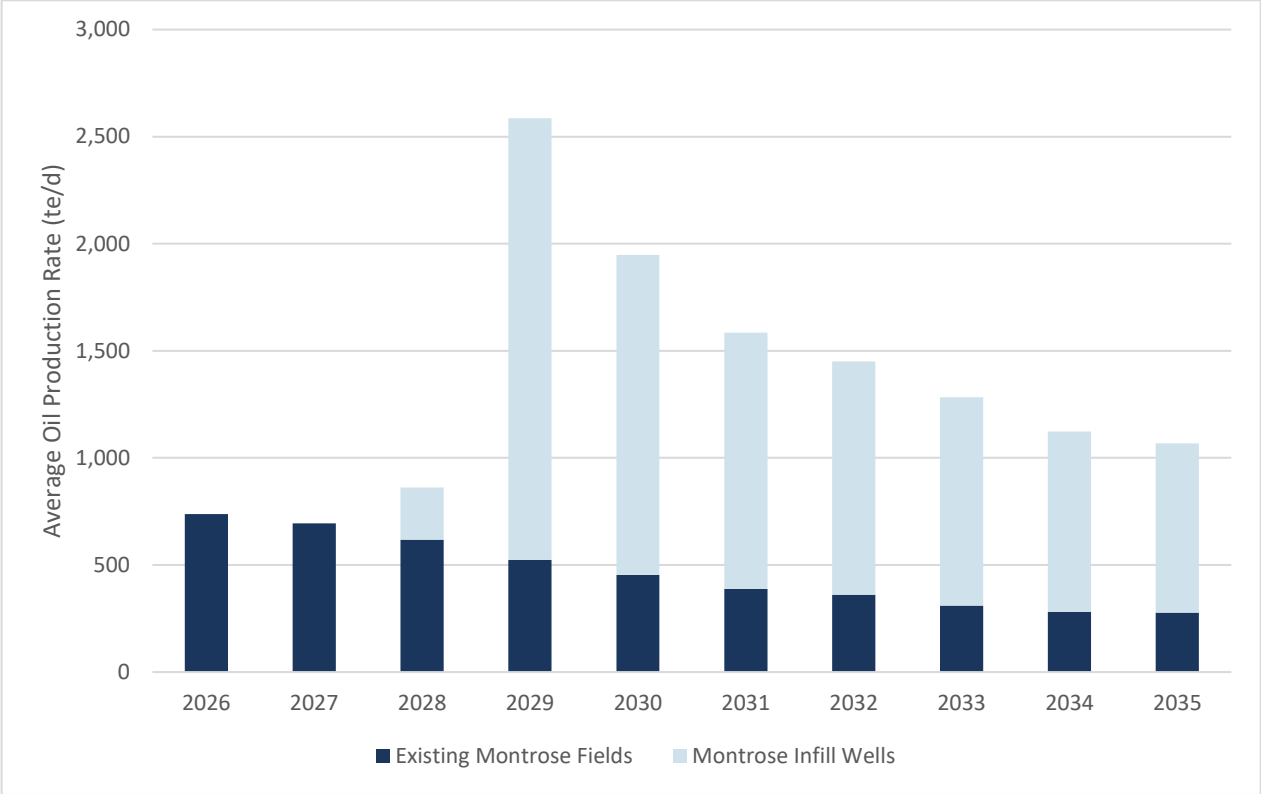


Figure 3-9: Existing Montrose fields High Case average oil production rate alone and with the additional proposed Montrose infill wells (te/d).

GAS PRODUCTION PROFILES

Table 3-12 and Figure 3-10 demonstrate the High Case average gas production rates from the Montrose field with and without the proposed Montrose infill wells. Maximum gas production from the Montrose infill wells is anticipated in 2029 during the first full year of production and then is expected to decline until end of field life in 2035. The production rate ranges from 263,433 m^3/d in 2029 to 99,296 m^3/d in 2035.

Mid Case and Low Case production profiles are presented in Appendix F.

Table 3-12: Montrose High Case average gas production rates (m^3/d).

Year	High Case Gas Production Rate (m^3/d)				
	Baseline from Existing Wells (BAU)	Life Extension of Existing Wells	Montrose Infill Wells	Montrose Infill Project	Total Production with Addition of Montrose Infill Project
2026	497,461				497,461
2027	644,867				644,867
2028	968,545		31,191	31,191	999,736
2029	547,306		263,433	263,433	810,739
2030	381,917		190,560	190,560	572,477
2031		348,266	151,814	500,080	500,080
2032		284,323	137,737	422,061	422,061
2033		192,125	122,891	315,017	315,017
2034		166,831	106,068	272,899	272,899
2035		158,828	99,296	258,124	258,124

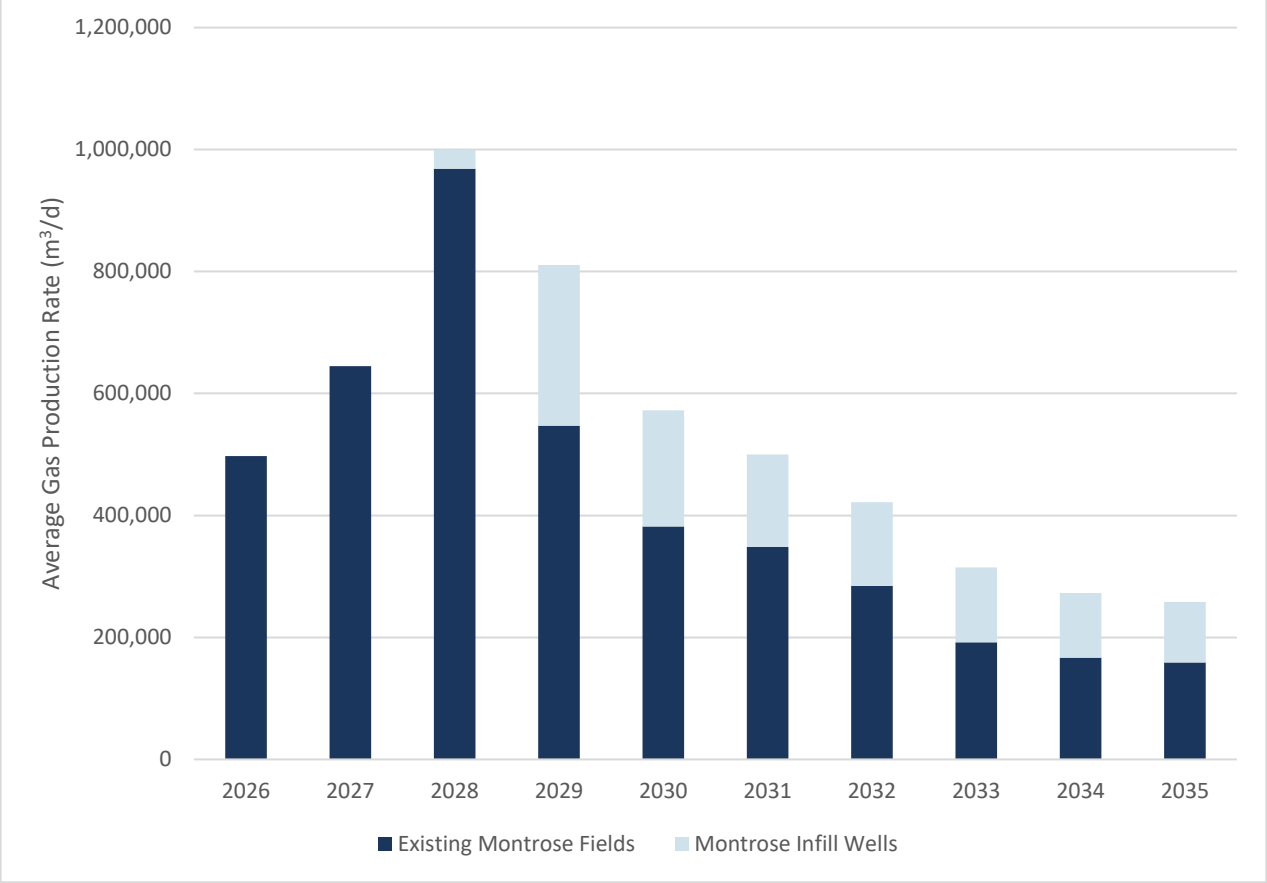


Figure 3-10: Existing Montrose Fields High Case average gas production rate alone and with the additional proposed infill wells High Case gas production rates (m^3/d).

WATER PRODUCTION PROFILES

Table 3-13 and Figure 3-10 demonstrate the worst-case average produced water production rates from the Montrose field with and without the proposed Montrose infill wells. Note that produced water profiles tend to increase over the field life with the maximum produced water rate associated with the final years of production. Maximum produced water production from the Montrose infill wells is anticipated in 2035 during the final year of production. The produced water production rate associated with the proposed infill wells ranges from 1,205 te/d in 2029 (first full year of production) to 2,146 te/d in 2035. The total produced water rate (existing Montrose Platform with addition of infill wells) ranges from 1,403 te/d in 2026, prior to introduction of the subsea tie-back wells, to 3,762 te/d in 2035.

Table 3-13: Montrose worst-case produced water production rates (te/d).

Year	Maximum Produced Water Production Rate (te/d)				
	Baseline from Existing Wells (BAU)	Life Extension of Existing Wells	Montrose Infill Wells	Montrose Infill Project	Total Production with Addition of Montrose Infill Project
2026	1,403				1,403
2027	1,557				1,557
2028	1,520		61	65	1,585
2029	1,720		1,139	1,205	2,925
2030	1,763		1,514	1,645	3,408
2031		1,745	1,605	1,743	3,488
2032		1,840	1,767	1,913	3,753
2033		1,578	1,847	2,006	3,584
2034		1,535	1,833	2,016	3,550
2035		1,616	1,925	2,146	3,762
Note: The produced water profiles provided are the highest across life of field and are associated with the mid-case hydrocarbon profiles.					

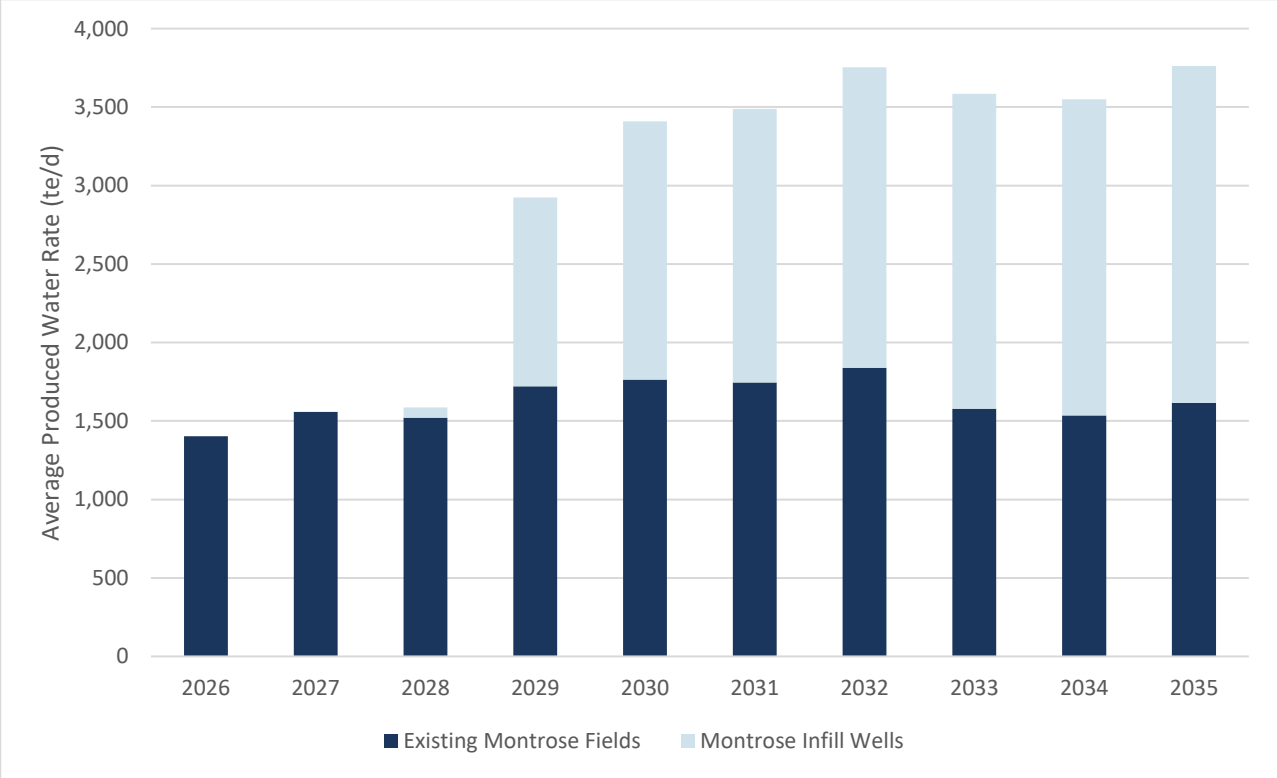


Figure 3-11: Montrose platform worst-case average produced water rate (te/d) (alone and with the additional proposed infill wells).

3.9.5 Vessel Use during Production

The existing Montrose BLP is served by an ERRV, helicopters, and supply vessels. There will be no change to vessel use as a result of the additional production from the Montrose Infill Project. Vessel emissions from 2030 (extended CoP due to Montrose Infill Project) are considered incremental emissions from the Montrose Infill Project and have been calculated in Chapter 7.

3.10 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 Portal Environmental Tracking System (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 Subsidiary Application Templates (SATs)). The ones required for Montrose Infill project permit application will be: Chemical Permit (CP), Oil Discharge Permit (OTP), CtL, Drilling Screening Direction (DR) and Production Screening Direction (PR).

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

3.10.1 Pollution Prevention and Control (PPC) Permit

It should be noted that the proposed Montrose Infill Project will require a slight increase in power demand on the platform. The existing Production Operations PPC Permit will therefore be reviewed and any changes as a result of the Project will be captured in a variation as required.

3.10.2 UK Emissions Trading Scheme (UK ETS)

No new GHG Permit under the UK ETS Trading Scheme will be required; however, the description of the installation in the existing permit application will be updated to reflect the infill wells.

3.10.3 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 Production Operations OPPC Life Permit (OLP) will be updated to capture the Montrose Infill Project.

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

3.10.4 Chemical Use and Discharges to Sea

The relevant permits to use and discharge chemicals offshore will be applied for 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.

3.10.5 Oil Pollution Emergency Plan (OPEP)

NEO NEXT+ will submit a Communication and Interface Plan (CIP) to interface with the existing approved Montrose Complex OPEP for the Montrose BLP and the Non-Production Installation (NPI) OPEP for the drilling rig.

3.10.6 Consent to Drill

NEO NEXT+ 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.

3.10.7 Consent to Locate (CtL)

Where applicable, NEO NEXT+ will apply for the following Consent to Locates (CtLs):

- Mobile Installation, e.g. drilling rig;
- Permanent / fixed structure, e.g. Xmas trees; and
- Flowline or cable system, e.g. polymer injection flowlines, and control umbilicals.

3.10.8 Flowline Works Authorisation (PWA) and Deposit Consent (DepCon)

NEO NEXT+ will submit an application for a Pipeline Works Authorisation (PWA) detailing the flowlines, structures and umbilical 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 flowline route.

3.11 Decommissioning

At Cessation of Production (CoP) the Montrose Infill Project 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.

As described in Section 2.3.3, a Carbon Capture Utilisation and Storage (CCUS) Review of the Montrose Arbroath Area was conducted in 2022 to explore opportunities for CO_2 storage, H_2 storage (and recovery) and EOR potential (through CO_2 injection). It was concluded that the configuration and structure of the wells / reservoirs at Montrose would not be suitable for CCUS or Hydrogen, or EOR. A Repsol Resources UK Repurposing Taskforce Report confirms that Montrose has no near-time potential for CCUS or Hydrogen.

3.11.1 Subsea Infrastructure and Flowline

It is expected that the subsea structures (mattresses, grout bags, spools and umbilical jumpers) will be removed from the seabed and returned to shore for reuse / recycling / disposal and a seabed clearance campaign conducted, however, this would be subject to future legislative requirements and guidance.

In line with current legislation, if mattresses are used to mitigate UHB along the full length of lines (base case), then the lines and associated mattresses would be recovered to shore. However, if it is necessary to rock cover the lines for UHB mitigation, the decommissioning of the lines under the rock would be subject to a Comparative Assessment. Should Comparative Assessment determine that the pipelines / umbilical should be decommissioned *in situ* (in the alternative case scenario), NEO NEXT+ will agree an ongoing monitoring plan with the relevant authority (currently this is OPRED).

3.11.2 Wells

All well programmes will be subject to a Well Notification assessed by the Health and Safety Executive (HSE) under the Offshore Installations (Offshore Safety Directive) (Safety Case etc) (SCR 2015). Wells will be plugged and permanently abandoned in accordance with Offshore Energy UK (OEUK) well decommissioning guidelines (OGUK, June 2018) (or applicable guidance at that time). All well programmes will be reviewed by the HSE Offshore Safety Department as required under the Design and Construction Regulations. In addition, the well construction and abandonment programmes will be examined by an Independent, Competent Authority (ICA) as per the SCR 2015 and the Offshore Installations and Wells (Design and Construction etc) Regulations 1996 (DCR).

On completion of the well-abandonment programme each conductor and internal tubing will thereafter be cut below the seabed, and the subsea wellheads recovered.

4 Environmental and Socio-Economic Baseline

The Montrose field is located in Blocks 22/17 and 22/18 in the CNS, *c*. 190 km from the Scottish coastline at Peterhead and *c*. 46 km from the UK/Norway median line.

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

4.1 Environmental Surveys

A number of environmental surveys have been carried out at the Montrose field. Where relevant this section draws on the findings of the environmental surveys detailed below and illustrated in Figure 4-1.

Environmental Baseline Survey Report – Montrose Site Survey Uk5306h-436-Emr-02 (Geoxyz, 2023)

An environmental baseline survey and habitat assessment survey (HAS) was carried out by GEOxyz in association with Benthic Solutions Limited (BSL) for NEO NEXT+ at the Montrose site in the CNS. Habitat and environmental baseline surveys were conducted at the Montrose site between the 11th and the 25th of October 2022 aboard the Geo Ocean V.

Environmental sampling involved acquisition of physico-chemical and macrofauna samples using a dual Van Veen grab at twelve stations. Underwater video footage and still photographs using a MOD4 camera system was undertaken at twelve stations to ground-truth features of interest.

Montrose Alpha and Bridge-Linked Platform Shallow Soils, Debris and Habitat Assessment Survey 1616: Habitat Assessment Field Report (BSL, 2016)

An HAS was conducted around the Montrose platforms for NEO NEXT+. Environmental operations were carried out by BSL in support of GEOxyz Offshore Limited aboard Skandi Constructor light well intervention vessel between the 24th and 26th of August 2016. The HAS encompassed an area of approximately 2 km x 2 km (anchor extents) containing an area of two Jack Up footprints and four anchor drop corridors. The water depth within the area surveyed was approximately 91 m Lowest Astronomical Tide (LAT). A total of four cruciform transects as well as two transects covering the jack-up footprints were investigated as part of the HAS.

The assessment was undertaken using a combination of acoustic and environmental ground-truthing techniques. Acoustic data were acquired in the field using side scan sonar (SSS) at all stations. Historical data was reviewed on board to interpret the potential for environmentally sensitive habitats to be present within the survey area, and to identify areas of sediment and habitat change. Environmental ground-truthing employed a combination of work-class remotely operated vehicle (ROV) seabed video footage and seabed sampling using a mini-Hamon grab sampler.

UKCS Blocks 22/17, 22/18 and 22/22a Montrose Arbroath Redevelopment Project Environmental Baseline Report comprising: Montrose BLP TO CATS T2 TEE, Cayley to Montrose BLP and Shaw to Montrose WI Option 1 (SL2) and WI Option 2 (SL4) Pipeline Route, Habitat Assessment and Environmental Baseline Surveys (Gardline, 2011a)

Gardline performed surveys along the pipeline routes from the Cayley and Shaw fields to the Montrose BLP (Gardline 2011b & 2011c); and from the Montrose BLP to the Central Area Transmission System (CATS) tie-in (Gardline, 2011d) (the 'MAR Project surveys') (Figure 4-1). Single and multibeam echo-sounder (SBES/ MBES), SSS, magnetometer and hull-mounted pinger were used to map water depth, seabed materials, obstructions and

pipeline crossings. Shallow (to 5 m) soils analysis was carried out using cone penetration testing (CPT) and Vibrocores. A habitat assessment for each route employed digital stills, video photography and grab samples. Grab samples were analysed for sediment hydrocarbons, metals, total organic matter and total organic carbon; sediment particle size; and benthic macrofauna.

Summary of Seabed Mapping and Sampling Around the Montrose/Arbroath and Auk/Fulmar Field Areas (Hartley Anderson, 2011)

Hartley Anderson Ltd summarised the available information on the seabed environment covering all or some of the blocks 22/17, 22/18 and 22/22. The areas included the Montrose and Arbroath production platforms.

Rig Site and Habitat Assessment Survey Vigne UKCS Block 22/17 (Fugro, 2010)

Fugro performed a site survey and habitat investigation of the Vigne prospect in block 22/17, southwest of the Montrose platform. The survey used SSS and digital video/stills to provide a detailed assessment of the area. The seabed was generally smooth and sandy with some areas of pebbles and cobbles. No Annex I habitats were recorded.

Rig Site and Habitat Assessment Survey Shaw UKCS Block 22/22a (Fugro, 2008)

Fugro performed a site survey of the Shaw location in block 22/22a. The survey used SSS and digital video/stills to provide a detailed assessment of the area. The seabed appeared generally featureless with minor topographic highs and lows scattered across the area. No Annex I habitats were recorded within the survey area.

Cayley Site Survey UKCS Block 22/17 (Gardline, 2006)

Gardline utilised SBES/ MBES, high resolution 2D seismic equipment, SSS and tow sub-bottom profilers at the Cayley location. The seabed topography was generally featureless with no hazards or obstructions identified.

Seabed Environmental Survey Cayley UKCS Block 22/17 (ERT, 2000)

ERT (Scotland) Ltd sampled the seabed at the Cayley field, using a van Veen grab. The sediments were predominantly classified as very well sorted fine sands. The sediment macrofauna were relatively homogeneous and broadly similar to that previously recorded from other regional surveys in this area of the North Sea.

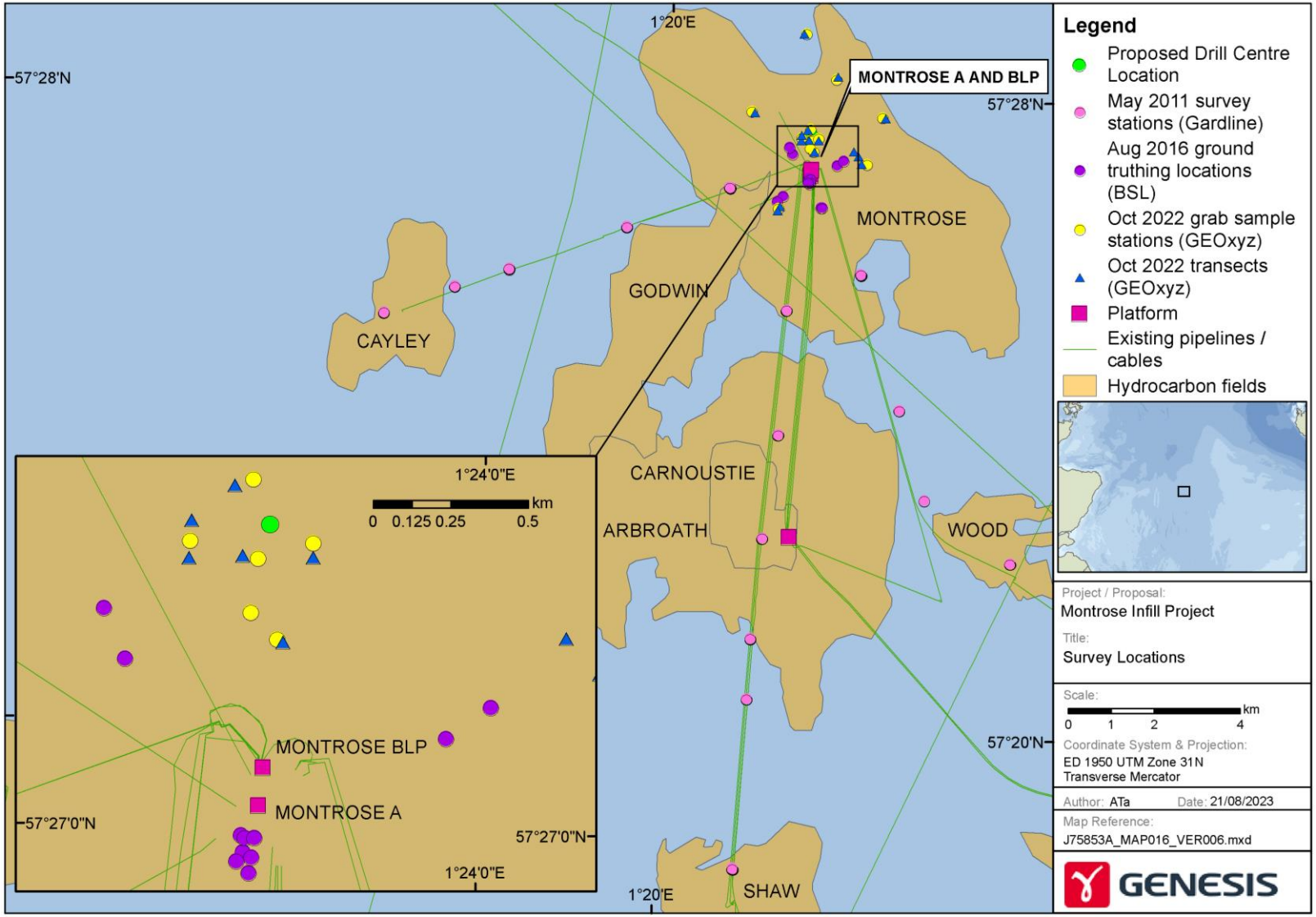


Figure 4-1: Montrose area survey stations and transects.

4.2 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 and tides, waves, temperature, salinity and wind also help set the design parameters for offshore facilities and influence the fate and behaviour of any emissions and discharges from an installation and the risks associated with them.

4.2.1 Climate Change

Atmospheric emissions from the proposed Montrose Infill Project have local effects on air quality and global effects in relation to climate change.

Local concentrations of atmospheric pollutants are not monitored but, given the remote offshore location of the Montrose complex, the baseline local air quality is closely linked to emissions from current operations at Montrose and how these emissions disperse after release. This has been quantified as part of air dispersion modelling undertaken in 2025 in support of the existing Pollution Prevention and Control (PPC) permit for Montrose and is presented in Appendix G.

The global impact of the project GHG emissions on climate change is intrinsically related to the existing background level of GHG concentrations in the atmosphere and how these concentrations are projected to change in the future, with or without the proposed Montrose Infill Project. The current levels of atmospheric GHG concentrations are well understood, as are historical changes in these concentrations over the past 100 – 150 years. These changes are estimated to have caused a change in global average temperature of 1.1 °C (IPCC, 2023). Conversely, the baseline for future atmospheric concentrations of GHGs, and resultant temperature increases, are highly uncertain. The baseline for GHG concentrations and its context for GHG impacts assessment is described within Section 7.5.2 of this ES.

4.2.2 Metocean Conditions

Metocean (meteorological and oceanographic) conditions including bathymetry, currents, tides and circulation patterns all influence the type and distribution of marine life and the behaviour of emissions and discharges from offshore facilities. For example, the speed and direction of water currents have a direct effect on the transport, dispersion and ultimate fate of any discharges from a vessel or installation.

BATHYMETRY

The seabed in the Montrose area is relatively flat. Water depth at the Montrose platform is *c.* 91 m. General gradients recorded throughout the MAR Project survey area were less than 0.5°, although some localised maximum gradients of up to 7.5° were recorded at existing wells and pipelines (Gardline, 2011a). Bathymetry data collated during the MAR Project surveys are presented in Figure 4-2.

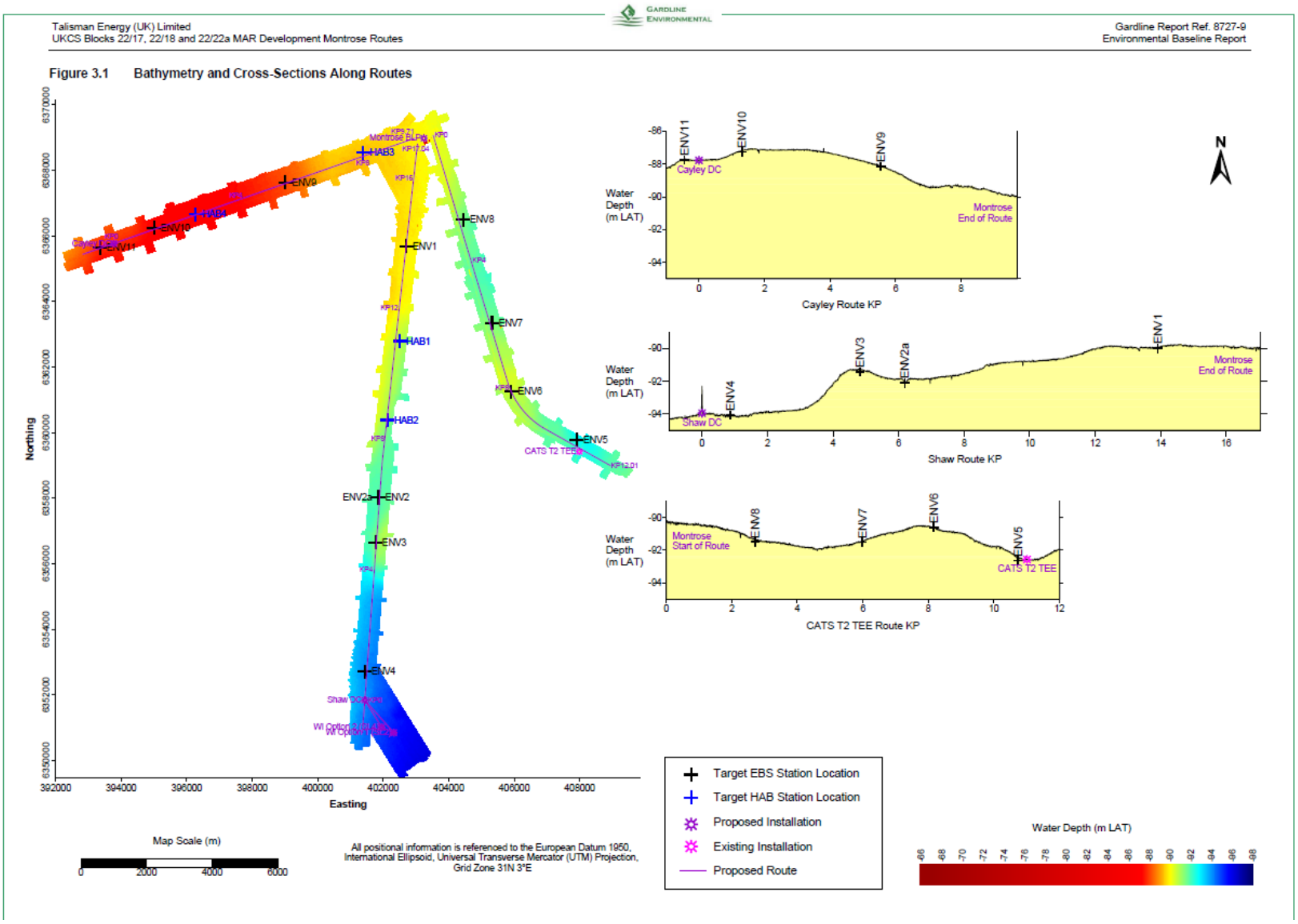


Figure 4-2: Bathymetry and MAR Project survey areas (Guardline, 2011a).

HYDROLOGY

Water masses and local current speeds and direction all influence the transport, dispersion and fate of marine discharges. The major water masses in the North Sea can be classified as Atlantic water, Scottish coastal water, northern North Sea water, Norwegian water, CNS water, southern North Sea water, Jutland water and Channel water (Turrell *et al.,* 1992). The Montrose field is located in the area influenced by the northern North Sea water mass (Figure 4-3). The predominant regional current in the CNS originates from the vertically well-mixed coastal water and Atlantic water inflow of the Fair Isle/Dooley current, which flows around the north of the Orkney Islands and into the North Sea. Weak residual currents of up to 0.05 m/s occur in the Montrose area (Marine Scotland, 2020).

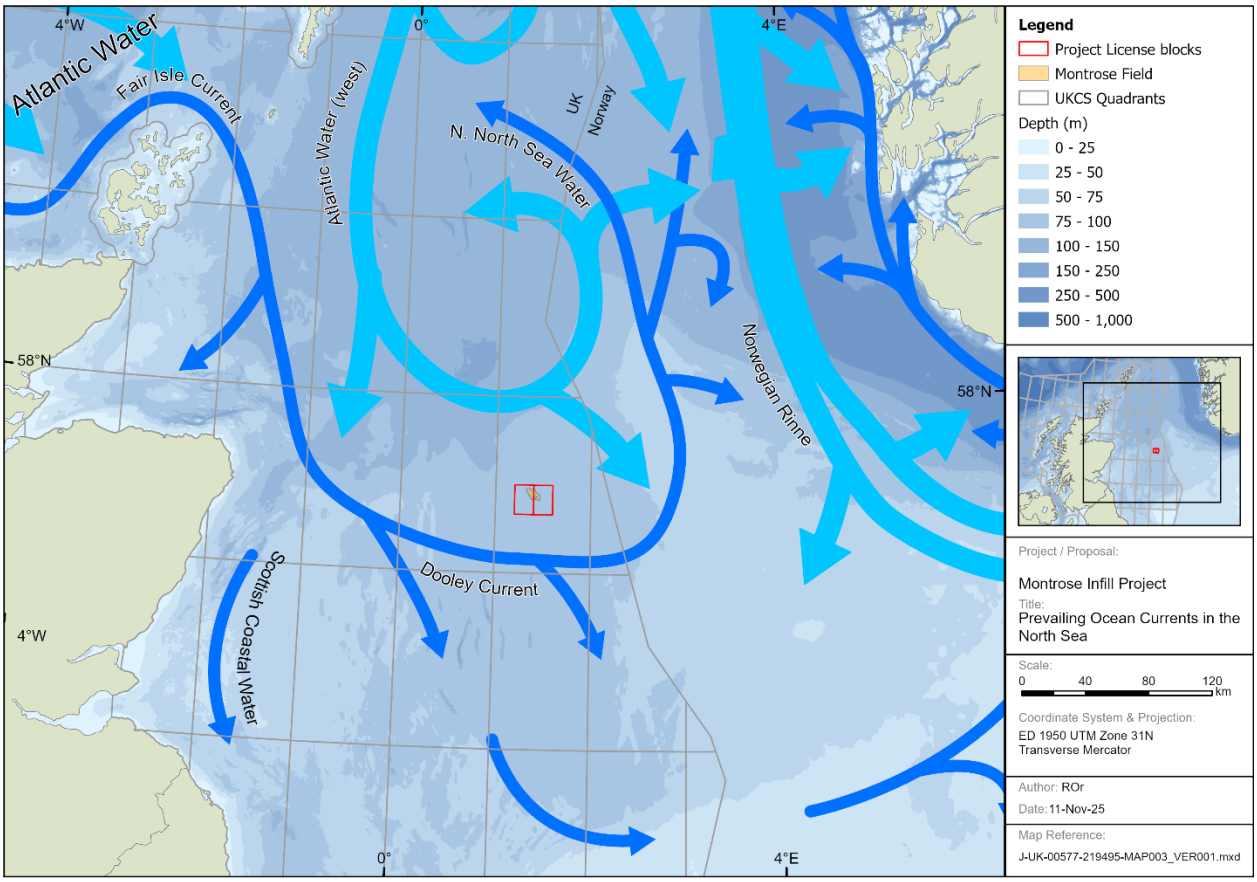


Figure 4-3: General circulation in the North Sea (Turrell *et al.*, 1992).

The mean spring tidal range in the Montrose area is 1.0 m and the mean significant wave height is 2.2 m (Scottish Government NMPi). The annual mean wave power is 24.6 kW/m (Scottish Government NMPi). The highest proportion of waves originate from the North, however, waves exceeding 4 m in height can occur from all directions as shown in Figure 4-4 (ABPmer, 2013).

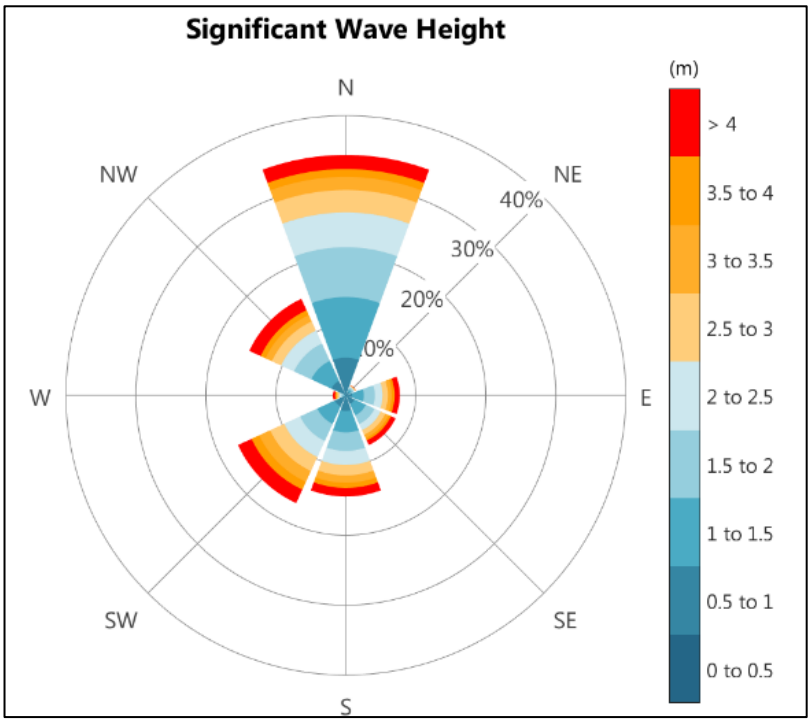


Figure 4-4: Wave rose for the Montrose area (ABPmer, 2013).

SEA TEMPERATURE AND SALINITY

Sea surface temperature and salinity in the area are governed by the flow of oceanic Atlantic waters into the North Sea through the Fair Isle Channel (Turrell *et al.,* 1992). According to data collected between 1971 and 2000, the annual mean seawater surface temperature in the Montrose area is *c*. 9 °C and the annual mean temperature at the seabed is *c*. 7 to 8 °C (Scottish Government NMPi).

Salinity data collected between 1971 and 2000 show little variation through the water column with annual mean salinity near the seabed and in surface waters of 35 ‰ (Scottish Government NMPi).

Most years, density stratification in the central and northern North Sea is well developed during the summer months, with the relative strength of the thermocline determined by solar heat input and turbulence generated by wind and tides. The area of the CNS in which the Montrose platforms are located is stratified in the summer. This stratification starts to break down in the autumn with the water being well mixed during the winter and becoming weakly stratified again in the spring (DESNZ, 2022).

Over the past 30 years, sea temperature around the UK has been increasing. The pace of warming is highest to the north of Scotland and over much of the North Sea, rising at up to 0.24 °C per decade. Plankton and fish communities are already changing in response to warming, as discussed in Sections 4.3.1 and 4.3.3. Warming of UKCS waters is projected to continue at a rate of 0.25 °C to 0.4 °C per decade over the next century (DESNZ, 2022).

METEOROLOGY

Wind speed and direction directly influence the transport and dispersion of atmospheric emissions. These factors are also important for the dispersion of water borne emissions, including oil, by affecting the movement, direction and break up of substances on the sea surface.

The prevailing wind in Blocks 22/17 and 22/18 originates from the southwest (Figure 4-5), with a 30-year long term average wind speed of 10.76 – 11.00 m/s (Saha *et al.,* 2010).

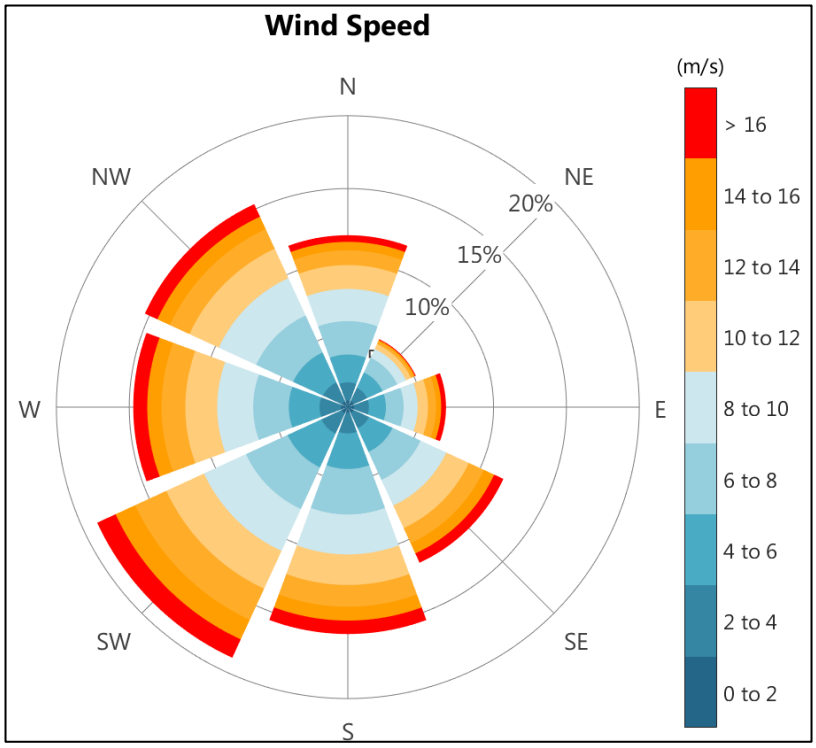


Figure 4-5: Wind rose for the Montrose area (Saha *et al.*, 2010).

4.2.3 Seabed Characteristics

The seabed gradient was generally < 0.5˚ with the seabed gently shoaling to the west-north-west (Gardline, 2011a; GEOxyz, 2023). Several items of linear debris, interpreted as abandoned wire / cable are present across the survey area (BSL, 2016; GEOxyz, 2023). The closest to the Montrose Infill Drill Centre is 37 m northwest and is 455 m long. Six depressions, shaped like the petals of a flower, are present on the seabed approximately 850 m northwest of the Montrose Infill Drill Centre. Each petal shaped depression is approximately 95-100 m long, 35-45 m wide with depths of up to 7.5 m and a build-up of sediment in the middle of the petal shape (GEOxyz, 2023).

Seabed sediments comprising mineral and organic particles occur commonly in the form of mud, sand or gravel and are dispersed by wind (waves), tides and contrasts in water density. The distribution of seabed sediments in the North Sea results from a combination of hydrographic conditions, bathymetry and sediment supply. The nature of the local seabed sediments is an important factor in providing information to help assess the potential for scouring of sediments around installed facilities. The characteristics of the local sediments and the amount of sediment transport within a project area are important factors in determining the potential effects of possible developments (drill cuttings, installation of pipelines, anchor scouring) on the local seabed environment.

A modelled distribution of seabed sediments in the North Sea is illustrated in Figure 4-6 which indicates that the Marine Strategy Framework Directive (MSFD) predominant habitat in Blocks 22/17 and 22/18 is 'offshore circalittoral sand' (EMODnet, 2023).

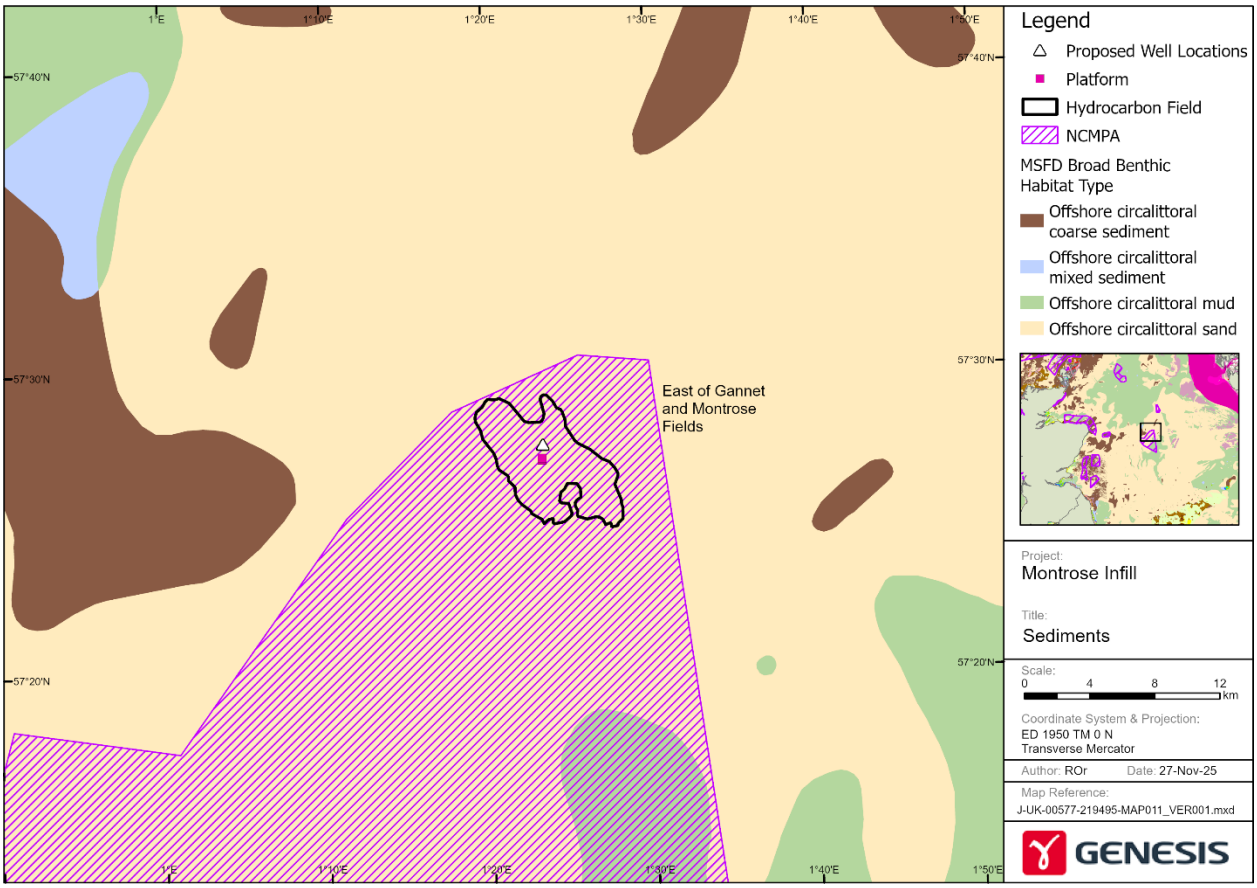


Figure 4-6: Seabed sediments in vicinity of Montrose Infill well locations (EMODnet, 2023).

SSS data from GEOxyz (2023) revealed the seabed sediments to comprise 'silty fine sand with occasional shell fragments' across most of the site with an area to the east comprised of 'silty fine sand with numerous shell fragments'. The seabed sediments within the Montrose survey area were dominated by sands (mean 81.1%±2.4SD), with a lower proportion of fines (mean 18.4%±1.9SD) and negligible gravel content (mean 0.55%±0.91SD). The homogeneous nature of the sediments was evidenced by a low coefficient of variation for sands (2.9%) and fines (10.6%). Conversely, gravel had a high coefficient of variation (165.4%) but this was due to the negligible levels of gravels across the entire site, such that the minor variation seen for this sediment fraction was high relative to the mean (GEOxyz, 2023).

Similar results were observed in 2016 surveys by BSL (2016) where most of the surveyed area represented silty sand with varying levels of shell material. These sediments were also generally homogenous fine to medium sands with varying levels of fragmented shell material. BSL (2016) also identified patches of dead shell overlying the silty sand, which appeared to be dominant in the vicinity of the Montrose Alpha and BLP platforms.

The MAR Project surveys showed that the sediments in the Montrose area comprise silty, shelly, Holocene sand with ≤ 1% gravel-sized material (> 2 mm) and 10-22% fine material (< 63 µm). The Cayley and Shaw pipeline route surveys suggest that sediments to the west and southwest of Montrose comprise silty shelly sand, with areas of clay outcropping along the Shaw pipeline route to the south. Sediments at Cayley were dominated by fine sand at all stations, with the proportion of fine material (< 63 µm, silt and clay) ranging from 10-14%. Sediments at Shaw were also dominated by fine sand, with the proportion of fine material (< 63 µm, silt and clay) ranging from 10-22%. All survey stations were classified as poorly sorted muddy sand (Modified Folk Classification) (Gardline, 2011a). Seabed samples collected by GEOxyz (2023) in the Montrose area were

represented by two Folk classifications, with 11 stations classified as 'Muddy sand' and one station to the northeast of the survey site classified as 'Slightly gravelly muddy sand'. The sediments across the survey area were all characterised as poorly sorted fine to very fine sand.

Sediments at the Vigne prospect to the southwest were identified as predominantly sand with occasional shell/ shell fragments and several small depressions containing 'sand with gravel and possible cobbles' (Fugro, 2010).

A veneer of very loose to very dense silty shelly sand, less than 1 m thick, is present over the MAR Project survey area, with the exception of occasional clay outcrops close to the Shaw field (more than 10 km south of the Montrose platform). The seabed is relatively flat across the survey area, with sparse fauna. The seabed across the site was characterised by muddy sands and gravelly muddy sands, primarily represented by consistent low reflectivity sonar data, with the exception of a large high reflectivity patch to the east of the area, ground-truthed as a higher density of shell fragments overlaying silty sands, with some agglomerations of white sea urchin (*Gracilechinus acutus norvegicus*) (GEOxyz, 2023).

Seabed features include localised depressions corresponding with pipelines; existing infrastructure; and occasional boulders and items of debris. A higher diversity of benthic fauna and accumulations of shells/ shell fragments were observed associated with these features (Gardline, 2011a; 2011b; 2011c; 2011d; GEOxyz, 2023).

SEDIMENT CHEMISTRY

Deep-water marine environments generally show relatively low levels of contamination compared to coastal waters and industrial estuaries.

Exposure of marine organisms to contaminants can occur either through uptake of dissolved fractions across the gills or skin, or direct ingestion of the pollutant. Organisms spending the majority of their lifecycle in the water column are likely to receive the highest exposure to contaminants that remain in solution, though some will also accumulate sediment bound contaminants indirectly through their diet (i.e. digestion of animals that have accumulated the contaminants in their tissues). Organisms associated with the seabed (benthic organisms) are more exposed to particle bound contaminants with the main exposure route being either directly through ingestion of contaminated sediments or through their diet. Benthic organisms can also absorb contaminants through the surface membranes as a result of contact with interstitial water. Elevated levels of contaminants can affect organisms (flora and fauna) in a variety of ways, ranging from cellular effects in individuals to ecosystem effects on populations or communities.

GEOxyz (2023) found that the total organic matter (TOM) content was above the United Kingdom Offshore Operators Association (UKOOA) (2001) 50th percentile reference level for background stations in the CNS (1.1%) at eight stations across the Montrose survey area, however, no stations exceeded the UKOOA 95th percentile level (4.5%). Additionally, the total organic carbon (TOC) results were low throughout the Montrose survey area, ranging from 0.22% at station M_ENV_10 to 0.28% at station M_ENV_06 (mean 0.24%±0.06SD). Increases in TOC may also reflect increases in both physical factors (i.e., fines) and common co-varying environmental factors through greater sorption on increased sediment surface areas (Thompson and Lowe, 2004).

During the MAR Project surveys, TOM ranged from 1.1 % to 1.8 % and TOC values varied between 0.10 % and 0.39%. These values were considered to be comparable with results recorded previously in neighbouring surveys and showed a weak positive correlation with the percentage fines (Gardline, 2011a).

The 2022 GEOxyz (2023) surveys further found that total hydrocarbon content (THC) of the sediments was variable, with moderate levels recorded across the site ranging from 8.2 mg.kg-1 at M_ENV_12 to 27.3 $mg.kg^{-1}$ at station M_ENV_04 (mean 15.0 $mg.kg^{-1}$±6.6SD). All stations exceeded the UKOOA (2001) 50th percentile

threshold for background stations in the CNS (4.1 $mg.kg^{-1}$), but no stations exceeded the 95th percentile (40.1 $mg.kg^{-1}$). Similarly, THC from 2011 Gardline surveys ranged from 5.7 $\mu g.g^{-1}$ at Station ENV3 (12.5 km south of the Montrose platform) to 12.8 μgg^{-1} at Station ENV8 (3 km south of the Montrose platform) (Gardline, 2011a). These results were consistent with background concentrations for sandy sediments in the CNS (UKOOA, 2001). Gas chromatography, from the 2011 surveys, indicated that the low-level, well-weathered hydrocarbons were derived from a mixture of petrogenic and biogenic sources. There was also a clear dominance of parent polyaromatic hydrocarbon (PAH) compounds from the higher weight (4-6 ring) fraction over their alkylated homologues and lower-weight fractions. This is indicative of a predominance of pyrogenically derived hydrocarbons (Gardline, 2011a). Total PAH concentrations recorded during 2022 surveys found that all stations were below the 95th percentile reference levels for background stations in the CNS (583 $\mu g.kg^{-1}$) (GEOxyz, 2023).

The total heavy and trace metal concentrations recorded during the GEOxyz (2023) surveys are presented in Table 4-1. Natural barium levels, recorded during GEOxyz (2023) 2022 surveys, were above the UKOOA (2001) 50th percentile threshold for background sediments in the CNS (118 $mg.kg^{-1}$) at all stations, with six of these (M_ENV_01, M_ENV_02, M_ENV_03, M_ENV_04, M_ENV_05, M_ENV_06) also exceeding the 95th percentile (523 $mg.kg^{-1}$). Cadmium, chromium, copper, lead, nickel, vanadium, zinc and iron were also all above their respective UKOOA 50th percentile thresholds at most stations. The 95th percentile threshold for lead (16.7 $mg.kg^{-1}$) was also exceeded at two stations (M_ENV_01: 19.3 $mg.kg^{-1}$ and M_ENV_04: 18.1 $mg.kg^{-1}$) within the Montrose field.

The 2022 surveys (GEOxyz, 2023) therefore show elevated heavy metal concentrations compared to those of the 2011 surveys whereby metals were all consistent with background concentrations for the sediment type and region (Gardline, 2011a; UKOOA, 2001). There was minor elevation in the concentration of cadmium at Station ENV4 (17 km south of the Montrose platform) but this was not sufficient to result in any toxicological effect on the faunal community (Gardline, 2011a). Despite this, no metal concentrations within the 2022 survey area were above their associated National Oceanographic and Atmospheric Association (NOAA) Effects Range Low (ERL) or Effects Range Medium (ERM) reference values where adverse effects would be affected on the macrofauna community (GEOxyz, 2023).

Table 4-1: Total heavy and trace metal concentrations (mg.kg^{-1} or ppm) recorded during GEOxyz (2023) surveys.

Station	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Manganese	Nickel	Vanadium	Zinc	Aluminium	Barium	Iron	Selenium	Strontium	Lithium	Tin
M_ENV_01	4.4	0.06	22.6	5.5	19.3	<0.01	167	6.2	18.6	31.7	22,800	672	8.760	0.8	113	10.0	1.2
M_ENV_02	3.9	0.05	19.9	3.9	13.0	<0.01	99	6.2	18.0	17.7	24,000	2,240	10,500	1.0	135	9.7	0.7
M_ENV_03	4.0	0.06	20.5	4.2	15.5	<0.01	102	6.0	17.5	22.1	22,700	594	8,180	1.1	94.5	9.7	0.8
M_ENV_04	4.2	0.07	20.3	4.4	18.1	<0.01	135	6.0	18.1	21.0	22,800	998	8,220	1.0	101	9.8	0.8
M_ENV_05	4.0	0.04	20.9	4.6	14.2	<0.01	111	7.1	19.0	17.8	22,800	1,380	8,980	1.0	106	9.6	0.6
M_ENV_06	5.2	<0.03	20.5	3.0	12.0	<0.01	117	5.8	17.5	16.1	23,600	575	8,910	0.8	97.5	10.5	<0.5
M_ENV_07	4.9	0.04	22.9	3.7	15.2	<0.01	159	6.8	20.6	18.3	22,300	323	8,300	1.3	134	9.8	0.8
M_ENV_08	3.9	0.04	18.2	2.9	11.9	<0.01	128	5.4	16.2	14.3	22,600	415	7,570	1.0	86.5	9.3	0.7
M_ENV_09	4.4	0.05	21.1	4.4	11.8	<0.01	110	6.8	17.4	14.4	23,600	359	8,610	0.8	85.9	10.1	0.6
M_ENV_10	4.1	0.04	20.0	4.3	10.8	<0.01	121	6.3	17.0	16.0	22,100	329	8,880	0.9	84.1	9.1	0.6
M_ENV_11	3.7	0.05	17.8	3.6	12.9	<0.01	115	5.9	16.3	14.3	21,300	379	7,630	0.9	87.8	9.3	0.6
M_ENV_12	4.1	0.04	20.3	4.9	11.6	<0.01	103	6.6	17.4	14.6	21,800	345	8,350	0.9	81.1	9.4	0.6
Mean	4.2	0.05	20.4	4.1	13.9	-	122.8	6.3	17.8	18.2	22,700	717.4	8,574	1.0	100.4	1.0	0.7
Reference Values																	
UKOOA CNS 50th %ile (UKOOA, 2001)	-	0.02	7.2	2	6.7	0.01	-	4.0	12.0	10.4	-	118	3,487	-	-	-	-
UKOOA CNS 95th %ile (UKOOA, 2001)	-	0.12	31.0	6	16.7	0.10	-	19.0	31.2	32.6	-	11,160	11,160	-	-	-	-
NOAA ERL (Buchman, 2008)	8.2	1.20	81.0	34	46.7	0.15	-	20.9	-	150	-	-	-	-	-	-	-
NOAA ERM (Buchman, 2008)	70.0	9.60	370	270	218	0.71	-	51.6	-	410	-	-	-	-	-	-	-

DRILL CUTTINGS PILE AT MONTROSE ALPHA PLATFORM

A contaminated cuttings pile is present directly below the Montrose Alpha platform. These cuttings were deposited during drilling activity prior to the ban on disposal of oil-based mud (OBM) contaminated cuttings at sea. Values reported by ERT (2000) show THC concentrations declining with increasing distance from the platform.

Higher concentrations of THC, barium and total n-alkanes were recorded at three stations (M_ENV_02, M_ENV_04 and M_ENV_05) closest to the cuttings pile (disturbed sediment) at the 22/17 well. Gas chromatography traces at stations sampled north of the cuttings pile (disturbed sediment) also showed a highly weathered OBM hydrocarbon contamination (nC14-nC22). This pattern reflects diffuse contamination from the cuttings pile at the 22/17 well drilled in the 1970s, when the discharge of OBMs was prevalent in the North Sea (GEOxyz, 2023).

In 2016, during installation of the Montrose BLP (approximately 70 m to the north of the Montrose platform), there was no disturbance to the cuttings pile. The proposed Montrose Infill Project wells will be tied back to the Montrose BLP and thus the proposed Project activities will be located over 100 m from the cuttings pile.

4.3 Biological Environment

This section describes the marine flora and fauna in the vicinity of the Montrose field.

4.3.1 Plankton

The Montrose platform occurs in the Offshore Energy Strategic Environmental Assessment 4 (OESEA 4) Regional Sea 1 which, since a plankton regime shift in the late 1980s, is considered to be a temperate province. Plankton in this area generally comprise Atlantic and offshore species. Dinoflagellates typically comprise a greater proportion of the phytoplankton community than diatoms from June to October, when waters are most stratified. The spring bloom in this region is stronger, relative to the autumn bloom, than elsewhere. Harmful algal blooms observed in the region include the diatom Pseudonitzschia, a cause of amnesic shellfish poisoning, and the dinoflagellate *Alexandrium tamarense* (DESNZ, 2022).

The richness and seasonal variability of zooplankton species is higher in Regional Sea 1 than further south. The zooplankton community is dominated by calanoid copepods such as the cold-water copepod Calanus finmarchicus and the temperate copepod *Calanus helgolandicus*. Between 1960 and 2015, *C. finmarchicus* abundance declined significantly in Regional Sea 1, whilst *C. helgolandicus* increased. Other important components of the zooplankton assemblage include Paracalanus, Pseudocalanus and larval stages of Calanus, euphausiids, Acartia, and decapods (DESNZ, 2022).

Rising sea surface temperature has resulted in migration of warmer water species and an increase in the diversity of zooplankton in UK waters. During the 21st century, non-native plankton species such as *Mnemiopsis leidyi* and *Sargassum muticum* have been recorded in UK waters, whilst a number of warm water Tripos species were recorded 40-100 miles off the coast of north-west Scotland in 2009, the furthest north these species have ever been recorded. Mechanisms including ships' ballast water and aquaculture are recognised as potential sources for the introduction of non-native and potentially harmful organisms. Species including the Indo-Pacific diatoms *Odontella sinensis* and *Coscinodiscus wailesii*; and the east-Asian copepod *Pseudodiaptomus marinus*, have been recorded in northern European and UK waters (DESNZ, 2022).

4.3.2 Habitat Type and Benthic Communities

HABITAT TYPE

The seabed within the GEOxyz (2023) survey area was deemed to include one main level four European Nature Information System (EUNIS) habitat type: MD52 'Offshore circalittoral sand' (JNCC: SS.SSa.OSa). This habitat was characterised by muddy sand with variable proportions of shell. Smaller areas along video transects consisted of a greater accumulation of shells and were classified as MC42 'Offshore circalittoral mixed sediment' (JNCC: SS.SMx.OMx). Areas along transects where a high density of sea urchins, thought to be *Gracilechinus acutus*, were present were classified as ME6212 '*Gracilechinus acutus norvegicus* assemblage on Atlantic mid bathyal mud' (JNCC: M.AtLB.Mu.UrcCom.GraAcu).

Similar findings were observed by BSL (2016) where the silty sand sediments were identified to fall into the EUNIS classification of A5.27 (deep circalittoral sand), which corresponds to the JNCC habitat code of SS.SSa.Osa ('offshore circalittoral sand'; JNCC, 2015). Further to this the coarser shelly sediments were identified to fall within the EUNIS classification of 'circalittoral coarse sediment' (A5.13), which corresponds to the JNCC habitat code SS.SCS.CCS (JNCC, 2015).

Two of the main sensitive habitats known to occur in the wider CNS include 'Seapen and burrowing megafauna communities'/'burrowed mud' and 'methane-derived authigenic carbonates'. However, surveys in 2010, 2016 and 2022 did not identify either of these habitats in the Montrose area (Gardline, 2011a; 2011b; 2011c; 2011d; BSL, 2016; GEOxyz, 2023).

No methane-derived authigenic carbonates were identified during ground-truthing by GEOxyz (2023). Burrows identified during GEOxyz (2023) surveys were assessed and identified to meet a SACFOR (Superabundant, Abundant, Common, Frequent, occasional, Rare) density of 'Rare', therefore not meeting the requirement for classification as 'Seapen and burrowing megafauna communities'/'burrowed mud' habitat.

Photographs showing the habitat types observed during the 2022 GEOxyz (2023) surveys are shown in Figure 4-7.

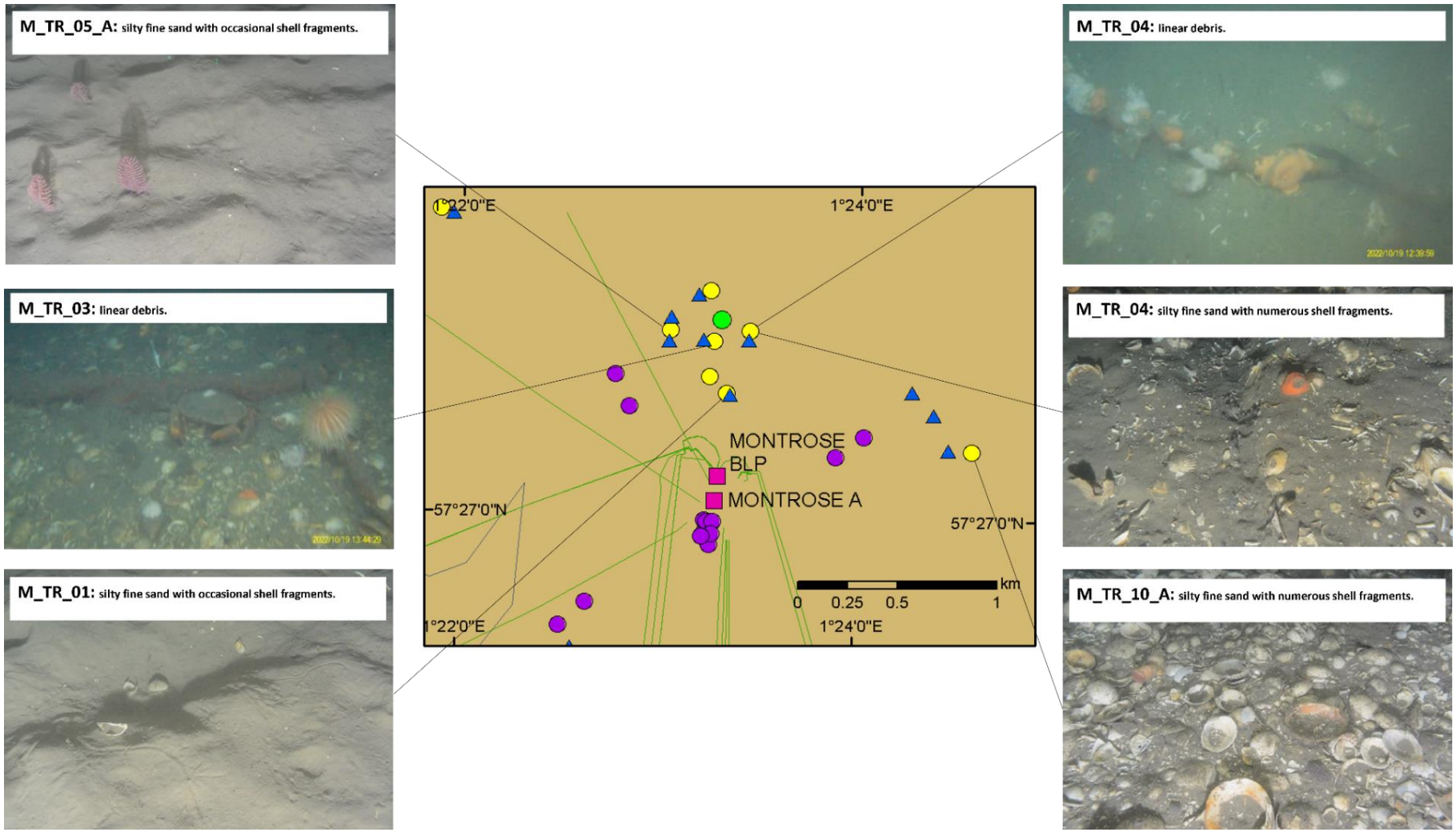


Figure 4-7: Survey points and associated Habitat photographs (GEOxyz, 2023).

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.

Grab sampling from 12 stations during 2022 surveys of the Montrose area, by GEOxyz (2023), revealed that the infaunal taxa consisted of 77 annelid species accounting for 65.6% of the total individuals. The mollusca were represented by 33 species (18.8% of the total individuals), the arthropods were represented by 31 species (4.4% of the total individuals) and the echinoderms by 10 species (1.9% of the total individuals). The solitary epifauna comprised of two individuals of the phosphorescent seapen *Pennatula phosphorea*. All other groups (Foraminifera, Chaetognatha, Nematoda, Nemertea, Platyhelminthes, Phoronida and Hemichordata) were represented by nine species, accounting for 9.3% of the total individuals.

Relic *Arctica Islandica* (ocean quahog) shells were a predominant component of the general shell debris found across the survey site and within sieved fauna samples; however, no adult specimens or evidence of distinct siphons were seen on any of the video footage or still photographs within the Montrose survey area. A total of 36 juveniles were found to be present within the survey area across all stations, indicating the presence of *A. islandica* at the proposed Project location (Figure 4-8; GEOxyz, 2023).

Retrieved grab samples from the 2016 survey showed the presence of empty shells from scaphopods, ocean quahogs and the cockle *Acanthocardia* sp. Sand habitats were further found to be characterised by starfish (*Asterias rubens*, *Astropecten irregularis* and possible *Virgularia mirabilis*), gastropods and hermit crabs (*Paguridae* sp.). The shelly sediments closer to Montrose Alpha and BLP were found to possess sparse fauna, with occasional sponges or anemones attached to hard substrates (BSL, 2016).

The closest sampling stations from the MAR Project surveys are *c*. 1.9 km west of the Montrose Platforms. These surveys found that the macrofaunal community at all stations was dominated by juveniles of the echinoderm taxa Echinocardium and Ophiuroidea, likely to have resulted from a spawning event. After discounting these juveniles, the macrofauna communities were similar to those recorded in neighbouring surveys, albeit less diverse. The macrofauna were dominated by polychaetes such as *Paramphinome jeffreysii* and *Spiophanes bombyx*. Multivariate analysis indicated a subtle change in community along the Cayley pipeline route (Stations ENV9, ENV10 and ENV11). The faunal community at these stations was characterised by the crustacean *Eudorellopsis deformis*, corresponding with slightly coarser sediments and shallower water closer to the Cayley drill centre. The community at Stations ENV2 and ENV3 on the Shaw pipeline route was characterised by a greater abundance of *Galathowenia oculate*, corresponding with clay outcrops and deeper water at these stations (Gardline, 2011a).



Figure 4-8: *A. islandica* shells within sieved samples and throughout the survey area (GEOxyz, 2023).

Visible fauna along the Cayley pipeline route consisted of cnidarians including sea pens (*Virgularia mirabilis* and *Pennatula phosphorea*), anemone (possible *Urticina felina*), and unidentified cnidarian sp. Mollusc species observed included possible common whelk (*Buccinum undatum*). In addition to these were crustacean species; common hermit crab (*Pagarus bernhardus*), common spider crab (*Maja squinado*), encrusting and massive Porifera sp., tusk shell (Scaphopod sp.), Flustra sp. and faunal burrows found only at Stations ENV14/HAB3 and ENV15/HAB4. An assortment of chordate species was observed on the video and still photography including hagfish (*Myxine glutinosa*) and angler fish (*Lophius piscatorius*) (Gardline 2011a & 2011b).

Along the Shaw pipeline route, visible fauna were limited but appeared more diverse at Stations ENV12/HAB1 and ENV2 corresponding with where debris was seen, and consisted of echinoderms (*Astropecten irregularis*), cnidarians including *V. mirabilis* and *P. phosphorea*, dead man's fingers (*Alcyonium digitatum*), possible *U. felina*, and unidentified cnidarian sp. Mollusc species observed included possible *B. undatum*, giant file clam (*Acesta excavata*) and Scaphopod sp., *P. bernhardus*, *M. squinado* and euphausiids. There was also a hydroid species (possible *Branchiocerianthus* sp.), encrusting and massive Porifera sp., bryozoan (*Flustra* sp.) and faunal burrows found only at Stations ENV13/HAB2 and ENV2. An assortment of chordate species were observed on the video and still photography including ling (*Molva molva*), gurnard or dragonet, possible dab (*Limanda limanda*) and a possible wrasse (Gardline 2011a & 2011c).

Visible fauna along the CATS tie-in route were also limited and consisted of *A. irregularis*, *V. mirabilis* and *P. phosphorea*, and possible *U. felina*. Mollusc species observed included *B. undatum*, and *Scaphopod* sp. In addition to these were crustacean species including euphausiids, *P. bernhardus* and echinoderm species including the sea cucumber (*Psolus phantapus*). Additionally there were bryozoan (*Flustra* sp.), Porifera sp.

and faunal burrows and bioturbation. An assortment of chordate species were observed on the video and still photography including witch (*Glyptocephalus cynoglossus*), a thornback ray (*Raja clavata*) and hagfish (*M. glutinosa*) (Gardline 2011a & 2011d).

No species or habitats of conservation significance under the UK's Conservation of Habitats and Species Regulations 2010 were observed (Gardline 2011a, 2011b, 2011c & 2011d).

4.3.3 Fish and Shellfish

More than 330 fish species inhabit the shelf seas of the UKCS (Pinnegar *et al.,* 2010). Pelagic species (e.g. herring, mackerel, blue whiting, and sprat) are found in mid-water and typically make extensive seasonal movements or migrations. Demersal species (e.g. cod, haddock, sandeels, sole 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 species are subject to numerous pressures including increasing sea temperatures, competition, commercial fisheries and energy developments. As the North Sea becomes warmer, species such as sea bass and red mullet are becoming more common further north, while stocks of cold-adapted species such as cod, haddock and whiting have declined. There is also a northwards movement of non-native species (DESNZ, 2022).

Fish occupying areas near offshore oil and gas installations will be exposed to aqueous discharges and may accumulate hydrocarbons and other contaminating chemicals in their body tissues (Bakke *et al.,* 2013). The most vulnerable stages of the life cycle of fish, 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 region is important when considering potential disturbance caused by drilling and installation activities and when responding to accidental releases during operations.

Blocks 22/17 and 22/18 lie within International Council for the Exploration of the Seas (ICES) rectangle 43F1. Table 4-2 summarises the presence of spawning grounds, nursery grounds, and juveniles for a number of commercially important species.

As noted in Section 4.5.2, a number of fish species likely to be present within the Montrose area are considered Scottish Priority Marine Features (PMFs).

Table 4-2: Spawning and nursery grounds for commercial fish species in ICES rectangle 43F1 and adjacent rectangles.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Blue whiting	N	N	N	N	N	N	N	N	N	N	N	N
Cod	SN	S*N	S*N	SN	N	N	N	N	N	N	N	N
European hake	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Haddock	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Herring	N	N	N	N	N	N	N	N	N	N	N	N
Horse mackerel	J	J	J	J	J	J	J	J	J	J	J	J
Lemon sole				S	S	S	S	S	S			
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N	N	S*N	S*N	S*N	SN	N	N	N	N
Nephrops	SN	SN	SN	S*N	S*N	S*N	SN	SN	SN	SN	SN	SN
Norway Pout	SNJ	S*NJ	S*NJ	SNJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Plaice	S*N	S*N	SN	N	N	N	N	N	N	N	N	SN
Sandeels	SN	SN	N	N	N	N	N	N	N	N	SN	SN
Spotted ray	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ
Key	S = Spawning S* = Peak Spawning N = Nursery J =Juveniles Highlighted species name indicates high intensity nursery. Highlighted species name indicates High intensity spawning.											
Sources: Ellis *et al*. (2012); Coull *et al*. (1998); Aires *et al*. (2014)												

Other fish species which may occur in the area include basking shark, porbeagle shark, round-nose grenadier and saithe (Tyler-Walters *et al.,* 2016).

Cod return to aggregate at specific spawning grounds, making them vulnerable to anthropogenic impacts. Cod spawning grounds are strongly influenced by sediment type, with coarse sand being a preferred spawning substrate compared with mud or sand (González-Irusta and Wright, 2016a). Sediments at Montrose are dominated by muddy sand and are therefore considered to be an unfavourable habitat for cod spawning.

Species which may use the seabed of the Montrose area include: lemon sole which, although they are most commonly found on stony seabed sediments, may occur and spawn on any substrate (Williams, 2022); plaice which are more common in shallower waters, but which may occur in deeper waters on mixed substrates; and sandeels which lay sticky clumps of eggs on sandy substrates with up to 10% silt/ clay component (DESNZ, 2022).

The species which are most likely to spawn on the seabed in the Montrose area include: *Nephrops* which live and spawn in shallow burrows in soft, muddy sediments (MarLIN, 2023); and Norway pout which occur on muddy substrates.

4.3.4 Marine Mammals

Marine mammals include 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.

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 both species are considered Scottish PMFs.

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 both harbour seals are unlikely to occur in the areas of operation, while 0 to 0.001 % of UK and Ireland at-sea grey seal population may be present (Carter *et al.,* 2022; Figure 4-9)

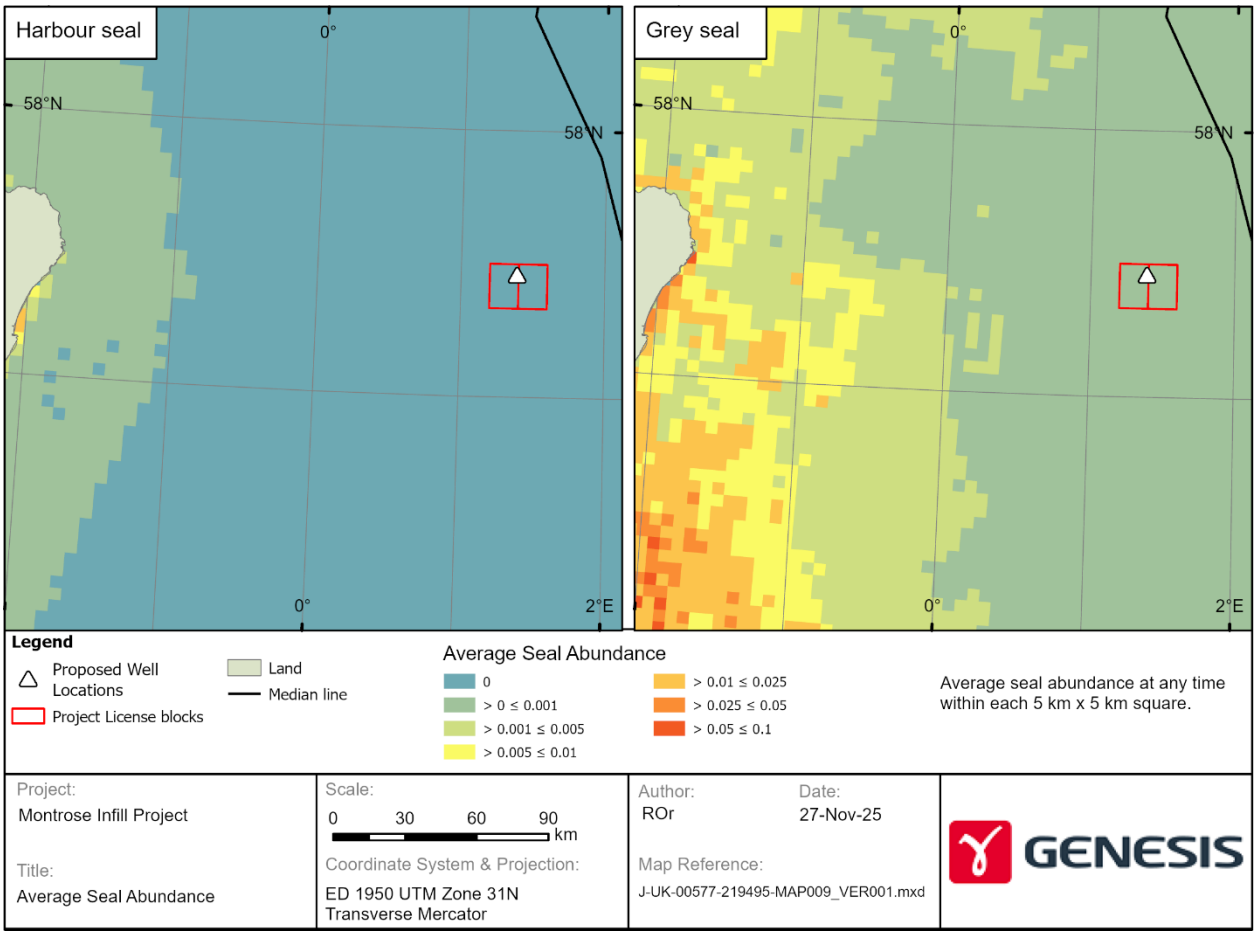


Figure 4-9: Mean UK and Ireland at-sea seal population distribution in the vicinity of the proposed Montrose Infill Project (Carter *et al.*, 2022).

CETACEANS

Table 4-3 and Figure 4-10 show actual sightings of cetaceans recorded in the Atlas of Cetacean Distribution in North-West European Waters (Reid *et al.*, 2003) in the vicinity of the proposed Montrose Infill Project area. It is noted that distribution of some species e.g. harbour porpoise has changed since these data were published (DESNZ, 2022).

Table 4-3: Cetacean sightings in the vicinity of blocks 22/17 and 22/18.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottlenose dolphin												
Harbour porpoise												
Killer whale												
Minke whale												
Risso's dolphin												
White-beaked dolphin												
Atlantic white-sided dolphin												
Note: Blue indicates species seen. Source: Reid *et al.,* 2003												

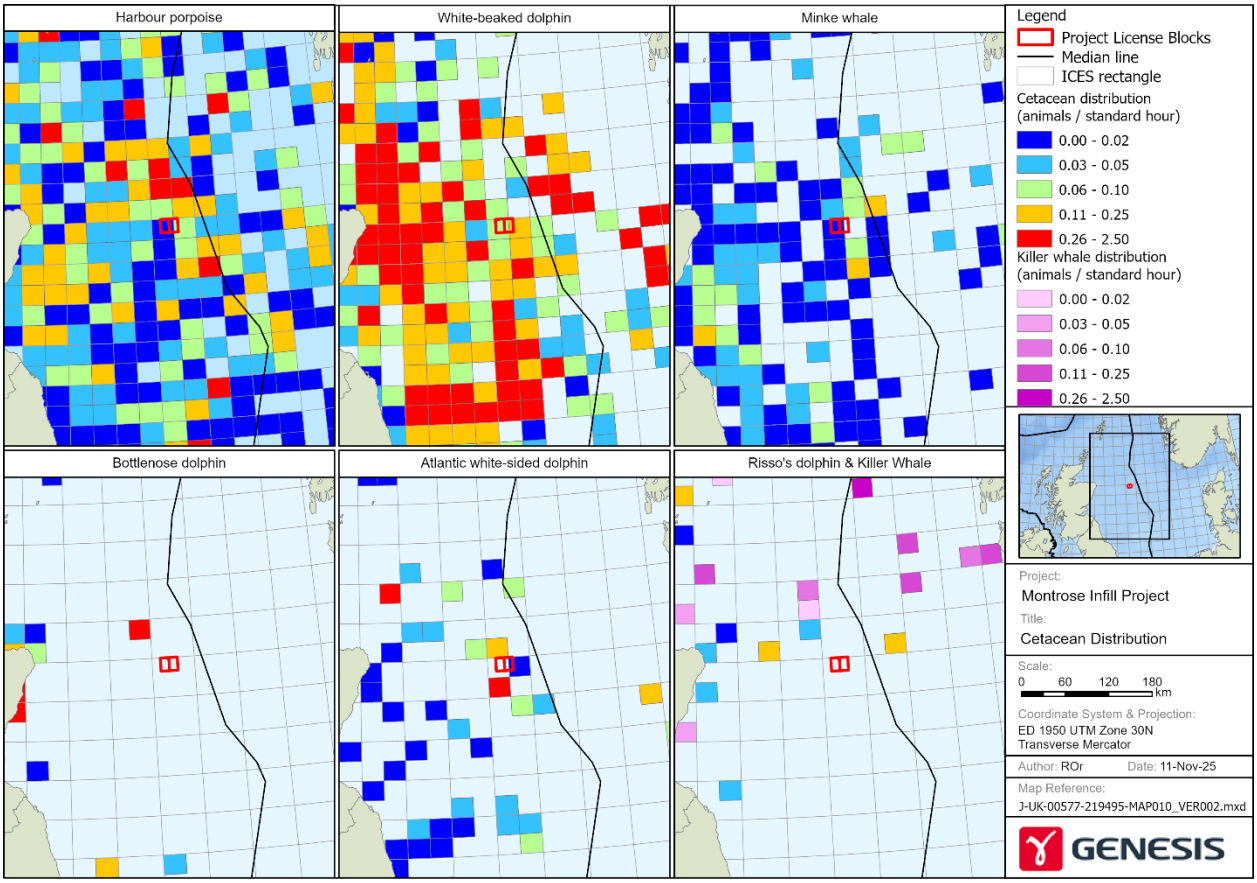


Figure 4-10: Cetacean observations in the vicinity of the Proposed Montrose Infill Project (Reid *et al.*, 2003).

Predicted density distribution maps presented by Waggitt *et al. (*2020) suggest that bottlenose dolphin and Atlantic white-sided dolphin were generally absent from the proposed project area. Harbour porpoise are likely to occur in densities of around 0.5 animals/km^2 throughout the year with higher densities occurring further

south. Results from Gilles *et al.* (2023) revealed that harbour porpoise, minke whale, white-beaked dolphin and fin whale all may occur in densities of < 0.01 animals/km^2 throughout the year in Block NS-D. In Block NS-G all the same species may occur in densities of < 0.01 animals/km^2 except for harbour porpoise, which may occur in densities of > 0.01 animals/km^2.

A series of Small Cetacean Abundance in the North Sea (SCANS) surveys were conducted to obtain an estimate of cetacean abundance in North Sea and adjacent waters, the most recent of which is SCANS-IV (Gilles *et al.,* 2023).

The Montrose field is located within SCANS-IV Blocks 'NS-D' and 'NS-G'. Aerial survey estimates of animal abundance and densities (animals per km^2) within this area are provided in Table 4-4. These data show that minke whale occurs in low densities while fin whales may occur at very low densities. Harbour porpoise and white-beaked dolphin occur more frequently.

The JNCC has also published the 'regional' population estimates for the seven most common species of cetacean occurring in UK waters (IAMMWG, 2022). Divided into Management Units (MU), these provide an indication of the spatial scale and the relevant populations at which potential impacts should be assessed. The relevant MU population estimates are also presented in Table 4-4. Note that the SCANS-IV survey excluded killer whales. Although Risso's dolphin, bottlenose dolphin, Atlantic white-sided dolphin and common dolphin were identified by Reid *et al*. (2003), there was insufficient data to produce modelled surface densities of these species during the SCANS-IV survey.

Table 4-4: Cetacean Abundance in SCANS-IV Blocks and IAMMWG Management Units.

Species	Block NS-D		Block NS-G		MU Population[2]
	Animal Abundance[1]	Density (animals/km^2)	Animal Abundance[1]	Density (animals/km^2)	
Harbour Porpoise	38,577	0.5985	51,646	1.0398	346,601
Minke whale	2,702	0.0419	510	0.0103	20,118
White-beaked dolphin	5,149	0.0799	5,218	0.1051	43,951
Fin Whale	57	0.0009	0	0	-
Sources: [1]Gilles *et al.* (2023), [2]IAMMWG (2022).					

4.3.5 Seabirds

The North Sea is an internationally important area for breeding and feeding seabirds. Using seabird density maps from European Seabirds at Sea (ESAS) data collected over 30 years, Table 4-5 identifies a number of bird species (and their predicted maximum monthly abundance) expected to occur in the proposed Montrose Infill Project area (Kober *et al.,* 2010).

The data indicate that, for all species combined, a maximum of 11 seabirds are predicted to occur per km^2 during the breeding season (April to September), whilst during the winter months (November to March) five to 12 seabirds are predicted to occur per km^2. Some of the seabirds that occur in the area are qualifying features of SPAs with marine components along the Scottish coastline.

Table 4-5: Predicted Monthly seabird surface density in the proposed Montrose Infill Project area.

Species	Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern gannet	Breeding												
	Winter												
Northern fulmar	Breeding												
	Winter												
Black-legged kittiwake	Breeding												
	Winter												
European storm-petrel	Breeding												
Glaucous gull	Winter												
Great black-backed gull	Winter												
Razorbill	Breeding												
Little auk	Winter												
Herring gull	Winter												
Arctic skua	Breeding												
Great skua	Breeding												
	Winter												
Common guillemot	Breeding												
	Additional												
	Winter												
Atlantic puffin	Breeding												
	Winter												
All species combined	Breeding												
	Summer												
	Winter												
Key: maximum number of individuals per km ^{2}		Not recorded		≤ 1.0		1.0 – 5.0		5.0 – 10.0		10.0 - 15.0		15.0 - > 20.0	
Source: Kober *et al*., 2010													

The OESEA 4 report brings together information from a wide range of sources, and presents a complex picture of declining and increasing populations across different species and locations. Overall, along the North Sea coast of Scotland, a general decline in seabird numbers has been seen since 1986. Of the species likely to occur in the proposed Montrose Infill Project area, the species showing the most notable decline are Arctic skua, black-legged kittiwake and northern fulmar. Conversely, northern gannet, black-headed gull and razorbill have shown a general increase (DESNZ, 2022).

The reasons for the decline in certain species are not fully understood, but are thought to include reduced food availability, mortality due to fisheries bycatch, extreme weather events and competition for nest sites. For

example, as northern gannet numbers increase they have established a presence at new sites and may be out-competing other seabird species such as common guillemot, at their traditional breeding sites (DESNZ, 2022).

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 well testing and flaring, when hydrocarbon dropout to the sea surface can occasionally occur, or from unplanned events such as accidental hydrocarbon spills.

The vulnerability of seabirds to surface oil in the blocks and surrounding areas has been assessed according to the Seabird Oil Sensitivity Index (SOSI). The purpose of this 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.

The SOSI combines the seabird survey data with individual seabird species sensitivity index values. These values are based on a number of factors which are considered to contribute towards the sensitivity of seabirds to oil pollution, and include:

- Habitat flexibility (the ability of a species to locate to alternative feeding grounds);
- Adult survival rate;
- Potential annual productivity; and
- Proportion of the biogeographical population in the UK.

The combined seabird data and species sensitivity index values were then subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution. The mean sensitivity SOSI data for the area is shown in Table 4-6. For blocks with ‘no data’, an indirect assessment has been made (where possible) using JNCC guidance (JNCC, 2017). The sensitivity of birds to surface oil pollution in the proposed Montrose Infill Project area ranges from low to medium throughout the year; no data are available for November.

Table 4-6: Seabird Oil Sensitivity Index for Blocks 22/17 and 22/18, and adjacent blocks.

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22/11	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/12	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/13	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/14	5	5	4	4*	5*	5	5	5	5	5*	N	5*
22/16	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/17	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/18	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/19	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/21	5	5*	5	5*	5*	5	5	5	5	5*	N	5*
22/22	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/23	5	5	5	5*	5*	5	5	5	5	5*	N	5*
22/24	5	5	5	5*	5*	5	5	5	5	5*	N	5*
KEY	1 – Extremely high		2 – Very high		3 - High		4 - Medium		5 - Low		N- No data	
Indirect Assessment – data gaps have been populated following guidance provided by the JNCC (JNCC, 2017). * Data gap filled using data from the same block in adjacent months. ** Data gap filled using data from the adjacent blocks within the same month.												
Sources: Webb *et al*., 2016; JNCC, 2017.												

4.4 Marine 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 Special Areas of Conservation (SAC) and Special Protection Area (SPA), which are designated under the EU Habitats Directive and EU Birds Directive, respectively, 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 Directives continue to apply to how European sites (SACs and SPAs) are designated and protected in the UK. The Habitats Regulations also provide a legal framework for species requiring strict protection, e.g. European protected species (EPS).

Nature Conservation Marine Protected Areas (NCMPAs) are designated under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009.

Blocks 22/17 and 22/18 lie within the East of Gannet and Montrose Fields NCMPA. There are no other protected areas within 40 km of these blocks. The next closest site is the Norwegian Boundary Sediment Plain NCMPA, located 62 km to the northeast (Figure 4-11).

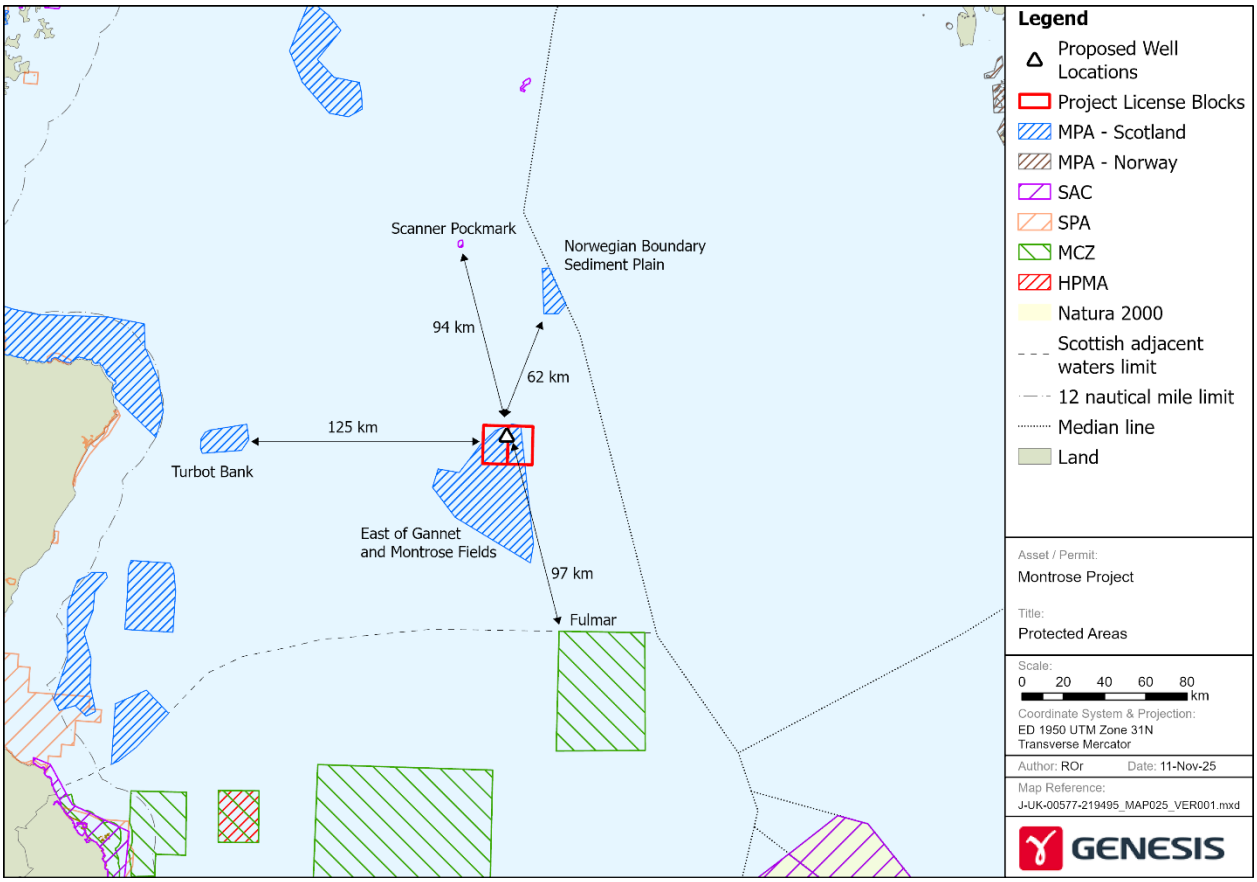


Figure 4-11: Protected areas in the vicinity of proposed Montrose Infill Project.

EAST OF GANNET AND MONTROSE FIELDS NCMPA

It should be noted that as of 16th October 2025, the East of Gannet and Montrose Fields NCMPA is a restricted fishing area (Scottish Government, 2025), described further in Section 4.6.1.

The East of Gannet and Montrose Fields NCMPA covers an area of 1,839 km^2 with water depths ranging from 80 to 100 m. It was designated in 2014 for the following protected features:

- low or limited mobility species 'ocean quahog (*A. islandica*) aggregations';
- 'offshore deep sea muds' habitat; and
- 'offshore subtidal sands and gravels' habitat (representing sediment types suitable for ocean quahog colonisation).

Ocean quahog (*A. islandica*) is a long-lived mollusc, which may live to over 400 years old, making it one of the longest-lived species on Earth. It can be found at depths > 400 m and has a thick rounded shell up to 13 cm in length. Recruitment may occur infrequently, often at intervals over 10 years, and up to 100 years in certain locations (Tyler-Walters and Sabatini, 2017). With exceptional longevity and slow reproductive rates, the species is vulnerable to anthropogenic pressures, particularly if large portions of a population are removed. In such cases, *A. islandica* resilience is graded as 'very low' (> 25 years; Tyler-Walters & Sabatini, 2017). Ocean quahog is afforded protected status under the OSPAR Commission due to its inclusion on the OSPAR list of threatened and/or declining species in the Greater North Sea area as a priority species (OSPAR, 2008; 2009). This species is also listed as a Scottish PMF.

The NCMPA is dominated by sands and gravels, which are the preferred habitat of *A. islandica*. The NCMPA also includes a substantial area of offshore deep-sea mud dominating the south-east half of the NCMPA. Many types of worm and mollusc live buried in the mud and provide an important food source for fish (JNCC, 2024). Figure 4-12 illustrates the different mud types within the NCMPA, as well as the distribution of *A. islandica*, which appears to be correlated with the sediment type given that more individuals were found within areas with a high proportion of sand. Their distribution in Figure 4-12 suggests that they are likely to be present at the proposed Montrose Infill Project location. McCabe *et al.* (2020) acknowledged that the greatest densities of *A. islandica* were observed to the south-west, north and north-west regions of the NCMPA, which encompasses the proposed Montrose Infill Project area.

JNCC grab sample surveys carried out by McCabe *et al.* (2020) across the East of Gannet and Montrose Fields NCMPA observed juvenile *A. islandica* in 44 % of samples. The majority of specimens found were juveniles, however, the JNCC surveys were unable to identify the overall population structure of the species in the MPA (McCabe *et al.,* 2020). As described in Section 4.3.2, both 2016 and 2022 surveys at Montrose (GEOxyz, 2023; BSL, 2016) have observed the presence of relic *A. islandica* shells as a predominant component of the general shell debris across Montrose survey sites and within sieved fauna samples. However, no adult specimens or evidence of distinct siphons were seen on any of the video footage or still photographs within the Montrose survey area.

McCabe *et al.* (2020) also observed that sea pens and burrowing megafauna were present in the NCMPA. 'Sea pens and burrowing megafauna in circalittoral fine mud' come under the epifaunal biotope code 'SMu.CfiMu.SpnMeg' and is a component biotope of the PMF category 'Burrowed mud' (Hill *et al.,* 2022). Where adult animals remain undisturbed the recovery rate may be 'very high' (< 2 years), however, where significant proportions of the population are damaged, this may reduce to 'low' (>10 years; Hill *et al.,* 2022). McCabe *et al*. (2020) found this biotope to be present within 82 % and 100 % of still images and video transects, respectively across the NCMPA (McCabe *et al*., 2020). Three species of sea pen were identified in the NCMPA, *V. mirabilis*, *P. phosphorea* and *Funiculina quadrangularis* (Figure 4-13). The resilience of this biotope depends largely on the species present and the intensity and frequency of impact.

As shown in Figure 4-6, the proposed drill centre location occurs in an area characterised by 'offshore circalittoral sand', therefore the habitat 'sea pens and burrowing megafauna in circalittoral fine mud' is less likely to be found at the location. However, Figure 4-13 shows that individuals of *P. phosphorea* may be found in the vicinity of the manifold.

As noted in Figure 4-6, the drill centre location is located outwith the 'offshore deep sea muds' habitat.

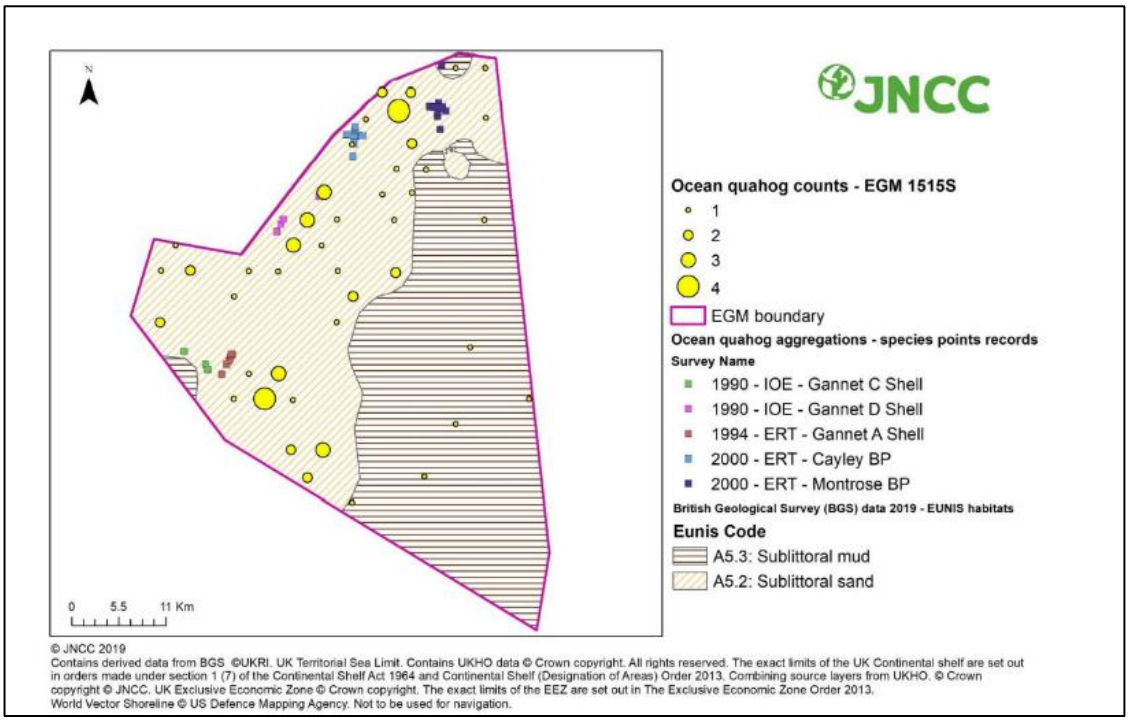


Figure 4-12: Distribution of ocean quahog obtained from grab samples conducted within the East of Gannet and Montrose Fields NCMPA. Abundance data from previous surveys is also shown (McCabe *et al.*, 2020).

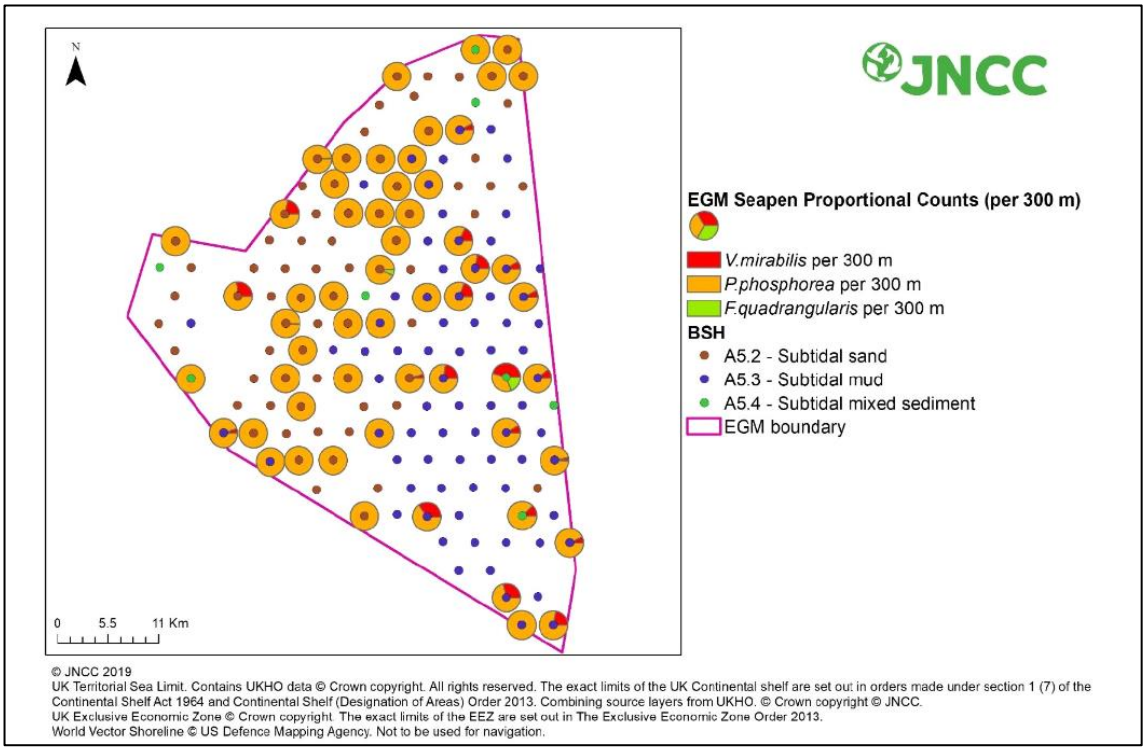


Figure 4-13: Proportional counts of the three observed sea pen species *F. quadrangularis*, *P. phosphorea* and *V. mirabilis* per 300 m tow within the NCMPA. All data derived from 58 video tows taken during a 2015 survey of the NCMPA (McCabe *et al.*, 2020).

4.5 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);
- OSPAR list of threatened and/or declining habitats and species (OSPAR, 2023);
- Scottish PMFs (habitats and species which are considered to be of particular importance in Scotland) (Tyler-Walters *et al.,* 2016); and
- 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).

4.5.1 Sensitive Habitats

As described in Section 4.3.2, two of the main sensitive habitats known to occur in the wider CNS include 'Seapen and burrowing megafauna communities'/'burrowed mud' and 'methane-derived authigenic carbonates'. However, surveys in 2010 and 2016 did not identify either of these habitats in the Montrose area (Gardline, 2011a; 2011b; 2011c; 2011d; BSL, 2016).

Recent 2022 surveys (GEOxyz, 2023) again revealed no methane-derived authigenic carbonates during ground-truthing, whilst the burrows were identified to meet a SACFOR density of 'Rare', thus not meeting the requirement for classification as 'Seapen and burrowing megafauna communities'/'burrowed mud' habitat.

'Sea pens and burrowing megafauna in circalittoral fine mud' are a PMF and have been observed widely across the East of Gannet and Montrose Fields NCMPA, generally showing a preference for muddy sediments (McCabe *et al.,* 2020). As noted in Section 4.4, given the location of the proposed Montrose drill centre within an area of 'offshore circalittoral sand', it is not likely that this biotope would be present in the vicinity of the proposed Project.

There are no other sensitive habitats potentially present within the Montrose area.

4.5.2 Sensitive and Protected Species

Table 4-7 lists the main sensitive and protected species that may be present within the proposed Project area, their conservation status and protected status.

Table 4-7: Sensitive and protected species potentially within the proposed Montrose Infill Project area.

Species		Trend[1]	IUCN[2]	Habitats Directive (Annex II species)	Birds Directive (Annex I species)	EPS	OSPAR[3]	PMF
Fish								
Anglerfish	*Lophius piscatorius*	Unknown	LC	No	-	No	No	Yes
Blue whiting	*Micromesistius poutassou*	Unknown	LC	No	-	No	No	Yes
Cod	*Gadus morhua*	Unspecified	VU	No	-	No	II & III	Yes
European hake	*Merluccius merluccius*	Unknown	LC	No	-	No	No	No
Haddock	*Melanogrammus aeglefinus*	Unspecified	VU	No	-	No	No	No
Herring	*Clupea harengus*	Increasing	LC	No	-	No	No	Yes
Horse mackerel	*Trachurus trachurus*	Decreasing	VU	No	-	No	No	Yes
Lemon sole	*Microstomus kitt*	Stable	LC	No	-	No	No	No
Ling	*Molva molva*	Unknown	DD	No	-	No	No	Yes
Mackerel	*Scomber scombrus*	Decreasing	LC	No	-	No	No	Yes
Nephrops	*Nephrops norvegicus*	Stable	LC	No	-	No	No	No
Norway pout	*Trisopterus esmarkii*	Increasing	LC	No	-	No	No	Yes
Plaice	*Pleuronectes platessa*	Increasing	LC	No	-	No	No	No
Sandeels	*Ammodytes marinus*	Unknown	LC	No	-	No	No	Yes
Spotted ray	*Raja montagui (Dipturus montagui)*	Stable	LC	No	-	No	II & III	No
Spurdog (spiny dogfish)	*Squalus acanthias*	Decreasing	EN	No	-	No	II & III	Yes
Whiting	*Merlangius merlangus*	Unknown	LC	No	-	No	No	Yes
Seabirds								
Arctic skua	*Stercorarius parasiticus*	Decreasing	LC	-	No	No	No	No

Species		Trend[1]	IUCN[2]	Habitats Directive (Annex II species)	Birds Directive (Annex I species)	EPS	OSPAR[3]	PMF
Atlantic puffin	*Fratercula sterna*	Decreasing	VU	-	No	No	No	No
Black-legged kittiwake	*Rissa tridactyla*	Decreasing	VU	-	No	No	II & III	No
Common guillemot	*Uria aalge*	Increasing	LC	-	No	No	No	No
European storm-petrel	*Hydrobates pelagicus*	Unknown	LC	-	Yes	No	No	No
Glaucous gull	*Larus hyperboreus*	Stable	LC	-	No	No	No	No
Great black-backed gull	*Larus marinus*	Stable	LC	-	No	No	No	No
Great skua	*Stercorarius skua*	Increasing	LC	-	No	No	No	No
Herring gull	*Larus argentatus*	Decreasing	LC	-	No	No	No	No
Little auk	*Alle alle*	Decreasing	LC	-	No	No	No	No
Northern fulmar	*Fulmarus glacialis*	Decreasing	LC	-	No	No	No	No
Northern gannet	*Morus bassanus*	Increasing	LC	-	No	No	No	No
Pomarine skua	*Stercorarius pomarinus*	Unknown	LC	-	No	No	No	No
Razorbill (lesser auk)	*Alca torda*	Increasing	LC	-	No	No	No	No
Cetaceans								
Minke whale	*Balaenoptera acutorostrata*	Unknown	LC	No	-	Yes	No	Yes
Bottlenose dolphin	*Tursiops truncatus*	Unknown	LC	Yes	-	Yes	No	Yes
White-beaked dolphin	*Lagenorhynchus albirostris*	Stable	LC	No	-	Yes	No	Yes
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Stable	LC	No	-	Yes	No	Yes
Risso's dolphin	*Grampus griseus*	Unknown	LC	No	-	Yes	No	Yes

Species		Trend[1]	IUCN[2]	Habitats Directive (Annex II species)	Birds Directive (Annex I species)	EPS	OSPAR[3]	PMF
Killer whale	*Orcinus orca*	Unknown	DD	No	-	Yes	No	Yes
Harbour porpoise	*Phocoena phocoena*	Decreasing	VU	Yes	-	Yes	II & III	Yes

[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)

4.5.3 MarESA

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.

A. islandica are the only species observed in any of the Montrose environmental surveys which are analysed in these sensitivity assessments.

As the species is long-lived, with a sexual maturity taking 5-15 years, recruitment is low and steady with sporadic successful peaks. *A.islandica,* therefore has a low recoverability (Hennen, 2015; Witbaard and Bergman, 2003). MarLIN highlight if an *A.islandica* population were to experience significant mortality then recovery is likely to take an excess of 25 years in the North Sea (Witbaard and Bergman, 2003).

A.islandica have a low tolerance and therefore high sensitivity to physical change; this includes abrasion and sediment disturbance. In comparison they have a high tolerance for the suspension of sediment and heavy rates of smothering and/or burial. The action of installing subsea infrastructure and associated stabilisation and protection features on the seabed results in the permanent physical change (change in habitat type from soft to hard substratum), abrasion, and the local temporary suspension of sediment.

4.5.4 FeAST

The associated Feature Activity Sensitivity Tool (FeAST) pressures resulting from the activity of oil and gas infrastructure development are listed in Table 4-8. 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 4-8, the potential presence of features in Blocks 22/17 and 22/18 are assessed according to UK biotopes map and known records of presence locally (JNCC, 2025).

In Table 4-8, the potential of a feature being present does not represent the confirmation of the feature being present, as the online FeAST tool is still being developed all potential pressure points and sensitivities were

included in the table. A feature being 'not sensitive' to a pressure indicated it has a high resistance and is likely to recover quickly; conversely a high sensitivity, occurred 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 4-8: FeAST summary of pressures and features associated with CNS oil and gas infrastructure development activity (JNCC, 2025).

Feature	Pressures														Potential presence in Blocks 22/17 and 22/18[1,2,3]
	Barrier to species movement	Death or injury by collision above water	Death or injury by collision below water	Hydrocarbon & PAH contamination	Introduction of non-indigenous species	Physical change	Physical removal	Sub-surface abrasion / penetration	Synthetic compound contamination	Transition elements & organo-metal contamination	Underwater noise	Visual disturbance	Water clarity changes	Water flow changes	
Priority Marine Feature															
Horse mussel beds	-	-	-	L	-	H	H	H	S	S	NS	-	-	M	Y
Burrowed mud	-	-	-	L	-	H	M	M	S	S	NS	-	M	M	Y
Shellfish and other invertebrates															
Ocean quahog (*A. islandica*) (aggregations)	-	-	-	L	-	H	H	H	S	S	NS	-	-	L	Y
Fan mussel aggregations	-	-	-	L	-	H	H	H	-	S	NS	-	NS	MS	Y
Northern featherstar aggregations on mixed substrata	-	-	-	L	-	M	M	-	S	S	-	-	-	M	Y
Fish															
Blue ling	-	-	-	L	-	-	-	-	S	S	NS	-	NS	-	Y
Orange roughy	-	-	-	L	-	-	-	-	S	S	NS	-	-	-	Y
Sandeels	-	-	-	L	-	H	H	H	S	S	-	-	-	L	Y
Flapper skate and blue skate	L	-	-	L	-	L	-	-	S	S	-	-	NS	NS	Y
Birds															
Black guillemot	M	M	M	-	-	L	L	NS	S	S	M	M	-	-	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 features possible to be present in Block 22/17 and 22/18 according to UK biotopes map and records of presence.

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

PHYSICAL CHANGE

This pressure encompasses changes to the substratum including artificial such as the introduction of hard substructures and rock. Northern sea fan and sponge communities, flame shell beds, horse mussel beds, burrowed mud, *A.islandica* (aggregations), fan mussel aggregations and sandeels are all habitats listed as highly sensitive to physical change in the environment. This pressure assumes a permanent change, whereas smothering as a short-term pressure is addressed under siltation.

PHYSICAL REMOVAL

Physical removal is the extraction of sediment to 30 cm depth. In highly mobile sediment areas the substrate may recover and be replenished by natural processes. If the location experiences a permanent change in substrate type through this removal, then it is also classed as a "physical change" pressure. Physical removal will only occur for the drilling of the new wells for the Montrose Infill project.

SUB-SURFACE ABRASION/ PENETRATION

Abrasion damage involves a degree of physical penetration to the seabed wherein the habitats and species beneath the surface are disturbance. Anchoring of the drilling rig, piling of the manifold and drilling template (if used), and drilling the infill wells are activities resulting in this associated pressure. The features highly sensitive to the pressure are flame shell beds, horse mussel beds, burrowed mud, *A.islandica* (aggregations), fan mussel aggregations and sandeels.

Chapter 9 (Seabed Disturbance) describes the extent of seabed impact expected as a result of the proposed Montrose Infill Project.

As the only features noted by JNCC to be of interest for East of Gannet and Montrose Fields NCMPA are offshore deep sea muds and *A.islandica* aggregations (and their supporting habitat), the sensitivity justification and therefore mitigation measures to ensure minimal disturbance for these features according to FeAST and Advice of Operations (AOps) are further described in Chapter 9 (Seabed Disturbance).

4.6 Socio-Economic Environment

This section describes the socio-economic activities and potential receptors in the vicinity of the proposed Montrose Infill Project.

4.6.1 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.

As of the 16th October 2025, the East of Gannet and Montrose Fields NCMPA is a restricted fishing area. The East of Gannet and Montrose Fields NCMPA has two restriction zones with dredge and beam trawling prohibited from the full site, and demersal mobile gear (other than demersal seines) prohibited from one zoned area (Scottish Government, 2025). The proposed Montrose Infill Project infrastructure is located within the area prohibited for both dredge and beam trawls, and demersal mobile gear (except demersal seines), as shown in Figure 4-14. Therefore, the quantities of demersal mobile fishing landings may reduce in the future; given these restrictions there will be no dredge or beam trawling fishing in the Montrose project area. Additionally, the Montrose infrastructure located within the East of Gannet and Montrose Fields NCMPA undergoing future decommissioning *in situ* will not impact the fishing industry given the restrictions in place for demersal mobile fishing.

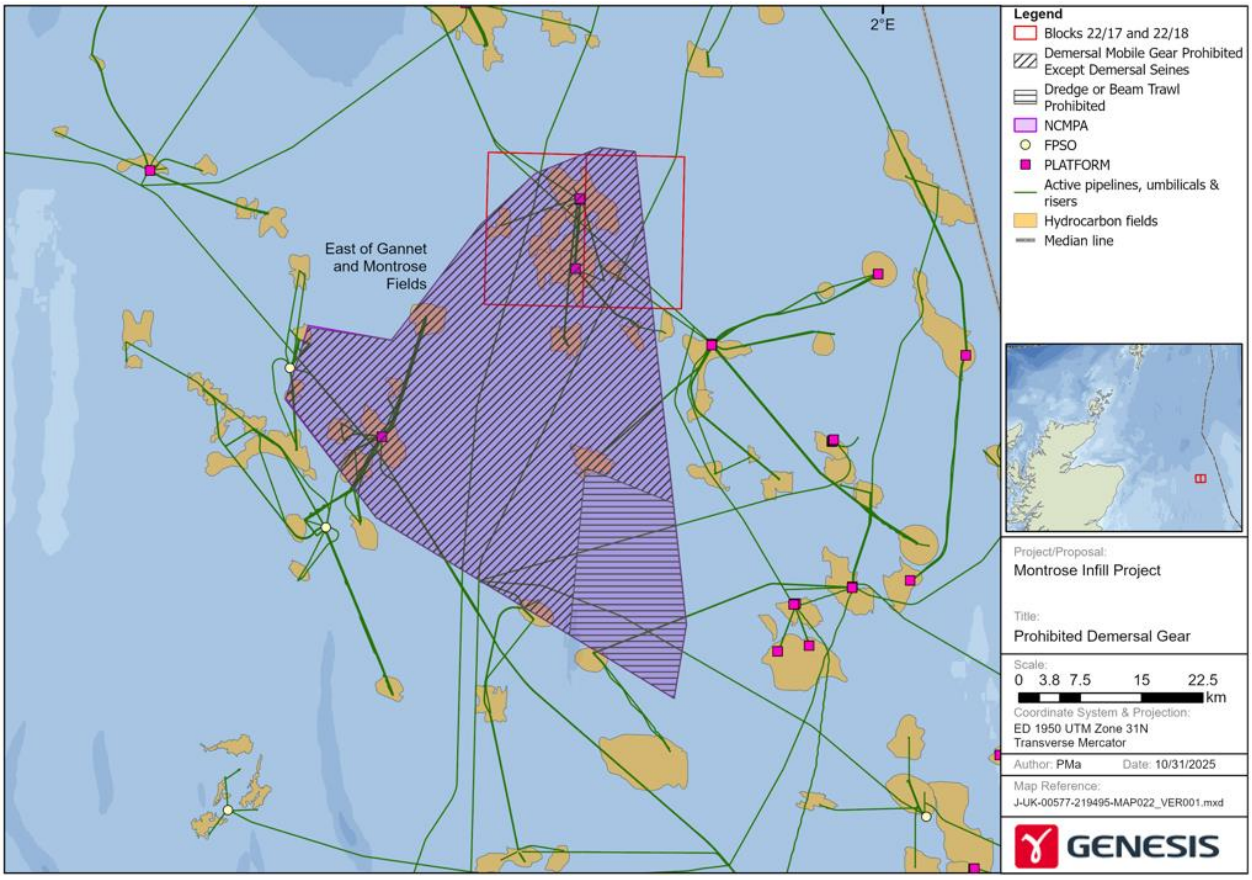


Figure 4-14: East of Gannet and Montrose Fields NCMPA is a restricted fishing area in relation the proposed Montrose Infill Project location (Scottish Government, 2025).

Fishing effort statistical data, of UK vessels over 10 m in length, between 2020 and 2024 for ICES rectangle 43F1 is provided in Table 4-9. There is an increase in fishing effort in the summer months compared to winter months. When fishing effort in 43F1 is compared against effort across all ICES rectangles in the UKCS, fishing effort within 43F1 accounted for 0.1% between 2020 and 2024 (Scottish Government Marine Directorate (SGMD), 2025). Fishing effort within this rectangle is therefore considered relatively Low.

The annual weight (te) and value (£) of landings from UK vessels into the UK and abroad, and foreign vessels into the UK for demersal, pelagic and shellfish species across 2020 to 2024 from ICES rectangles 43F1 is shown in Table 4-10.

The data show that between 2020 to 2024, generally demersal and shellfish catches contributed greatest in terms of both value and quantity in 43F1. Demersal catches dominated both value and quantity in 2020 and 2024 and dominated quantity in 2021 and 2022. Shellfish dominated value in 2021, 2022, and 2023. In 2023, pelagic catches dominated quantity.

Table 4-9: Monthly fishing effort for ICES rectangle 43F1, for the period of 2020 to 2024 (SGMD, 2025).

Year	Monthly fishing effort												43F1 Total	UK total	43F1 as % of UK
	J	F	M	A	M	J	J	A	S	O	N	D			
2020	7	D	D	27	7	14	3	36	4	D	D	D	97	104,678	0.1
2021	8	3	D	0	D	38	D	1	D	D	D	D	50	105,977	0.1
2022	24	D	D	5	12	0	D	D	0	D	D	0	41	95,516	0.1
2023	14	10	D	D	0	4	12	D	D	D	7	D	47	96,131	0.1
2024	2	D	6	0	0	0	3	D	D	4	16	D	31	92,322	0.04
Average (days)	11	6	6	8	5	11	6	18	2	4	12	0	53	98,925	0.1
Key	Disclosive data[2]				≤ 20 days		21 – 30 days			31 – 40 days			41 – 50 days		>51 days

[1] Monthly effort data are shown where five or more UK vessels over 10 m undertook fishing activity on a given year. Where less than five such vessels undertook fishing activity in a given month, the data are disclosive (D) and not shown.

[2]If less than five vessels over 10 metres undertook fishing activity in the ICES rectangle the data is considered to be disclosive (D) and therefore not shown.

Note: In the column labelled "43F1 Total" the total number of effort days for ICES rectangle 43F1 includes the months with disclosive data and the total therefore may not equal the number of days shown under "Monthly Fishing Effort".

Table 4-10: Annual landings in weight and value for ICES rectangle 43F1 from 2020 to 2024 (SGMD, 2025).

Year	Species	Variable	43F1 total	UK total	43F1 as % of UK total
2020	Demersal	Value (£)	257,542.02	177,603,349.49	0.1%
		Weight (te)	196.7	116,517.2	0.2%
	Pelagic	Value (£)	126,797.83	291,139,518.10	0.0%
		Weight (te)	173.0	339,441.3	0.1%
	Shellfish	Value (£)	107,451.13	179,360,854.10	0.1%
		Weight (te)	42.3	73,727.0	0.1%
2021	Demersal	Value (£)	83,455.16	173,292,073.13	0.0%
		Weight (te)	69.9	99,316.3	0.1%
	Pelagic	Value (£)	21.88	284,429,672.66	0.0%
		Weight (te)	0.0	367,339.4	0.0%
	Shellfish	Value (£)	127,949.09	214,218,804.00	0.1%
		Weight (te)	41.0	74,801.7	0.1%
2022	Demersal	Value (£)	38,633.88	167,087,022.58	0.0%
		Weight (te)	37.3	95,049.5	0.0%
	Pelagic	Value (£)	-	291,902,064.74	0.0%
		Weight (te)	0.0	321,096.1	0.0%
	Shellfish	Value (£)	106,169.45	228,733,494.42	0.0%
		Weight (te)	26.5	68,439.9	0.0%
2023	Demersal	Value (£)	60,712.75	180,002,198.13	0.0%
		Weight (te)	60.8	101,918.7	0.1%
	Pelagic	Value (£)	30,920.21	365,580,597.23	0.0%
		Weight (te)	77.0	374,852.4	0.0%
	Shellfish	Value (£)	99,124.12	256,538,149.28	0.0%
		Weight (te)	20.4	71,885.8	0.0%
2024	Demersal	Value (£)	54,974.35	188,523,050.34	0.0%
		Weight (te)	65.4	99,562.7	0.1%
	Pelagic	Value (£)	-	480,014,497.63	0.0%
		Weight (te)	0.0	427,082.7	0.0%
	Shellfish	Value (£)	50,904.64	213,716,112.46	0.0%
		Weight (te)	10.3	67,835.9	0.0%

The intensity of fishing vessels located in the CNS has been assessed by tracking the number of Vessel Monitoring System (VMS) messages received. Figure 4-15 shows the number of fishing hours per km^2/year for all gear types, ranging from five hours to greater than 300 hours. Figure 4-16 shows the main gear types used within Blocks 22/17 and 22/18 between 2010 and 2020, otter trawls are used most intensely in the area (ranging between 4-60 fishing hours per year in the relevant blocks) and seine nets used on occasion (around 4 fishing hours per year), with beam trawl/dredge not used in the area (ICES, 2021).

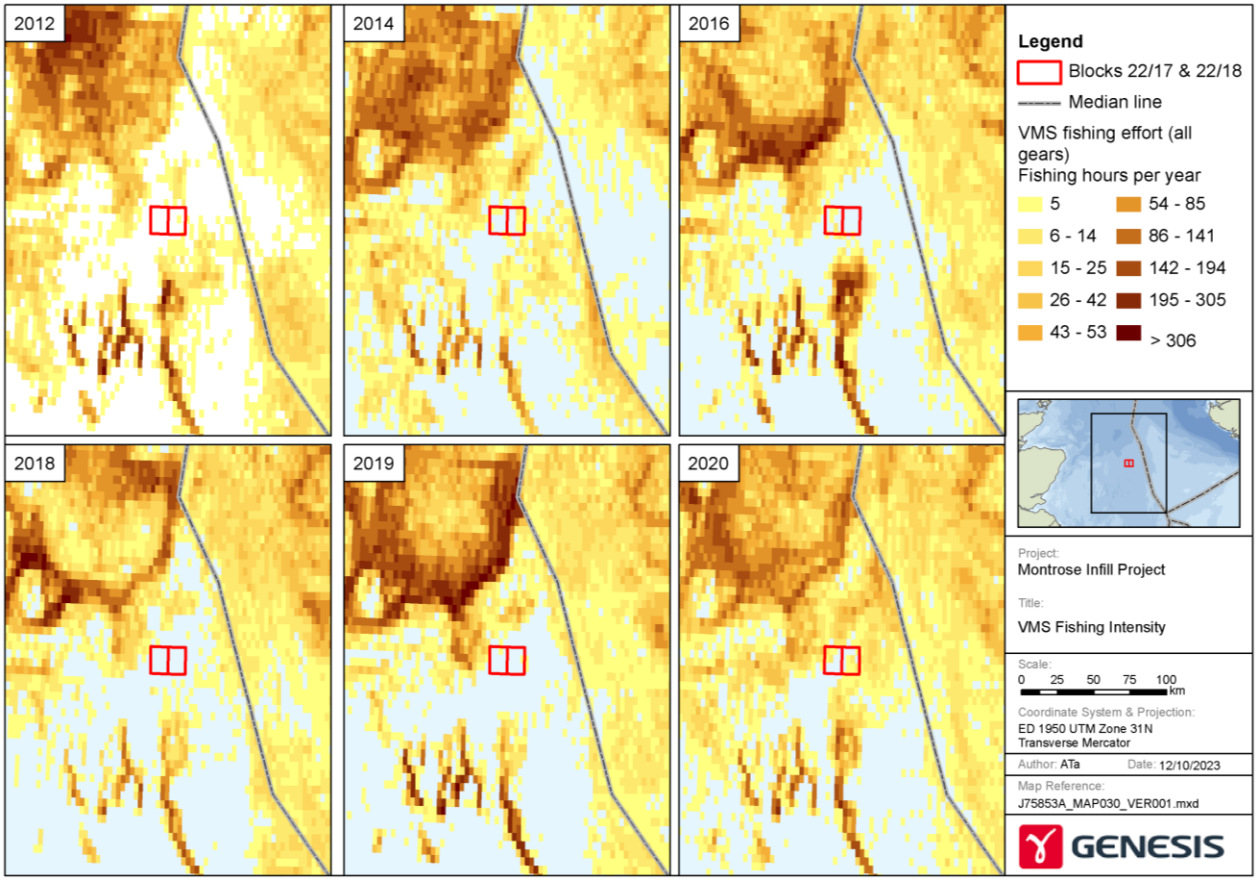


Figure 4-15: Fishing vessel intensity in the vicinity of Montrose (ICES, 2021).

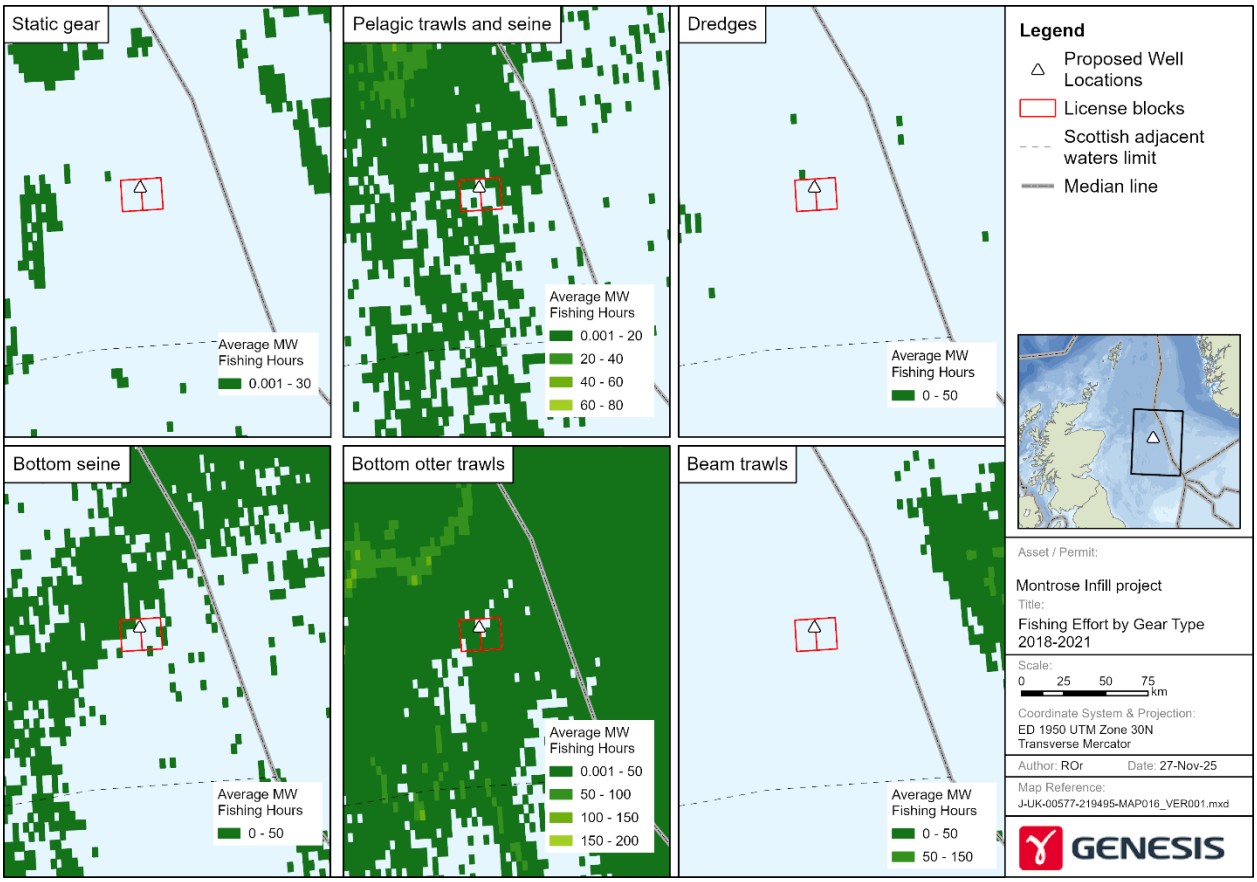


Figure 4-16: Fishing gear used between 2018-2021 around the Montrose area (ICES, 2021).

4.6.2 Vessel Density

The 2023 vessel densities in the North Sea have been presented by European Marine Observation and Data Network (EMODnet) (2024) as hours per km^2 per month. The vessel density in Blocks 22/17 and 22/18 ranges from 0 to greater than100 hours per km^2 per month (Figure 4-17). 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.

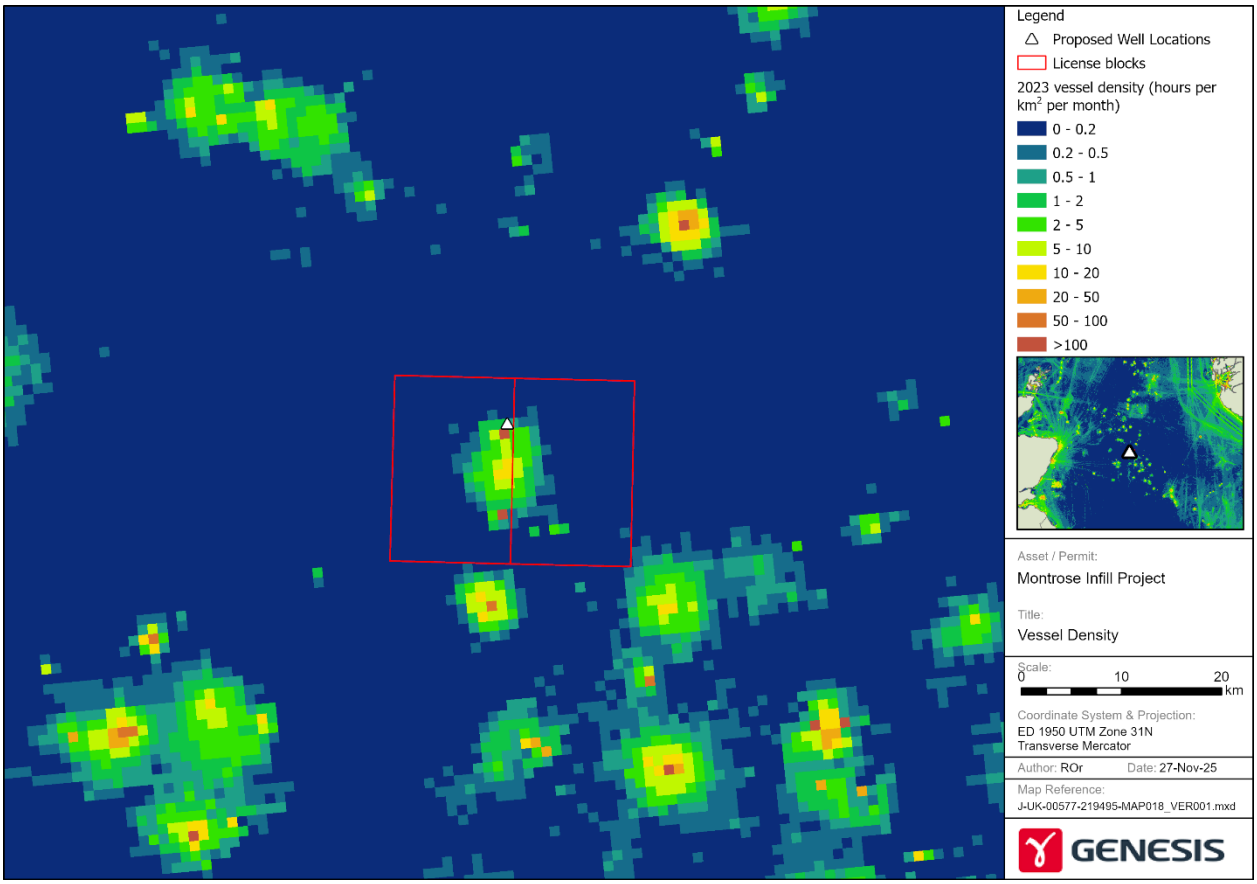


Figure 4-17: 2017-2023 Shipping Density in the vicinity of Blocks 22/17 and 22/18 (EMODnet, 2024).

4.6.3 Cultural Heritage

Human occupation of Britain has been characterised by successive glacial and interglacial periods, during which sea levels have varied substantially. This resulted in parts of the North Sea being exposed as terrestrial land suitable for subsistence and settlement of early hominins in the region to the south of 53°N. There is also strong evidence that the land area was actually much larger, and that it may have extended over the entire North Sea area (except for the Norwegian Trench just off the coast of Norway) (DESNZ, 2022).

Whilst most archaeological finds have been in coastal, more southerly locations, prehistoric submarine archaeological remains up to about 12,000 years old could occur with low probability anywhere in the northern region of Regional Sea 1. There is a higher probability of remains up to about 11,000 years old occurring further south e.g. in the area in which the Montrose platforms are located (DESNZ, 2022).

A large number of ship and aircraft wrecks are known in UK waters, including more than 5,200 records in Scottish waters. There is also potential for substantial unidentified aircraft remains (primarily WWII) to be found on the seabed, since there are extensive documentary sources relating to aviation loss at sea, but these do not provide accurate positions (DESNZ, 2022).

There are no protected wrecks or sites in the vicinity of the proposed Montrose Infill Project. The closest wreck to the proposed well locations is the non-dangerous wreck of the Theresa Boyle located *c.* 8 km to the north. There is also an area of foul ground located *c.* 9 km northwest of the proposed drill centre (Figure 4-18; Admiralty, 2025).

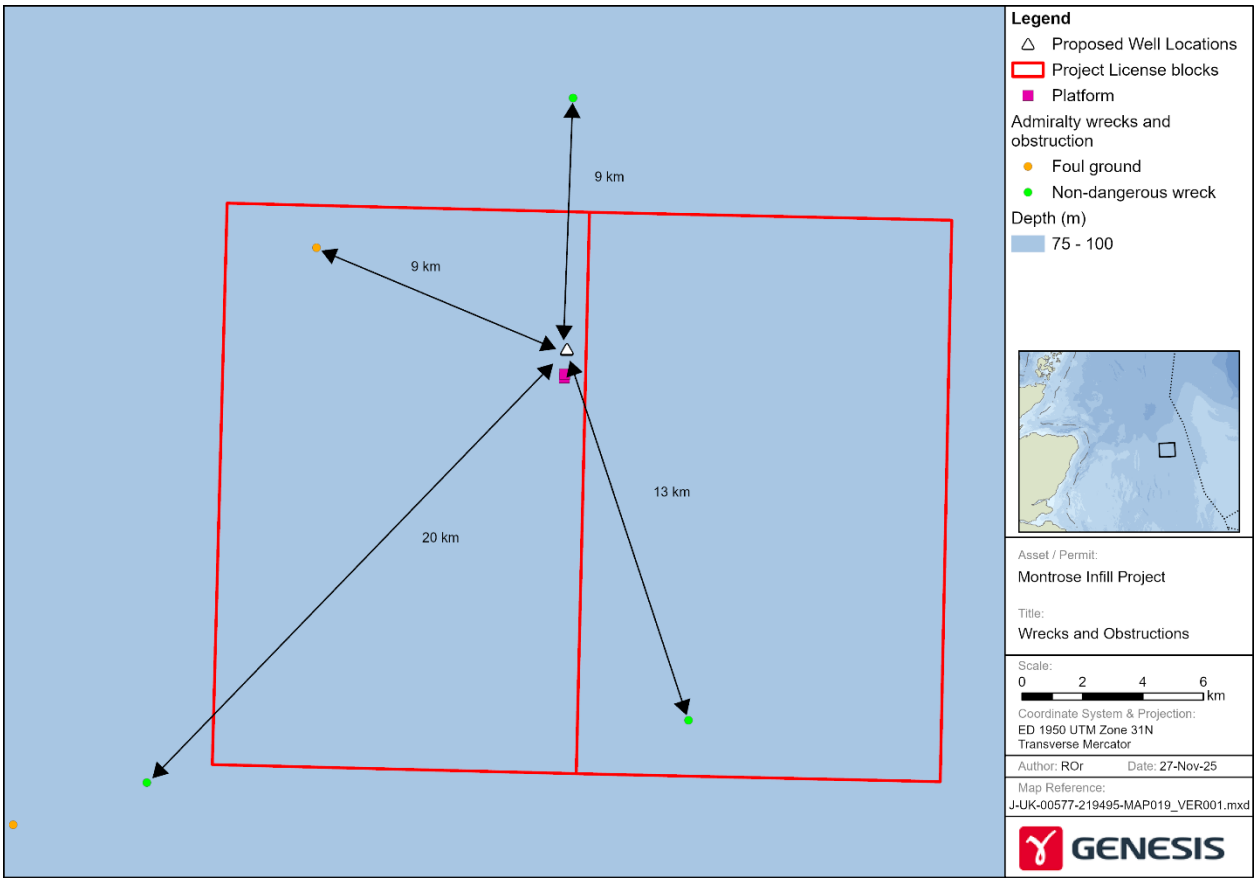


Figure 4-18: Wrecks in the vicinity of the proposed Montrose Infill Project (Admiralty, 2025).

4.6.4 Offshore Renewable Energy

The proposed Montrose Infill Project is located within the vicinity of six confirmed Innovation and Targeted Oil and Gas (INTOG) application sites, the closest awarded INTOG site is located *c.* 23 km south of the proposed Montrose drill centre (Figure 4-19). The closest operational wind farm is the Hywind Scotland wind farm located off the coast of Peterhead, over 100 km west of the Montrose area. The closest Scotwind lease area is E2, which is located *c.* 65 km west of the Montrose platform.

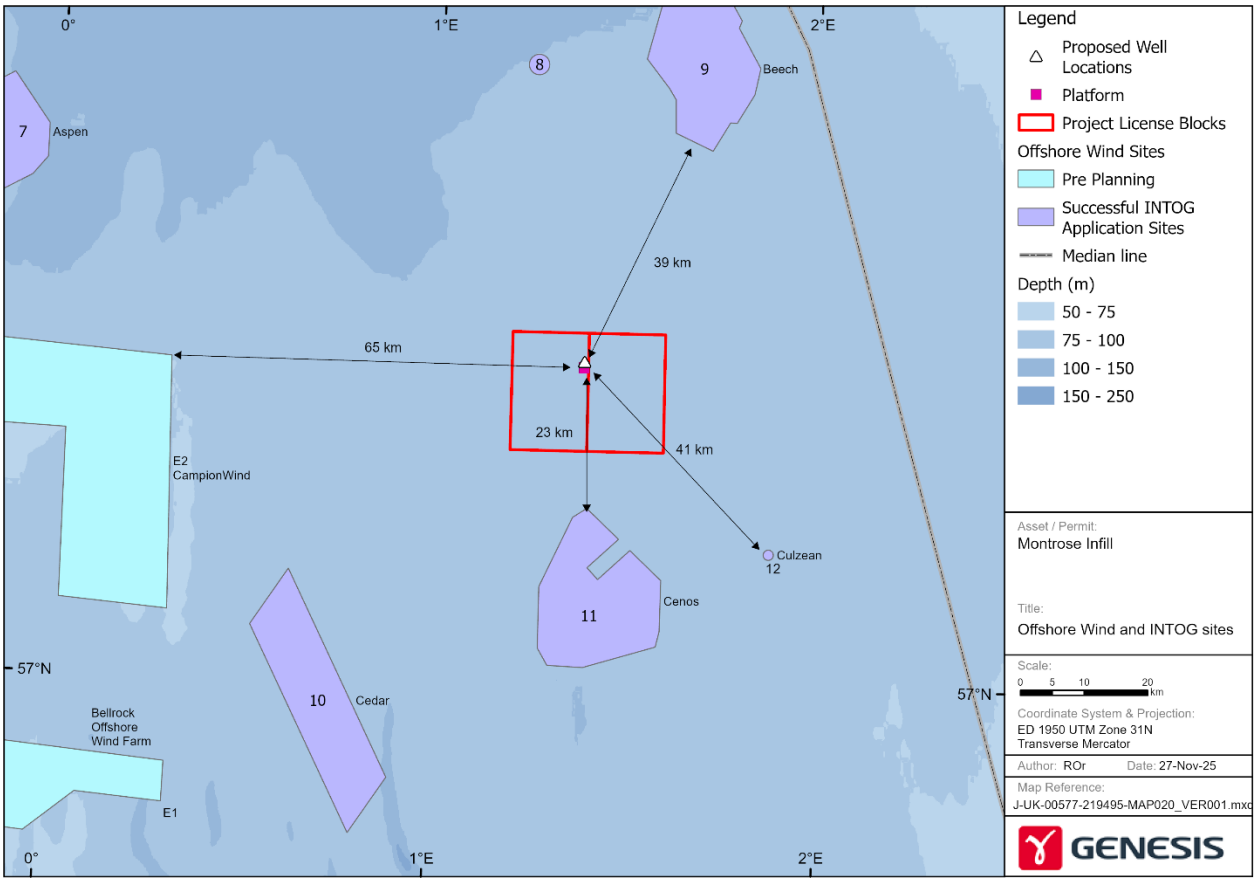


Figure 4-19: INTOG and offshore wind energy sites in the vicinity of the Montrose Field.

4.6.5 Oil and Gas Infrastructure

The proposed drilling activities are located within a well-developed brownfield oil and gas production area, with many installations, pipelines and umbilicals within the vicinity. Installations within 40 km of the drilling location are detailed in Table 4-11 and presented in Figure 4-20. Given the scale of the map, the Montrose A and BLP platforms (located 0.7 km to the south of the proposed drill centre) have been omitted to allow the drill centre location to be seen.

Table 4-11: Installations within 40km of the proposed Drill centre Location.

Map Indicator	Installation	Operator	Distance from Proposed Drill Centre Location (km)
N/A	Montrose A and BLP	NEO NEXT+	<1
1	Arbroath	NEO NEXT+	11
2	ETAP PDR	bp	25
3	ETAP QU	bp	25
4	Nelson A	Adura	27
5	Forties Echo	Apache	35
6	Gannet A	Adura	37
7	Mungo	bp	38
8	Forties Alpha	Apache	40
9	FASP (Forties Alpha Satellite Platform)	Apache	40

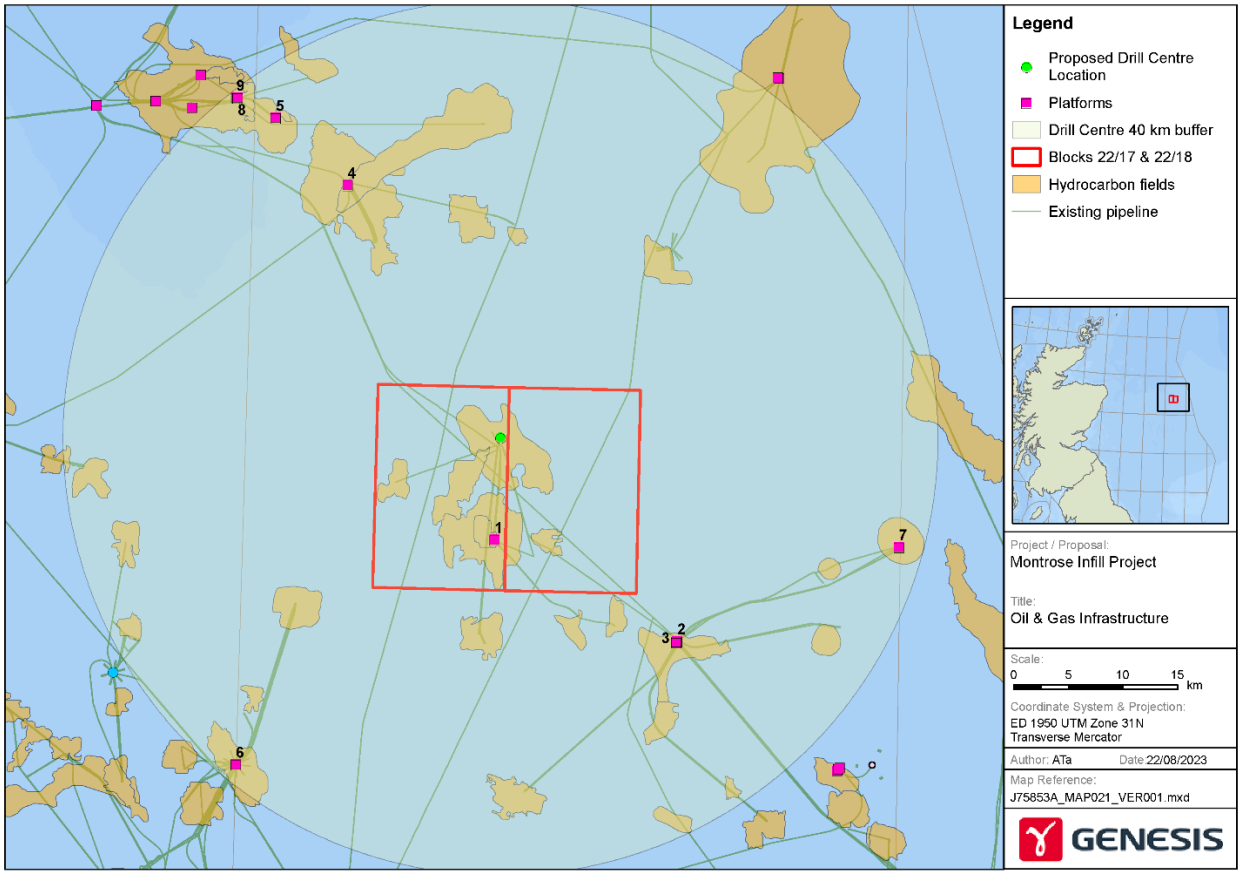


Figure 4-20: Existing oil and gas infrastructure in the vicinity of Blocks 22/17 and 22/18.

4.6.6 Other

There are no known military activities, telecommunication/power cables, or offshore aggregate extraction in the vicinity of the proposed project (Scottish Government NMPi). As shown in Figure 4-21, the closest aquaculture and shellfish water protection areas sites are 176 km away.

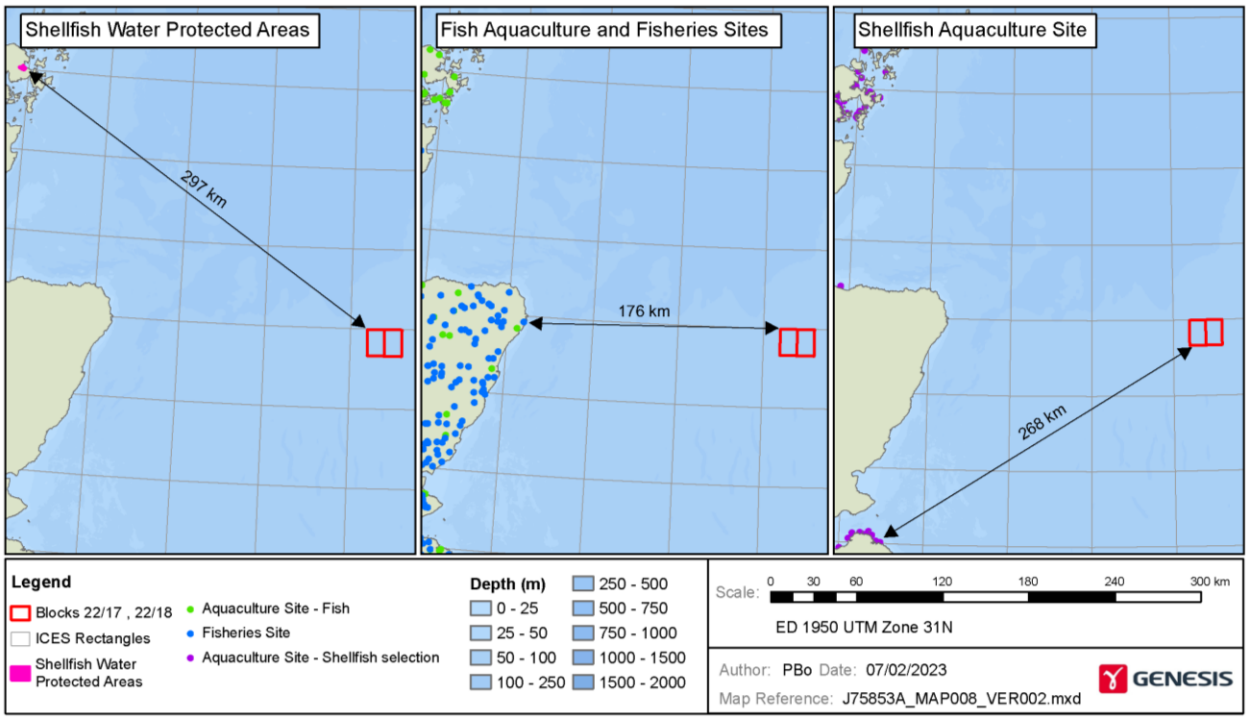


Figure 4-21: Closest aquaculture sites and shellfish protection areas to the Montrose field.

5 Environmental Impact Assessment Methodology

5.1 Introduction

In order to determine the impacts that the proposed Montrose Infill Project 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.

The impact assessments have been made based on the best understanding of all input data at the time of the assessment. Some inputs may be subject to updates in the future as the project definition matures further. To accommodate uncertainties where possible, the assessments adopt conservative values for data inputs to represent a worst realistic case for impacts.

5.2 Receptors and Aspects

The ESIA and ESRA considered the impact of a number of aspects on the receptors in the area (receptors are described in Chapter 4).

5.2.1 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, if anchored, disturbance to the seabed. Receptors potentially impacted by these aspects include air quality, climate, resource depletion, marine mammals, seabirds, other users of the sea, seascape and benthic communities (if anchored).

5.2.2 Environmental and Socio-Economic Receptors

Receptors to be considered in the ESIA and ESRA include:

- Environmental receptors:
  - Resource Availability;
  - Air Quality/ Climate;
  - 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.

5.3 ESIA for Planned Activities

The significance of the environmental/socio-economic 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.

5.3.1 Receptor Sensitivity

Four categories of Receptor Sensitivity were applied, ranging from 'Low' to 'Very High', as shown in Table 5-1.

Table 5-1: Receptor Sensitivity.

Category	Environmental/ Societal 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 International Union for Conservation of Nature (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: Local, e.g. recognised within a town, project location as being of cultural or historical importance to the local population. 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

Category	Environmental/ Societal Definition
	› Significant numbers of at least one receptor of national importance (e.g. Priority Marine Features (PMFs) in Scottish waters and Features of Conservation Importance (FOCI) in English waters. › Significant numbers of a species which is listed as IUCN 'Near Threatened'. › Nationally designated habitat/sites (e.g. PMFs). › Species may be of regional value. Air quality: Populated areas nearby. Water quality: Semi-enclosed water body with good flushing. Cultural heritage sites: Regional, i.e. of significance to a wider area, often representing shared cultural or historical identity across multiple localities. 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 OSPAR designations). › Significant numbers of a species which are listed as IUCN 'Vulnerable'. › Designated habitats/sites (e.g. OSPAR designations and Annex I habitats: Special Areas of Conservation (SACs) and Special Protection Areas (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: National, i.e. of importance to the entire country, often recognised for their contribution to national history, culture, or identity. 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, Marine Protected Areas (MPA) Networks; Special Areas of Conservation (SACs), Special Protection Areas (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: International, i.e. sites of global importance, often recognised by organisations such as United Nations Educational, Scientific and Cultural Organisation (UNESCO) for their outstanding universal value. 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

5.3.2 Climate Change

With respect to the emission of greenhouse gases (GHG), climate is considered a global receptor rather than a local receptor. The categories identified in Table 5-1 do not capture definitions for climate change. This is because the sensitivity status of climate is considered to be 'Very High' in line with the 2021 Climate Change Report produced by the Intergovernmental Panel on Climate Change (IPCC, 2021).

Life-cycle GHG emissions impact assessment in the ES follows the approach set out by the Institute of Sustainability & Environmental Professionals (ISEP) (formerly the Institute of Environmental Management & Assessment (IEMA)) in its guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022) and aligns with OPRED's supplementary guidance for assessing the effects of downstream scope 3 emissions on climate from offshore oil and gas projects (OPRED, 2025). The methodology is further detailed in Chapter 7.

5.3.3 Magnitude of Effect

Definitions for the Magnitude of Effect on the receptors are presented in Table 5-2. Prior to determining the Magnitude of Effect, industry recognised 'base case' mitigation measures were 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 5-2: Magnitude of Effect.

Magnitude Level		Description	
		Environmental Impact	**Socio-economic Impact**
0	**Positive/ No effect**	No environmental concerns › Positive environmental impact e.g. retaining a 500 m safety zone resulting in a 'protected area'. › No significantly negative environmental effects. › Regulatory compliance or Company goals are not breached.	› Possible enhancement in the availability of a resource benefitting the persons utilising the area e.g. removal of 500 m safety 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**	Negligible environmental effects › Any effects are unlikely to be discernible or measurable and will reverse naturally. › No beaching or transboundary impacts. › Regulatory compliance or Company goals are not breached.	› 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 safety 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**	Minor, localised, short term, reversible effect › Any change to the receptor is considered low, would be barely	› 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.

Magnitude Level		Description	
		Environmental Impact	**Socio-economic Impact**
		detectable and at same scale as existing variability. › Recover naturally with no Company intervention required. › No beaching or transboundary impacts. › Without mitigation, possible breach of regulatory compliance.	› 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**	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. › Without mitigation, possible breach of regulatory compliance.	› 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**	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. › Without mitigation, possible breach of regulatory compliance.	› 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**	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 › Without mitigation, possible breach of regulatory compliance.	› 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).

5.3.4 Environmental / Socio-Economic Impact Significance

The Receptor Sensitivity (Table 5-1) and the Magnitude of Effect (Table 5-2) are then combined using the matrix presented in Table 5-3 to determine the Impact Significance for planned activities.

Table 5-3: Environmental / Socio-Economic Impact Significance (ESIA) Matrix for Planned Activities.

		Receptor Sensitivity			
		a) Low	b) Medium	c) High	d) Very high
Magnitude of Effect	(0)				
	(1)				
	(2)				
	(3)				
	(4)				
	(5)				

(i) Positive / no effect significance	› Positive or no environmental or social impact. › Activities not likely to promote public interest, or positive public support.
(ii) Low significance	› No/negligible environmental and social impact. › Likely to be no concerns from consultees.
(iii) Moderate significance	› Discernible environmental and social impacts. › Requirement to identify project specific mitigation measures. › Potential to cause concern to consultees, which can be adequately addressed by the Company.
(iv) High significance	› Substantial environmental and social impacts. › May result in serious concerns by consultees requiring Corporate support. › Alternative approaches should be identified.

5.3.5 Cumulative and Transboundary Impacts

The ESIA sets the activities and potential impacts in the context of all other activities taking place in the Montrose Field 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.

5.4 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.

5.4.1 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 significance of impacts that may result from unplanned events.

5.4.2 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 5-4.

Table 5-4: Likelihood of an Unplanned Event.

Likelihood	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.

5.4.3 Environmental Risk of an Unplanned Event

Combining the Impact Significance of the environmental/social impact (see Table 5-3) with the Likelihood of the unplanned event occurring (see Table 5-4) allows the level of Environmental Risk associated with an unplanned event to be determined using the matrix presented in Table 5-5. 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 5-5: Environmental / Socio-Economic Risk Assessment Matrix for Unplanned Activities.

		Impact Significance of Unplanned Event		
		I. Low	II. Moderate	III. High
Likelihood of Event	Extremely remote			
	Remote			
	Unlikely			
	Possible			
	Likely			

*Note the numbers associated with each Impact Significance level range from (ii) to (iv) in keeping with the scoring assigned in Table 5-4.

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.

5.5 Assessment of Significance of Environmental and Social Risks

Using the information provided in Chapters 3 (Project Description) and 4 (Environmental Baseline), and the criteria set out above, Appendix B (ENVID Results) identifies all activities associated with the proposed Montrose Infill Project and their Impact Significance / Environmental Risk.

Appendix A is split into five nodes:

- Vessel and rig use during drilling, subsea installation and commissioning;
- Drilling operations;
- Montrose BLP modifications;
- Subsea installation activities; and
- Commissioning and Production.

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 five of the planned activities are considered to have an Impact Significance of Moderate, whilst none are considered to be High (Table 5-6). 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 East of Gannet and Montrose Fields NCMPA. Although Air Quality was assessed as having a Low Impact Significance (Appendix B ENVID Results), a further study was carried out whereby ADMS was used to model the dispersion of emissions of NO_2, CO and SO_2 from the Montrose Complex based on recorded metocean data for 2022 – 2024. The methodology for this assessment is described in the full report in Appendix G.

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. Three were found to be of potential Moderate Impact Significance, whilst two were considered to be High Impact Significance (Table 5-6).

Table 5-6: Summary of activities identified to have Moderate or High Impact Significance.

Aspect	Source/ Activity	Impact Significance
Discharges to Sea	Deliberate discharge to sea from the drilling operations. Disturbance to seabed impacting on benthic species.	Moderate
Seabed Disturbance	Interaction of semi-submersible drilling rig anchors or HDJU contingency anchors and spud cans with seabed. Cement plateau on seabed as a result of cementing top-hole sections; and Physical presence of flowlines.	Moderate
Physical presence of subsea infrastructure	Physical presence of seabed infrastructure. Disturbance to seabed impacting on benthic species.	Moderate
Atmospheric emissions	Power generation (during operations) from essential systems diesel generator. Note: All atmospheric emissions were evaluated in the ENVID and, whereas only those from Power Generation were concluded to be of Moderate impact, the impact assessment in this ES considers the cumulative effects of all project atmospheric emissions. The impact assessment methodology used to assess all atmospheric emissions, including GHGs, is further detailed in Chapter 7.	Moderate
Unplanned Events	Major hydrocarbon/ chemical spillage (i.e. vessel collision and loss of containment).	Moderate
	Major loss of drilling rig fuel inventory. Hydrocarbon release to sea.	Moderate

	Well blowout. Uncontrolled hydrocarbon (gas) flow to surface.	High
	Blowout. Uncontrolled hydrocarbon flow to surface.	High
	Major dropped objects impacting on live lines.	High
	New flowline rupture.	Moderate

Chapters 6 – 12 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 12 (Accidental Events) presents the results of Oil Spill Modelling carried out to determine the impact of a major hydrocarbon loss.

6 Physical presence

This section discusses the potential impacts associated with the physical presence of:

- The vessels and the drilling rig associated with the proposed Montrose Infill Project; and
- All subsea infrastructure,

on other sea users as well as fish, marine mammals and seabirds using the impact assessment methodology presented in Chapter 5. The impacts on the seabed and the local benthic communities are discussed in Chapter 9 (Seabed Disturbance).

The new reception facilities will be housed on the existing Montrose BLP. If the new module extends beyond the existing structure, navigational lighting will be adjusted (as required) to ensure that the platform continues to comply with the Standard Marking Schedule for Offshore Installations. It is therefore considered that the alterations to the topsides are not expected to have any additional impacts and therefore are not considered further in this chapter.

6.1 Presence of Vessels and the Drilling Rig

The vessels required for the drilling, installation and commissioning activities associated with the proposed Montrose Infill Project are summarised in Table 3-7 and Table 3-10 and may include: drilling rig (semi-submersible or HDJU), tugs, AHVs, CSVs, DSVs, supply vessels, and rock dumping vessel (contingency rock placement may be deployed). During routine production operations (after drilling, installation and commissioning activities) the number of vessels usually present in the area will not significantly increase as a result of the proposed Montrose Infill Project.

As described in Section 3.5.2, if a semi-submersible drilling rig is deployed, then it will be kept on location by the use of anchors and AHVs will be required. For the HDJU, contingency anchors may be required for the positioning of the HDJU over the location of the wells.

It is anticipated the drilling rig will be on location for *c*. 485 days as the worst case (excluding mobilisation and demobilisation) and it is expected that the ERRV supporting the Montrose Complex will also support the drilling rig (joint purpose with existing operations) and therefore no separate ERRV has been considered for the drilling campaign.

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

6.1.1 Impact of Vessels and Drilling Rig on Other Sea Users

When compared to shipping levels throughout the North Sea, shipping levels in the Montrose area are considered to be relatively Low with the majority of the Project area within a vessel density of less than 10 vessel hours per km^2 per month (EMODnet, 2024; Section 4.6.2).

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 lightings 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.

The selected drilling rig 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 Health and Safety Executive (HSE) Operations Notice 6 (HSE, 2022), a rig warning communication will be issued at least 48 hours before any rig movement. The drilling rig route 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 Consent to Locate (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. The existing ERRV at Montrose will also provide support during installation and drilling operations.

The proposed Montrose Infill Project will be located within ICES rectangle 43F1. The information presented in Section 4.6.1 suggests that fishing effort to date within this rectangle is relatively Low. In addition, as of the 16th October 2025, the East of Gannet and Montrose Fields NCMPA is a restricted fishing area and therefore, the number of demersal mobile fishing vessels within this area and the MonArb area will be zero going forward in the future; given these restrictions there will be no demersal mobile gear in the MonArb area (Scottish Government, 2025).

As detailed in Section 3.5.2, either a HDJU or a semi-submersible drilling rig will be used to drill the wells. The HDJU has allowed for the deployment of up to two contingency anchors to assist with the placement of the rig. For the semi-submersible rig, up to eight main anchors and four contingency piggy-back anchors would be used. For the semi-submersible drilling rig, the anchors will be located out with the 500 m exclusion zone. However, as described in Section 3.5.2, although a guard vessel typically would be present to warn other sea users, given the restrictions on demersal mobile gear within the East of Gannet and Montrose NCMPA as of October 2025 (Section 4.6.1; Scottish Government, 2025), NEO NEXT+ will discuss with OPRED the necessity of a guard vessel.

The area is known to have a sandy seabed, however the ES considers the potential for clay deposits (clumps rather than berms) to be left on the seabed during the installation and recovery of the anchors and during recovery of the HDJU drilling rig (if selected). If selected, the anchors for the semi-submersible drilling rig would be laid out with the 500 m safety zone but within the East of Gannet and Montrose NCMPA within which demersal mobile gear is prohibited. Therefore, given this restriction any resultant clay clumps would not impact on fishing gear as demersal gear is prohibited from the area. Given the fishing restrictions, NEO NEXT+ do not propose to carry out a post-anchor recovery survey to determine if any clay deposits remain. At the time of decommissioning, a clear seabed survey will be carried out and if clay deposits are identified, and where required NEO NEXT+ will discuss the potential requirement for mitigation with OPRED.

Using the impact assessment methodology presented in Chapter 5; as both shipping and fishing activities in the area are considered relatively Low with the capacity to absorb change without impact, Receptor Sensitivity for

other users of the sea is considered **Low (A)**. Given the recent fishing restrictions within the East of Gannet and Montrose Fields NCMPA, use of navigational aids; the 500 m safety zone at the drilling location; the submission of a CtL, and NEO NEXT+ 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 **Negligible (1)**. Given the Low Receptor Sensitivity and the Negligible 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.

6.1.2 Impact of Vessels and Drilling Rig on Marine Mammals

Note the impact of underwater noise associated with vessels and drilling activities are discussed in Chapter 10. This section discusses the physical presence of the vessels and drilling rig. From Section 4.3.4, 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 Annex II species occur in the area (grey seal, harbour porpoise, and bottlenose dolphin) and all cetaceans are EPS, Receptor Sensitivity is considered **Medium (B)**.

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 **Minor (2)**. Given the Medium Receptor Sensitivity and the Minor 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.

6.1.3 Impact of Vessels and Drilling Rig on Seabirds

As described in Section 4.3.5, a number of seabird species are found in the Montrose area and given that some of the seabirds that occur in the area are qualifying features of SPAs with marine components along the Scottish coastline, Receptor Sensitivity of seabirds is considered **Medium (B)**.

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 **Minor (2)**. Given the Medium Receptor Sensitivity and the Minor

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.

6.2 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 3.6.2 summarises the types of subsea infrastructure to be installed as part of the proposed Montrose Infill Project. As noted previously, impacts on the seabed and the local benthic communities are discussed in Chapter 9 (Seabed Disturbance).

6.2.1 Impact of Subsea Infrastructure on Other Sea Users

At the time of writing the ES, the majority of the fish caught in ICES rectangle 43F1 by UK vessels were demersal species (Section 4.6.1). Given the fishing restrictions within the East of Gannet and Montrose Fields NCMPA (previously described in Section 6.1.1), there will be no demersal mobile gear in the MonArb area (Scottish Government, 2025). As discussed previously, fishing activity in the area is considered relatively Low (Section 4.6.1) such that Receptor Sensitivity for other sea users is considered **Low (A)**.

Many of the fishing gears used to catch demersal species are towed along the seabed such that they may impact on any subsea structures that they come into contact with. Despite the recent fishing restrictions, NEO NEXT+ acknowledge that whilst fishing restrictions are currently enforced, future changes are outside the control of NEO NEXT+ and thus it is prudent to ensure subsea infrastructure design caters for this possibility as far as practicable (Section 3.2.4).

The existing Montrose platform has a 500 m exclusion zone in place and there will be a new 500 m safety zone in place around the new drill centre such that all infrastructure to be laid will be within the two over lapping 500 m zones.

Prior to installing the subsea infrastructure, the project will apply for a Pipeline Works Authorisation (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 and umbilicals. 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 SFF. Given NEO NEXT+'s adherence to these mitigation measures, the recently introduced fishing restrictions and the placement of all infrastructure within 500 m exclusion/safety zones, the Magnitude of Effect of the installation of the subsea infrastructure on other sea users is considered **Negligible (1)**. Given the Low Receptor Sensitivity and the Negligible Magnitude of Effect, the Impact Significance is considered **Low** such that any social impacts of the physical presence of subsea infrastructure are considered to be negligible.

6.2.2 Impact of Subsea Infrastructure on Marine Mammals and Fish

With respect to the impact of subsea infrastructure on marine mammals and fish, Receptor Sensitivity is considered **Medium (B)** due to the presence of designated species e.g. PMFs (such as cod, mackerel and sandeel; Section 4.3.3 and 4.5.2), Annex II species (grey seal, harbour porpoise, and bottlenose dolphin; Section 4.3.4) and EPS (all cetaceans; Section 4.3.4).

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 such that the Magnitude of Effect is considered **Minor (2)**. Given the Medium Receptor Sensitivity and the Minor Magnitude of Effect, 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.

6.3 Decommissioning Phase

At end of field life, the Montrose Infill Project infrastructure will be decommissioned as part of a Decommissioning Programme. At the commencement of the decommissioning activities, vessel activity in the area will increase relative to the number of vessels typically present in the area of the development during the production phase.

As described in Section 3.11, it is expected that the subsea structures (mattresses, grout bags, spools and umbilical jumpers) will be removed from the seabed and returned to shore for reuse / recycling / disposal and a seabed clearance campaign conducted, however, this would be subject to future legislative requirements and guidance.

In line with current legislation, if mattresses are used to mitigate UHB along the full length of lines (base case), then the lines and associated mattresses would be recovered to shore. However, if it is necessary to rock cover the lines for UHB mitigation, the decommissioning of the lines under the rock would be subject to a Comparative Assessment and Decommissioning Programme. Should the Comparative Assessment determine that the pipelines / umbilical should be decommissioned in situ (in the alternative case scenario),NEO NEXT+ will agree an ongoing monitoring plan with the relevant authority (currently this is OPRED).

6.4 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 Montrose Infill Project is located within the vicinity of six confirmed INTOG application sites, the closest awarded INTOG site is located *c*. 23 km south (Section 4.6.4), however it does not overlap with any approved or planned projects. 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 Montrose Infill Project is located *c*. 46 km from the UK/Norway median line and therefore no transboundary impacts associated with the physical presence of the additional subsea infrastructure, drilling rig or vessels are expected.

6.5 Mitigation Measures

The following industry standard mitigation measures will be undertaken to minimise the impacts from the physical presence of the vessels, drilling rig, subsea infrastructure and associated stabilisation and protection materials on other sea users, marine mammals, fish and birds.

Proposed Mitigation Measures
› Operations Notice 6 notification will be submitted prior to rig mobilisation; › A Vessel Traffic Survey (VTS) will inform a CtL application for the drilling rig; › A Collision Risk Management Plan will be produced, if determined to be required; › All vessels will adhere to COLREGS and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.; › The drilling rig will have a 500 m safety zone to mitigate any collision risk;

- An ERRV will patrol the area during the drilling operations;
- The drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations;
- Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site; and
- All infrastructure will be laid within one of two 500 m exclusion/safety zones.

Applying the impact assessment methodology described in Chapter 5 and taking account of the mitigation measures listed above, the physical presence of the vessels, drilling rig and subsea infrastructure associated with the proposed Montrose Infill Project 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 9 (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.

7 Emissions to Air

The proposed Montrose Infill Project will result in emissions to air. These emissions will have local impact on air quality and a global impact through climate change, with different pollutants contributing to one or both processes. This chapter begins by identifying the sources of emissions included in the assessment, then quantifies the magnitude of the emissions of pollutants attributed to those sources before 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).

The assessment also considers the global impact on climate change of emissions of carbon dioxide (CO_2), nitrous oxide (N_2O) and CH_4.

First oil is currently planned to be achieved in Q4 2028. The production profiles presented in Chapter 3, and the emissions estimates presented in this section for 2028, are based on achieving this date.

Following the adoption of appropriate control and mitigation measures, residual effects and impacts are assessed in the context of the sensitivity of, and the dispersive capacity of, the receiving environment.

7.1 Summary of Assessment Assumptions

In order to assess the magnitude of the impacts resulting from atmospheric emissions associated with the proposed Project, emissions of air pollutants are estimated based on the assumptions / exclusions listed below as per the EIA guidance (OPRED, 2020) and supplementary guidance (OPRED, 2025):

- Emissions during production are related to the production profiles of the proposed Montrose Infill Project including the production profiles for Montrose, Wood, Cayley (including Cayley North) and Shaw. A degree of uncertainty will remain over the Montrose Infill production profiles until the reservoir behaviour can be monitored following commencement of production. The highest predicted hydrocarbon case represents the greatest potential for emissions and, in alignment with the rest of the ES, the emissions estimates presented herein are based on the High hydrocarbon case production scenario with the following exception:
  - Projected estimates of GHG intensity during production (emissions per barrel or tonne of oil equivalent) for the field are presented for Mid case production profiles. Whereas the GHG emissions profiles during production are expected to be similar for both the mid and high cases, production figures for the Mid case are lower than the High case, leading to higher GHG intensity estimates.
- Projected emissions associated with the production phase are estimated to represent a reasonable worst-case assumption of power requirements. The proposed Montrose Infill Project does not involve installation of any new combustion equipment. There will be an additional electrical demand of up to 1 MW for process heating. The emissions forecast considers that the Montrose Complex power generation is predominantly from fuel gas with diesel used as back up.
- The assumed cessation of production (CoP) date for the Montrose Complex without the proposed Montrose Infill Project is December 2030. With the proposed Montrose Infill Project, life of field for the Montrose Complex as a host is expected to extend to December 2035. As well as production from the Infill wells, the life of field extension will also enable continued production from Wood, Cayley and Shaw fields and the existing Montrose well. Projected production from these fields between 2031 and 2035 are attributed to the proposed Montrose Infill Project for the purposes of this assessment.
- With the increased production from the proposed Montrose Infill Project, and the extended field life of the Montrose Complex, flare gas recovery (FGR) will be available on the Montrose Complex from July 2029.
- The environmental impact associated with GHG emissions includes:

- Direct emissions at the host platform resulting from production of Montrose Infill Project fluids. This includes fluids produced from the Montrose Infill wells and fluids produced after 2030 from existing Montrose hub fields;
- Indirect GHG emissions associated with drilling, offshore installation and production logistical services (helicopters, vessels and shuttle tankers);
- Indirect downstream emissions associated with the transport of Montrose Infill hydrocarbon products, their subsequent refining or other processing, the distribution of refined products and the end use of these refined products.

Further information on GHG emissions sources is presented in Table 7-1.

- In keeping with assessing a worst-case scenario, the impact assessment in this section assumes that drilling will be undertaken from a semi-submersible drilling rig as opposed to a HDJU drilling rig due to the overall higher fuel consumption should a semi-submersible be used. Higher diesel usage is primarily for maintaining dynamic positioning of the semi-submersible rig.
- In keeping with assessing a worst-case scenario, the impact assessment in this section assumes that all hydrocarbon products from the proposed Montrose Infill Project will be used as fuels and therefore will be combusted by the end users.
- Emissions of GHGs and other pollutants from the proposed Montrose Infill Project are derived based on applying standard emissions factors (EF) to the quantity of hydrocarbons used in a particular activity (e.g. combusted in flaring or emitted in venting) as follows:

  ‘M(is) = A(s) x 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.
- All estimates for future direct and indirect emissions during pre-production and production phases of the proposed Montrose Infill Project have been calculated using appropriate EFs provided in the draft guidance for reporting under the Environmental and Emissions Monitoring System (EEMS, 2025). This includes the use of proposed polynomial coefficients for the LM2500+ turbine model to derive a NO_x EF for the open cycle gas turbines (OCGT).
- Whereas the draft EEMS guidance recommends reporting CO_2 emissions from combustion equipment based on site-specific EFs to align with reporting under the UK ETS, emissions estimates for the proposed Montrose Infill Project have used default EEMS EFs for CO_2 since these are higher than site derived EFs and therefore give a more conservative, worst case, estimate of emissions.
- Downstream indirect GHG emissions are derived using emissions factors published by the UK Government (UK Govt. 2024).
- The values for GHG emissions are derived from aggregated CO_2, CH_4 and N_2O calculations, using Global Warming Potentials (GWP) for 100-year time horizon values from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (IPCC, 2014).
- Due to compression capacity limitations on the Montrose Complex (which primarily affects the amount of gas lift available) back-out of Arbroath production is anticipated to be required in order to provide sufficient compression to satisfy the North Cayley and Montrose Infill profiles. Back-out will target wells of high water cut and there is no clear indication of the impact, if any, this will have on Arbroath hydrocarbon export and the assessment has assumed no change.

7.2 Emissions Estimation by Source

The principal planned activities, including their location and estimated duration, are described in Chapter 3. Of these, the general use of vessels (including the drilling rig), well completion, commissioning and the production of hydrocarbons have been identified as warranting further assessment in terms of the impact of their atmospheric emissions on air quality and its receptors.

In addition, the impact of GHGs emitted during all phases of the proposed Montrose Infill Project and the subsequent use of the hydrocarbons produced from Montrose Infill wells requires further assessment in terms of their impact on climate change.

Table 7-1 lists the sources of emissions generated by project activities that are included in the scope of this assessment.

Emissions from each source are quantified in the following subsections.

Table 7-1: Source of emissions from activities related to the proposed Montrose Infill Project

Project Phase	Activity	Source of Emissions
Drilling	Drilling rig	Onboard power generation
	Drilling rig support activity	Support vessels i.e. tugs, supply vessel, anchor handling vessel and helicopters
	Well completion and clean-up	Non routine flaring during well clean-up and testing onboard drilling rig for each of the 5 infill wells.
Subsea Installation and HUC	Installation and commissioning of flowlines, EHC umbilicals, subsea structures, stabilisation material etc	Construction support vessels, dive support vessels and rock lay vessel.
BLP Modification	Installation of a new purpose-built extension on the east face of the existing BLP.	n/a (see text below)
Production Start-Up	Well start-up activity	Gas to flare
Production Phase – Montrose Complex: From Infill First Oil to the end of 2030	Power generation	Incremental fuel gas demand associated with additional process heating duty as a result of production from Montrose Infill wells.
	Operational Flaring	No additional flaring anticipated. FGR will be installed, to reduce emissions from flaring.
	Operational Venting	No incremental venting anticipated.
	Miscellaneous diesel engines	No incremental diesel use anticipated.
	Fugitive emissions	No incremental fugitive losses anticipated.
	Support logistics during operations	No incremental demand on existing support logistics.
Production Phase – Montrose Complex: From 2031 to 2035	Power generation, flaring and venting, diesel use, fugitive emissions, logistics support	All emissions sources on Montrose Alpha and BLP attributed to the proposed Montrose Infill Project
Processing of sold products	Transportation and refining/processing of oil and gas products from the proposed Montrose Infill Project and subsequent distribution of refined fuels.	Downstream GHG emissions including fugitive losses, power/fuels used for processing/refining and distribution of refined fuels.
End use of sold products	Use of refined fuels for energy by end users	Combustion of refined fuels.

7.2.1 Drilling and Support Logistics

Based on the overall anticipated diesel consumption and the scheduled work programmes outlined in Chapter 3, combustion emissions related to the power requirements of the drilling phase and related logistical support are included in Table 7-2 (see section 7.2.5). This is based on the worst-case assumption of a semi-submersible drilling rig being used; if a HDJU rig is used then fuel consumption will be lower. These emissions include the drill rig, tow vessels, supply vessels and helicopter flights. Drilling related emissions will spread across the second half of 2027 and the first three quarters of 2028.

Sources of emissions to air during drilling will be managed within the framework of NEO NEXT+'s Management System as outlined in Chapter 2. Vessels associated with the drilling will be owned and operated by a third party and the activities subject to the company's construction contract and tendering process and will include the following proposed measures to reduce emissions:

- Inclusion of optimised energy efficiency and GHG emissions reduction in the rig selection and tendering process such as:
  - Use of low sulphur diesel (<0.1% S content);
  - Implementation of a Shipboard Energy Efficiency Management Plan (SEEMP) describing how fuel consumption is minimised during transit (economical fuel use mode where possible);
  - Demonstrable equipment efficiency and operations e.g., optimised power management system, planned maintenance system etc.
  - Drilling execution plan with optimised mobilisations and / rig move (where applicable) frequency.
- The drilling rig will be subject to a Health, Safety and Environment Management System audit upon contract award (including planned maintenance system implementation).
- Implementation of a Simultaneous Operations (SIMOPs) plan which allows for simultaneous operations to occur in a safe and optimised manner whilst minimising rig downtime and mobilisation/demobilisation frequency associated with drilling logistics.
- Batch drilling and completion opportunities will be evaluated. These would reduce emissions through reduced logistical requirements and fluid handling efficiencies.

7.2.2 Well Clean up and Testing

Hydrocarbon fluids will be flared from the drill rig during well clean-up and testing activities scheduled for Q4 2028. The predicted maximum volume of hydrocarbons to be flared and associated emissions are presented in Table 7-2.

The following mitigation measures will be applied to reduce the impacts of the flaring associated with the proposed well clean-up and testing activities:

- Flaring operations during well clean-up and well testing will only commence in daylight hours and weather conditions will be monitored throughout. A dedicated person will be assigned for full-time fire watch duties to ensure that all performance related conditions are monitored, and adjustments are made accordingly.
- The information gained from each well test will be assessed with a view to reducing the volumes of hydrocarbons to be flared during well testing for each subsequent production well.

7.2.3 Subsea Installation

Various support vessels will be required to support the installation of subsea infrastructure. Energy in the form of liquid fuel (e.g., marine diesel, combustion of which will result in atmospheric emissions) is required by vessels to provide propulsion, dynamic positioning and ancillary services (e.g., electrical power). Vessels anticipated to be utilised on site include Construction Support Vessel (CSV), Diving Support Vessel (DSV), Rock Laying Vessel.

While contracts securing the services of named vessels have not yet been established, the performance characteristics (including the fuel consumption) of the required generic vessel types are well understood. This, in conjunction with a consideration of the planned vessels' work programme (as outlined in Chapter 3), has allowed estimates of atmospheric emissions to be made by using EFs for diesel engines presented in the EEMS Atmospheric Emissions Calculations guidance (EEMS, 2025). These emissions estimates, which are all scheduled to occur in Q4 2028, are presented in Table 7-2.

As with the drilling phase, vessels associated with the subsea installation phase will be owned and operated by a third party and the activities subject to the company's construction contract and tendering process managed within the framework of NEO NEXT+'s Management System (see Chapter 2).

In line with the emissions reduction commitments outlined in Chapter 2, the following proposed measures will form part of the tendering selection criteria for the installation vessels:

- Selection of vessels which are compliant with MARPOL requirements.
- Use of low sulphur diesel (<0.1% S content).
- Implementation of a SEEMP for each vessel including information relating to minimising fuel consumptions e.g., economical speeds when operationally appropriate.
- Optimisation of construction activities where appropriate through effective construction and SIMOPs planning to minimise number of vessels required and duration on site; and
- Review of vessels' Common Marine Inspection Documents (CMID) as part of vessel assurance (e.g. for evidence of maintenance).

7.2.4 Production Start-Up

During start-up some gas will be flared until the flowlines and topsides reception equipment is brought up to the required temperature and pressure conditions. This is estimated to result in a total amount of 4.5 te of hydrocarbon gas being flared which corresponds to the initial start-up of the production wells.

The resultant emissions from well start up are presented in Table 7-2 based on the applicable EFs for flaring (EEMS, 2025).

7.2.5 Total Pre-Production Emissions

The aggregate of all emissions resulting from the implementation of the proposed Project up to the point of routine production are presented in Table 7-2 and with these separated by year of emission in Table 7-3.

Table 7-2: Emissions during phases of field development leading up to first oil. All values in tonnes.

Combustion Emission Source	Quantity used	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
Drilling and support vessels (diesel)	17,133	54,824	1,018	3.77	34.3	269	3.08	34.3	55,909
Subsea installations (diesel)	1,269	4,061	75.4	0.28	2.54	19.9	0.23	2.54	4,141
Well test and clean up (gas flared)	369	1,034	0.44	0.03	0.00	2.47	16.6	1.85	1,507
Well test and clean up (oil flared)	3,152	10,086	11.7	0.26	0.04	56.7	78.8	78.8	12,360
Well start up (gas flared)	4.5	12.2	0.01	0.00	0.00	0.03	0.08	0.01	14.5
Total Pre-Production	-	**70,017**	**1,105**	**4.3**	**37**	**348**	**99**	**117**	**73,932**

Table 7-3: Total pre-production phase emissions by year of emission. All values in tonnes.

Year of Emissions	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
2027	22,002	408	1.51	13.8	108	1.24	13.8	22,437
2028	48,016	697	2.82	23.1	240	97.6	104	51,495

7.2.6 Production Phase

LIFE OF FIELD EXTENSION

If the proposed Montrose Infill Project were not to go ahead, the Montrose Complex is intended to cease production in December 2030. In the event the proposed Montrose Infill Project comes online however, the Montrose Complex life of field is planned to be extended to 2035 in line with the production profiles presented in Chapter 3.

MAIN POWER GENERATION AND COMPRESSION

Primary power on the Montrose Complex is provided by two Dresser Rand LM2500+, 75.4MW thermal input (MWth), dual fuel, OCGT which were installed on the BLP to meet the electrical demands of both the BLP and the Montrose Alpha platform.

Electric power demand is for process related equipment and non-process related activities. The latter is not related to throughput and will not change as a result of the proposed Montrose Infill Project. A large part of the process related power demand is for gas compression to raise lift gas and for gas export. The High Pressure compression system currently operates at maximum capacity and there will be no increase in power demand for compression due to the proposed Montrose Infill Project. The increased gas flow from the Infill wells will be managed by adjusting the amount of lift gas available. The deployment of lift gas will be managed across the portfolio of wells within the Montrose Complex to optimise hydrocarbon production and, where necessary, by reducing production from more mature wells with a high water-cut.

There will be a small increase in power demand for liquid hydrocarbon export booster pumps and additional process heating duty is expected as a result of production from the Infill wells. For the High production profile, this is estimated to result in an increase of 1 MW electrical output (MWe) to the existing platform load compared to the platform normal operating load of 20 MWe. In terms of fuel gas demand, this relates to an increase of approximately 70 tonnes of gas per year.

Minor differences in the total increased power demand between the High, Mid and Low case production scenarios will have an insignificant effect on total fuel gas consumption and, consequently, production emissions for each scenario are considered to be equal within the uncertainty of the predictive assumptions made.

The baseline annual emissions from combustion of fuel gas in the OCGTs, in the absence of the proposed Montrose Infill Project, are shown in Table 7-4. These are fixed and would apply for each year up to Cessation of Production (CoP) in 2030.

Emissions of NO_x from the OCGTs have been based on an EF of 0.01509 derived by applying the default polynomial parameters for LM2500+ turbines in the draft EEMS guidance (EEMS, 2025) to the annual average thermal input predicted from the estimated fuel gas use and the net calorific value of the gas. This EF is similar to, though higher than, the EF derived from site specific stack gas monitoring results undertaken over a range of loads in monitoring campaigns between 2019 and 2024 and has been adopted to provide a conservative estimate of emissions.

Table 7-4: Baseline annual emissions from fuel gas combustion for the Montrose Complex without Infill. All values in tonnes per year.

OCGT Fuel Gas Use	Quantity used	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
Annual Emissions until 2030	38,111	108,996	575	8.38	0.49	229	35.1	1.37	112,200

The additional fuel gas required for production of the Montrose Infill wells will lead to a small increase in emissions from the OCGTs for one month of 2028 and all year round thereafter. The emissions are shown in Table 7-5.

Table 7-5: Emissions from fuel gas combustion following Montrose Infill first oil. All values in tonnes per year.

OCGT Fuel Gas Use	Quantity used	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
Annual Emissions 2028	38,117	109,013	575	8.39	0.49	229	35.1	1.37	112,217
Annual Emissions 2029 - 2035	38,180	109,196	576	8.40	0.49	229	35.1	1.37	112,406

OPERATIONAL FLARING

As discussed in Section 3.9.2, the existing Montrose Complex has stable operations, therefore trips or shutdowns longer than 12 hours (which would require a subsea depressurisation and cold, low-pressure restart to flare) are rare.

Baseline annual emissions from flaring, in the absence of the proposed Montrose Infill Project, are shown in Table 7-6. These are stable and would apply for each year up to the baseline CoP (2030).

Table 7-6: Baseline emissions from flaring during production without Infill. All values in tonnes per year.

Flare	Quantity used	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
Annual Emissions until 2030	10,800	29,160	13.0	0.87	0.14	72.4	194	21.6	34,835

No additional flaring is anticipated as a result of producing the Montrose Infill wells. However, with the extension of field life resulting from the proposed Montrose Infill Project, NEO NEXT+ will implement FGR on the Montrose Complex. FGR is projected to result in a decrease in flaring of 5,640 te/yr starting from July 2029.

Annual emissions from flaring will therefore reduce stepwise from 2028 to 2030 and then are assumed to remain constant up to the extended CoP (2035). These emissions are shown in Table 7-7.

Table 7-7: Annual emissions from flaring during production with Montrose Infill wells. All values in tonnes per year.

Flare	Quantity used	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
Annual Emissions 2028	10,800	29,160	13.0	0.87	0.14	72.4	194	21.6	34,835
Annual Emissions 2029	7,980	21,546	9.58	0.65	0.10	53.5	144	16.0	25,739
Annual Emissions 2030 - 2035	5,160	13,932	6.19	0.42	0.07	34.6	93	10.3	16,643

OPERATIONAL VENTING

Current venting rates on the Montrose Complex are anticipated to remain unchanged following the addition of the Montrose Infill wells. These will remain, as currently estimated, at 0.69 te CO_2/yr and 7.79 te methane /yr.

Vent emissions from the Montrose Complex have historically been reported to NSTA as the aggregate for the MonArb hub as a whole, in line with the Vent Consent and the most recent NSTA records show a value of 10 mmscf for 2023 (NSTA, 2024). The majority of venting from the MonArb hub is from the Arbroath closed drains system and, as of 2025, MonArb venting has been separated into quantities for Arbroath and for the Montrose Complex. The Montrose Infill project vent related emissions include Montrose Platform vent emissions only.

OPERATIONAL FUGITIVE EMISSIONS

Current fugitive emission rates on the Montrose Complex are anticipated to remain unchanged following the addition of the Montrose Infill wells. These will remain, as currently estimated, at 4.19 te CO_2/yr, 8.77 te CH_4 /yr and 20.63 te VOC/yr.

DIESEL USE

No additional equipment running on diesel are expected to be installed as part of the proposed Montrose Infill Project. It is anticipated that diesel use onboard the Montrose Complex will remain as existing, which averages at 3.5 te/day. Emissions from topsides combustion of diesel are shown in Table 7-8.

Table 7-8: Emissions from topsides use of diesel. All values in tonnes per year.

Topsides Diesel Use	Quantity used	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
Annual Emissions	1,278	4,088	75.9	0.28	2.56	20.1	0.23	2.56	4,169

OPERATIONAL LOGISTICS

The Montrose Complex is currently served by supply vessels and helicopters. There is also an Emergency Response and Recovery Vessel (ERRV) stationed on site at all times, with change over of vessels occurring every three weeks. It is anticipated that current support logistics to the Montrose Complex will remain unchanged, although they would continue beyond the current expected CoP until 2035. Indirect emissions associated with these services are shown in Table 7-9.

Table 7-9: Annual indirect emissions from fuel combustion by supply vessels, helicopters and ERRV. All values in tonnes per year.

Emissions Source	Quantity used	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
Supply Vessels	432	1,383	25.7	0.10	0.86	6.78	0.08	0.86	1,410
Helicopters	160	513	9.5	0.04	0.32	2.52	0.03	0.32	523
ERRVs	898	2,872	53.3	0.20	1.80	14.09	0.16	1.80	2,928
Total	**1,490**	**4,768**	**88.5**	**0.33**	**2.98**	**23.39**	**0.27**	**2.98**	**4,862**

AGGREGATED DIRECT EMISSIONS WITH AND WITHOUT MONTROSE INFILL PROJECT

The total baseline annual direct emissions estimated to be generated at the Montrose Complex during production without the proposed Montrose Infill Project are shown in Table 7-10 along with actual reported emissions for 2023 and 2024 reported via EEMS. Emissions for 2025 derived from actual activity data for January through October and pro-rated to a full year estimate are also presented.

EEMS reporting of direct emissions for the Montrose Complex uses EFs for CO_2 and CH_4 that are based on site-specific gas composition information, as recommended in the draft EEMS Guidance (OPRED, 2025), whereas future estimates (including for 2025) provided in this ES have been derived using the applicable default values given in the EEMS Guidance, since these are considered to be more conservative (as per Section 7.1).

Table 7-10: Direct emissions generated at the Montrose Complex in recent years and estimated during production without Infill. All values in tonnes per year.

Baseline Production Emissions	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
2023	125,701	586	8.86	10.06	274	129	103	131,666
2024	114,507	554	8.10	7.01	248	115	98.6	119,865
2025	97,476	424	6.63	3.67	202	161	23.4	103,729
2026	142,249	664	9.54	3.18	321	246	46.2	151,672
2027	142,249	664	9.54	3.18	321	246	46.2	151,672
2028	142,249	664	9.54	3.18	321	246	46.2	151,672
2029	142,249	664	9.54	3.18	321	246	46.2	151,672
2030	142,249	664	9.54	3.18	321	246	46.2	151,672

Notes on Table 7-10:

- In the estimate shown in Table 7-10 the flare activity does not account for implementation of FGR. Without the proposed Montrose Infill Project, early CoP (2030) would mean that implementation of FGR is considered a disproportionate investment and therefore would not be implemented.
- Indirect emissions from logistics services supplied by third parties are excluded from these estimates since these are not included in offshore operators' EEMS returns or in NSTA GHGI calculations. They are of relevance to assessment of combined air quality impacts and of full life-cycle GHG estimates and are included in relevant sections of this assessment below.
- Forecast values assume that production will proceed without unplanned outages whereas, for previous and current years, emissions during any downtime, or when fuel gas is unavailable, will have a different profile, influenced by reduced fuel gas use, increased diesel use and some increase in flaring.
- Values provided for 2025 are relatively low due to a long period of outage between January and March for work to be undertaken on the platform deluge systems.

The net effect of the proposed Montrose Infill Project will be to reduce the annual baseline emissions from the Montrose Complex in 2029 and 2030, due to the introduction of FGR. Emissions during the extended life of field period (2031-2035) will also be less than the current baseline emissions due to FGR. The benefit of FGR outweighs the increased fuel gas consumption, whilst all other annual emissions sources will not materially change. The incremental increase in aggregated production emissions attributed to the proposed Montrose Infill Project have been determined by deducting the baseline emissions (in the absence of the proposed Montrose Infill Project) from the total production emissions estimated should the Project proceed. These are shown by year in Table 7-11. All emissions beyond 2030 are attributed to the proposed Montrose Infill Project.

Table 7-11: Estimated annual change in emissions resulting from the Montrose Infill Project during production. All values in tonnes per year.

Incremental Production Emissions	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC	CO_2e
2028	17	0.09	0.00	0.00	0.04	0.01	0.00	17
2029	-7,414	-2.33	-0.21	-0.04	-18	-51	-5.6	-8,890
2030	-15,028	-5.71	-0.44	-0.07	-37	-101	-11.3	-17,986
2031	127,221	658	9.10	3.11	284	145	34.9	133,686
2032	127,221	658	9.10	3.11	284	145	34.9	133,686
2033	127,221	658	9.10	3.11	284	145	34.9	133,686
2034	127,221	658	9.10	3.11	284	145	34.9	133,686
2035	127,221	658	9.10	3.11	284	145	34.9	133,686
Total Life of Field	**613,680**	**3,283**	**44.8**	**15.4**	**1,363**	**572**	**157**	**641,573**

The negative incremental emission values for 2029 and 2030 are a result of the decrease in flaring in these years relative to the baseline that is brought about by the introduction of FGR as a consequence of implementing the proposed Montrose Infill Project.

YEAR OF PEAK EMISSIONS

The period of highest total emissions at the Montrose Complex would be between July 2027 and the end of 2028 when baseline production emissions occur at the same time as drilling, subsea installation and well cleanup, testing and start up. Combined emissions during these years are shown in Table 7-12 bookended by baseline emissions for 2026 and production emissions for 2029 for the proposed Montrose Infill Project. The emissions are the total emissions anticipated in each year, not the incremental Project emissions, and include both direct (pre-production and production) and indirect (logistics) emissions.

Table 7-12: Combined pre-production and production emissions. All values in tonnes per year.

Year of Emissions	CO_2	NO_X	N_2O	SO_2	CO	CH_4	VOC
2026	147,017	752	9.9	6.2	344	247	49
2027	169,019	1,161	11.4	19.9	452	248	63
2028	195,049	1,449	12.7	29.3	585	344	153
2029	139,603	750	9.7	6.1	326	196	43

After a short increase in emissions during the drilling and start up phase, emissions are predicted to revert back to baseline levels following Project first oil and remain at these levels until the revised CoP.

PRODUCTION GHG INTENSITY

Projected oil and gas production from the existing fields processed at the Montrose Complex and from the Infill wells are shown for each year between 2026 and 2035 in Appendix F in Système International (SI) units. Production is shown in Appendix F for the baseline (existing wells between 2026 and 2030), for the existing wells during their extended life enabled by the proposed Montrose Infill Project, for the Infill wells, for the total Project (Infill wells plus extended life of existing wells) and also for the full field (Baseline plus Project). Estimates for the existing wells are based on reservoir monitoring data during the production of these wells to date. Since these are relatively well understood a single central estimate is used. Production from the Infill wells will remain more uncertain until production commences and so High, Mid and Low case production estimates are provided in Appendix F to present

a range of estimates. The values, in all cases are for exported fluids. These differ from reservoir production rates by the amount of gas used on the Montrose Complex.

The combined baseline production of oil and gas are presented in Table 7-13 in units of million barrels of oil equivalent (mmboe) to present the derivation of GHGI in units of $kgCO_2e$/boe which the NSTA uses for benchmarking (NSTA, 2024). GHGI values for the baseline, for the proposed Montrose Infill Project and for the combined full field production are also presented in Table 7-13 based on the direct emissions estimates relevant to each scenario. For the baseline GHGI values, emissions are taken from Table 7-10. For the Project GHGI, the incremental emissions shown in Table 7-11 are used. For the full field GHGI values, the combined baseline plus Project incremental emissions are used.

In keeping with assessment of GHGI by the NSTA, indirect emissions associated with logistics supply services are excluded from the estimates shown in Table 7-13.

Table 7-13: Montrose Infill Project aggregated incremental production profile (Mid case) and associated GHGI.

Year	Production (mmboe)					GHGI ($kgCO_2e$/boe)		
	Baseline	Existing Wells Life Extension	Infill Wells	Total Project	Full Field	Baseline	Project	Full Field
2026	3.21				3.21	47.3		47.3
2027	3.40				3.40	44.7		44.7
2028	3.89		0.63	0.63	4.51	39.0	0.03	33.6
2029	2.70		4.50	4.50	7.20	56.2	-1.97	19.8
2030	2.13		2.80	2.80	4.93	71.1	-6.43	27.1
2031		1.61	2.12	3.73	3.73		35.9	35.9
2032		1.39	1.83	3.22	3.22		41.5	41.5
2033		1.04	1.53	2.57	2.57		52.0	52.0
2034		0.90	1.24	2.15	2.15		62.3	62.3
2035		0.88	1.10	1.98	1.98		67.5	67.5
Life of Field	**15.3**	**5.83**	**15.8**	**21.6**	**36.9**	**49.5**	**29.7**	**37.9**

The Mid Case production estimate is used in Table 7-13 as a basis for GHGI calculations since this presents a most likely value. The total life-of-field production-related emissions are the same for both High and Mid production cases[1]. The lower production denominator of the Mid case consequently leads to a higher GHG intensity estimate for the Mid case than for the High case and consequently the Mid case intensities have been used for benchmarking.

The low, or negative, GHGI derived for the first three years of the proposed Montrose Infill Project are a result of the small net reduction in emissions brought about by the Project relative to the Baseline (as noted in relation to Table 7-11).

In each scenario, the GHGI increases in later years due to declining production, while emissions remain the same.

[1] Production related emissions stem from power generation, flaring, venting, fugitives, logistics and use of diesel. All sources except for power generation are independent of throughput. The increase in power generation required for producing the Infill wells is discussed in Section 7.2.6 and concludes that differences in power generation between the High, Mid and Low case production profiles are negligible.

MINIMISING GHG EMISSIONS DURING THE PRODUCTION PHASE

As detailed in Chapter 2, various studies have shown that electrification of the Montrose Complex is challenging, with further study work ongoing. Alternative efforts to reduce emissions during production at the Montrose Complex include:

- The installation of a FGR system (as detailed previously) which will be in operation prior to 2030;
- Prioritising use of gas over diesel: diesel use by the gas turbine generators (GTGs) onboard the BLP is routinely limited to turnarounds and shutdowns and for plant re-start when fuel gas is unavailable; and
- The Montrose Complex ERAP which summarises and assesses the applicability of identified emissions abatement and technologies and sets out commitment to planned emissions reduction initiatives (see Chapter 2). In line with the obligations set out under the NSTA Stewardship Expectation 11 (NSTA, 2021c), the Montrose Complex's ERAP will continue to be reviewed for potential opportunities to further reduce emissions against the sector targets outlined in the NSTD (NSTA, 2023).

NEO NEXT+ are committed to continually monitor and review emissions and carbon intensity of the Montrose Complex in line with the company's ESG strategy and commitments and in an effort to support the UK's Net Zero target (Chapter 2).

7.2.7 Downstream GHG Emissions

Classifying emissions by scopes (either Scope 1, 2, or 3) as detailed in the GHG Protocol (WRI, 2013) was developed to enable companies to assess emissions for reporting of corporate emissions. Whilst not strictly developed for project reporting, the notion of Scopes are useful for contextualising project emissions. Similarly, the Corporate Value Chain (Scope 3) Accounting and Reporting Standard (a supplement to WRI, 2013) 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 summarized in the context of the proposed Montrose Infill Project as follows:

- Scope 1 GHG emissions are those arising directly from activities of NEO NEXT+ (e.g. combustion of fuel at a NEO NEXT+ facility) related to the project;
- 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 NEO NEXT+ (there are no Scope 2 emissions identified for the proposed Montrose Infill Development); and
- Scope 3 GHG emissions include all other indirect emissions from activities that occur either upstream or downstream. Downstream activities for the proposed Montrose Infill Development include the use of produced hydrocarbons by others following their export from the Montrose Complex.

Please see WRI (2013) 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 NEO NEXT+, they result in emissions of GHGs, and the impact of these emissions also require assessment.

Products exported from the site of production (in this case the Montrose Complex) 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 the Montrose Complex 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, 2013).

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 Montrose Infill sold products will be combusted in some form as fuel.

Other Scope 3 categories of the GHG Protocol Guidance (WRI, 2013) are not of relevance (or are of *de minimis* scale) to the Project GHG emissions.

The following subsections describe how the Scope 3 downstream Category 9, 10 and 11 GHG emissions have been estimated and present the results of the calculations. For this assessment the emissions from the activities downstream of the Montrose Complex are separated into two categories:

- The transportation of NEO NEXT+ 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 (Category 11).

GHG EMISSIONS FROM TRANSPORTATION, PROCESSING OF SOLD PRODUCTS AND DISTRIBUTION OF END-USE PRODUCTS

Following separation on Montrose BLP, oil and gas products from the Montrose Infill wells will be exported, along with those from the existing Montrose Complex wells, into the Forties Pipeline System (FPS) and Central Area Transmission System (CATS) respectively, where they become comingled with products from multiple other central North Sea production fields that also export via these pipeline systems.

Gas in the CATS pipeline, including Montrose Infill gas, will be processed at the CATS terminal at Teesside and then fed into the National Gas Transmission System (NTS) network, from which downstream industrial, commercial and domestic users will off-take natural gas for final use. A small portion of the GHG emissions at CATS terminal and booster compression units throughout the NTS network are an inevitable consequence of Montrose Infill gas export.

Along with crude oils from other fields that export to the FPS, the Montrose Infill oil will be stabilised at the Kinneil FPS terminal and transported via ship from the Dalmeny/Hound Point facility either to UK refineries or for export.

The UK Government publishes emissions factors for hydrocarbon fuels, known as Well to Tank (WtT) EFs, which account for aggregated GHG emissions associated with the extraction, transport, refining, purification or conversion of primary fuels to fuels for direct use by end-users as well as the distribution of these fuels (DESNZ, 2024a).

Emissions accounted for within the WtT EFs therefore include the indirect Scope 3 Category 9 and Category 10 emissions and also the direct Scope 1 emissions associated with production. These latter, direct emissions, have been estimated in Section 7.2.6. Emissions for the transportation, processing and distribution of Montrose Infill sold products have therefore been estimated using WtT EFs for natural gas and crude oil and then deducting the direct Scope 1 production emissions. The production emissions are not separated into an oil production fraction and a gas production fraction and so the subtraction of production emissions is from the combined WtT emissions for both oil and gas products. This is shown in Table 7-14.

All gas is assumed to be used as a single end-use product; natural gas. The WtT EF for natural gas is 423 $kgCO_2e$ per tonne of natural gas taken from the NTS by end users (DESNZ, 2024b)[2].

[2] The value, accurate at the time it was accessed, is subject to updates by DESNZ based on the most recent gas composition data. Variations over time are minor and would not significantly affect the emissions calculations and would have no impact on the conclusions of the impact assessment. This also applies for some other data used in this assessment that are frequently reviewed, updated and published by the UK Government, such as EFs for liquid fuels, calorific value of fuels and monthly or annual import and export of commodities.

Conversely, there are multiple end-use products on the market derived from crude oil. Each end-use product may require a different degree of processing and hence has an individual WtT EF assigned (DESNZ, 2024b).

DESNZ publishes a quarterly update of energy trends in the UK (DESNZ, 2024c). The report, supplemented by tables of statistics, provides a detailed and comprehensive picture of the production and consumption of individual fuels and of energy as a whole in the UK. Figures for 2024 (accessed in August 2025) indicate consumption is dominated by motor spirit (20%), diesel (37%) and aviation turbine fuels (20%). The data has been used to provide a theoretical breakdown of end-use products that might be produced from crude oil from the proposed Montrose Infill Project. WtT EFs for each end-use product have been used to derive a weighted average WtT EF of 729 $kgCO_2e/te$ for estimating the life-cycle GHG emissions associated with getting the suite of final products to their UK users[3]. This is shown in Table 7-15, and the resulting EF has been used as a proxy for the fate of Montrose Infill crude oil to derive the downstream indirect emissions shown in Table 7-14.

Table 7-14: Indirect GHG emissions from processes between sold products leaving Montrose Complex to arrival of refined products at end users.

Source:	LoF Quantity Exported (te)	WtT EF ($kgCO_2e/te$)	WtT Emissions ($teCO_2e$)	Production Emissions ($teCO_2e$)	Downstream Transport, Refinement & Distribution ($teCO_2e$)
Oil	3,764,111	729	2,744,400	Not fluid specific	
Gas	578,463	423	244,785		
Total Hydrocarbons	**4,342,574**	**-**	**2,989,185**	**641,573**	**2,347,611**

GHG EMISSIONS FROM THE COMBUSTION OF END-USE PRODUCTS

Although there may be some exceptions, most end-use products derived from hydrocarbons are ultimately combusted, either directly for providing energy or at the end of life waste chain for hydrocarbon-derived materials (e.g. plastics, fibres) and chemicals. A currently small, though increasing, proportion of combustion CO_2 emissions may be captured and either used or sequestered. However, to provide a worst case estimate of GHG emissions from the end-use of oil and gas from the proposed Montrose Infill Project, it has been assumed that all products are ultimately combusted.

The UK Government publishes GHG conversion factors for a variety of hydrocarbon end-use products and these have been used to estimate emissions from natural gas and the blend of liquid products discussed in relation to WtT EFs.

The end-use EF for natural gas is 2,590 $kgCO_2e$ per tonne combusted (DESNZ, 2024b).

A weighted average end-use EF of 3,172 $kgCO_2e$ per tonne combusted has been derived for the representative blend of liquid products consumed in the UK. This is shown in Table 7-15 and the resulting life of field end use emissions are shown in Table 7-16.

[3] An alternative, more simplistic, approach would be to assume a WtT EF for a single product (such as gasoline). However, the weighted average approach is considered more appropriate for the spread of products used in the UK (the EFs are derived for UK products). Different approaches may also be as valid (eg adopting EU EFs, as most oil is exported to EU) but would make a non-material difference to the scale of downstream emissions estimated.

Table 7-15 Derivation of weighted EFs for downstream indirect Scope 3 emissions.

	Motor Spirit	White Diesel	Gas Oil	Aviation turbine oil	Fuel oils	Petroleum Gases	Burning Oil	Other Products	Weighted EF
UK Supply & Use (Total Supply, 2024, kte)[1]	11,843	22713	2,200	11,970	401	5030	3117	3387	
	19.5%	37.4%	3.6%	19.7%	0.7%	8.3%	5.1%	5.6%	
WtT EF ($kgCO_2e/te$)[2]	816	752	744	662	715	353	661	1,123	729
Combustion EF ($kgCO_2e/te$)[2]	3,154	3,204	3,227	3,178	3,229	2,998	3,165	3,229	3,172

[1] Table 3.4 in DESNZ (2024c). [2] UK Government (2024)

Table 7-16: Indirect GHG emissions from combustion of end-use products (High case).

Source:	LoF Quantity Exported (te)	EF ($kgCO_2e/te$)	End-Use Combustion ($teCO_2e$)
Oil	3,764,111	3,172	11,941,349
Gas	578,463	2,590	1,498,489
Total Hydrocarbons	**4,342,574**	**-**	**13,439,838**

BREAKDOWN OF TOTAL GHG EMISSIONS FROM THE FULL LIFE CYCLE VALUE CHAIN

GHG emissions estimated for the pre-production phase of the Montrose Infill Project, 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 7-17.

Table 7-17: Life cycle GHG emissions.

Project Phase	Mid Case		High Case	
	GHG Emissions ($MteCO_2e$)	% of Total Life Cycle	GHG Emissions ($MteCO_2e$)	% of Total Life Cycle
Pre-Production	0.07	0.6%	0.07	0.4%
Production	0.64	5.5%	0.64	3.9%
Downstream Processing	1.45	12.4%	2.35	14.2%
End-Use Combustion	9.60	81.6%	13.4	81.4%
Total	**11.8**	**100.0%**	**16.5**	**100.0%**

7.3 Air Quality Impacts and Receptors

Increased concentrations of NO_2, CO and SO_2 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.

7.3.1 Production Phase

The impact of production emissions from the Montrose Complex on offshore and onshore receptors has been assessed through atmospheric dispersion modelling and comparison of received air quality with UK short-term and long-term ambient air quality objectives.

The Cambridge Environmental Research Consultant (CERC) Atmospheric Dispersion Modelling Software (ADMS) was used to model the dispersion of emissions of NO_2, CO and SO_2 from the Montrose Complex based on recorded metocean data for 2022 – 2024. Parameters of the study, including sources, grid sizes, etc., are presented in the Modelling Study Report which has been included in Appendix G.

The modelling assumed a NO_x emission rate from the OCGT based on stack monitoring results across a range of loads over the period 2019 – 2024 and assumed continuous operation at 85% load to provide a conservative, worst case estimate of impacts. This equates to approximately 24.2 MWe output, which is considerably higher than the 20 MWe anticipated during the production phase of the proposed Montrose Infill Project. The NO_x concentration in the OCGT exhaust at the modelled load is higher than the BAT-Associated Emission Level of 350 mg/Nm^3 that is stipulated for NO_x in the Large Combustion Plant BAT Conclusions document (European Commission, 2021) for offshore open cycle gas-fired turbines operating above 70% load. In accordance with provisions set out under Article 15(4) of the EU Industrial Emissions Directive (and transposed into UK regulations via the Offshore Combustion Installations (Prevention and Control of Pollution) Regulations), OPRED has set a higher NO_x emission limit for the OCGTs in the Montrose Complex PPC permit. The limit set by OPRED, under a time-limited derogation from the BAT-AEL, was based on justification, including cost benefit analysis of alternatives, provided by NEO NEXT+ (then Repsol Resources UK) in its PPC permit application. The application was based on current operating parameters and with explicit provision made for incorporation of the proposed Montrose Infill Project, should it be consented.

The results of the air dispersion modelling study (Appendix G) showed that the ground (sea) level concentrations of all of the pollutants assessed were considerably lower than the respective UK air quality objectives and that the highest predicted results were expected to occur between 550 m and 1. 3 km from the Montrose Complex during normal operation. The maximum process contribution for NO_2 was less than 1.1% of the long- term, and less than 3% of the short-term, national air quality standards (AQS). Process contributions of CO and SO_2 were less than 1% of all respective air quality objectives, with predicted environmental concentrations (including background levels) less than 3% of relevant AQS.

Given these low maximum levels, and their occurrence being local to the Montrose Complex, the effect of production emissions on air quality at all onshore and offshore receptors (the closest being the Marnock-Skua platform, approximately 25 km from Montrose) were concluded to be negligible.

Production from the Montrose Infill wells is predicted to result in a small net decrease in emissions of all pollutants from the Montrose Complex, as the slight increase in fuel gas use is offset by reduced emissions following the implementation of FGR. Although the duration of emissions will be extended from 2030 out to the revised COP date of 2035, given the conclusions of the modelling study, the impact of the extended production is considered minimal.

The modelling study considered the sensitivity of the conclusions to periods of operating both OCGTs in tandem. During such times the load on each generator is low (35% - 40%) leading to low flame temperatures and consequently low NO_X emissions. For comparison, two OCGTs operating at 45% load (10.1 g/s of NO_X each) would result in lower aggregate emissions than one OCGT operating at the 85% load assumed in the modelling study (25.2 g/s NO_X). Consequently, short periods of operation with two OCGTs would not affect the conclusions of the impact assessment.

The impacts at all identified sensitive receptors, which included neighbouring platforms and the nearest landfall point, were negligible.

7.3.2 Drilling Phase

Drilling of the Infill wells will be undertaken over a period of approximately 15 months and will run in parallel with ongoing baseline production at Montrose. Over this period, baseline production related emissions from the Montrose Complex will be supplemented by those from the drill rig, which will be located within approximately 750 m of Montrose Alpha.

The modelling study (Section 7.3.1) also included a scenario for simultaneous production and drilling. The conditions studied and the results of the assessment are reported in Appendix G.

The results of the study showed that, for the duration of drilling, the ground (sea) level concentrations of all pollutants were considerably lower than the respective UK air quality objectives and that the highest predicted results were expected to occur between 750 m and 1.6 km from the Montrose Complex. Within this area the maximum process concentration of NO_2 was predicted to be less than 9% of the short-term AQS and the predicted environmental concentration, including background levels, was 12.3% of the AQS. Predicted concentrations of CO and SO_2 were insignificant with regard to all respective air quality objectives.

The impacts at all identified sensitive receptors, which included neighbouring platforms and the nearest landfall point, were concluded to be negligible during the period of drilling combined with baseline production.

7.3.3 Installation, well clean-up and production start up Phases

Emissions during subsea installations will be of short duration and with lower emissions than during drilling. Flaring during well testing, clean-up and start-up will be of short duration (estimated to be just over one day per well), during which the emissions would be no greater than those from drilling activities for the same duration.

Whereas these scenarios have not been modelled as part of the air quality assessment study, it can be concluded that emissions during this phase will have no greater impact than is predicted for the drilling phase.

7.3.4 Decommissioning Phase

As part of the anticipated decommissioning activities a drilling rig and associated support vessels will be mobilised to plug and permanently abandon the wells. In addition, vessels will be required to remove and recover seabed infrastructure, and to complete pre-decommissioning, execute phase and post-decommissioning legacy surveys. These activities will lead to an increase in vessel activity relative to that associated with production.

Vessel emissions associated with decommissioning activities are likely to be similar to those associated with drilling, installation and commissioning phases (see Table 7-2). The extent, magnitude and duration of impact on air quality from offshore decommissioning activities are therefore anticipated to be similar to those from the pre-production activities such that the significance of impact is expected to be low.

This will be confirmed during the preparation of the decommissioning programme and supporting documents.

7.3.5 Transboundary and Cumulative Impacts to Air Quality

The emissions reported for the UK, and for the UKCS offshore oil and gas (O&G) industry in 2023 are presented Table 7-18 in units of thousand tonnes per year.

The estimated contributions of the annual production emissions of the proposed Montrose Infill Project to these national and sector-wide aggregated emissions are represented in Table 7-18.

By way of an example, aggregated NO_x emissions for production of the Montrose Complex in 2029 (including the infill wells) would be approximately 1.90% of the annual emissions from the UKCS offshore O&G industry in 2023 and approximately 0.077% of the total annual UK emissions in 2023. There is a negligible change from the estimated emissions in the absence of the proposed Montrose Infill Project. There will be a short-term increase from the baseline emissions during drilling of the Montrose Infill wells and the combined production and drilling emissions

of, for example, NO_x emissions in 2028 would be approximately 3.68% of the annual emissions from the UKCS offshore O&G industry in 2023 and approximately 0.15% of the total annual UK emissions in 2023.

The proposed Montrose Infill Project will be located approximately 46 km from the UK/Norway median line. Given this distance and the localised nature and low level of air quality impacts expected, no transboundary impacts are anticipated.

Table 7-18: Comparison with emissions from the UK and from the UKCS as reported in 2023.

	Emissions						
	CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
UK Emissions (kTe) (2023) [1]	**306,200**	**968**	**68.68**	**139**	**1,257**	**2,046**	**853**
2028 Montrose Production and drilling emissions - contribution to UK emissions (%)	0.064	0.150	0.018	0.021	0.047	0.017	0.018
2029 Montrose Production - contribution to UK emissions (%)	0.046	0.077	0.014	0.004	0.027	0.010	0.005
UKCS Offshore O&G Emissions (kTe) (2023) [2]	**9,609**	**39.4**	**0.7**	**1.6**	**20.7**	**20.3**	**21.5**
2028 Montrose Production and drilling emissions - contribution to UKCS emissions (%)	2.03	3.68	1.70	1.88	2.83	1.69	0.71
2029 Montrose Production - contribution to UKCS emissions (%)	1.45	1.90	1.29	0.39	1.58	0.96	0.20

1. UK Greenhouse Gas Inventory, 1990 to 2023 – Annual Report for Submission under the Framework Convention on Climate Change' - (NID, 2025)
2. UKCS EEMS emissions data (EEMS, 2025)

7.3.6 Conclusion of Air Quality Impact Assessment

Emissions of pollutants that impact on air quality will increase from present levels for the duration of the drilling, subsea installation, well clean-up and initial start up of the Montrose Infill wells. The emissions will then return to existing levels (or slightly lower) for the duration of Montrose Infill production.

At all stages of the project, modelling has shown that there will be no discernible impact on air quality from present or future emissions at, and in the vicinity of, the Montrose Complex.

7.4 Benchmarking of Production GHG Emissions Performance

This section provides context for the GHG emissions from the proposed Montrose Infill project through comparison with UKCS metrics for GHG emissions, GHG intensity and flaring and venting.

7.4.1 Production Emissions Benchmarking

The North Sea Transition Deal (NSTD) (DBEIS, 2021) is a joint industry and regulatory framework for decarbonising oil and gas activities across the UKCS and is a key UK Environmental Protection Objective of UK commitments for meeting the objectives of the Paris Agreement. Through the NSTD oil and gas operators commit to collectively achieving net zero production emissions by 2050, with interim targets established for 2025, 2027 and 2030. The reductions are expected to be achieved partly due to falling production activity and partly through emissions reduction measures being implemented at operating facilities in line with the NSTA's Stewardship Expectation 11 (NSTA, 2023). Production emissions for the Montrose Complex are shown in the context of NSTD sector-wide emissions targets in Table 7-19.

Production emissions from the Montrose Complex currently make up a minor proportion of the target aggregate for the offshore sector and this would continue to be the case were the proposed Montrose Infill Project to go ahead.

Table 7-19: Production GHG emissions as a proportion of NSTD targets.

Year	NSTD UKCS Target Production Emissions		Montrose Complex Production Emissions	
	% Relative to 2018	$MteCO_2e$	$MteCO_2e$	% of UKCS Target
2018[1]	100	14.5	0.19	1.32%
2025[2]	90	13.1	0.15	1.14%
2027[2]	75	10.9	0.16	1.44%
2030[3]	50	7.3	0.13	1.84%
2050[4]	0	0	0	-

[1] Actual data reported for Montrose Complex.
[2] Estimated for Montrose Complex for 2025 and 2027, predating Infill First Oil.
[3] Estimated total emissions for Montrose Complex in 2030 assuming Infill project executed.
[4] Montrose Complex is not planned to be operational in 2050.

7.4.2 GHG, Flaring and Venting Intensity Benchmarking

GHG intensity expressed in kg CO_2e per boe is used as a key performance metric at group level by NEO NEXT+ (Section 2) as well as the NSTA to compare asset performance and drive improvements integral to the sector's stewardship process (NSTA, 2023). NEO NEXT+ is fully committed to developing the proposed Montrose Infill Project in line with the NSTA Stewardship expectations and to drive GHG intensity performance as low as reasonably practicable in accordance with the company's pathway to Net Zero (Chapter 2).

GHG intensity of the proposed Montrose Infill Project Mid case production is shown in Table 7-13 and is presented in the context of UKCS benchmarks in Table 7-20.

Whereas the majority of emissions across the UKCS derive from fuel gas combustion, a significant proportion of UKCS emissions derive from flaring (17.1%) and a more modest proportion from venting of methane (0.27%) (NSTA, 2024). As such, the NSTA's strategy for decarbonising UKCS production includes obligations for reducing flaring and venting, with zero routine flaring and venting to be met by 2030 (NSTA, 2024b).

Oil and gas production facilities are designed and operated so as to minimise any losses of hydrocarbons from flaring, venting or fugitive emissions without compromising safe production. This philosophy helps to optimise environmental performance as well as production. Safe operation however does require a degree of flaring and venting during normal operating conditions and for other than normal operating conditions (OTNOC) (such as planned shut down and start-up, safe response to equipment trips, etc.). Flaring intensities and venting intensities are metrics which are used to drive optimal performance.

Flaring intensity is the volume of hydrocarbons flared per boe of hydrocarbons produced. NSTA processes data from all production sites in the UKCS and publishes the UKCS average flare intensity and benchmark intensity values for different types of production facility. Montrose Complex sits in the category of large offshore platforms of more than 25 years' service.

Venting intensity is the volume of methane vented per boe of hydrocarbons produced. NSTA also publishes venting intensity benchmark values for the average across the UKCS and for different types of production facility. The most recent benchmarking analysis published by the NSTA is for 2023.

The GHG intensity, the flaring intensity and venting intensity of the Montrose Complex following Infill first oil are shown in Table 7-20, based on aggregated life of field production and emissions values. Table 7-20 also includes benchmark values published by NSTA using 2023 data for the UKCS as a whole and for the relevant facility category of large platforms that are >25 years old. Although emissions across the UKCS are being reduced, the annual benchmark intensity values across the basin are anticipated to increase as production continues to decline.

Table 7-20: Montrose Infill emissions benchmarking.

Production Emissions Benchmarks	GHG Intensity ($kgCO_2e/boe$)	Flare Intensity (scf/boe)	Vent Intensity (scf/boe)
Montrose Current (2023)	29.0	73	2.20
Montrose Infill High Case	20.1	20	0.06
Montrose Infill Mid Case	29.7	30	0.09
UKCS Average for Large Platforms >25 years old	**50.3**	**166**	**2.10**
UKCS Average	24.5	91	0.97

Based on Mid case production levels, the life-of-field GHGI, flare intensity and vent intensity for the proposed Montrose Infill Project are all significantly below the respective benchmark values for the applicable asset category.

The respective intensity values reported from the Montrose Complex in this year are also included in Table 7-20. The difference between the reported flare intensity in 2023 and predicted values for the proposed Montrose Infill Project are a result of the installation of FGR as well as the increased production.

The difference between the vent intensity reported from the Montrose Complex for 2023 and those for the proposed Montrose Infill Project are because historically all venting from the MonArb hub has been reported as being from the Montrose Complex, as per the Vent Consent. The main source of MonArb hub venting is from the Arbroath Platform closed drain system. MonArb Venting has now been separated into Montrose Platform related venting and Arbroath Platform related venting. The proposed Montrose Infill Project vent related emissions include Montrose Platform vent emissions only.

7.5 Impact on Climate Change

In accordance with the expectations included in the OPRED Supplementary Guidance, the assessment follows the structure of an Environmental Impact Assessment (EIA) and the steps outlined in the Institute of Environmental Management & Assessment (IEMA – now known as the Institute of Sustainability & Environmental Professionals (ISEP)) guide on Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022). This includes:

- Determining the mechanism of impact; Describing the baseline situation and its future variation in the absence of a proposed project;
- Estimating the emissions for the proposed project;
- Ranking the impact magnitude;
- Ranking the receptor sensitivity; and
- Applying a matrix approach to conclude the significance of the impact to the receptor.

The application of these steps to the whole-life GHG emissions of the proposed Montrose Infill Project is presented in the following subsections.

Assessment of life-cycle GHG emissions in the National context draws on the UK Nationally Determined Contribution (NDC) to achievement of the objectives of the Paris Agreement. The UK government's plan for implementing its NDC commitments is through its published strategy for transitioning to net zero GHG emissions by 2050. The impact assessment therefore considers whether the proposed Montrose Infill Project, in combination with other potential oil and gas developments during the project lifetime, is aligned with this strategy or would risk preventing its implementation.

In the global context, the baseline incorporates realistic ranges for projected cumulative downstream GHG emissions from all potential oil and gas developments. The assessment then uses the ISEP categories to assign impact significance levels to the impact of the Montrose Infill Project on this baseline.

7.5.1 Mechanism of impact

The presence of CO_2, and other GHGs, in the atmosphere impedes the transmission of heat from the earth's surface into space and a direct correlation has been identified between atmospheric CO_2 concentrations and average global surface temperature of land and sea (IPCC 2021). Surface temperatures affect aspects of the physical environment, such as ice and permafrost coverage, regional climate systems and mean sea level (IPCC 2023, WMO 2026, IPCC 2019). Abrupt changes to surface temperature puts stress on many, if not all, species, not least to human health, habitation and agriculture IPCC, 2022). The atmospheric CO_2 concentration also affects the acidity of the seas, changes to which can put additional stress on some marine species (IPCC, 2023). Changes to surface temperatures are also linked to changes in soil quality and aridity and changes to regional climate systems are linked to extreme weather events such as frequency of severe storms and wildfires (IPCC 2021).

The magnitude of impact to each separate receptor from GHG emissions is linked to the magnitude of change to average global surface temperature. 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 (IEMA, 2022).

Atmospheric GHG concentrations and related global temperature increase are the metrics adopted in the Paris Agreement for controlling the potential future impact of GHG emissions on individual local and regional receptors.

The receptor for GHG emissions is the global atmosphere (IEMA, 2022) and this, along with its direct effect on average global surface temperature increase, is therefore used for the impact assessment for proposed Montrose Infill Project GHG emissions.

NEO NEXT+ recognises that the emission of GHGs as a direct or indirect consequence of the proposed Montrose Infill Project will contribute to the global atmospheric concentrations, and thereby to the consequences of increased global average temperature. In isolation, the GHG emissions from the proposed Montrose Infill Project would not cause a change to the global climate, however it is their contribution to the cumulative impact of total global emissions that is of relevance in assessing the impact of the proposed Project. The impact assessment methodology adopted in the following sections is designed to evaluate the significance of the proposed Project on cumulative impacts from all global emissions.

7.5.2 Baseline

BASELINE GHG EMISSIONS, ATMOSPHERIC CONCENTRATIONS, EFFECTS AND FUTURE PROJECTIONS

As of 2021 the concentration of CO_2 in the atmosphere was estimated to be 415 parts per million (ppm), with methane estimated to be 1,896 parts per billion (ppb), and nitrous oxide to be 335 ppb (IPCC, 2023). Pre-industrial level concentrations of CO_2 are considered to have been approximately 280 ppm (Petit et al., 1999) and without international action to reduce GHG emissions, the concentration of CO_2 may have reached more than 1,000 ppm by 2100 (for example baseline scenarios in IPCC (2014)).

As of 2020, it is estimated that the effect of the higher GHG concentrations in the atmosphere has been to increase the global average temperature by 1.1 °C from pre-industrial levels and, if emissions continued unabated, could result in an increase of between 3.3 °C and 5.7 °C relative to pre-industrial levels by 2100 for very high emissions scenarios (IPCC, 2023).

The Paris Agreement seeks to hold the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels. Signatory parties to the Paris Agreement, of which there are currently 195, will aim to achieve a balance between

anthropogenic emissions of GHG from sources and the removals of GHG by sinks in the second half of this century. Each signatory to the Agreement has set Nationally Determined Contributions (NDC) towards achieving these goals through a combination of reducing emissions and increasing sinks.

Global GHG emissions in 2019 have been estimated to be approximately 59 $GtCO_2e$. How this baseline value will change in the future will depend on the extent of action taken. Policies and incentives to enable NDC commitments to be achieved are set at the national level by governments. Several organisations have projected various scenarios, including the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Association (IEA), among others.

The IPCC has considered a series of what it terms Shared Socio-economic Pathways (SSP) that cover the range of possible future developments of anthropogenic drivers of climate change, combining socio-economic assumptions, levels of climate mitigation, land use and air pollution controls. The IPCC has modelled the resulting atmospheric CO_2 concentrations and consequent temperature increases for each SSP scenario. In pathways that limit warming to 1.5°C, with no or limited overshoot, net global GHG emissions are projected to fall by 43 % below 2019 levels by 2030, to fall by 60 % by 2035, 69 % by 2040 and 84 % by 2050 (IPCC, 2023).

The UK's NDC includes the commitment to achieve net zero emissions by 2050, with interim commitments to a 68% reduction in emissions by 2030 (relative to the baseline year of 1990) and 81% reduction by 2035. The Climate Change Act (2008) establishes the framework for achieving the national commitments, with legally binding interim targets for emissions reductions established over successive 5-year periods for which 'carbon budgets' have been set. The Net Zero Strategy (DESNZ, 2022) provides an outline for how the carbon budgets up to 2037 would be achieved. Amongst other measures, the Strategy includes decarbonisation of the power sector (including the development of infrastructure for hydrogen supply), decarbonisation of industry (including the development of Carbon Capture Use and Sequestration (CCUS)) and decarbonisation of the transport sector (including zero emissions vehicles and Sustainable Aviation Fuels (SAF)).

The seventh carbon budget was published by the UK Climate Change Committee (CCC) in February 2025, covering the five-year period 2038 to 2042 and limits the UK GHG emissions to 535 $MtCO_2e$ over this period (UKCCC, 2025). The so called 'Balanced Pathway' on which the limits are based requires further emissions reductions across multiple sectors, for which policy, plans and proposals will be required from the UK Government to initiate or incentivise action.

The UK NDC and plans for achieving the commitments are broadly mirrored by EU Member States (MS), which is of relevance to the proposed Montrose Infill Project in that the majority (69% in 2024) of oil produced in the UKCS is exported to the EU.

By delivering on these NDC commitments, and thereby achieving net zero emissions nationally by 2050, the UK and EU governments will implement emissions trajectories that are consistent with the IPCC's SSP scenarios that limit global average temperatures rising less than 1.5°C above pre-industrial levels.

Whereas the NDCs of many economically advanced nations are aligned with the objective of keeping temperature rises below 1.5°C, at a global level the IPCC estimates that the combined effect of all NDCs would result in global emissions of approximately 50 $GtCO_2e$ in 2030 and are consistent with warming of around 2.5°C by 2100.

When major emitters' Net Zero pledges are also considered alongside NDCs, the latest commitments in combination imply warming below 2°C if implemented in full. Even so, the Paris Agreement states that temperature increases below 1.5°C are preferable; this would require implementation of more wide-reaching actions at a global level.

The modelled emissions profiles for certain SSP scenarios are depicted in Figure 7-1. The scenarios cover a wide range of outcomes for the level of emissions mitigation actions taken, including the timing of their implementation. The most probable increase in global average temperature that would be reached by 2100 is given for each SSP in the Figure legend. These range from 1.4°C, if global action is taken to achieve net zero emissions by 2050 with

subsequent net GHG removals, to 4.4ºC for very high emissions scenarios. (Figure reproduced from data in Riahi *et al.*, 2017)

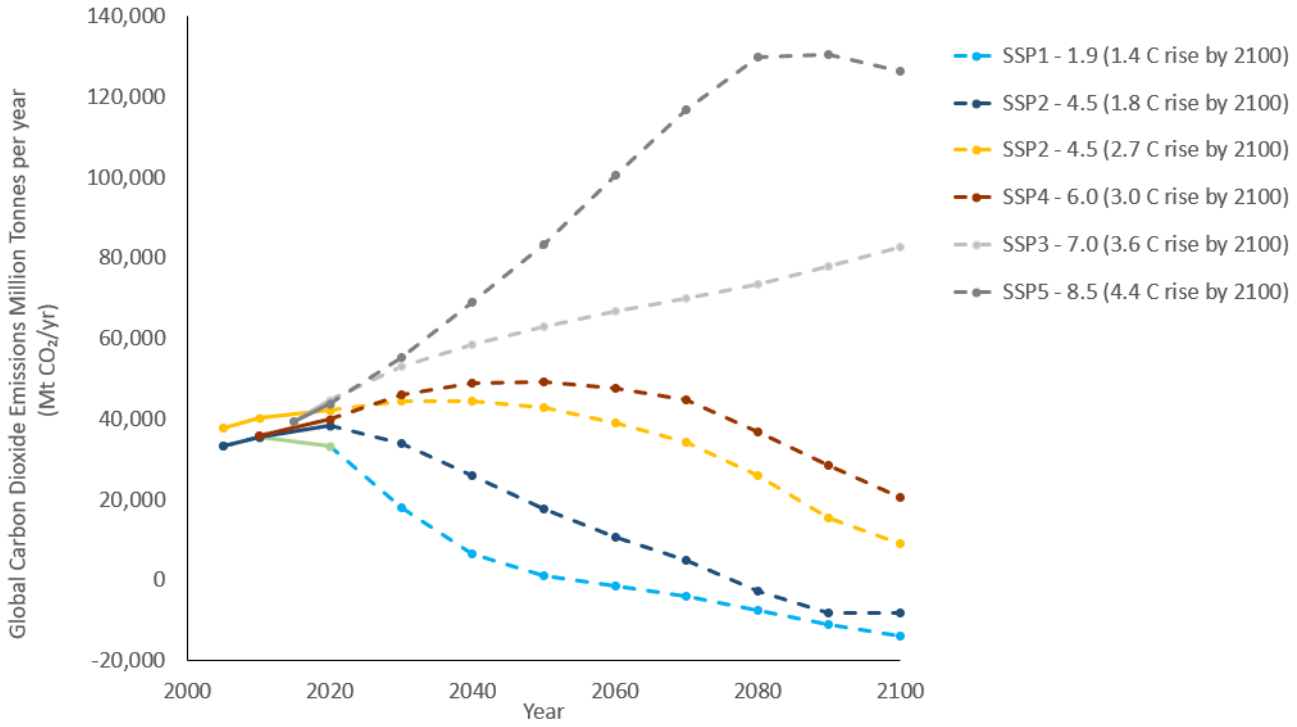


Figure 7-1 Summary of some key SSPs depicting potential future baseline emissions scenarios

The assessment of GHG emissions considers the impact of the proposed Montrose Infill Project on achievement of the UK's contribution to tackling climate change and on the global emissions trajectory required to meet the objectives of the Paris Agreement.

BASELINE UK OIL AND GAS PRODUCTION AND DEMAND AND FUTURE PROJECTIONS

To achieve the UK's transition to Net Zero through the UK Government's Balanced Pathway requires the continued use of oil and gas products in a phased decline (DESNZ, 2025).

The UK's baseline demand for crude oil is currently approximately 70 million tonnes per year and demand for natural gas is approximately 62 billion cubic metres per year. These figures are projected to reduce to approximately 15 million tonnes of oil per year and 15 billion cubic metres of natural gas per year in 2050 (NSTA, 2025b).

Production from the UKCS is also projected to decline between now and 2050. Domestic production cannot meet the projected UK demand on its own and needs to be supplemented with imports of crude oil and natural gas as well as of refined hydrocarbon products. Although demand, production and imports are all projected to decline, the proportion of demand met by imported crude oil is anticipated to be roughly stable at approximately 60% of demand each year for the next 25 years. For natural gas the proportion of demand to be met by imports is projected to increase from approximately 50% currently to 90% in 2050 (NSTA, 2025b).

UK Demand for crude oil and Natural Gas Liquids (NGL) required to facilitate the Balanced Pathway is shown in Figure 7-2 together with the projected decline in UK oil production and resultant need for imported oil. The equivalent trends for natural gas are shown in Figure 7-3 (data sourced from NSTA, 2025b).

In each case the dashed red line shows the projected UKCS production when supplemented with the output from the proposed Montrose Infill Project, assuming the High case production scenario. The full (orange) line beneath it shows UKCS production without Montrose Infill.

During the period of production from 2028 to 2035, the High case production profile of the proposed Montrose Infill Project would increase UKCS oil production by approximately 3.8% and provide approximately 1% of the projected UK oil demand required to make the transition to net zero emissions by 2050 under the Balanced Pathway. The respective figure for gas production increase is approximately 0.8% and for meeting gas demand is approximately 0.2%.

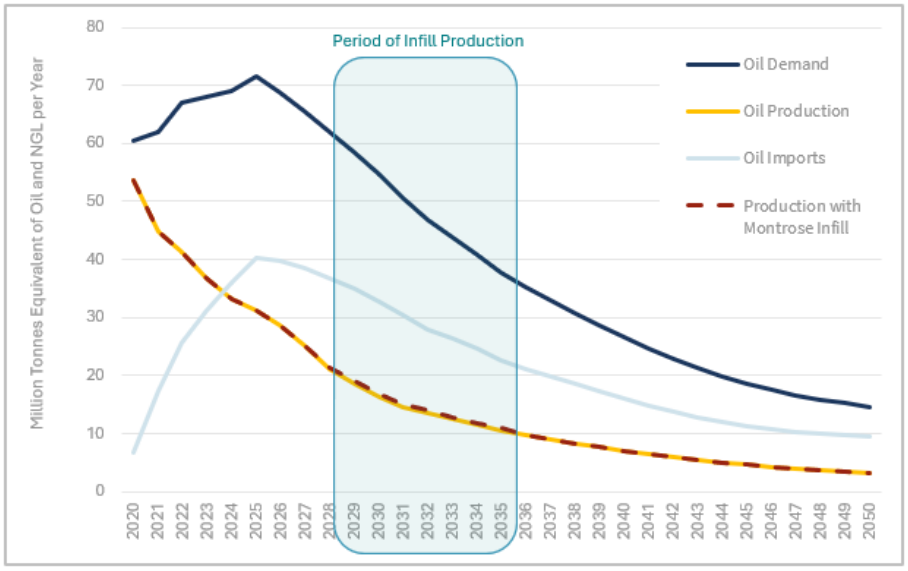


Figure 7-2: UK projected oil demand, production and imports

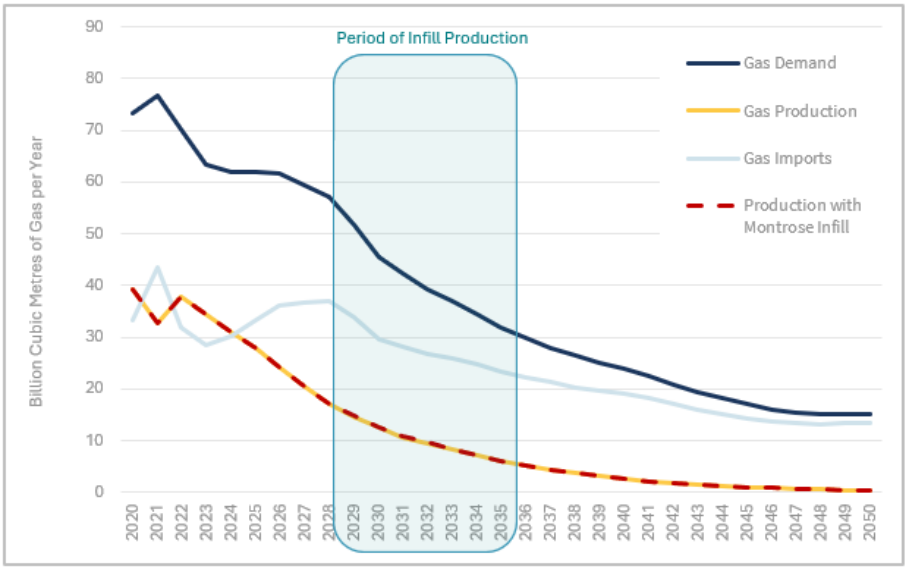


Figure 7-3: UK projected gas demand, production and imports

BASELINE GLOBAL HYDROCARBON PRODUCTION AND DEMAND AND FUTURE PROJECTIONS.

Global oil production in 2024 was determined to be approximately 97,000 thousand barrels per day (kbpd), or approximately 4,500 million tonnes aggregate for the year (Energy Institute, 2025).

Future oil production is subject to transient and underlying changes in geopolitical and global financial indicators and is extremely hard to forecast. Changes to supply are influenced by short-term assumptions on demand and market price and can result in substantial fluctuations in production. As an example, OPEC alone having increased production in May 2025 by 430 kbpd, following a reduction of 150 kbpd the previous month. This following a more strategic cut of approximately 2,200 kbpd in November 2023.

By comparison, in the peak year of production, the proposed Montrose Infill Project will produce an average of 15.3 kbpd of oil.

In its World Energy Outlook of 2022, the IEA (IEA, 2022) outlines the assumptions it has included in its projection of global GHG emissions and energy requirements for future scenarios based on stated policies (STEPS), on announced national pledges (APS) for emissions reduction and provides an updated description of its scenario of accelerated emissions reduction that would achieve net zero emissions by 2050 (NZE). Under the APS, the IEA projects that global oil demand will reduce from its present level to 93.0 million barrels per day (mbpd) in 2030, 72.9 mbpd in 2040 and 57.2 mbpd in 2050. Even under the NZE scenario, the IEA projects an oil demand for 25 mbpd, with three quarters of this used in processes where the oil is not combusted. To meet the NZE demand the IEA anticipates a need for continued investment in existing fields (including in the UK) such as through infill drilling to ensure that supply does not fall faster than decline in demand.

7.5.3 Magnitude of Impact

GHG emissions from the different life-cycle stages are summarised, and aggregated, in Table 7-17.

As is evident from Table 7-17 the aggregated direct and indirect GHG emissions are dominated by those from the combustion of end-use products, with direct emissions from pre-production and from production making a minor contribution to the total.

The magnitude of the impact of these emissions has been determined in line with the following definitions derived from the ISEP Guidance for evaluating the significance of impacts from GHG emissions (IEMA, 2022):

- Beneficial

  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.

- Negligible

  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.

- Minor Adverse

  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.

- Moderate Adverse

  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.

- Major Adverse

  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.

MONTROSE INFILL PROJECT ALONE

Total aggregated direct and indirect GHG emissions from the Montrose Infill development, assuming High case production, within each of the 4th, 5th, 6th and 7th carbon budget period are shown in Table 7-21 along with the respective total UK budgets.

Table 7-21: Contribution of Montrose Infill full life-cycle emissions to UK carbon budgets.

High Case GHG Emissions	Budget	Montrose Infill Full Life-Cycle	
	$MteCO_2e$	$MteCO_2e$	% of Budget
4th Carbon Budget (2023 - 2027)	1,950	0.02	0.00
5th Carbon Budget (2028 - 2032)	1,725	11.04	0.64
6th Carbon Budget (2033 - 2037)	965	5.45	0.56
7th Carbon Budget (2038 - 2042)	535	n/a	n/a

The Montrose Infill High case emissions for 2030 and for 2035 are also shown in Table 7-22 alongside the annual UK emissions committed to in the NDC for these years.

Table 7-22: Contribution of Montrose Infill emissions to UK emissions targets.

High Case GHG Emissions	Target	Montrose Infill Full Life-Cycle	
	$MteCO_2e$	$MteCO_2e$	% of Budget
UK Annual Emissions 2030	260.7	2.35	0.90%
Uk Annual Emissions 2035	154.8	1.66	1.07%

The proposed Montrose Infill Project emissions align with the rating of Minor Adverse on account of the following summary points:

- The GHG production emissions intensity, flaring intensity and venting intensity are consistent with applicable benchmarks (see Section 7.4).
- Production emissions are consistent with the UKCS meeting established targets for emissions reduction as part of the planned transition to achieving net zero emissions by 2050 (see Table 7-21 and Table 7-22).
- Were all produced fluids from the High case production scenario used within the UK, the life-cycle emissions would form a very low proportion (<1%) of the established UK carbon budgets, and a low

proportion (approximately 1%) of the UK emissions targets set for 2030 and 2035. This is while providing approximately 1% of the UK oil demand and approximately 0.2% of UK gas demand required to sustain the transition to Net Zero via the Balanced Pathway (see Section 7.5.2.2).

- The contribution of <1% of the carbon budgets is considerably less than the 5% threshold proposed in the ISEP GHG assessment guidance above which emissions from a project are considered likely to be significant (IEMA, 2022).

MONTROSE INFILL PROJECT IN COMBINATION WITH OTHER UK PROJECTS

The UK's Climate Change Act (2008) is the principal legislative mechanism for reducing UK emissions. The Act sets the framework to address climate change mitigation and adaptation, including end user emissions. It requires the Government to propose regular, legally binding milestones on the way to achieving Net Zero GHG emissions, which it has done in the form of its carbon budgets.

By setting tangible emission targets, carbon budgets allow for clear and measurable goals, enabling the Government and organisations to track progress towards emissions reduction performance effectively. The UK has met its successive emissions targets within each of the first three carbon budgets (UKCCC, 2025) and is on course to meet the targets of the fourth carbon budget.

Whereas further policies and incentives will be needed to maintain the downward trajectory of emissions and meet the requirements of subsequent carbon budgets, and ultimately net zero emissions by 2050, the UK Government is committed to following this path.

It is therefore reasonable to conclude that future plans and projects that receive consent from the UK Government, including the proposed Montrose Infill Project, will continue to be aligned with achieving the objectives of the Climate Change Act, and that cumulative GHG emissions from all sanctioned projects will be within the targets of the carbon budgets, the commitments of the UK NDC and hence, at a national level, will be consistent with achieving the goals of the Paris Agreement for atmospheric CO2 concentrations and global average temperature increases.

The magnitude of impact of the proposed Montrose Infill Project in combination with other projects at a national UK level is therefore assessed as being Minor Adverse under the ISEM description (IEMA, 2022) that GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards and the projects in-combination would be fully in line with measures necessary to achieve the UK's trajectory towards Net Zero.

MONTROSE INFILL PROJECT IN COMBINATION WITH OTHER GLOBAL PROJECTS

Whereas at a national level, the UK is on course to meet the objectives of the Paris Agreement, this is currently not the case for many countries. The United Nations Environmental Program (UNEP) concludes that whereas national Net Zero targets and ambitions now cover approximately 90% of present global GHG emissions, many of these targets are lacking detail and credibility, with short-term ambitions out of step with long-term goals (UNEP, 2023). Global GHG emissions implied by NDCs would not lead to global temperature increase being held below 1.5 ºC and are more consistent with warming of around 2.5 ºC by 2100. Furthermore, current policies fall short of what would be needed to deliver NDCs, implying warming of around 3 ºC by 2100 although, when major emitters' Net Zero pledges are considered alongside NDCs, latest commitments imply warming below 2 ºC if implemented in full (UKCCC, 2025).

Currently operating assets and future development projects will meet whatever demand for oil and gas is generated by the framework of policy measures enacted by national governments in relation to emissions control.

If these collectively do not lead to emissions reductions in line with scenarios that limit global warming to 1.5ºC, the baseline magnitude of impact from all global projects in-combination may be assessed to be Major Adverse using the scale provided in the ISEP Guidance (IEMA, 2022).

Conversely, if further action is taken globally, for example along the lines of the IEA's NZE scenario, which enables an emissions trajectory that achieves limiting global warming to 1.5ºC, then the baseline in-combination impact magnitude may be Minor Adverse, again using the scale provided in the ISEP Guidance (IEMA, 2022).

Given the uncertainty around future national climate strategies globally, the baseline in-combination impact in the absence of the proposed Montrose Infill Project could be anywhere between minor and major adverse.

Continued investment in infill wells in the UK is specifically stated in IEA's World Energy Outlook as being consistent with its NZE scenario (IEA, 2022) and consequently does not inherently jeopardise future global trajectories to Net Zero.

Given the insignificant scale of Montrose Infill production in comparison to global production, or even in comparison to fluctuations in global production (see Section 7.5.2.3), the conclusion for global impact magnitude would be the same with or without the proposed Montrose Infill Project. In this context, there is no, or negligible, additional impact from the proposed Montrose Infill Project relative to the baseline global in-combination scenarios.

7.5.4 Sensitivity of the Receptor

In accordance with ISEP guidance on the assessment of impacts of GHG emissions (IEMA, 2022), the receptor is the global atmosphere. The effect of GHGs in the global atmosphere on local and regional physical, biological, human and socio-economic receptors is accepted as being a consequence, linked by the global temperature increase caused by GHG emissions.

Given the global effect of GHG emissions, the current state of the climate and the concentration of CO_2 and other GHGs in the atmosphere, the sensitivity of the receiving environment to impacts from GHGs is evaluated as being High, in keeping with ISEP guidance (IEMA, 2022).

7.5.5 Significance

The following correlation matrix (Table 7-23) has been used to determine the impact significance of the whole life GHG emissions of the proposed Montrose Infill Project alone, nationally and in combination globally. The matrix is derived from definitions included in the ISEP guidance (IEMA, 2022) which is specifically designed to relate to the five categories of impact magnitude recommended for GHG assessments (see Section 7.5.3). The matrix has only one category for receptor sensitivity on the understanding that the global atmosphere is always to be considered to have High sensitivity to the effect of GHG emissions (see Section 7.5.4).

Accordingly, the proposed Montrose Infill Project in isolation is identified as being Not Significant.

In combination with other projects at a national level the Project is likewise identified as Not Significant.

Globally, human activity is currently projected to produce a demand for oil at quantities for which the cumulative effect of downstream GHG emissions would result in a Significant impact.

Table 7-23: Correlation matrix assigning significance rating for different levels of impact magnitude.

Impact Magnitude	Significance based on High Receptor Sensitivity
Beneficial	Beneficial
Negligible	Not Significant
Minor Adverse	Not Significant
Moderate Adverse	Significant
Major Adverse	Significant

7.6 Mitigation Measures

The large majority of GHG emissions estimated for the proposed Montrose Infill Project are from downstream Scope 3 activities over which NEO NEXT+ has little if any control.

Conversely, pre-production and production emissions are from activities under the direct control of NEO NEXT+ and have been subject to close scrutiny.

In the drive towards supporting the UK's Net Zero target and meeting the company's GHG commitments (as outlined in Chapter 2), the identification, assessment, and minimisation of emissions have been embedded in all stages of the project management process. The following integrated measures across drilling, installation, commissioning and production will be adopted to ensure emissions are minimised to 'as low as reasonably practicable'.

The mitigation measures described below will be managed and delivered within the framework of NEO NEXT+'s Environmental Management System, and will be recorded within the Project Risk Register, as detailed in Section 1.9 of Chapter 1.

Proposed Mitigation Measures

Proposed Pre-Start Up Mitigation Measures

- Inclusion of optimised energy efficiency and GHG emissions reduction in the rig selection and tendering process.
- Batch drilling and completion opportunities will be evaluated. These would reduce emissions through reduced logistical requirements and fluid handling efficiencies.
- The information gained from each well test will be assessed with a view to reducing the volumes of hydrocarbons to be flared during well testing for each subsequent production well.
- During flaring from well clean-up and testing operations, environmental conditions will be monitored, and a dedicated person will be assigned for full-time fire watch duty.
- The drilling rig and other project vessels will be subject to audits ensuring compliance with UK legislation.
- Vessel use will be optimised where possible by minimising the number of vessels required, and their length of time on site.
- Vessels will be operated where possible in modes that allow for economical fuel use.

Proposed Production Mitigation Measures

In accordance with the revised NSTA strategy, and associated Stewardship Expectation 11, as well as with the industry commitments within the NSTD, NEO NEXT+ will incorporate the following controls:

- Select, plan and execute NEO NEXT+'s emissions reduction and monitoring initiatives over a reasonable timescale in line with the Montrose Complex's ERAP.

- Where it is not considered reasonable to electrify, NEO NEXT+ is committed to pursue other power emissions reductions.
- With the proposed Montrose Infill Project and planned production post-2030, the goal of no routine flaring and venting through the provision of a new FGR system onboard the Montrose Complex is anticipated.
- Diesel use by the gas turbine generators (GTGs) onboard the BLP is limited to turnarounds and shutdowns and for plant re-start when fuel gas is unavailable.
- With the proposed Montrose Infill Project, continual monitoring and reviewing of emissions and carbon intensity of the Montrose Complex. The Montrose Complex's ERAP will continue to be reviewed for potential opportunities to further reduce emissions against the sector targets outlined in the NSTD

These measures will help to ensure that opportunities for efficiency and reduction of atmospheric emissions, where not in conflict with safe operations, are identified, actioned as appropriate and reviewed.

7.7 Uncertainties

The assessment is based on multiple aspects, each of which are subject to uncertainty.

The quantification of GHG emissions is based on well established EFs which are considered to be of low uncertainty. Some data on publicly available Government databases is updated regularly as it is based on analysis of changing trends in product demand or on changing composition of fuels and products. The values from such sources were taken from the internet during the second half of 2025 and were accurate at the time of download. The variations in such numbers are minor, however, and re-calculating Project emissions with any updated values would have a low impact on the emissions estimates provided in this ES and would not alter the impact assessments and their conclusions.

The GHG calculations are also based on the projected production profile for the Montrose Infill wells. These are subject to a high degree of uncertainty and will remain so until production starts (if approved) and the resulting changes to reservoir properties can be assessed. This has negligible impact on Pre-Production and Production GHG emissions, but a large impact on downstream indirect emissions. Downstream emissions for the High case have been used in the assessment to indicate the highest reasonable level of impact. These are approximately 42% higher than those for the Mid case (which is the most likely estimate for production). However, using the emissions estimate for the Mid case would not have altered the conclusions of the significance of the impact of GHG emissions.

Assumptions made for Pre-production and Production emissions have taken a realistic worst case, but uncertainties with these parameters are insignificant to the total GHG emissions assessed.

The estimate of indirect downstream Scope 3 emissions has assumed all products will ultimately be combusted and resulting GHGs emitted to the atmosphere. This takes no account of the relatively minor proportion of oil that is currently used for non-energy purposes, nor for the planned uptake of carbon capture by industrial processes. This, along with other assumptions, leads to a worst case estimate for Project emissions.

The assessment has also drawn on projections for UKCS output over the next 25 years. This is derived by the NSTA using best available understanding of existing assets and anticipated likely new developments within currently leased blocks. This is considered to have a low level of uncertainty.

Projected UK demand for oil and gas over the next 25 years is highly dependent on continued commitment to pursuing the pathway to Net Zero detailed in the Net Zero Strategy and carbon budgets. This has been assumed to be of low uncertainty.

The baseline for future global oil demand is highly dependent on decisions taken by nations, globally to combat climate change. This, and consequently the baseline global emissions, atmospheric CO_2 concentrations and global temperature rise, carries some uncertainty into the conclusion for global in-combination impact.

Overall, the uncertainties inherent in the assessment do not change the conclusion that the impact of the proposed Montrose Infill Project alone and in combination with other UK plans and projects is not significant. The uncertainty in the global future baseline does not alter the conclusion that the proposed Montrose Infill Project has negligible influence on this baseline, nor on the global impact significance rating.

7.8 Consideration of Alternatives

The Montrose Infill Project considered a number of development concepts for the additional wells at the Montrose Field, as described in Section 3.2. This section considers the differences in the GHG emissions associated with each alternative relative to those for the proposed project scenario, as estimated in Section 7.2.

DECISION TO DRILL MORE WELLS IN THE MONTROSE FIELD

This is the decision whether to proceed with the proposed Montrose Infill Project or not. The alternative to the decision taken would be for the Montrose Complex to cease production at the end of 2030.

The GHG emissions differential of this alternative would be the reduction of all emissions estimated for all phases of the proposed Montrose Infill Project.

This alternative would be contrary to the NSTA strategy of maximising economic recovery from the UKCS basin, would result in a loss of income to the UK exchequer, would result in reduced UK employment opportunities and would weaken security of UK energy supply options during the transition to a decarbonised energy sector.

The loss of the proposed Montrose Infill Project would lead to a minor reduction in production related emissions across the UK offshore oil and gas industry, and an insignificant reduction in total UK emissions.

It would not alter UK GHG emissions from the use of hydrocarbon derived products as these are set at a political policy level to constrain demand, rather than at a supply level.

Conversely, development of the proposed Montrose Infill Project would provide the market with a crude oil product with high credentials in Environment, Social and Governance (ESG) performance which is likely to appeal to many purchasers when faced with alternatives from regions of political instability, lower environmental standards or higher upstream GHG emissions.

SUBSEA VS PLATFORM WELLS

This decision favoured the contracting of an independent mobile drill rig rather than to reinstate the topsides drilling capabilities of the Montrose Alpha platform for the drilling of the Infill wells. The decision to use a mobile drill rig was taken on economic grounds, given the extent of refurbishment works that would be required to make the topsides drill rig safely operational.

The option to reinstate the topsides drilling facilities would have removed emissions associated with the mobilisation and demobilisation of the mobile drill rig, associated towing vessels and anchor handling vessels. These total approximately 4,400 teCO_2e and represent approximately 6% of the pre-production phase emissions and approximately 0.04% of the project life-cycle emissions.

Conversely, GHG emissions for the alternative option would have included emissions from activities, including support vessels etc., for the deconstruction and reconstruction of relevant drilling equipment. These emissions have not been estimated but, given the prohibitively high cost differential of the reinstatement of the topsides drilling facilities, even if these were zero this option would not represent good value for money relative to alternative emissions reductions opportunities.

SEPARATE WELLS VS DRILLING TEMPLATE

The decision whether to use a drilling template or not has not been finalised. The GHG emissions estimate includes fuel use for the installation of a template. If the decision is taken not to install a template then these emissions, approximately 400 teCO_2e, would be removed from the estimate.

Conversely the use of a template can lead to more efficient changeover between wells during batch drilling, and the actual difference in GHG emissions between the two options is likely to be negligible and would be within the uncertainty in the overall drilling emissions estimate.

INSTALLATION METHOD FOR MANIFOLD

The subsea manifold will be secured in place with hammer piles. Alternative options were ruled out as being technically not feasible given the seabed substrates at the site. Installation of the piles would take a minor proportion of the time estimated for the subsea installations, which in total are estimated to result in 4,140 teCO_2e. Since piling of the manifold is an essential aspect of the project there is no opportunity for GHG emissions reductions by selecting an alternative to the adopted option.

PIPELINE INSTALLATION OPTIONS

The flowline connecting the subsea wells manifold to the Montrose BLP will be surface laid, with protection applied as found to be required in the field. This is expected to include protection applied at the flowline ends and may require some intermediate cover.

Alternative options for trenching and backfilling of the flowline were rejected. These options would have resulted in additional on-site activity with approximately 2,000 teCO_2e additional GHG emissions compared to the selected option.

SUMMARY OF GHG IMPACTS OF ALTERNATIVES

The impact of the first alternative described (to proceed or not with the project) is the subject of the impacts assessment of this chapter of the ES.

Alternatives for all other decisions would not significantly alter the total emissions and would not materially affect the impact assessments.

7.9 Conclusion

Applying the risk assessment methodology described in Section 5 and taking account of the mitigation measures listed above, the following conclusions are made:

- The impact of installation, completions and start-up activities on air quality will be localised, short term and will mainly occur approximately 200 km from the nearest shoreline. Atmospheric dispersion modelling has demonstrated that the significance of impact to the local ecological receptors during the installation and start-up phase is Low.
- The introduction of production from the proposed Montrose Infill Project will result in a minor increase in emissions of some pollutants such as NO_x and CO. Nevertheless, atmospheric dispersion modelling has demonstrated that the significance of impact to the local ecological receptors during the production phase is Low.
- The proposed Montrose Infill Project would reduce the GHGI of hydrocarbon fluids produced at the Montrose Complex.
- In addition, the proposed Project would contribute to lower than average GHG intensity compared to oil imports and would support the goals for emissions reduction in the UKCS established by the NSTD.

- GHG emissions from the Montrose Complex with the proposed Project would represent only a small proportion of the UKCS and UK annual totals and make up a small proportion of the UK Carbon Budget allocations and of the total UKCS emissions targets established under the NSTD.
- The proposed Project will help to fill part of the gap between projected UKCS production and UK oil demand required to expedite the transition to Net Zero by 2050.
- The proposed Project is in alignment overall with the UK Government strategy for transitioning to Net Zero GHG emissions by 2050.
- The impact from whole-life GHG emissions on the climate is of Minor Adverse magnitude for the project in isolation and in combination with other projects at a national level. This is determined to be Not Significant under the ISEP guidance.
- Whereas at a national level the UK has a strong commitment to implement policies in accordance with achieving the objectives of the Paris Agreement, there is less certainty that this will happen at a global level. The baseline for GHG emissions impact magnitude and significance at a global level, in the absence of the proposed Project, is therefore also uncertain. This could range from Minor Adverse (Not Significant), if nations increase the ambition of their NDCs and fulfil these commitments, to Major Adverse (Significant) if no new commitments are agreed.
- The effect of the proposed Montrose Infill Project on this uncertain baseline is negligible.

8 Discharges to Sea

This section assesses the planned and permitted marine discharges from the proposed Montrose Infill Project (using the impact assessment methodology presented in Chapter 5) 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**. In addition, discharges of food waste and sewage from the existing Montrose platform are not expected to significantly change as a result of the addition of the Montrose infill wells. They are therefore not assessed further. Note that this chapter covers the impacts of the discharges on the water column and Chapter 9 (Seabed Disturbance) covers impacts to the seabed.

8.1 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 3.5.5, drill cuttings contaminated with WBM sweeps will be discharged directly to the seabed and the base case is that LTOBM contaminated cuttings will be thermally treated offshore and discharged at the sea surface.

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.

8.1.1 Discharge of Drilling Fluids and Drill Cuttings

The proposed development involves the drilling of five infill wells. Section 3.5.5 estimates the maximum quantities of drill cuttings that will be produced at each well as a result of the proposed drilling operations (Table 3-5).

As described in Section 3.5.5, the first two well sections (42" and 26") will be drilled with seawater and WBM sweeps, with the cuttings discharged at the seabed. LTOBM will be used for the lower three sections of the well, and the resulting cuttings will be thermally treated at the drill rig prior to being discharged at the sea surface.

Drill Cuttings Discharge Modelling (Appendix E) 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 9 (Seabed Disturbance) whilst this section 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 E. Note that following discussion with OPRED a worst-case scenario was modelled whereby it was assumed that each of the five wells would be drilled twice (i.e. due to technical challenges at every well, a re-spud of the first two sections would be required). In addition, in line with OPRED recommendations the modelled scenario assumed that sidetracks would be required for the lower sections of each well. Therefore, as shown in Table 3-5, the total volume of discharged cuttings considered in the modelling is 6,666.6 te of cuttings contaminated with WBM sweeps and 10,849.3 te of LTOBM contaminated cuttings. In reality, the requirement for re-spudding all five wells or for drilling sidetracks of the two lower sections across the five wells is extremely unlikely such that the total volume of

cuttings is more likely to be 3,333.3 te of cuttings contaminated with WBM sweeps and 6,164.1 te of LTOBM contaminated cuttings. [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.

Even with the overly conservative contingency included, the modelling indicated that the discharge of drill cuttings at the Montrose Infill wells will result in a very localised reduction in water quality, primarily due to an increase in suspended solids (comprising barite, bentonite and barite powder from the RotoMill™). The reduction in water quality mostly occurs in the lower water column with a small amount of risk occurring near the surface where the LTOBM cuttings from the lower well 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 E 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 14.07 km^3, as illustrated in Figure 8-1. Although the volume of water where the risk to the most sensitive species exceeds 5 % appears extensive, 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 of water where risk exceeds 5 % at any instance in time would be much smaller (*c*. 7.41 km^3 for the modelled scenario, and even less given the level of contingency allowed for in the modelling) than that shown in Figure 8-1.

The modelling predicts that the volume of water column where there is a risk to over 5 % of sensitive species varies over time. The risk is dominated by the drilling of the two top hole sections, after each batch of sections are drilled the volume at risk reduces to zero and disappears completely within 48 hours of the end of drilling.

[1] The modelled contingencies were requested by OPRED and are considered to represent a highly unlikely scenario of multiple re-spuds and side-tracks such that it is expected that the mass discharge of drill cuttings will be lower than that modelled.

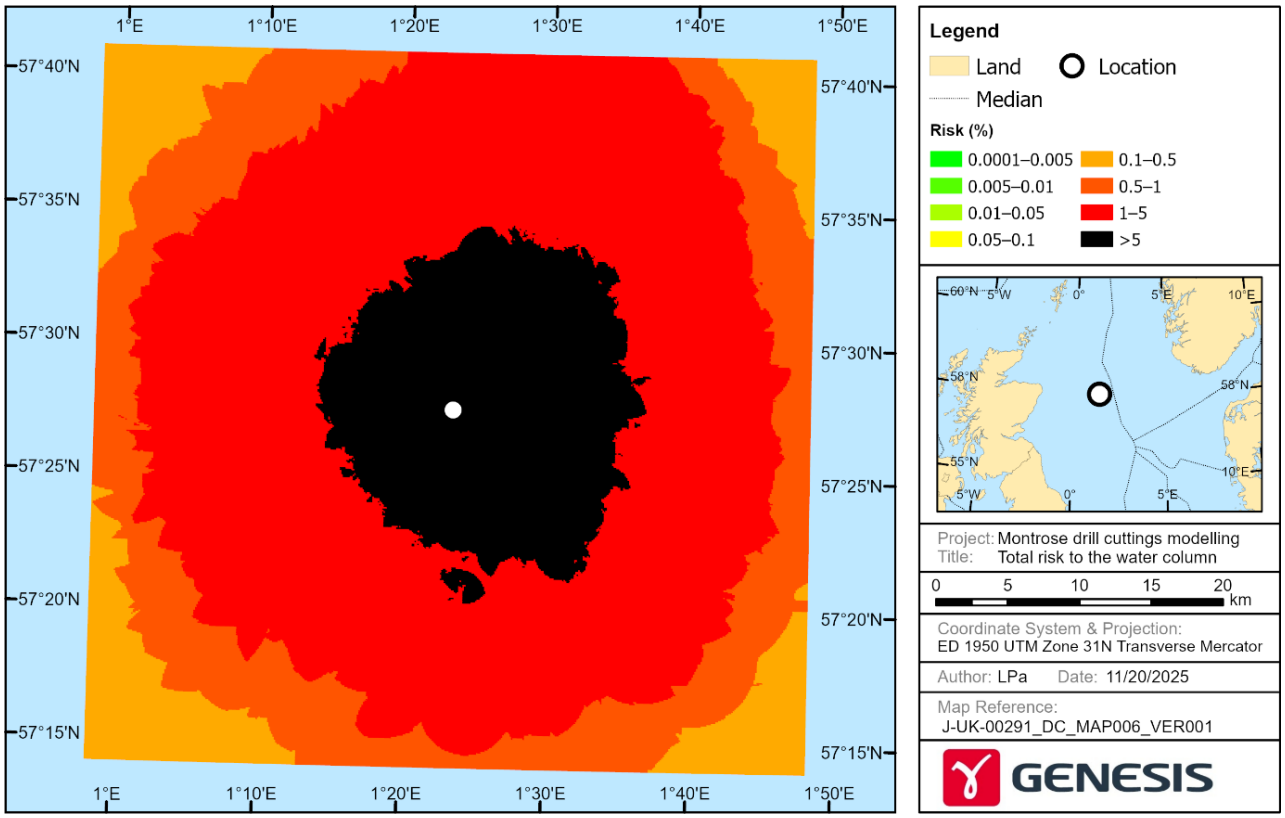


Figure 8-1: Total risk to the water column (swept path).

All chemicals discharged from the drilling and installation activities associated with the proposed Montrose Infill Project 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 with Hazard Quotient (HQ) <1 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. In addition, drilling chemicals added to the LTOBM that pass through the RotoMill™ are destroyed by the high temperatures (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, lemon sole, mackerel, *Nephrops*, Norway pout, plaice and sandeels (Section 4.3.3).

As some fish species in the area are considered to be PMFs (Section 4.5.2) including sandeel, mackerel and cod, Receptor Sensitivity is considered **Medium (B)**. 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 **Minor (2)**. 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.

8.1.2 Cement and Cementing Chemicals

As described in Section 3.5.6, 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 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 sensitivity of the fauna in the water column that could be impacted by these discharges ranges from **Low (A)** (e.g. plankton) to **Medium (B)** (e.g. fish species considered to be PMFs), 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.

8.1.3 Well Clean-up

Upon completion of the production wells, they will be cleaned-up which will require flaring of some oil and gas. As the new Montrose wells will be drilled before the tie-back to the existing Montrose BLP will be installed, there will be a requirement for all hydrocarbons produced during the well clean-up to be flared at the drilling rig. Well testing and clean-up will involve flaring of a maximum of 369 te of gas and 3,152 te of oil over a 28-hour period for all five wells.

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 below 30 mg/l will be discharged to sea. The well bore clean-up process will typically result in a volume of approximately 550 bbls (*c*. 87.4 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 sensitivity of the fauna in the water column that could be impacted by these discharges ranges from Low (a) (e.g. plankton) to **Medium (B)** (e.g. fish species), 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.

8.2 Subsea Installation and Commissioning Phase

Depending on detailed design it is possible that the pipeline testing and commissioning operations would require discharging the pipeline preservation fluids to sea (Section 3.6.5).

These discharges could contain chemicals including oxygen scavengers and biocides to mitigate the risks of corrosion or bacterial growth whilst an ultraviolet-fluorescent dye may be added to assist in leak detection.

NEO NEXT+ 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 of a Hazard Quotient (HQ) <1. 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.

There is the possibility of some hydraulic fluids being released during subsea valve operation and maintenance. However, given the use of water based hydraulic fluids, any environmental impacts will be limited.

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.

Marine flora and fauna may be affected on a localised level but given NEO NEXT+ commitment to prioritise the use of chemicals which are PLONOR, or are of a HQ <1, the rapid dilution that will occur on discharge means that the Magnitude of Effect is considered **Negligible (1)**. Combined with a Receptor Sensitivity of **Medium (B)** as above, the Impact Significance is considered **Low** such that any impacts of the chemicals discharged during subsea installation and commissioning on the water column are considered negligible.

8.3 Production Phase

8.3.1 Water Discharges

Formation water is naturally trapped in oil and gas reservoirs and despite efforts to produce the hydrocarbons selectively, a fraction of this water is brought to the surface mixed with oil and gas. This produced water may comprise dispersed oil, metals and organic compounds such as dissolved hydrocarbons, organic acids and phenols.

As described in Section 3.7 and Section 3.9.3, produced water is currently discharged overboard at the Montrose BLP after being treated and sampled for compliance with below 30 mg/l oil in water content. The produced water profiles tend to increase over the field life with the maximum produced water rate associated with the final years of production. Once the Montrose infill wells are brought online, production from other fields will be ramped down or "backed out" in order to maintain the produced water rate within the design envelope of the Montrose Complex.

Maximum produced water production from the Montrose infill wells is anticipated in 2035 during the final year of production. The produced water production rate associated with the proposed infill wells ranges from 1,139 te/d in 2029 (first full year of production) to 1,925 te/d in 2035. The total produced water rate (existing Montrose Platform with addition of infill wells) ranges from 1,403 te/d in 2026, prior to introduction of the subsea tie-back wells, to 3,541 te/d in 2035.

The RBA (NOV Wellstream UK, 2025) states that at present it is considered that the existing produced water treatment equipment on Montrose represents BAT. NEO NEXT+ remains committed to ensuring that the principles of BAT and BEP continue to be applied to the treatment and discharge of produced water.

OIL ASSOCIATED WITH PRODUCED WATER

As mentioned above, the worst case produced water rate for total production at the Montrose Complex with the addition of Montrose Infill Project is predicted to occur in 2035.

The maximum annual forecasts for produced water and associated hydrocarbons at the Montrose Complex for two scenarios: with and without the proposed Project are shown in Table 8-1. In the absence of the proposed Infill Project, it is estimated that a maximum of 20.46 tonnes of oil in produced water would be discharged (associated with 2030 production and assuming production for 12 months). With the Montrose Infill wells online, the maximum volume of hydrocarbons is estimated to be 43.66 te (associated with 2035 production assuming production for 12 months).

Table 8-1: Worst-Case-Forecast Peak Oil in Produced Water Discharges (based on 30mg/l).

Existing Montrose Platform Annual Produced Water (te/yr)	Annual Oil Discharge Associated with Existing Montrose Platform (te/yr)	Predicted Maximum Montrose Platform Produced Water in 2035 (te/yr)	Annual Oil Discharge Associated with Montrose Platform in 2035 (te/yr)
643,495	20.46	1,373,130	43.66

1. Produced water quantity for existing wells in absence of the proposed Project. Volume is associated with 2030 production (See Table 3-13)
2. Produced water quantity associated with Montrose Infill Project (and includes produced water from existing wells due to life extension of these wells). Volume is associated with 2035 production (see Table 3-13)
3. Quantity of oil per annum assumes 30 mg/l (and produced water density of 1.060 te/m^3)

A recent assessment carried out by NOV Wellstream UK at the Montrose Complex to meet OSPAR Recommendation 2012/5 requiring Contracting Parties to implement an RBA for the management of produced water discharges requirements concluded that the produced water discharges from the Montrose Complex is adequately controlled and is considered to represent BAT (NOV Wellstream UK, 2025). The assessment was based on a discharge volume of 1,423,5000 m^3 per annum (i.e. 150,8910 te per annum) which is greater than the anticipated maximum volume associated with the proposed project.

Following its discharge to sea, produced water undergoes several weathering processes, partly influenced by the behaviour of the discharge plume which may be dense and sink towards the seabed or buoyant and rise to the surface. The effluent dilutes rapidly upon discharge to well-mixed seawater. Low molecular weight organic compounds will either volatilise into the air or be degraded by micro-organisms present in seawater. Many constituents will precipitate on discharge (e.g. metals). Higher molecular weight organic particles could adsorb onto suspended solid and sediment. Individually or collectively, these processes tend to reduce concentrations of produced water compounds in the receiving environment and thereby decrease their potential toxicity and bioavailability to marine organisms (IOGP, 2003).

Research into the effects of produced water discharges has focused on components that could result in chronic biological effects, in particular Polyaromatic Hydrocarbons (PAHs) and high molecular weight phenols. PAHs are known to have mutagenic, carcinogenic and teratogenic properties. However, many marine organisms have the ability to metabolise and detoxify PAHs at the concentrations found in the receiving environment. In the laboratory, high molecular weight phenols can be shown to exhibit endocrine disruption. However, for both PAHs and phenols it has not been possible to identify any significant biological effects resulting from exposure to produced water discharges (Bakke *et al.,* 2013).

The produced water system is designed to reduce the oil content in the produced water to a target of below 30 mg/l oil in water or less (monthly average). Produced water discharges will mix with seawater and be dispersed by local currents. Potential impacts on water quality could affect plankton drifting in the water column that come into contact with the discharge plume. It is unlikely that fish or marine mammal species will be directly impacted by produced water discharges to sea due to their ability to avoid the discharge.

CHEMICALS ASSOCIATED WITH PRODUCED WATER

Chemical use and discharge during production is regulated under the Offshore Chemicals Regulations 2002 (as amended). Chemicals discharged into the marine environment have the potential for acute or long-term effects on marine organisms. Whether these effects are realised depends on a number of factors such as the inherent toxicity of the material, the quantities discharged and resulting concentrations in the water column, the length of

time biota are exposed to that concentration and the sensitivity of the organisms to the particular chemical. Chemicals discharged from offshore operations are immediately diluted in the sea. The amount of dilution depends on the water depth and water currents but is estimated at approximately 1,000 at a distance of 500 m from the discharge point. This dilution tends to reduce concentrations to levels which are not acutely toxic to marine organisms (OGUK, 2016).

The chemicals associated with the production phase of the proposed Project will be the same as those used for the existing production at the Montrose Complex, the treatment of which is considered BAT (NOV Wellstream, 2025).

The existing Montrose Production MAT will be updated to reflect any changes to chemical use and discharge as a result of the Montrose Infill Project.

IMPACT SIGNIFICANCE OF PRODUCED WATER DISCHARGES

Given the open nature of the North Sea, the Receptor Sensitivity of water quality as a receptor is considered **Low (A)**.

The oil in water content will be below 30 mg/l whilst the addition of the Montrose Infill wells to the existing produced water discharges will not result in an order of magnitude increase as production from other fields will be "backed out" in order to maintain the produced water rate within the design envelope of the Montrose Complex. In addition, the proposed Infill wells will use the same chemicals, treatment process and dilution rate as currently used at the Montrose Complex and as the maximum annual produced water quantity will be less than that assessed in the recent RBA analysis the Magnitude of Effect of the produced water discharges associated with the proposed Project is considered **Negligible (1)**. The Impact Significance is therefore considered to be **Low**, such that any impacts of produced water discharges on water quality are considered negligible.

8.3.2 Produced Sand Discharges

Sand production is expected as part of the Montrose Infill wells production, however, it is not considered to be a significant risk. Any produced sand will be managed similarly to other MonArb fields producing from the Forties reservoir. Sand prediction work has been carried out to help understand completion strategy for each well and will be managed via the start-up procedure as well as any additional instructions provided through the monthly work in progress (WIP). Regular vessel clean out and skip and ship back to shore are undertaken as per existing operations at Montrose.

There is no significant sand production anticipated. Where accumulation does occur in the vessels, the current Montrose Complex OPPC permit details the discharge of produced sand to sea however preference is onshore disposal. Where discharge to sea occurs, oil on sand content is permitted to 10,000mg/l with an annual limit for the Montrose BLP of 2 tonnes/yr.

Given the location within the Montrose and East of Gannet NCMPA, receptor sensitivity is considered **High (C).** As the discharge of produced sand is expected to be minimal given that it is typically skipped and shipped back to shore, the Magnitude of Effect is considered **Negligible (1)** and the Impact Significance is considered **Low** such that any impacts from any produced sand discharged during commissioning are considered negligible.

8.4 Decommissioning Phase

Some planned discharges to sea are likely to occur during the decommissioning of the proposed Montrose infrastructure at the end of field life. 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 pipe spools, umbilical jumpers, pipeline, etc.

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.

8.5 Cumulative and Transboundary Effects

The cumulative impact of drill cuttings and cement on the seabed are discussed in Chapter 9 (Seabed Disturbance). In relation to all other discharges, given the proposed mitigation measures no significant cumulative impacts are anticipated.

Modelling conducted for the RBA Report (NOV Wellstream UK, 2025) found that the worst-case substance level model predicts that the produced water plume will travel no more than 38 km from Montrose. Given that the proposed Montrose Infill Project is located *c*. 46 km from the UK/Norway median line, the findings demonstrate that the produced water will not reach the UK/Norway median line such that no transboundary impacts are anticipated from the discharges associated with the proposed drilling, installation, commissioning, production or decommissioning activities.

8.6 Mitigation Measures

The following mitigation measures are proposed to minimise impacts resulting from the discharges to sea associated with the proposed Montrose Infill Project.

Proposed Mitigation Measures
❯ Minimise use of vessels, through efficient journey planning; ❯ The drilling rig used will be audited under NEO NEXT+'s Marine Operations and Vessel Assurance Standards and subject to rig recertification audits; ❯ All vessels used will be MARPOL compliant; ❯ Where technically feasible NEO NEXT+ will prioritise the selection of chemicals which are PLONOR, or chemicals with a lower RQ for all project phases; ❯ Preference will be given to skipping and shipping produced sand; ❯ Produced water will be treated to reduce OiW content to below 30 mg/l; and ❯ The discharges of any water based hydraulic fluids, sand or chemicals are regulated by the OPPC and/or OCR regulations and reported through the Environmental and Emissions Monitoring System (EEMS). As such, NEO NEXT+ will confirm that sampling, analysis and reporting are undertaken in line with the regulations and permit conditions.

Applying the impact assessment methodology described in Chapter 5 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 9

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. Please note this includes discharges to sea associated with ballast water and biofouling.

9 Seabed Disturbance

A number of activities will be carried out during the proposed Montrose Infill Project which have the potential to impact seabed habitats and benthic communities in the area. 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 5.

The extent to which the habitats and species will be impacted depends on the size of the area that will be affected and the temporal extent of the impact e.g. the use of anchors would have a temporary impact, whilst the area of seabed beneath the infrastructure to be installed can be considered a permanent impact (given that it will be in place for the life of the field). In addition, species sensitivity and the habitat type in the area, and whether they are unique to the area or of significant conservation importance, are important in determining the overall impact of the proposed Project.

9.1 Drilling Phase

9.1.1 Drilling Rig

As described in Section 3.5.2, at the time of writing the ES, it is not known if a semi-submersible drilling rig or a HDJU drilling rig will be used. In addition, the wells may be either drilled with or without a drilling template. This section considers the worst-case seabed impact associated with the anchoring of a semi-submersible drilling rig and drilling with no template as this would result in a greater impact than the positioning of the HDJU drilling rig and drilling on-template. However, the potential for spud can depressions remaining is also considered should a HDJU drilling rig be selected.

Having been towed to the site, the semi-submersible drilling rig will be held on location using eight drag anchors connected to the drilling rig via eight *c*. 1,500 m length anchor lines. Maximum anchor dimensions of 6.7 m (L) x 6 m (W) are assumed. During positioning it is assumed each anchor will impact an area of 15 m x 15 m (to allow for movement/disturbance during placement), whilst a maximum length of *c*. 600 m of each anchor line is anticipated to come into contact with the seabed. As noted in Section 3.5.2, up to four piggy-back anchors may also be deployed on additional shorter anchor lines of 150 m each. A single positioning of the drilling rig at the drill centre will allow all wells to be drilled as they are within close proximity, with the drilling rig skidding between the wells if needed.

The maximum anticipated area of seabed disturbance associated with the installation of the anchor system is provided in Table 9-1, with the impacts on the seabed and associated ecosystem discussed in Section 9.5.

If a HDJU drilling rig is used, the spud can penetration into the seabed will be up to 12 m deep and 18 m in diameter. It is expected that all wells will be reached with one positioning of the HDJU rig regardless of template or off-template option, such that a maximum of three spud can depressions would remain. As noted in Section 3.5.2, two contingency anchors may be used to assist with the positioning of the HDJU rig.

9.1.2 Drill Cuttings

As discussed in Section 3.5.5 and Section 8.1.1, the drill cuttings contaminated with WBM sweeps from the first two sections (42" and 26") of the wells will be discharged at the seabed, whilst the base case is that the LTOBM contaminated drill cuttings from the lower sections will be thermally treated offshore and discharged at the sea surface.

Drill Cuttings Modelling (Appendix E) has been carried out using DREAM to determine the environmental impact to the seabed from drill cutting discharges from the proposed Montrose Infill Project, based on five separate well locations (drilled without a template). The drill cuttings modelling also includes a large contingency[1]. The impacts to fish from dispersion in the water column has been assessed in Chapter 8 (Discharges to Sea), whilst this chapter focuses on the deposition of drill cuttings on the seabed and impacts to benthic communities. The risk assessment method and results are summarised in Appendix E.

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 / base oil, 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 E):

- 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 Montrose Infill wells is oxygen depletion (84.95 %). Burial thickness and grain size change contribute to 8.48 % and 5.72 % respectively. There is minimal contribution (0.86 %) from toxicity, made up of reservoir oil and base oil. A number of chemicals are added to the LTOBM. However, these are assumed to be destroyed by the thermal desorption process (Vik *et al.*, 2014) and have therefore not been included in the final treated solids discharge. Further details are provided in Appendix E.

BURIAL THICKNESS

In terms of cuttings thickness, the modelling predicted a maximum estimated thickness of cuttings of 373 mm in the immediate vicinity of the wells, reducing rapidly with distance.

The area where the cuttings thickness is over 6.5 mm is predicted to be *c*. 0.17 km^2 at the end of drilling (up to approximately 333 m from the discharge locations). In reality, the area impacted by the cuttings pile is expected to be smaller as the model includes the discharges from the contingency re-spuds and side-tracks. To put this area 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 as a result of bioturbation and re-suspension. It is noted that the resultant cuttings pile is primarily made up of cuttings from the top hole sections (drill cuttings contaminated with WBM sweeps) that are discharged straight to the seabed. The finer grained powder discharged from the LTOBM sections tends to disperse over a wider area but results in a smaller burial thickness. Very fine particles (<0.5 mm grain size) will spread over much larger distances, extending beyond the model domain. The distribution of these very fine particles does not change significantly over time.

[1] The modelled contingencies were requested by OPRED and are considered to represent a highly unlikely scenario of multiple side-tracks and re-spuds; it is anticipated that the mass discharge of drill cuttings will be lower than that modelled. Further details are provided in Section 8.1.1.

COMBINED RISK

Overall, the maximum area where there is a combined risk (i.e. from burial thickness, oxygen depletion, change in grain size and toxicity) to more than 5 % sensitive species is predicted to be 2.64 km^2, occurring 36 days after drilling discharges end. The area reduces to 1.30 km^2 after two years, to 0.87 km^2 after 5 years, and to 0.56 km^2 after 10 years. The area where there is a risk to 5 % of the most sensitive species reduces 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 reality the area of risk will reduce faster than calculated by the model as a result of re-colonisation by benthic species. The predicted combined risk at 5 days post drilling, at two years, five years and 10 years is shown in Figure 9-1. Note that the area of impact at 10 years 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 9-1 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 9.5. As noted above, potential impacts to the water column from the discharge of drill cuttings are discussed in Chapter 8 (Discharges to Sea).

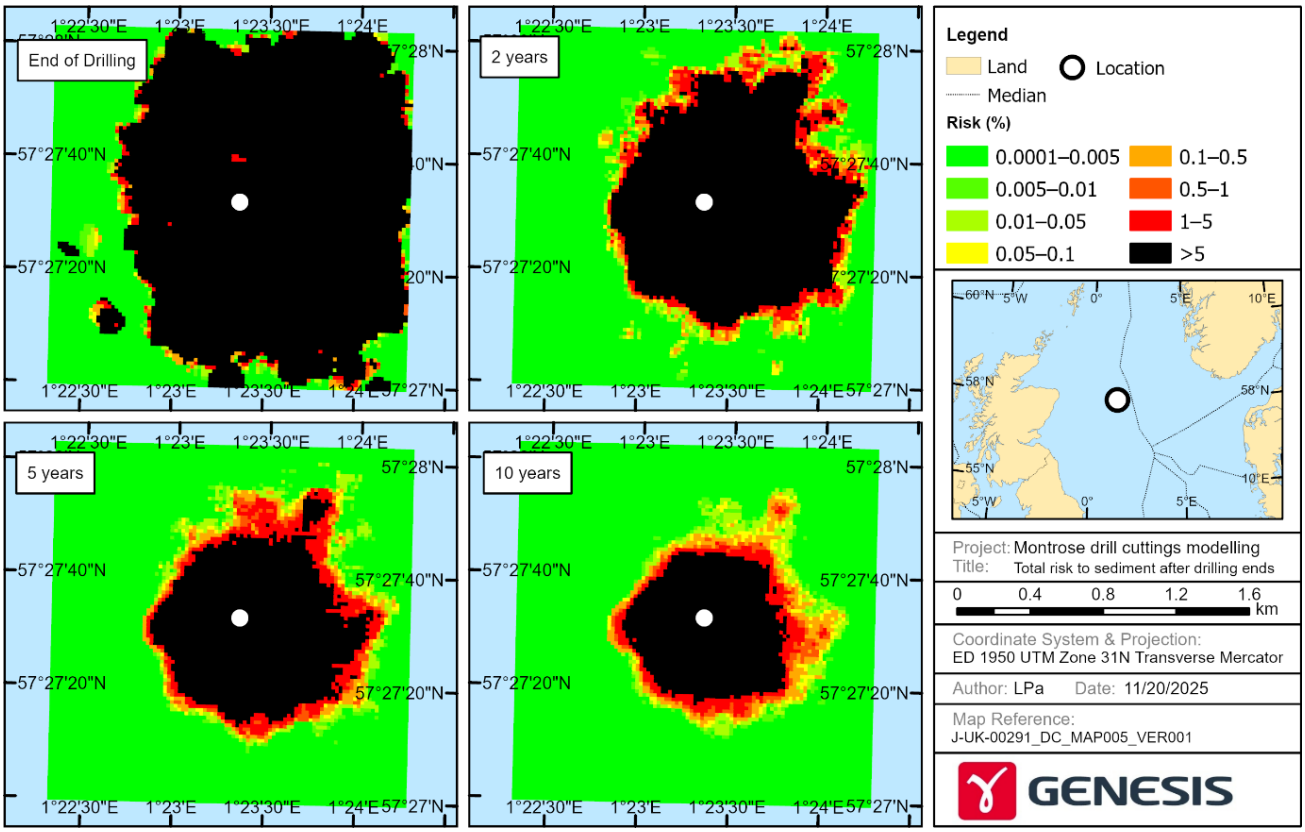


Figure 9-1: Predicted combined risk to the sediment over time, resulting from the drilling of the proposed Montrose Infill wells.

9.1.3 Cement Deposits at the Wells

As discussed in Section 3.5.6, 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.* 0.0009 km^2 permanently, based on approximately 25 te impacting on an area extending 7.5 m around each well. The worst-

case area assumption for cement patios has been made, however it is expected that there may be some overlap in the area of disturbance from the cement patios given the close proximity of the wells (wells are expected to be 13 m – 25 m apart as a worst case). The impact of these deposits on the seabed and its associated ecosystem are discussed in Section 9.5.

9.2 Installation Phase

9.2.1 Subsea Infrastructure and Associated Stabilisation and Protection Materials

Table 3-9 and Table 3-10 summarise the subsea infrastructure and associated stabilisation and protection features to be installed as part of the proposed Montrose Infill Project, with Table 9-1 summarising the seabed areas anticipated to be temporarily and permanently impacted for the base case. 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 (Section 3.6.4).

As described in Section 3.2.4, it is not yet known which pipeline protection method will be selected to protect the surface laid lines from dropped objects and mitigate the risk of UHB. The preferred method (and most likely solution) is protection using mattresses instead of rock cover, presented as the base case seabed disturbance in Table 9-1. However, the ES also assesses rock cover as a contingency given it represents the worst case, presented as the alternative case seabed disturbance in Table 9-2.

Given that only the line lengths on approach to the manifold or the BLP are considered to be at risk of dropped objects, it is likely that in reality only the line ends would require protection, as well as any areas of UHB. However, on-bottom stability and UHB analysis is ongoing, therefore as a worst case, the assessment presented in this chapter assumes that the full length of the flowlines between the drill centre and BLP require rock cover.

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.

For those structures laid on the seabed (including Xmas trees and stabilisation features if no drilling template is used), 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.

As described in Section 4.2.3, the existing Montrose Alpha platform has a contaminated drill cuttings pile that is found immediately below the platform. These cuttings were deposited during drilling activity prior to the ban on disposal of OBM contaminated drill cuttings at sea. Values reported by ERT (2000) show THC concentrations declining with increasing distance from the platform. Given that the proposed Montrose Infill Wells will be tied back to the Montrose BLP, the proposed Project activities will be located over 100 m from the Montrose Alpha platform and therefore there will be no interaction with the existing drill cuttings pile. Furthermore, in 2016, during installation of the Montrose BLP approximately 70 m to the north of the Montrose platform, there was no disturbance to the cuttings pile.

9.3 Production Phase

No planned seabed disturbance is anticipated to occur during routine production operations.

9.4 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);
- Recovery of surface laid pipelines, subsea infrastructure, mattresses and grout bags;
- 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, NEO NEXT+, as operator, will meet survey requirements prior to the commencement of decommissioning activities. It is expected that the subsea structures will be removed from the seabed and returned to shore for reuse / recycling / disposal and a seabed clearance campaign conducted, however, this would be subject to future legislative requirements and guidance.

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 EIA(s) submitted in support of the decommissioning project.

9.5 Seabed Disturbance Impact Assessment

9.5.1 Quantification of Impact

Table 9-1 summarises the anticipated temporary and permanent areas of seabed disturbance associated with the base case for the proposed Montrose Infill Project, whilst Table 9-2 summarises anticipated seabed disturbance associated with the alternative case.

For the base case (using mattresses to mitigate UHB), the maximum total area of seabed predicted to be permanently impacted by the proposed project is anticipated to be around 0.57 km^2 whilst the total area of temporary seabed disturbance is estimated to be around 3.20 km^2 (Table 9-1). For the alternative case (using rock placement to mitigate UHB), the maximum total area of seabed predicted to be permanently impacted by the proposed project is anticipated to be around 0.57 km^2 whilst the total area of temporary seabed disturbance is estimated to be around 3.19 km^2 (Table 9-2).

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 9-1: Anticipated area of seabed disturbance associated with the base case for the proposed Montrose Infill Project (mattresses used to mitigate UHB).

Item number	Infrastructure	Assumptions / Comments	Area of seabed impacted (km^2)	
			Temporarily impacted	Permanently impacted
Area impacted during anchoring of the semi-submersible drilling rig				
1.	Eight anchors	Assessment assumes: › the area of disturbance when positioning each anchor is 15 m x 15 m. › that the semi-submersible drilling rig and associated anchor system will only need to be positioned once. *Calculation: 8 anchors x (15 m x 15 m) area of disturbance each x 1 placement of drilling rig = 1,800 m^2 (**0.0018 km^2**)* As all anchors will be recovered at the end of the drilling campaign, the impact is considered temporary. No permanent impact.	**0.0018**	**N/A**
2.	Eight anchor lines	Assessment assumes: › up to 600 m of each anchor line will be in contact with the seabed. › to skid between wells, assume a worst case of anchor lines impacting a corridor width of 100 m. › that the semi-submersible drilling rig and associated anchor system will only need to be positioned once. *Calculation: 8 anchor lines x (600 m length x 100 m width) x 1 placement of drilling rig = 480,000 m^2 (**0.48 km^2**)*	**0.48**	**N/A**
3.	Four piggyback anchors	Assessment assumes: › the area of disturbance when positioning each piggyback anchor is 15 m x 15 m. › that the semi-submersible drilling rig and associated anchor system will only need to be positioned once. *Calculation: 4 piggyback anchors x (15 m x 15 m) area of disturbance each x 1 placement of drilling rig = 900 m^2 (**0.0009 km^2**)*	**0.0009**	**N/A**
4.	Four piggyback anchor lines	Assessment assumes: › up to 150 m of each piggyback anchor line will be contact with seabed. › to skid between wells, assume a worst case of anchor lines impacting a corridor width of 100 m. › that the semi-submersible drilling rig and associated anchor system will only need to be positioned once. *Calculation: 4 piggyback anchor lines x (150 m length x 100 m width) x 1 placement of drilling rig = 60,000 m^2 (**0.06 km^2**)*	**0.06**	**N/A**
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 (36 days after discharges), which is estimated to be **2.64 km^2** (Section 9.1.2); and › permanent disturbance is the area where this risk remains after 10 years, which is estimated to be **0.56 km^2** (Section 9.1.2).	**2.64**	**0.56**

Item number	Infrastructure	Assumptions / Comments	Area of seabed impacted (km²)	
			Temporarily impacted	Permanently impacted
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 each of the five wells. › Radius of each patio is 7.5 m (based on consultant's experience). *Calculation: 5 wells x π (7.5 m radius cement patio)² = 900 m² (**0.0009 km²**)*	**N/A**	**0.0009**
Area impacted by subsea structures				
7.	Xmas trees and protective structures (off-template option)[1]	Assessment assumes (including protection structure): › 5 x Xmas trees: 8 m (L) x 8 m (W) › To assess the temporary area of disturbance, an area of temporary impact extending 2 m on either side of the structures has been allowed for. *Permanent impact calculation: 5 Xmas trees x 8 m (L) x 8 m (W) = 320 m² (**0.0003 km²**)* *Temporary impact calculation: 5 Xmas trees x 12 m (extended length) x 12 m (extended width) – permanent impact area (320 m²) = 400 m² (**0.0004 km²**)*	**0.0004**	**0.0003**
8.	Subsea Manifold	Assessment assumes: › Subsea manifold with dimensions: 18 m (L) x 11 m (W). › Permanent impact is considered to be the dimensions of the structure itself. › 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: 18 m (L) x 11 m (W) = 198 m² (**0.0002 km²**)* *Temporary impact calculation: 22 m (extended length) x 15 m (extended width) – permanent impact area (198 m²) = 132 m² (**0.0001 km²**)*	**0.0001**	**0.0002**
Area impacted by surface laid lines and associated stabilisation features				
9.	Surface laid lines[2]	Assessment assumes: › Three lines (1 x production flowline, 1 x gas lift flowline, 1 x EHC umbilical) of length 400 m each will be surface laid without continuous mattress cover; › Permanent impact is considered to be the footprint of the lines themselves, for which a diameter of 8" has been assumed as worst-case given this is the greatest diameter of the three lines (Table 3-9); › To assess the temporary area of sediment resuspension, a 1 m total corridor of temporary impact has been allowed for along each line. *Permanent impact calculation: 3 lines x 400 m length x 8" (0.2 m) diameter = 240 m² (**0.0002 km²**)* *Temporary impact calculation: 3 lines x 400 m length x 1 m corridor = 1,200 m² (**0.0012 km²**)*	**0.0012**	**0.0002**
10.	Mattresses[3,4]	As detailed in Table 3-10, it is anticipated up to 236 mattresses will be required (measuring 6 m (L) x 3 m (W)).	**0.0123**	**0.0042**

Item number	Infrastructure	Assumptions / Comments	Area of seabed impacted (km²)	
			Temporarily impacted	Permanently impacted
		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: 236 mattresses x 6 m (L) x 3 m (W) = 4,248 m² (**0.0042 km²**)* *Temporary impact calculation: 236 mattresses x 10 m (extended length) x 7 m (extended width) – permanent impact area (4,248 m²) = 12,272 m² (**0.0123 km²**)*		
11.	Grout bags[3]	No. of grout bags within Montrose BLP 500 m zone: 492 No. of grout bags within drill centre 500 m zone: 924 (Total no. of grout bags: 1,416) 35.4 te of grout bags (1,416 x 25 kg) to be used. Assessment assumes 1 te of grout bags permanently impacts on 1 m² of seabed and temporarily impacts on an additional 1 m² during installation. *Permanent impact calculation: 35.4 te of grout bags x 1 m² = 35.4 m² (**0.00004 km²**)* *Temporary impact calculation: 35.4 te of grout bags x 1 m² = 35.4 m² (**0.00004 km²**)*	**0.00004**	**0.00004**
Maximum area of impact			**3.20 km²**	**0.57 km²**

Notes:

[1] Seabed disturbance calculations are based on the off-template option (xmas trees and protective structures) given that it is worst-case from a seabed disturbance perspective. If the template option is selected, the Xmas trees would be located within the drilling template.

[2] This line item represents the length of line that will not be continuously covered by mattresses and does not include the 300 m of spools associated with the lines.

[3] As the spools and umbilical jumpers will be protected by mattresses and grout bags, the area of seabed impacted by the spools and umbilical jumpers themselves is within the footprint of that covered within line items 9 and 10.

[4] 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.

Table 9-2: Anticipated area of seabed disturbance associated with the alternative case for the proposed Montrose Infill Project (rock placement along full length of line to mitigate UHB).

Item number	Infrastructure	Assumptions / Comments	Area of seabed impacted (km²)	
			Temporarily impacted	Permanently impacted
Area impacted during anchoring of the semi-submersible drilling rig				
1.	Eight anchors	As above in Table 9-1.	**0.0018**	**N/A**
2.	Eight anchor lines	As above in Table 9-1.	**0.48**	**N/A**
3.	Four piggyback anchors	As above in Table 9-1.	**0.0009**	**N/A**

Item number	Infrastructure	Assumptions / Comments	Area of seabed impacted (km^2)	
			Temporarily impacted	Permanently impacted
4.	Four piggyback anchor lines	As above in Table 9-1.	**0.06**	**N/A**
Area impacted during drilling				
5.	Discharged drill cuttings	As above in Table 9-1.	**2.64**	**0.56**
6.	Cement deposits	As above in Table 9-1.	**N/A**	**0.0009**
Area impacted by subsea structures				
7.	Xmas trees and protective structures (off-template option)	As above in Table 9-1.	**0.0004**	**0.0003**
8.	Subsea Manifold	As above in Table 9-1.	**0.0001**	**0.0002**
Area impacted by stabilisation features on surface laid lines[1]				
9.	Mattresses	As detailed in Table 3-10, anticipated up to 206 mattresses will be required for the alternative case (measuring 6 m (L) x 3 m (W)). 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: 206 mattresses x 6 m (L) x 3 m (W) = 3,708 m^2 (**0.0037 km^2**)* *Temporary impact calculation: 206 mattresses x 10 m (extended length) x 7 m (extended width) – permanent impact area (3,708 m^2) = 10,712 m^2 (**0.0107 km^2**)*	**0.0107**	**0.0037**
10.	Grout bags	As above in Table 9-1.	**0.00004**	**0.00004**
11.	Contingency rock cover to mitigate UHB	Assessment assumes: › that a maximum of 11,100 te of rock will be required; › that 400 m length of lines are rock covered (one rock berm covering all 3 surface laid lines); › that the rock berm will be 7 m width; › to assess the temporary area of sediment resuspension, the rock berm width has been extended by 1 m on either side (9 m total extended width). *Permanent impact calculation: 400 m length of berm x 7 m width of berm = 2,800 m^2 (**0.0028 km^2**)* *Temporary impact calculation: 400 m length of berm x 9 m extended width of berm – permanent impact area (2,800 m^2) = 800 m^2 (**0.0008 km^2**)*	**0.0008**	**0.0028**
Maximum area of impact			**3.19 km^2**	**0.57 km^2**
Note:				

Item number	Infrastructure	Assumptions / Comments	Area of seabed impacted (km²)	
			Temporarily impacted	Permanently impacted
[1] As the full length of surface laid lines will be covered by rock in the alternative case, the area of seabed impacted by the surface laid lines are within the footprint covered by line item 11.				

9.5.2 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 Montrose Infill Project. Impacts to the East of Gannet and Montrose Fields NCMPA are summarised in Section 9.5.4, however, impacts to the specific designated features are discussed throughout the following sections.

PERMANENT DISTURBANCE

The placement of the anchors associated with holding the drilling rig on location will likely cause some scars on the seabed.

Installation of subsea infrastructure (including stabilisation and protection materials) will result in a permanent impact to the seabed within the East of Gannet and Montrose NCMPA as captured in Table 9-1. 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 within the footprint of the seabed area impacted by the drill cuttings.

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, and contingency rock cover) can lead to a direct loss of habitat with the addition of 'hard' substrate to a sandy seabed within an area of habitat type 'Offshore circalittoral sand' (Section 4.3.2) and the designated habitat 'offshore subtidal sands and gravels' (representing sediment types suitable for ocean quahog colonisation) (Section 4.4). 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 (if used), as has been observed at other developments in the North Sea (such as the Donan field in Block 15/20).

In terms of sensitive species, relic *A. islandica* shells were a predominant component of the general shell debris found across the Montrose survey site during the 2022 surveys (GEOxyz, 2023). Although no adult specimens were identified, a total of 36 juveniles were found to be present within the survey area across all stations which indicates the presence of *A. islandica* at the proposed Project location. *A. islandica* aggregations (including sands and gravels as their supporting habitat) is one of the designated features of the East of Gannet and Montrose Fields NCMPA, with the greatest number of individuals found within areas with a high proportion of sand. Their distribution within the NCMPA suggests that they are present at the proposed Montrose Infill Project location (Section 4.4).

Taking account of the MarESA sensitivity assessment (Section 4.5.3), *A.islandica* is noted to have low recoverability (Hennen, 2015; Witbaard and Bergman, 2003) and a high sensitivity to physical change, including abrasion and sediment disturbance. 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 *A.islandica* are particularly vulnerable. Contrastingly, they have a

high tolerance for the suspension of sediment and heavy rates of smothering and/or burial, as discussed under Temporary Disturbance. JNCC's FeAST also describes that the pressures to which *A.islandica* have a high sensitivity include physical change, physical removal, and sub-surface abrasion / penetration (Section 4.5.4; FeAST, 2023).

Given the proposed Project location within the East of Gannet and Montrose Fields NCMPA and presence of *A.islandica* and 'offshore subtidal sands and gravels' habitat, considering their sensitivity to the permanent seabed disturbance planned as part of the proposed Project, Receptor Sensitivity is considered **High (C)**. Taking account of the widespread distribution of *A. islandica* across the CNS, any mortality caused to individual specimens as a result of the proposed activities is not considered significant given the relatively limited area of impact. In addition, as described further within Section 9.5.4, the area of the 'offshore subtidal sands and gravels' habitat within the NCMPA that will be permanently impacted by the proposed Project is 0.045 % in total (Table 9-3), which represents a relatively small proportion of the overall habitat area. The Magnitude of Impact of permanent seabed disturbance on habitats and benthic communities within the area 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, the Impact Significance of permanent seabed disturbance on habitats and benthic communities 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 receptors.

TEMPORARY DISTURBANCE

Temporary disturbance can be divided into two categories:

- 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.

Both categories are covered separately under the following subsections.

Items Temporarily Coming into Contact with the Seabed

As summarised in Table 9-1, the placement of the drilling rig anchors and anchor lines 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 the semi-submersible drilling rig anchors or the HDJU contingency anchors and 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.

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 East of Gannet and Montrose Fields NCMPA and presence of *A.islandica*, and considering their sensitivity to abrasion and penetration caused by items temporarily coming into

contact with the seabed, 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, 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 should be noted that, as described above, the existing Montrose Alpha platform has a contaminated drill cuttings pile that is found immediately below the platform. However, the proposed Montrose Infill Wells will be tied back to the Montrose BLP, such that the proposed Project activities will be located over 100 m from the Montrose Alpha platform and no disturbance is expected to the existing cuttings pile at Montrose Alpha as a result of the proposed Montrose Infill Project. This section therefore does not account for any drill cuttings contamination within the suspended sediments. Impacts related to discharge of drill cuttings resulting from the drilling of the proposed Montrose Infill wells are covered in Section 9.5.3.

Given that the Montrose area is characterised by 'offshore circalittoral sand' (EMODnet, 2023) (Section 4.2.3), 'silty fine sand with occasional shell fragments' (GEOxyz, 2023) and the designated habitat 'offshore subtidal sands and gravels' (representing sediment types suitable for ocean quahog colonisation) (Section 4.4), sand particles may be lifted from the seabed and suspended or transported. Due to the grain size of sandy particles, this sediment type tends to settle quickly when compared to muddy or silty clay sediments (Wang, Chen and Xia., 2025). This means that the suspended sediments resulting from the proposed Project activities would likely result in a short-lived sediment plume, likely to settle close to the source.

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 or those with limited movement, for example the annelid, mollusc, and echinoderm species identified in grab samples within the Montrose area (Section 4.3.2), 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 (Section 4.3.2) and fish (Section 4.3.3), 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,* both of which are known to occur in the area (Section 4.3.2).

Although *A. islandica* burrow into the sediment, they use a short inhalant siphon which sits above the sediment surface for feeding and respiration (Taylor, 1976). Surface abrasion and siltation may therefore damage/clog the inhalant siphon. However, according to the MarESA sensitivity assessment (Section 4.5.3) and FeAST (Section 4.5.4), *A. islandica* have a high tolerance for the suspension of sediment and heavy rates of smothering and/or burial. It has been suggested that they are able to burrow to the surface following up to 30 cm of material added to the seabed in a single event (Tyler-Walters and Sabatini, 2017). Powilleit *et al*., (2009) suggest that this could even be up to 40 cm of sediment. 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 and given that sandy sediments mean suspended sediment plumes are likely to be short-lived and remain close to the source, any impacts from low visibility are expected to be temporary and are not considered significant.

Given the proposed Project location within the East of Gannet and Montrose Fields NCMPA and presence of *A.islandica* (Section 4.3.2) and 'offshore subtidal sands and gravels' habitat, as well as fish species that are considered Scottish PMFs (Section 4.5.2), 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.

9.5.3 Impacts from Drill Cuttings Discharges

The discharge of drill cuttings from the proposed Montrose Infill wells will impact on the sediments and associated benthic communities within the Project area. As described in Section 9.1.2 and Table 9-1, following drilling, the area where the combined risk to the sediment to over 5 % of the most sensitive species is predicted to be approximately 2.64 km^2, reducing to 0.56 km^2 after 10 years. The main contributor to the risk is oxygen depletion, with smaller contributions resulting from burial thickness, grain size change, and toxicity.

In the model (Appendix E), 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, *A. islandica* have a high resilience to smothering of up to 30 cm of material added to the seabed in a single event (Tyler-Walters and Sabatini, 2017). At the end of drilling, the area over which the drill cuttings will settle out at a thickness > 30 cm is 0.01 km^2 (up to c. 122 m from the discharge locations). *A. islandica* are highly tolerant of low oxygen supply and can survive in the complete absence of oxygen (anoxia) and even the presence of H_2S (euxinia) for several weeks or months (Theede *et al.*, 1969; Dries and Theede, 1974; Oeschger, 1990). Therefore, *A. islandica* may not be significantly impacted by smothering as a result of drill cuttings and drilling mud discharges.

As for their supporting habitat 'offshore subtidal sands and gravels', which are also a protected feature of the East of Gannet and Montrose Fields NCMPA, the deposition of drill cuttings will alter the sediment grain size of existing sandy sediments in the Montrose area. A change in grain size and thus habitat type may result in the habitat being unsuitable for *A.islandica* aggregations, which are known to have a high sensitivity to physical change to another seabed habitat type (Section 4.5.4; JNCC, 2025). However, given that the footprint of permanent impact resulting from the proposed Project is small (Section 9.5.1), this is not expected to alter a significant area of available sandy habitat throughout the wider region.

Nephrops are known to be tolerant to burial depths of at least 5 cm (MarLIN, 2006). The area over which depth of burial is > 5 cm is 0.09 km^2 (up to *c*. 277 m from the discharge locations). However, given that *Nephrops* tend to occur in deep, sheltered muddy habitats, they are therefore unlikely to be significantly impacted given the proposed Montrose Infill Project is located within a sandy habitat.

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).

This could be of concern in longer-lived species such as *A. islandica*, although areas of high exposure would be spatially very limited as indicated by modelling studies (Appendix E).

Resuspension and resettlement of disturbed cuttings (e.g. during tie-in operations) 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). 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 East of Gannet and Montrose Fields NCMPA and presence of *A.islandica* and 'offshore subtidal sands and gravels' habitat, Receptor Sensitivity is considered **High (C)**. However, the area over which 5 % of species are at risk 10 years post drilling is significantly small and in addition, the area of the 'offshore subtidal sands and gravels' habitat within the NCMPA that will be permanently impacted

by the Project is 0.045 % in total (Section 9.5.4), which represents a relatively small proportion of the overall habitat area. Therefore, the Magnitude of Effect on benthic communities and seabed sediments from the Montrose Infill well drill cuttings discharges is considered to be **Minor (2)**, and thus the Impact Significance is considered **Moderate**.

9.5.4 Impacts to East of Gannet and Montrose Fields NCMPA

The East of Gannet and Montrose Fields NCMPA is described in Section 4.4. The NCMPA covers an area of 1,839 km^2. Of the total protected area, approximately 575.1 km^2 is covered by the deep-sea muds sediment type and approximately 1,264 km^2 is covered by sandy seabed[2]. As noted in Section 4.4, the NCMPA is designated for the following:

- low or limited mobility species 'ocean quahog (*A. islandica*) aggregations';
- 'offshore deep sea muds' habitat; and
- 'offshore subtidal sands and gravels' habitat (representing sediment types suitable for ocean quahog colonisation).

The percentage area of designated features within the East of Gannet and Montrose Fields NCMPA which may be impacted by seabed disturbance associated with the proposed Montrose Infill Project, are provided in Table 9-3. The percentage of area impacted has been calculated based on the proposed Project's permanent and temporary areas of seabed impact as summarised in Table 9-1.

As can be seen in Table 9-3, the percentage of area permanently impacted by the proposed Montrose Infill Project is relatively small compared with the overall areas of the sandy habitat within the protected area. It should be noted that the total area of seabed impact is an over-estimate as the area covered by the disturbances will overlap, therefore the percentage of area permanently impacted will in reality be even smaller.

Table 9-3: Designated features and area of potential Montrose Infill Project impact within East of Gannet and Montrose Fields NCMPA.

Option	Designated Features of the NCMPA	
	***A. Islandica* aggregations (including sands and gravels as their supporting habitat)**	**Offshore deep-sea muds**
Area of protected habitat (km^2)	1,263.9	575.1
Impacted by proposed Montrose Infill development	Yes	No
Percentage (%) of area permanently impacted	0.045 %	-
Percentage (%) of area temporarily impacted	0.25 %	-

The JNCC FeAST and AOps tool provides sensitivity assessments and justifications for the features of interest present within the East of Gannet and Montrose Fields NCMPA. Features relevant to the proposed Project are detailed in Table 9-4.

[2] Area of deep-sea muds and sandy seabed within the NCMPA calculated based on the EMODnet sediment map data, as shown in Figure 4-6 (EMODnet, 2023).

A. islandica juveniles have been recorded in the proposed Project area, and given the sandy substrate, assessment of the impact to the species and their supporting habitat (sands and gravels) has been undertaken in Sections 9.5.2 and 9.5.3, with the impact significance considered to be **Moderate**.

A modelled distribution of seabed sediments in the North Sea indicates that the MSFD predominant habitat in Blocks 22/17 and 22/18 is 'offshore circalittoral sand' (EMODnet, 2023). The survey data (GEOxyz, 2023) revealed the seabed sediments within the proposed Montrose Infill Project to comprise 'silty fine sand with occasional shell fragments' across most of the site with an area to the east comprised of 'silty fine sand with numerous shell fragments'. Therefore, there will be no impacts to the 'offshore deep sea muds' habitat within the East of Gannet and Montrose Fields NCMPA from seabed disturbance, as the proposed Project footprint and extent of anticipated seabed impacts is located out-with the area of mud habitat (Figure 4-6 and Figure 4-12). Therefore, 'offshore deep sea muds' are not considered relevant and have been excluded from Table 9-4.

Table 9-4: *A.Islandica* Species and Supporting Habitat, and Offshore Deep-Sea muds Habitat Sensitivity to Oil and Gas activities (FeAST, AOps; JNCC).

Pressure	*East of Gannet and Montrose Fields NCMPA Features of Interest*		Project Source	Mitigation Measures	AOps and Relevance to Proposed Project
	A.islandica species	*A.islandica* habitat			
Barrier to species movement	NR	NS	Physical presence.	NA	Not applicable to non-highly mobile organisms.
Death or injury by collision below water	NR	NR	Vessel movement.	NA	Not applicable to benthic organisms other than larvae.
Hydrocarbon and PAH contamination	S	S	Accidental release or introduction.	Section 12.6	Environmental Quality Standards (EQS) exist for the marine environment, compliance with these EQS is not considered appropriate to ensure a Not Sensitive scoring and therefore no additional mitigation beyond that described in Section 12.6 is required.
Introduction of non-indigenous species	NE	S	Direct or indirect introduction.	Appendix B	The potential to introduce non-indigenous species is mitigated and therefore has not been assessed in the ES. Mitigation measures include discharges of ballast water being monitored, and records maintained. As part of the Company's auditing process, only vessels adhering to the IMO 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Species will be used.
Physical change	S	S	Change to substrate e.g. rock placement or installation of infrastructure.	Section 9.7	Drilling of infill wells and installation of subsea infrastructure and associated stabilisation and protection materials. Assessed in Section 9.5.2.

Pressure	*East of Gannet and Montrose Fields NCMPA Features of Interest*		Project Source	Mitigation Measures	AOps and Relevance to Proposed Project
	A.islandica species	*A.islandica* habitat			
Physical removal	S	S	Removal of substratum up to 30 cm, e.g. during drilling.	Section 9.7	Substrata will be removed during drilling of the infill wells and the effect is localised.
Surface abrasion / penetration	S	S	Scouring from anchors, chains, temporary placement of material.	Section 9.7	Physical disturbance to sedimentary habitat. Risk of the pressure depends on spatio-temporal scale of project. Temporary placement of material is assessed in Section 9.5.2.
Sub-surface abrasion / penetration	S	S	Anchors and HDJU spud cans (if used) on seafloor.	Section 9.7	Compression of sediments resulting in damage to sub-surface features. Risk of the pressure depends on spatio-temporal scale of project. Assessed in Section 9.5.2.
Smothering and Siltation rate changes - Light	NS	S	Sediment suspension resulting from placement of items on the seabed.	Section 9.7	Accumulation of sediments from a single discrete event reaching up to 5 cm of fine material deposited. Benthic biota may be able to adapt by vertical migration. Assessed in Section 9.5.2.
Smothering and Siltation rate changes - Heavy	NS	S	Drilling, discharge of drill cuttings.	NA	Accumulation of sediments from a single discrete event reaching up to 30 cm of fine material deposited. Similar biota over time can re-stablish from surrounding area. Assessed in Sections 9.5.2 and 9.5.3.
Synthetic compound contamination	S	S	Accidental release or introduction.	Section 12.6	Compliance with these EQS is not considered appropriate to ensure a Not Sensitive scoring and therefore no additional mitigation beyond that described in Section 12.6 is required.
Transition elements and organo-metal contamination	NE	NE	Accidental release or introduction.	Section 12.6	Compliance with these EQS is not considered appropriate to ensure a Not Sensitive scoring and therefore no additional mitigation beyond that described in Section 12.6 is required.
Underwater noise	NR	NR	Piling, vessel and drilling noise.	NA	Features of interest are not thought to be sensitive to the pressure.

Key:
S – Sensitive
NR – Not Relevant
NS – Not Sensitive
NA – Not Assessed
NE – Not Exposed

9.6 Cumulative and Transboundary Effects

The impacts resulting from the seabed disturbance associated with the proposed Montrose Infill Project have the potential to act cumulatively with both existing and new developments, as well as other activities ongoing within the East of Gannet and Montrose Field NCMPA.

This section describes other activities and existing infrastructure within the East of Gannet and Montrose NCMPA. Key infrastructure located within the NCMPA is illustrated in Figure 9-2.

There are four platforms located within the East of Gannet and Montrose NCMPA, specifically; Montrose A, Montrose BLP, Arbroath, and Gannet A. The closest platform to the proposed activities (other than Montrose A and Montrose BLP) is Arbroath, located 11 km to the south (Section 4.6.5). There are many subsea structures such as wellheads and tie-backs present within the NCMPA and in close proximity to the proposed Montrose Infill Project infrastructure, including the Cayley and Shaw manifolds, wells and associated pipelines and umbilicals, and the Wood well. As can be seen there are a number of pipelines and umbilicals passing within the NCMPA and the additional proposed Project lines (totaling 2.1 km) would comprise a relatively small comparative increase.

The Montrose Oil Offloading Line (disused) is the closest pipeline to the proposed Montrose Infill Project, roughly 50 m southwest of the Montrose BLP, followed by the CATS (*c*. 6 km southwest of the Montrose BLP) and the Montrose Oil Trunkline (*c*. 9 km southwest of the Montrose BLP).

Key infrastructure within close proximity to the proposed Montrose Infill Project are considered qualitatively throughout the following subsections with respect to the potential for cumulative impacts on the NCMPA.

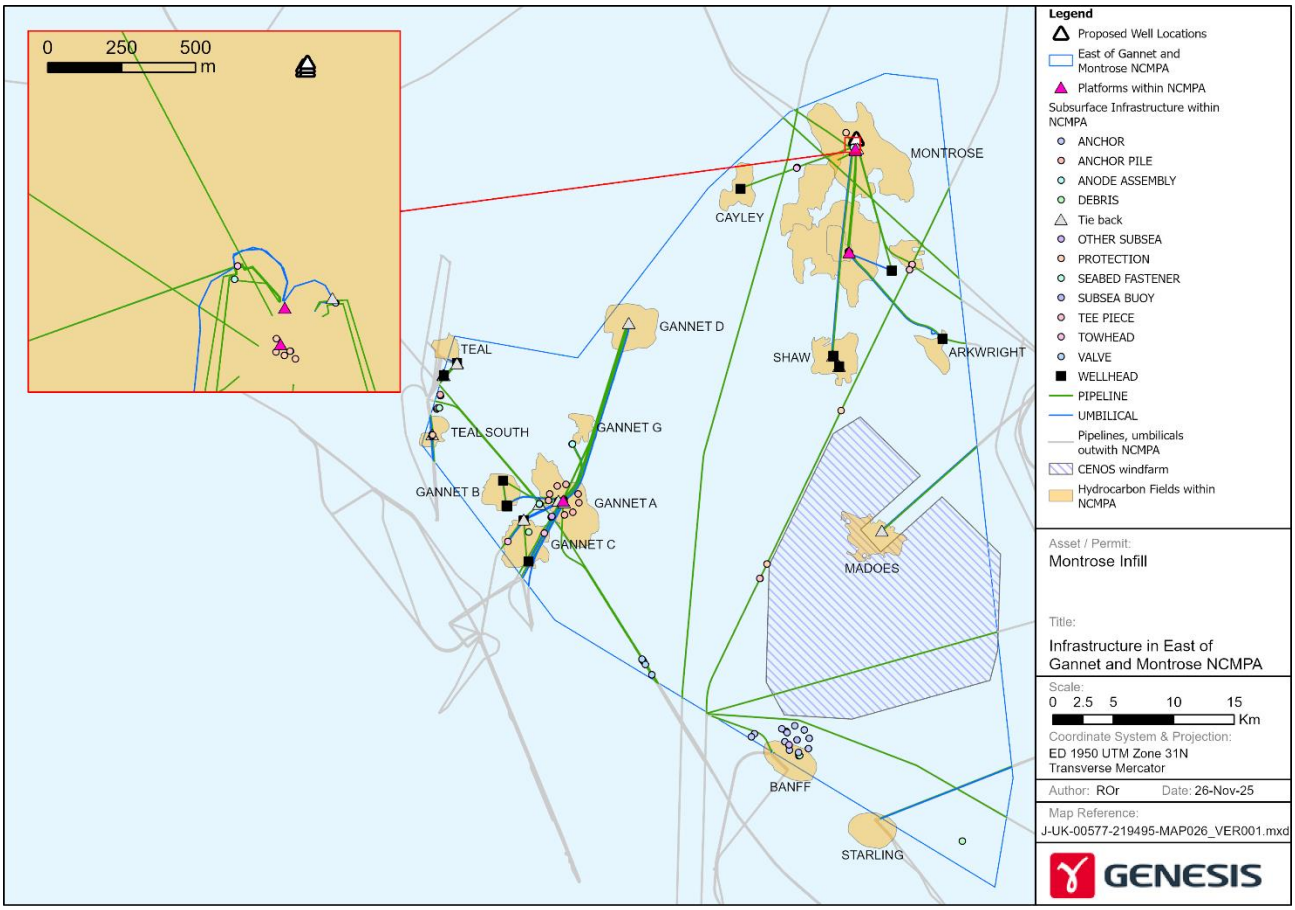


Figure 9-2: Infrastructure within East of Gannet and Montrose NCMPA.

9.6.1 MonArb Area

As described in Chapter 1 (Introduction), the Montrose Field is one of nine fields comprising the MonArb Area. The other eight fields within the MonArb Area are Arbroath, Carnoustie, Arkwright, Brechin, Wood, Godwin, Cayley and Shaw. There are three platforms in the MonArb Area operated by NEO NEXT+ including Montrose Alpha commissioned in 1976, the Arbroath Platform commissioned in 1990, and the Montrose BLP commissioned in 2017 (NSTA, 2025). The Montrose Alpha and Montrose BLP combined are referred to as the Montrose Complex.

The Shaw and Cayley fields are subsea wells tied back to the Montrose BLP whilst the Montrose field is currently producing via production wells drilled from the Montrose Alpha platform. The Wood Field also ties directly back to the Montrose Alpha platform.

Oil from all fields is exported from Montrose Alpha via the FPS. Gas is exported from the Montrose BLP to the CATS, which transports gas to the Teesside gas terminal for processing and entry into the UK NTS.

The latest development within the Shaw field was the 2017 production wells planned as part of the MAR Project (MonArb Hub), as described in Chapter 1 (Introduction).

There are no other developments planned to take place within the MonArb Area at the same time as the proposed Montrose Infill Project other than continuing production from existing wells. Given that the proposed Project is a subsea tie-back with no new platform or surface infrastructure to be installed (only modifications to existing Montrose BLP) and the short length of line to be laid on the seabed (drill centre located 0.7 km from BLP, with 0.5 km of line located within the existing Montrose 500 m exclusion zone), significant cumulative impacts are not expected as a result of the Project.

9.6.2 Gannet

The Gannet Field is located within Blocks 21/25, 21/30, 22/21 and 22/26a of the CNS, to the southwest of Montrose. The development comprises one platform (Gannet A), located *c*. 37 km from the proposed drill centre (Section 4.6.5). Gannet A, operated by Shell, produces from the Gannet A field via platform wells and five subsea satellite tiebacks: Gannet B, C, D, F and G.

Production from the wider Gannet field is ongoing and is currently expected to continue until 2031. Planned decommissioning activities at the Gannet field will not pose any potential cumulative impacts with the proposed Montrose Infill Project given that the current Decommissioning Programmes submitted to OPRED are for decommissioning of the Gannet A Mast and Gannet Subsea Wells GB01S1 and GF01S1 (OPRED, 2025). The proposed drilling and installation activities at Montrose are currently scheduled to take place from Q3 2027 to Q4 2028 (Section 3.4) and therefore installation will be completed prior to decommissioning of the wider Gannet field.

9.6.3 CENOS Wind Farm

The closest awarded INTOG project, CENOS wind farm, is located *c*. 23 km south of Montrose (within the NCMPA) as shown in Figure 9-2. It is proposed to develop the CENOS as a floating wind farm with up to 95 floating turbines that will be anchored to the seabed. There will also be a substation and 350 km of inter-array cables (280 km of buried cables and 70 km cabling in water column), as well as a portion of the export/import cable bundle within the NCMPA.

Work to construct the wind farm is expected to commence in 2030 and would continue for approximately 6 years, with aim to complete the windfarm by 2035 (with first power from 2031).

Potential impacts to seabed as a result of the CENOS wind farm include: temporary seabed disturbance during site preparation activities, risk of introduction of invasive species, introduction of hard substrates in a predominantly sedimentary environment, and operational effects of electromagnetic / heat.

Given that CENOS construction activities are not expected to commence until 2030, the installation activities for the proposed Montrose Infill Project will be completed by then. Therefore, cumulative impacts in terms of activities happening at the same time, i.e. vessels within the NCMPA at the same time, are not expected. In addition, the planned seabed footprint occupied by the proposed Project is significantly smaller than that required to accommodate the 95 wind turbines at the CENOS wind farm.

9.6.4 Summary of Permits Dating 2027-2028

At the time of writing the ES, there were no permits with a SAT expiration date beyond 2026 within the NCMPA for drilling, pipelines, well intervention, production, decommissioning or as a standalone (DESNZ, 2025). Therefore, at this time it is not possible to take account of permit applications for activities that may coincide with the Montrose Infill Project activities (Q3 2027 to Q4 2028)

However, considering the proposed Montrose Infill Project activities are not scheduled to initiate until 2027 at the earliest, it cannot be concluded with certainty which activities may be taking place within the NCMPA at that time. Permits to be submitted in support of execution will take account of any other permit applications that may be submitted closer to the time.

9.6.5 Cumulative and Transboundary Summary

Having given consideration to the existing/planned infrastructure and ongoing activities within the East of Gannet and Montrose NCMPA, it can be concluded that the seabed disturbance resulting from the proposed Montrose Infill Project is not expected to contribute to any significant cumulative effects. The footprint of permanent disturbance is relatively small, as summarised in Table 9-1. Potential impacts have been assessed in the context of the NCMPA in Section 9.5.4, nothing that only 0.045 % of the sandy seabed area within the NCMPA will be occupied by the proposed Project's permanent seabed footprint (Table 9-3).

The base case is that contingency rock placement (if used) is the only material which could be expected to be decommissioned *in situ*, however, if it is necessary to rock cover the lines for UHB mitigation, the decommissioning of the lines under the rock would be subject to a Comparative Assessment. Accounting for the future decommissioning of Montrose Field and its associated infrastructure, the long-term permanent impact on the seabed within the NCMPA is constrained to the field lifetime and the subsequent recolonisation. It is expected that the subsea structures will be removed from the seabed and returned to shore for reuse / recycling / disposal and a seabed clearance campaign conducted, however, this would be subject to future legislative requirements and guidance. This further reduces the long-term impact of the Montrose Infill Project on the NCMPA.

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.

9.7 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with disturbance to the seabed resulting from the proposed Montrose Infill Project.

Proposed Mitigation Measures
› Pre-deployment surveys will be undertaken to identify suitable locations for the anchors (if required);
› Anchors of the drill rig (if used) will be maintained under tension to minimise chain contact on seabed;
› Pipeline and umbilical route surveys will be undertaken;
› Pipelines will be surface laid;
› The use of mattresses, grout bags and contingency rock placement (if used) will be minimised through optimal project design;
› If circumstances end up requiring rock placement, rock deposits would be placed using a fall pipe vessel to ensure accurate targeting of placement and minimisation of disturbance;
› Cement volumes required will be planned and optimised;
› Use of ROV for visual monitoring and pH monitoring during cementing jobs that allows stopping when cement is either observed or detected at seabed (to minimise excess cement);
› Sea dye will be used to indicate when cement is approaching the surface;
› The use of dynamically positioned vessels will minimise anchor use;
› Use of low toxicity chemicals in WBM sweeps;
› Use of specialist contractors to minimise dropped objects; and
› Lifting plans in place.

Applying the impact assessment methodology described in Chapter 5 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. It is noted that the area of sandy habitat within the East of Gannet and Montrose Fields NCMPA (which supports *A. islandica* aggregations) that will be impacted by seabed disturbance represents a relatively small proportion of the overall habitat area (0.045 % permanently impacted).

NEO NEXT+ 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.

10 Underwater Noise

This chapter assesses the impact of underwater noise associated with the proposed Montrose Infill Project, using the impact assessment methodology outlined in Chapter 5.

10.1 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 sound has the potential to impact on marine animals by interfering with the animal's ability to use and receive sound (OSPAR, 2009b). Offshore exploration and production activities invariably generate underwater sound; for example, during geophysical exploration, during drilling activities or piling operations and from the vessel operations. The level and frequency range of sound generated varies with the type of activity.

It is generally accepted that exposure to anthropogenic sound can induce a range of adverse effects on marine life (e.g. OSPAR, 2009b). The type and extent of potential impact associated with sound on an animal depends on many factors including the level and frequency characteristics of the sound, hearing sensitivity and behaviour of the species, propagation characteristics of the operational area and whether marine species are using the areal extent of the sound 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; Richardson *et al.,* 1995).

The Conservation of Offshore Marine Habitats and Species Regulations 2017 make it an offence to injure or disturb EPS (European Protected Species), 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. It also includes the likelihood of significantly affecting the local distribution or abundance of the species. New developments must assess if their activity, either alone or in combination with other activities, is likely to cause an offence involving an EPS.

10.2 Noise Sources associated with the Proposed Project

Activities associated with the proposed Montrose Infill Project, resulting in the generation of underwater sound, include:

- Drilling activities;
- Use of perforation guns during well completion;
- Rock dumping activities (contingency);
- Vessel operations; and
- Piling of the subsea manifold (and the drilling template if used).

These underwater noise sources are discussed in more detail in the next section.

10.3 Impacts of Noise Sources

The potential impact of underwater sound on receptors depends on the actual level of sound received by the receptor relative to background sound level and other sound sources/activities, as well as the receptor's sensitivity and response to that sound (Southall *et al.,* 2019).

Applying the assessment methodology presented in Chapter 5, the Receptor Sensitivity of marine mammals and fish in the area is considered **Medium (B)** given the cetaceans are EPS, whilst a number of fish species in the area (e.g. sandeel, cod and mackerel) are considered PMFs (Section 4.5.2).

10.3.1 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). Furthermore, a study by Greene (1987) found that the noise generated by drilling activities from a semi-submersible drilling rig did not exceed local ambient levels beyond 1 km. Recent studies by Long-Fei *et al.* (2023) show that drilling noise does not induce a high risk of hearing damage beyond 40 m from the drilling activity location. Noise associated with the drilling activities is therefore considered to be of a relatively low level. Receptor Sensitivity of marine mammals and fish in the area is considered **Medium (B)** 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.

10.3.2 Use of Perforation Guns

The use of perforation guns during well completion, if required, would be carried out a minimum of 2,400 m below the seabed. The Receptor Sensitivity of marine mammals to this source of noise is considered **Medium (B)**; however, given the depth at which the charges would be used, the Magnitude of Effect of this activity is considered **Negligible (1)**. The Impact Significance is therefore assessed as **Low**, such that the impact from the use of perforation guns is considered negligible.

10.3.3 Rock Dumping Activities

The ES captures a contingency of rock placement along c. 400 m length of the lines to be laid between the Montrose BLP and the new manifold location to mitigate against potential UHB (Section 3.6.4). Nedwell and Edwards (2004) reported the noise from the Rollingstone, a vessel with a specialised underwater chute to position rock on the seabed. The vessel used dynamic positioning and was powered by two main pitch propellers, two bow thrusters and two azimuth thrusters. It was concluded that the noise levels were dominated by the vessel and not the rock dumping activities. Receptor Sensitivity of marine mammals and fish in the area is considered **Medium (B)** whilst the Magnitude of Effect of noise associated with rock placement is considered **Negligible (1)**. The Impact Significance of underwater noise from rock placement is therefore assessed as **Low** such that the impact of noise from contingency rock placement is considered negligible.

10.3.4 Vessel Activities

Vessel traffic is a substantial contributor to general anthropogenic sound scape with the primary sources of sound coming from the propellers, propulsion and other machinery (Ross, 1976; Wales and Heitmeyer, 2002).

Richardson *et al*. (1995) reviewed the effects of sound 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 sound may be associated with chronic stress in whales; Rolland *et al.* (2012) reported a decrease in baseline levels of stress-related faecal hormones

concurrent with a 6 Decibel (dB) reduction in underwater sound along the shipping lane in the Bay of Fundy, Canada, when traffic levels decreased.

Anthropogenic sound has the potential to interfere with acoustic communication, predator avoidance, prey detection, reproduction and navigation in fish. The effects of "excessive" sound 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 sound is the cause; for example, sound from research vessels has the potential to bias fish abundance surveys by causing fish to move away (de Robertis and Handegard, 2013; Mitson and Knudsen, 2003). Reactions include diving, horizontal movement and changes in tilt angle (de Robertis and Handegard, 2013). Popper *et al.* (2014) reviewed the effects of vessel sound on fish. They noted that there is no direct evidence of mortality or potential mortality to fish from vessel sound or other continuous sound sources. The authors concluded that the likelihood of sound from vessels causing mortality or injury to fish was remote, even for fish in close proximity to vessels, however, it is possible sound from vessels may cause some behavioural disturbance to fish.

The area around Montrose presents many background noise sources associated with vessel movements to which marine mammals and fish are exposed. Given that 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 **Medium (B)** Receptor Sensitivity and the Negligible Magnitude of Effect, the Impact Significance of the increased vessel noise in the area is considered **Low** such that any environmental impacts are considered to be negligible.

10.3.5 Piling Activities

Piling requires a hydraulic hammer to forcibly drive tubular steel piles into the seabed, resulting in substantial levels of pulsed underwater sound being generated. The level of this sound 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 the physical factors that will influence sound propagation (such as bathymetry, type of seabed substrate, water temperature and salinity).

A piled subsea manifold (18 m Length (L) x 11 m Width (W) x 6 m Height (H)) will be required in addition to the drill centre, as well as a drilling template if the template option is selected.

Piling of the manifold will be the loudest sound source associated with the proposed Project and will be the activity that results in the largest extent of potential injury or behavioural disturbance to marine mammals and fish. Therefore, underwater sound propagation modelling has been conducted to estimate the potential impacts of piling the manifold (Appendix D).

Four piles measuring around 26 m in length and 24" (*c*. 0.61 m) in diameter will be required for the subsea manifold. It is expected that it will take four hours to install each pile with a maximum of four piles being installed in a single day. The piling activities will start with a soft start with the energy of 9 kJ for 20 minutes. The maximum 90 kJ hammer energy will be gradually reached within 180 minutes. The maximum, worst case energy requirement for a single pile would be 90 kJ, which has been considered in the underwater noise modelling undertaken to support the impact assessment (Appendix D).

MARINE MAMMALS

Section 4.3.4 describes the abundance, distribution and seasonal occurrence of marine mammals known to occur in the Montrose area. Marine mammals have been grouped by Southall *et al.* (2019) according to the hearing range for the species (Table 10-1; Southall *et al.,* 2019) indicating which activities present during the development

may produce sounds within the hearing range of the various hearing groups. In many species sensitive to underwater sound, sensitivity is related to their use of high frequency sound for echolocation.

Table 10-1: Marine mammals known to occur in the Montrose area and hearing group.

Functional hearing group (Southall *et al*. 2019)	Generalised hearing range[1]	Species known to occur in the Montrose area
Low-frequency (LF) cetacean	7 Hz to 35 kHz	Minke whale
High-frequency (HF) cetacean	150 Hz to 160 kHz	Atlantic white-sided dolphin, white-beaked dolphin, bottlenose dolphin, Risso's dolphin, killer whale, fin whale
Very High-frequency (VHF) cetacean	275 Hz to 160 kHz	Harbour porpoise
Phocid pinnipeds	50 Hz to 86 kHz	Grey seal, harbour seal
[1]The frequency bands distinguish between very broad categories of sensitivity and noise sources		

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 sound on the marine mammal receptors has been assessed using the recommended JNCC guidance (JNCC, 2010). To support the assessment of the impact of piling, underwater sound propagation modelling was carried out. Full details of the modelling are available in Appendix D.

The predicted sound levels from piling have been compared with the Southall *et al*. (2019) precautionary thresholds for permanent threshold shift (PTS) to marine mammals. The thresholds are based on a comprehensive review of evidence for impacts of underwater sound on marine mammals and are widely applied as appropriate precautionary criteria for assessing the impact of underwater sound on marine mammals (JNCC, 2010a).

As discussed in detail in Appendix D, predicted sound levels from the proposed piling at Montrose have been compared to the Southall *et al*. (2019) zero-to-peak sound pressure level (SPL) and cumulative sound exposure level (SEL) thresholds for PTS onset. The predicted distances to the Southall *et al*. (2019) PTS thresholds are summarised in Table 10-2 and Table 10-3. As the distances shown in Table 10-2 are less than the nominal 500 m mitigation zone radius included in the JNCC Guidelines (JNCC, 2010), implementation of JNCCs standard mitigation measures (Section 10.5) will further reduce the likelihood of PTS occurring for all marine mammal groups.

The predicted maximum distances where the zero-to-peak SPL thresholds for PTS onset are exceeded during the piling are summarised in Table 10-2. It is predicted that the zero-to-peak SPL generated throughout the piling will not exceed the PTS thresholds for any marine mammal hearing group outside the standard 500 m mitigation zone that will be employed during the piling operations (JNCC, 2010).

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 PTS thresholds after they swim away are shown in Table 10-3. The modelling predicts that the PTS thresholds will not be exceeded for any marine mammals assuming that they swim away from the piling location at a minimum 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. For example, the normal swimming speed of minke whales (which are the only LF cetaceans likely to be in the area) is 2.1 m/s (Williams, 2009) and they have been observed swimming at speeds of up to 7.2 m/s (Lockyer, 1981). The 500 m mitigation zone and associated mitigation measures (e.g., marine mammal observers (MMOs), passive

acoustic monitoring (PAM), and marine mammal mitigation protocol (MMMP)) is expected to be sufficient to mitigate against PTS occurring to any marine mammals.

Table 10-2: Predicted maximum distances from the piling location where sound levels decrease to below the zero-to-peak SPL for potential PTS onset using a 90 kJ hammer energy.

Marine Mammal Hearing Group	Zero-to-peak SPL PTS Threshold (dB re 1 µPa)	Maximum Distance to Threshold Exceedance (m)[1]
LF Cetaceans	219	3
HF Cetaceans	230	Threshold not exceeded
VHF Cetaceans	202	30
Phocid Pinnipeds	218	4
[1] Predicted distances have been rounded up to the nearest 1 m.		

Table 10-3: Predicted maximum distances that marine mammals must be from piling location at the start of piling in order to not be exposed to cumulative SEL exceeding the PTS threshold when they swim away.

Marine Mammal Hearing Group	Cumulative SEL Threshold for PTS (dB re 1 µPa^{2}s)	Swim Speed (m/s)	Maximum Distance to Threshold Exceedance (m) [1]
LF Cetaceans	183	1.5	Threshold not exceeded
HF Cetaceans	185	1.5	Threshold not exceeded
VHF Cetaceans	155	1.5	Threshold not exceeded
Phocid Pinnipeds	185	1.5	Threshold not exceeded
[1] Predicted distances have been rounded up to the nearest 10 m.			

Table 10-4 presents the results of the modelling for predicting the distance associated with any marine mammal behavioural disturbance due to piling at the Montrose field area. The predicted disturbance is consistent with observations made during piling activities at other developments (Brandt *et al.,* 2018). The piling activities at the manifold are expected to be completed within one day of commencement, such that any marine mammals disturbed are expected to return to the area after cessation of activities (Brandt *et al.,* 2011, 2016, 2018). Any disturbance experienced is therefore considered to be temporary.

Table 10-4: Predicted distances where sound levels decrease to below the adopted marine mammal behavioural disturbance thresholds and areas of potential disturbance for a 90 kJ hammer energy.

Criteria	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]	2	14
Tougaard (2016) criteria for behavioural disturbance to all marine mammals	145	4	62

[1] Predicted distance has been rounded up 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 **Medium (B)** Receptor Sensitivity and the Minor Magnitude of Effect, the Impact Significance of piling noise on marine mammals is considered **Low** such that any environmental impacts are considered to be negligible.

FISH

The fish species associated with the project area are identified in Section 4.3.3. 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) (Table 10-5). Many species of fish produce sounds for communication that are typically emitted at frequencies below 1 kHz (Montgomery *et al.,* 2006).

Table 10-5: Fish groupings and species within the Montrose area with respect to presence/absence of swim bladder.

Fish group	Species
Fishes with no swim bladder	Lemon sole and plaice
Fishes with swim bladder involved in hearing	Herring
Fishes with swim bladder not involved in hearing	Angler fish, blue whiting, cod, European hake, haddock, horse mackerel, ling, mackerel, Nephrops, Norway pout, sandeel, spotted ray, spurdog and whiting[1]
Eggs and larvae	Cod, lemon sole, mackerel, Nephrops, Norway pout, plaice and sandeel (spawning areas, other species listed above have nursery areas within project area)

[1] Insufficient information available to confirm whether or not the swim bladder is involved in hearing.

Potential impacts to fish species were also assessed by comparing the underwater sound modelling results presented in Appendix D to the Popper *et al.* (2014) fish injury thresholds. The results summarised in Table 10-6 predicts that injury to fish due to the zero-to-peak SPL will be limited to distances up to a maximum of 20 m from the location of the piling activities.

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 throughout the piling (Wardle *et al.,* 2001; Mueller-Blenkle *et al.,* 2010). Not all fish exhibit a startle response (Wardle *et al.,* 2001) and a conservative swim speed of 0.5 m/s has been assumed. The predicted minimum initial distances that fish must be from the pile noise source at the start of pile driving operations (i.e., safety distances) are summarised in Table 10-7. These distances equate to exposure exceedance of the Popper *et al.* (2014) thresholds for potential injury. 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.

Table 10-6: Predicted maximum 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	10
Fishes with swim bladder involved in hearing	207	20
Fishes with swim bladder not involved in hearing	207	20
Eggs and larvae	207	20
[1] Predicted distances have been rounded up to the nearest 10 m.		

Table 10-7: Predicted maximum 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 Injury Threshold (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	Threshold not exceeded
Fishes with swim bladder involved in hearing	207	0.5	Threshold not exceeded
Fishes with swim bladder not involved in hearing	210	0.5	Threshold not exceeded
Eggs and larvae	210	Stationary	90
[1]Predicted distances have been rounded up to the nearest 10 m.			

With the implementation of a piling soft-start procedure it is expected that any fish in the area would disperse to areas where injury or mortality would not occur, therefore any occurrence of injury to fish would be low. Furthermore, if fish are disturbed by sound, evidence suggests they will return to an area once the activity causing the disturbance has ceased (Slabbekoorn *et al.,* 2010). Therefore, the Magnitude of Effect of underwater sound associated with the piling activities on fish is considered **Minor (2)**. Given the **Medium (B)** Receptor Sensitivity and the Minor Magnitude of Effect, the Impact Significance of piling noise on fish is considered **Low** such that any environmental impacts are considered to be negligible.

10.4 Cumulative and Transboundary Effects

The additional vessels associated with the proposed Montrose Infill Project will cause a modest increase in underwater noise in the area. However, as the vessels will be located within a well-developed oil and gas area, any cumulative impacts of underwater noise due to vessels are not considered significant given the existing shipping levels. Piling activities associated with the installation of the manifold and drilling template (if used) 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 Montrose field is located *c*. 46 km from the UK/Norway median line and therefore no transboundary impacts associated with the underwater sound from the vessels or piling activities are expected.

10.5 Mitigation Measures

The following industry standard mitigation measures will be undertaken to minimise the impacts of the underwater noise sources associated with the Montrose Infill Project.

Proposed Mitigation Measures
› A qualified, trained and equipped marine mammal observer (MMO) will be present during piling. The MMO will carry out a pre-piling survey of a 500 m mitigation zone and, if an animal 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;
› Passive Acoustic Monitoring (PAM) will be employed during periods of low visibility and at night to detect marine mammal presence;
› Avoiding commencing piling at night or in poor visibility when marine mammals cannot reliably be detected. If this cannot be avoided, then PAM will be used; and
› Commitment to preparing a MMMP to summarise all mitigation measures.

Applying the impact assessment methodology described in Chapter 5 and taking account of the mitigation measures listed above, the overall Impact Significance of the various underwater noise sources associated with the proposed Project is considered **Low**. The impacts are therefore considered acceptable when managed within the additional controls and mitigation measures identified.

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 Waste Generation

This chapter discusses the types of waste likely to be generated as a result of the proposed Montrose Infill Project, 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.

NEO NEXT+ 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 similar to that shown in Figure 11-1. 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 NEO NEXT+'s 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 11-1: NEO NEXT+'s Waste Management Hierarchy.

Consent to transfer to the UK shore is not required but 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.

11.1 Vessel Waste

Waste will be generated from a number of vessels associated with the proposed activities (Table 3-8 and Table 3-11 provide a list of vessels). Waste from these vessels will be managed in line with the individual vessel WMP in accordance with MARPOL requirements, which regulate discharges of waste to sea from ships.

11.2 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.

For note, the WBM contaminated drill cuttings will be discharged at the seabed whilst the LTOBM contaminated cuttings will be treated offshore and discharged (described in Section 3.5.5). However, in the event that the TCC system breaks down the contaminated cuttings may be skipped and shipped to shore for treatment and management in line with the waste hierarchy.

11.3 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 NEO NEXT+'s WMP and Controlled Waste Transfer Notes will be completed.

11.4 Production Phase

The Montrose platforms comply with NEO NEXT+'s WMP. Controlled waste transfer notes will continue to be completed as required and records on monthly waste disposal activities will be maintained. The proposed project is not expected to result in a change to the current waste streams occurring at the Montrose platforms.

11.4.1 General Waste

The Montrose platform's 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 the platform's WMP, and the NEO NEXT+ waste management standard and controlled waste transfer notes will be completed. A Waste Management Duty of Care audit will also be carried out. Generation of general waste on the Montrose installations are not expected to change as a result of the proposed Montrose Infill Project.

11.4.2 Produced Water and Laboratory Waste

Produced water will continue to be processed on the Montrose BLP, with oil and water separator efficiency improved by running the crude oil start-up heater continuously; this will ensure produced water discharges are within 30 mg/l oil in water content. Volumes of produced water from the Montrose Infill Project will remain within existing processing capacities. Once the infill wells are brought online, production from other fields will be ramped down or "backed out" in order to maintain the produced water rate within the design envelope of the Montrose Platform. Any other waste chemicals are segregated on site (where possible) and sent to shore for disposal via a suitably licensed contractor. As for general waste streams, the platform WMP is in place to minimise laboratory waste. Production of laboratory waste on the Montrose platforms is not expected to change as a result of the proposed project.

11.4.3 Special Waste

The Montrose platforms ship to shore a number of hazardous solid and liquid waste streams which may include Naturally Occurring Radioactive Material (NORM) / Low Specific Activity (LSA) scale. The types of hazardous wastes handled on the Montrose platforms will not change as a result of the proposed Montrose Infill Project.

11.5 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, NEO NEXT+ 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 11-1.

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.

11.6 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.

11.7 Mitigation Measures

The following mitigation measures are proposed to minimise the waste produced from the proposed Montrose Infill Project.

Proposed Mitigation Measures
› NEO NEXT+ will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle; › Existing asset and vessel WMPs will be followed; and, › Only suitably permitted and licensed disposal yards / landfill sites will be used, in compliance with relevant legislation.

As a receptor, landfill sites can be considered abundant, such that applying the impact assessment methodology presented in Chapter 5, the Receptor Sensitivity of landfill sites is considered **Low (A)**. NEO NEXT+ recognise landfill sites as a finite resource, however, as the majority of waste will be recycled and the vessels / platform will have a WMP 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.

12 Accidental Events

In line with OPRED Guidance (BEIS, 2022) this ES assesses the environmental impacts associated with a well blowout, which is considered the worst-case accidental hydrocarbon release, and for which Oil Spill Modelling has been undertaken (Appendix C). The potential impacts resulting from a well blowout 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 (Section 12.2 and 12.3). It should be noted that the likelihood of a blowout occurring is extremely low (see Section 12.3.1).

It is acknowledged that other smaller spills could occur during the different project phases. These other spill sources are summarised in Section 12.1 and have not been modelled.

The Montrose Field has an approved Oil Pollution Emergency Plan (OPEP) in place, and this will be amended to capture the proposed Montrose Infill wells including details on the flowrate and interface with the drilling rig. The likelihood of an accidental event at the Montrose installations is not considered to change as a result of the proposed Montrose Infill Project.

12.1 Sources of Accidental Hydrocarbon Releases

Sources of accidental releases of hazardous liquids and gases are varied and potentially 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 during bunkering.

12.1.1 Drilling Phase

During drilling, in addition to a potential subsea well blowout (Section 12.2 and 12.3), accidental releases of contaminated discharges could include the loss of cleaning chemicals, mud inventory, other oily slops etc. There is also a risk of an accidental spillage of drilling fluids (drilling mud) or diesel during bunkering operations.

These releases could result in toxic or sub-lethal effects on sensitive species. The resultant impacts depend on spill size, prevailing wind, sea state, temperature and sensitivity of environmental receptors affected (e.g. benthic species, fish, marine mammals, birds and protected areas).

Approved operational procedures will be adhered to, to mitigate the likelihood of such accidental events and to minimise their impact should they occur. For example, the quantities of chemicals stored on the drilling rig will be minimised. Control of Substances Hazardous to Health (COSHH) assessments will be completed and Safety Data Sheets (SDS) will be made available. Where possible given technical requirements, chemicals that are PLONOR, have a RQ < 1, or do not carry substitution warnings, will be prioritised. Spill kits will be located in close proximity to chemical and oil storage areas to enable a quick response.

Procedures, in line with best industry practice guidelines, will be in place to minimise the risk of an accidental spill from bunkering. These will include, for example, regular checks of the integrity of the hoses and competence of operators. Trained personnel will undertake bunkering operations in accordance with approved procedures. Containment facilities and drains will be inspected as part of marine assurance standards.

An approved OPEP will be in place to respond to an accidental hydrocarbon release. NEO NEXT+ is a member of Oil Spill Response Limited (OSRL) and the Offshore Pollution Liability Association Limited (OPOL). Local access to dispersant will be available via the ERRV on-site at Montrose. Oil Pollution Prevention and Control (OPPC) permit requirements will be adhered to. Any accidental hydrocarbon release from a drilling rig at the Montrose Field will be responded to in accordance with arrangements set out in the Montrose Complex OPEP and out of hours support will be provided by NEO NEXT+.

The environmental impact is considered to vary between the different accidental discharges identified. For example, the Impact Significance associated with the release of hydrocarbons during bunkering operations is considered **Low** whilst the impact associated with a loss of fuel inventory is considered **Moderate**. However, when the Likelihood of these accidental events taking place is taken into account, most are considered a **Low** overall Environmental Risk. Any risk will be reduced to as low as reasonably practicable and managed under the mitigation measures described such that it is considered acceptable.

12.1.2 Installation and Commissioning Phase

To mitigate the potential of accidental chemical or hydraulic fluid releases occurring, containment facilities will be inspected as part of the vessels HSE Management System audit and NEO NEXT+ routinely use hydraulic fluid containing dye for rapid detection. Industry standard operating procedures and checks will be carried out to prevent such a release where possible. Chemicals that are PLONOR, have a RQ < 1 and/or do not carry substitution warnings will be prioritised where technically possible.

With the above mitigation measures in place the Magnitude of Effect of accidental discharges of water-based hydraulic fluids or treated seawater is considered **Minor (2)** whilst the Environmental Risk is considered **Low,** and the Likelihood is ranked **Remote**. The risk is therefore considered acceptable when managed within the additional mitigation measures described.

12.1.3 Production Phase

The potential for accidental events associated with the production phase is not considered to differ to the current potential of such events at the Montrose Field.

Mitigation measures include the pre-existing 500 m safety zones at the Montrose installations, as well as the new 500 m zone which will be in place around the drill centre. Further mitigation measures include optimal material selection, operating procedures in place and preference for the use of water-based hydraulic fluids. With these mitigation measures in place the Environmental Risk of an accidental event is considered **Low** (Likelihood ranked as **Remote**) and therefore acceptable when managed within the mitigation measures described.

12.1.4 Decommissioning Phase

During decommissioning activities, the impact of any accidental events is anticipated to be within the range of impacts discussed in the previous sections.

12.2 Oil Spill Modelling

The Oil Spill Modelling is described in detail in Appendix C. Note that the modelling presents a worst-case scenario assuming no intervention. In reality, mitigation and response measures would be in place, as described in the Montrose Complex OPEP, which would reduce the extent of a spill.

12.2.1 Modelled Scenario

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.

Modelling has been undertaken using the Oil Spill Contingency and Response (OSCAR) model to evaluate potential spills from the proposed Montrose Infill Project. The primary aims of the modelling are to understand:

- The fate and behaviour of the released hydrocarbons;
- The probability of hydrocarbons accumulating on the sea surface, in the water column, reaching the shoreline and accumulating in the sediment;
- The minimum time taken for hydrocarbons to cross median lines and to reach the shore; and,
- The volume/area of water column, sea surface, coastline and sediment where hydrocarbon concentrations could exceed thresholds identified to have a significant environmental impact.

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 and the minimum time taken to reach median line and the shore.

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 oil concentrations deposited in the sediment in the selected modelled worst-case scenario.

A summary of the key parameters of the modelled scenario is presented in Table 12-1.

Table 12-1: Key parameters used in the Montrose Infill Project spill scenario.

Release location (projection: WGS 84)			Release Depth (m below sea level
57° 27' 27.71" N, 1° 23' 9.85" E			0.5
Modelled release rate (m^3/d)	Release duration (days)[2]	Modelled Total release (m^3)	Release temperature (°C)
4,681.1	1	4,681	103.2
3,955.7	1	3,956	103.0
3,529.2	1	3,529	102.8
3,222.5	1	3,223	102.6
2,966.7	1	2,967	102.4
2,532.8	5	12,664	102.2
2,213.6	5	11,068	102.0
2,031.9	5	10,160	101.6
1,822.7	10	18,227	101.1
1,627.8	10	16,278	100.6
1,493.6	10	14,936	100.2
1,387.6	10	13,876	99.7
1,299.5	10	12,995	99.2
1,227.5	10	12,275	98.7
1,169.7	10	11,697	98.2
1,102.0	20	22,041	97.8
1,033.9	20	20,678	97.6
983.7	20	19,674	97.4
941.8	25	23,545	97.2
Total	**175**	**238,469**	**-**

[1] Constant release depth throughout all simulations.

[2] Total release duration is 175 days, and total simulation duration is 205 days (30 additional days to allow for dispersion).

A declining flow rate was simulated in the model. However, the model is unable to simulate a continuously declining flow rate, therefore the release duration was divided into discrete periods and an average release rate for that period was used. During the early part of the simulation when the rate is declining rapidly, the rates were averaged over a single day whereas in the latter part of the simulation when the rate is declining much more slowly, rates were averaged over longer periods (up to 25 days).

12.2.2 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 was selected from this database to represent the Montrose crude (Table 12-2).

Table 12-2: Montrose oil properties and selected OSCAR analogues.

Property	Montrose Crude	North Star
API (°)	41.06	42
Specific gravity	0.821	0.816
Viscosity (cP at 13°C)	9.94	10
Pour Point (°C)	-	-39
Asphaltene content (% weight)	0	0.002
Wax content (% weight)	5.3	5.9

12.2.3 Summary of Modelling Results

A summary of the stochastic and deterministic modelling results for the modelled scenario (surface well blowout), are presented in Table 12-3.

Table 12-3: Oil spill modelling results summary.

Variable	Environmental Fraction		Surface Well Blowout
Release volume over whole simulation			238,469 m^3
% total oil in environmental fraction; (end of deterministic simulation)	Sea surface		0.03%
	Shoreline		0.1%
	Water Column		5.6%
	Sediment		22.5%
	Atmosphere		46.9%
	Biodegraded		24.0%
Total oil (tonnes) in environmental fraction; (end of deterministic simulation)	Sea surface		70 t
	Shoreline		280 t
	Water Column		11,450 t
	Sediment		46,350 t
	Atmosphere		96,750 t
	Biodegraded		49,250 t
	Fraction	**Thresholds**	
Extent above thresholds (deterministic simulations	Sea surface	0.3 µm	72,874 km^2
	Shoreline	0.1 kg/m^2 (100 g/m^2)	98.8 km
	Water column	10 µg/l	4,740 km^3
	Sediment	5 g/m^2	451.8 km^2
	Environmental Fraction		
Shoreline oiling maximum probability (%, stochastic)	Northeast Scotland		6%
	Eastern Scotland		13%
	Southern Scotland		12%

Variable	Environmental Fraction	Surface Well Blowout
	Northumberland and Tyne and Wear	9%
	Tees Valley and Durham	1%
	Denmark	4%
	Sweden	2%
	Western Norway	15%
	Eastern Norway	8%
	Southern Norway	15%
Maximum probability of crude/oil on the surface crossing median lines (%, stochastic)	UK-Norway	100%
	UK-Denmark	33%
	UK-Germany	19%
	UK-Netherlands	8%
	Norway-Denmark	32%
	Germany- Denmark	22%
	Germany - Netherlands	8%

12.3 Impact Assessment

The environmental impact of a hydrocarbon spill depends on various factors which include:

- Location and time of the spill;
- Spill volume;
- Hydrocarbon properties;
- Prevailing weather and metocean conditions;
- Environmental sensitivities; and
- Spill response strategy.

This section evaluates the impacts of a well blowout by considering the predicted modelling results (Appendix C) in relation to the environmental receptors that could be impacted (Chapter 4).

The classification of Receptor Sensitivity and Magnitude of Effect is in line with the impact assessment methodology described in Chapter 5. As with planned events, Receptor Sensitivity and Magnitude of Effect are combined to give an environmental Impact Significance of impact. For accidental events, this is then combined with Likelihood (Section 12.3.1) to give an overall Environmental Risk. All matrices explaining terminology are shown in Chapter 5.

12.3.1 Likelihood of a Blowout

During drilling, if uncontrolled pressure builds up in the wellbore, this could cause a sudden release of oil, gas, or drilling fluids from the well and is referred to as a blowout. In the unlikely event of an influx, the flow of reservoir fluids into the well is stopped by closing the blowout preventer (BOP) which is the initial stage of secondary well control. The BOP has multiple sets of rams that can close off the well bore in an emergency. Secondary well control is completed by circulating the well with kill weight fluid and displacing the influx out of the well. A blowout can occur if primary and secondary well control fails.

Down hole safety valves (DHSVs) are in place to seal wells should an unplanned well event occur during production. These DHSVs complement the valves that are contained within the tree. Wells are plugged with cement and decommissioned when production has ceased.

The International Association of Oil & Gas Producers (IOGP) has issued datasheets (IOGP, 2019) on well blowout frequencies for drilling operations of a North Sea Standard (NSS), where the operation is performed with a BOP installed and the "two barrier" principle is followed (Table 12-4). The dataset is derived from the Sintef well blowout database where a blowout is defined as an incident where formation fluid flows out of the well or between formation layers after all the predefined technical well barriers or the activation of the same have failed. Well blowout frequencies have been calculated per well drilled in the North Sea and are not an annual frequency. Note that well blowout frequency per total wells drilled is very low, indicating that the Likelihood of a well blowout occurring is **Remote** (similar event has occurred elsewhere but unlikely to occur with current practices). The Likelihood of a blowout occurring at a maximum flow rate, or for an extended period of time, is lower still.

Table 12-4: Well blowout frequencies for North Sea offshore operations (IOGP, 2019).

Operation	Gas	Oil	Unit
Development drilling (oil)*	4.2 × 10-5	3.4 × 10-5	Per well drilled
Development drilling (HP/HT)	2.6 × 10-4	2.1 × 10-4	
Development drilling shallow gas (topside)	1.7 × 10-3	-	
Development drilling shallow gas (subsea)	1.0 × 10-3	-	
*This figure is relevant to the proposed Montrose Infill Project. Other types of well are shown for comparison.			

12.3.2 Impact on Water Quality

Given the open nature and strong currents in the North Sea, the Sensitivity of water quality as a receptor is considered **Low (A)**.

Accidentally released crude or oil 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 (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 Montrose crude is not expected to form emulsions as the asphaltene content is less than 0.5 %.

When a hydrocarbon enters the marine environment, it will become exposed to numerous 'weathering' processes which will impact the behaviour and fate of the hydrocarbon. As each hydrocarbon has its own specific properties each one will weather differently. Montrose Crude is an International Tanker Owners Pollution Federation Limited (ITOPF) Category Group II oil. The specific gravity of oil is its density in relation to pure water, which has a specific gravity of 1. Montrose Crude has a specific gravity of 0.82 indicating that the oil is likely to remain on the sea surface during calmer conditions, however; there is the potential for this oil to suspend below the sea surface during rougher weather conditions.

Modelling results for the deterministic scenario suggest that the level of hydrocarbons in the water column may reach or exceed the defined No Observed Effect Concentration of 10 µg/l over a considerable volume of 4,740 km^3. The maximum predicted concentration is 1,471.9 µg/l (Figure 12-1). For comparison, typical background values of total petroleum hydrocarbons in the North Sea range from 0.5-0.7 µg/l (pristine), 1-30 µg/l near installations, to 2 µg/l in coastal waters (DTI, 2001). Consequently, the Magnitude of Effect from a potential release is considered **Major (4)** (includes transboundary impacts).

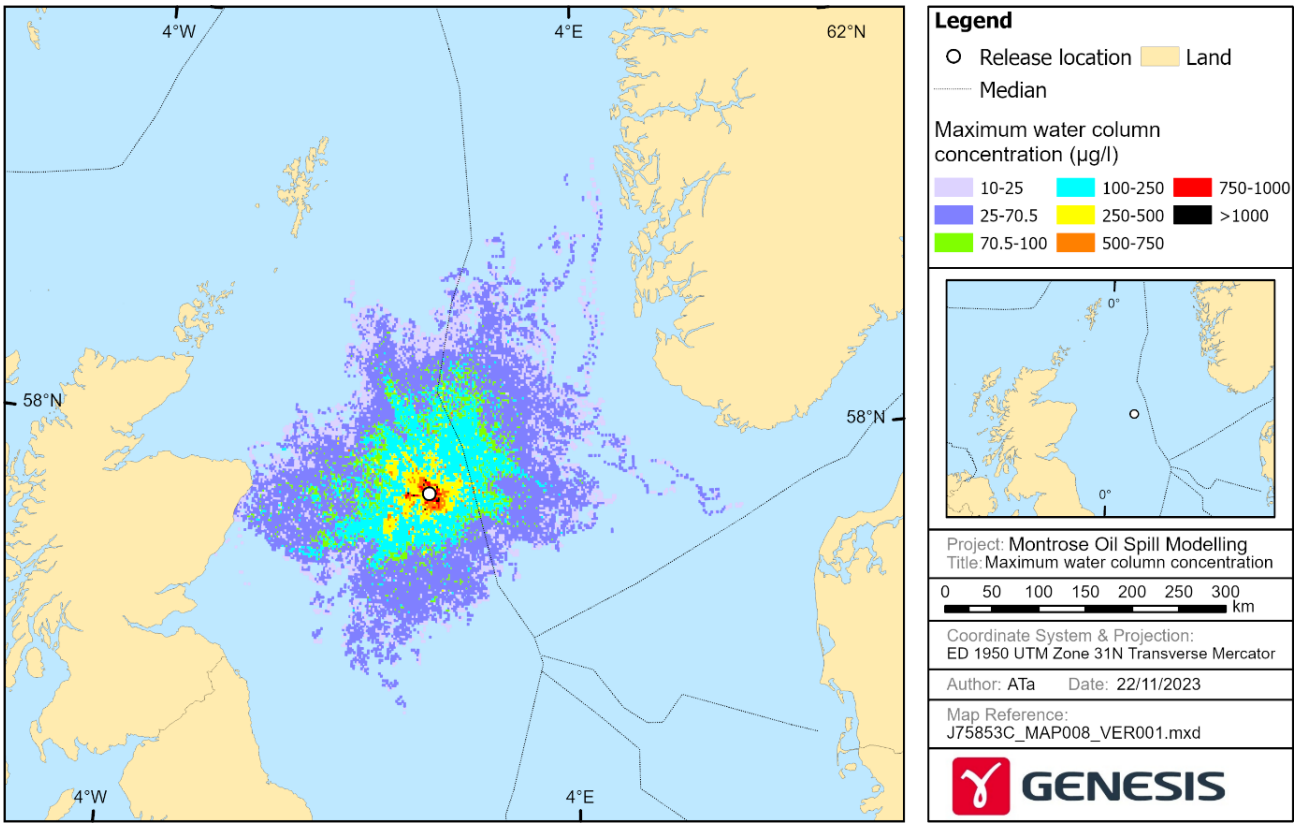


Figure 12-1: Maximum oil concentration in water column (deterministic).

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Water Quality	Low	Major	Moderate	Remote	Low

12.3.3 Impact on Sediment Quality

Sediments in the proposed Montrose Infill Project area generally comprise 'silty fine sand with occasional shell fragments' across most of the site with an area to the east comprised of 'silty fine sand with numerous shell fragments' (GEOxyz, 2023; Chapter 4). The Receptor Sensitivity of sediments in the area is considered to be **High (C)** given that the proposed project area lies within the East of Gannet and Montrose Fields NCMPA, designated for the low or limited mobility species 'ocean quahog aggregations (including sands and gravels as their supporting habitat)', as well as 'offshore deep-sea muds' habitat. Further discussion of the potential presence of sensitive habitats and species in the area can be found in Section 4.5.

Worst-case deterministic modelling predicted that there would be a 451.8 km^2 area of seabed impacted by oil at a concentration above the 5 g/m^2 threshold (Figure 12-2). Consequently, the Magnitude of Effect from these potential releases is considered **Serious (3)**.

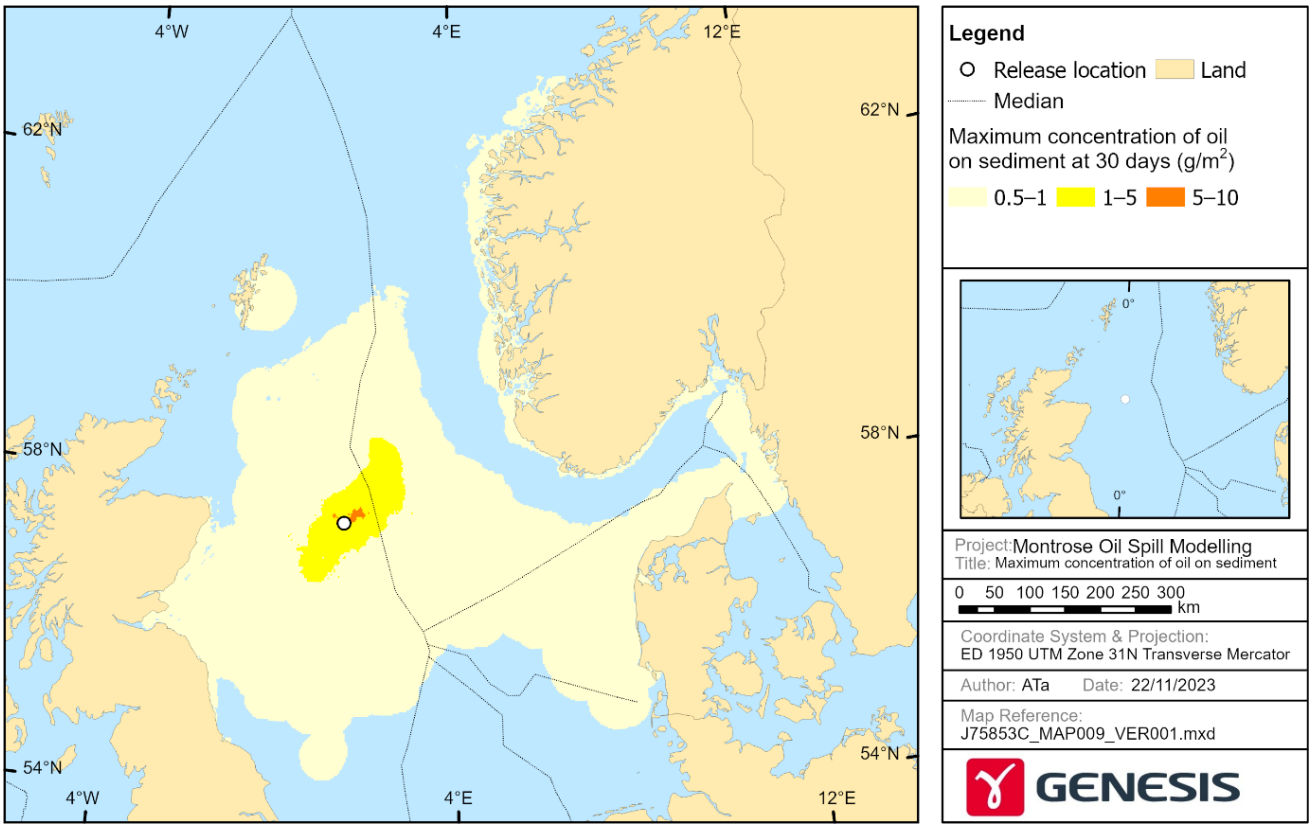


Figure 12-2: Maximum oil concentration in sediment (deterministic, 205 days).

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Sediment Quality	High	Serious	Moderate	Remote	Low

12.3.4 Impact on Plankton

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). Receptor Sensitivity of plankton at the proposed Project location is therefore considered Low **(A)**.

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 the entire ecosystem (Ozhan *et al*., 2014). Both oil and oil 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). Figure 12-1 therefore demonstrates that plankton across a large

area (including transboundary) surrounding the proposed release location would potentially be impacted during a well blowout.

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). The volume of water that would be impacted by a blowout at the proposed Project location is relatively large, however given the evidence that plankton biomass levels can be re-established after a short period of time, the Magnitude of Effect is considered **Serious (3).**

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Plankton	Low	Serious	Moderate	Remote	Low

12.3.5 Impact on Benthos

Seabed habitats and associated benthic species may potentially be impacted by a well blowout where hydrocarbons are present in the water column or in the seabed sediment (Figure 12-2).

In response to hydrocarbon exposure, benthic fauna can move, tolerate the pollutant (with associated impacts on the overall health and fitness), or die (Gray *et al.,* 1988; Lee and Page, 1997). The response to hydrocarbons by benthic species differs depending on their life history and feeding behaviour, as well as the ability to metabolise toxins, especially PAH compounds. 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).

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).

As described in Section 4.3.2, seabed surveys carried out in the area of the Montrose Field identified a number of benthic species in the area including filter feeders (e.g. sea pens and *A. islandica*). Filter feeders are vulnerable to

ingesting oil during feeding. Generally, infaunal polychaetes are particularly affected by oil pollution (Suchanek, 1993), however, their recolonisation of effected areas varies with some species decreasing after an oil spill whilst others may be the first colonisers (Blackburn *et al.,* 2014 and references therein). Burrowing bivalves and small crustaceans called amphipods can be sensitive to even brief exposures of relatively low hydrocarbon concentrations (IPIECA-IOGP, 2015; Suchanek, 1993), possibly because of their low dispersal rate and limited mobility. *P. jeffreysii* is known to be highly tolerant of hydrocarbon contamination (MarLIN, 2016 and references therein) and intolerant of elevated heavy metal concentrations such as copper (Rygg, 1985).

According to FeAST (Marine Scotland, 2023), oil from spills would have to be dispersed deep into the water column to affect a burrowed mud feature. Information on the impacts of hydrocarbons on sea pens is limited (Hill and Wilson, 2000), however, a study on the impact of oil on deep-sea megafauna (McClain *et al.,* 2019) notes that at the Deepwater Horizon oil spill site in 2017 (seven years after the spill incident), there was lowered species diversity and sessile fauna such as sea pen were absent. This may reflect low resiliency to pollution, especially in cnidarians.

Given the presence of habitats and species identified as PMFs (Section 4.5.2) the Receptor Sensitivity is considered **High (C)** whilst the Magnitude of Effect is considered **Serious (3)**.

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Benthos	High	Major	Moderate	Remote	Low

12.3.6 Impact on Fish

Exposure of fish to hydrocarbons can occur either through uptake across the gills or skin or by direct ingestion of the pollutant through contaminated prey. Pelagic species, which spend the majority of their life cycle in the water column, are likely to receive the highest exposure to contaminants that remain near the surface, whereas demersal fish species, associated with the seabed, are more likely to be exposed to particle-bound contaminants.

The likelihood of adult fish mortality due to open water hydrocarbon 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 hydrocarbon spill event. A spill could have the potential to impact fish spawning success because the eggs and larvae of many species are very sensitive to pollution.

The Montrose Field is located within ICES rectangle 43F1 and a number of fish spawning and nursery grounds occur there (Section 4.3.3). Several of these are PMFs including anglerfish, blue whiting, cod, herring, mackerel, ling, Norway pout, sandeels, spurdog and whiting. The eggs and larvae of broadcast spawners, such as Norway pout, which are widely dispersed, could be exposed to oil in the water column. Additionally, species such as lemon sole, plaice and sandeels may occur and spawn on the seabed within the Montrose Field area and thus be impacted by deposition of oil. The deterministic simulation estimated that the concentration of oil on the seabed exceeded the threshold of 5 g/m^2 over an area of 451.8 km^2 (Figure 12-2). The stochastic simulation estimated that water column concentrations above the 10 ppb threshold could occur up to a maximum distance of approximately 270 km from the release site, with a probability of ≥ 50 % (Figure 12-1). This includes areas across the UK/Norway median line but represents a relatively small area in comparison to the size of spawning grounds in the North Sea (all species that spawn in the Montrose area spawn over extensive areas of UK waters) and sediment.

Given the presence of fish species identified as PMFs the Receptor Sensitivity is considered **Medium (B)** whilst the Magnitude of Effect is considered **Serious (3)**.

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Fish	Medium	Serious	Moderate	Remote	Low

12.3.7 Impact on Seabirds

Seabirds are particularly sensitive to the effects of surface oil pollution, and some oil pollution incidents have resulted in mass mortality of seabirds (e.g. Munilla *et al.,* 2007; 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 sea ducks (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).

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). Seabird sensitivity to surface oil pollution in the Montrose Field area is generally low throughout the year (Section 4.3.5).

There are birds of conservation importance (Section 4.5.2) at national (Scottish), OSPAR, European or International Red List Levels within the area of the proposed Montrose Infill Project. Of these species the conservation status of the Black-legged Kittiwake and Atlantic Puffin is classified as 'vulnerable' on the IUCN Red List for Birds, due to the rapid declines recorded in its 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).

There is a high probability of surface oiling over a wide area following a blowout (Figure 12-4). Oil spill modelling also indicates there is a low probability of oil reaching the coast in areas that are internationally or nationally designated for seabirds (Figure 12-6 and Section 12.3.10). Shoreline oil concentrations would exceed the threshold of 100 g/m^2 (0.1 kg/m^2) above which impacts are considered potentially significant over 98.8 km length of coastline.

Given the potential vulnerability of seabirds to surface oil pollution and fact that many of the species in the area will be associated with coastal SPAs, the Receptor Sensitivity is considered **High (C),** and the Magnitude of Effect is considered **Major (4)** (transboundary and coastal impacts).

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Seabirds	High	Major	High	Remote	Medium

12.3.8 Impact on Marine Mammals

Marine mammals may be exposed to hydrocarbons either internally (swallowing contaminated water, consuming prey containing oil-based chemicals, or inhaling of volatile hydrocarbon related compounds); and externally (swimming in hydrocarbon or dispersants contacting the skin).

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 form 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. The available 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. Hydrocarbons tend 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 feeding a 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 metabolized, and for contaminants to be passed to juveniles through the mother's milk.

Several cetacean species are known to occur in the vicinity of the Montrose Field (Section 4.3.4) with sightings of harbour porpoise, bottlenose dolphin, minke whale, Risso's dolphin, Atlantic white-sided dolphin, white-beaked dolphin and killer whale throughout the year. Therefore, it is possible that a hydrocarbon spill at Montrose could impact cetaceans.

Seals are vulnerable to hydrocarbon pollution because they spend much of their time near the surface and regularly haul out on beaches. Stochastic oil modelling of the well blow-out scenario identified a potential for significant adverse impact on seals because of predicted oil beaching. Seals have been seen swimming in hydrocarbon slicks during several documented spills (Geraci and St. Aubins, 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.

Given that the marine mammals in the area include PMFs, and Annex II and Annex IV species, the Receptor Sensitivity is considered **High (C)**. Given the potential impact of hydrocarbons on marine mammals (cetaceans and seals) the Magnitude of Effect is considered Serious **(3)**.

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Marine Mammals	High	Serious	Moderate	Remote	Low

12.3.9 Impact on Offshore Protected Areas

The offshore protected areas which could potentially be affected by hydrocarbons released as a result of the well blowout or inventory rupture scenarios are summarised in Table 12-5 and shown in Figure 12-3, Figure 12-4 and Figure 12-5. Of the designated areas that fall within areas where there is a greater than 50 % probability of either surface or water column oiling, Gytefelt Makrell and Tobisfelt Particularly Valuable Areas (PVAs) are designated for mackerel and sandeel spawning respectively and fall within areas where there is 100 % probability of water column oiling.

Mackerel are broadcast spawners and their eggs and larvae float free in the water column, therefore impacts to the water column could impact mackerel spawning success over one season to a year. Consequently, impacts to the Gytefelt Makrell PVA may result in significant adverse effects to the current mackerel population structure within the site. Sandeels spawn in sediments and occupy benthic regions. As previously mentioned in Section 12.3.3, the concentration of oil on the seabed exceeded the threshold of 5 g/m^2 over an area of 451.8 km^2, however this does not overlap with the Tobisfelt PVA and so sandeel spawning is not likely to be impacted (Figure 12-5).

The remainder of the sites where there is a greater than 50 % probability of either surface or water column oiling are designated for benthic/sediment features.

Table 12-5: Potential impact to offshore protected areas from a well blowout at the proposed Project location.

Map Ref	Protected Area	Blowout		Protected features
		Probability of surface oiling above impact threshold (> 50%)	Probability of water column oiling above impact threshold (> 50%)	
1	Norwegian Boundary Sediment Plain NCMPA	100	100	*A. islandica* and sediments.
2	East Of Gannet and Montrose Fields NCMPA	100	100	*A. islandica* and sediments.
3	Scanner Pockmark SAC	97	100	Submarine structures made by leaking gases.
4	Fulmar MCZ	80	83	*A. islandica* and sediments.
5	Gytefelt makrell PVA	100	100	Mackerel spawning.
6	Tobisfelt PVA	100	100	Sandeel habitat and spawning.

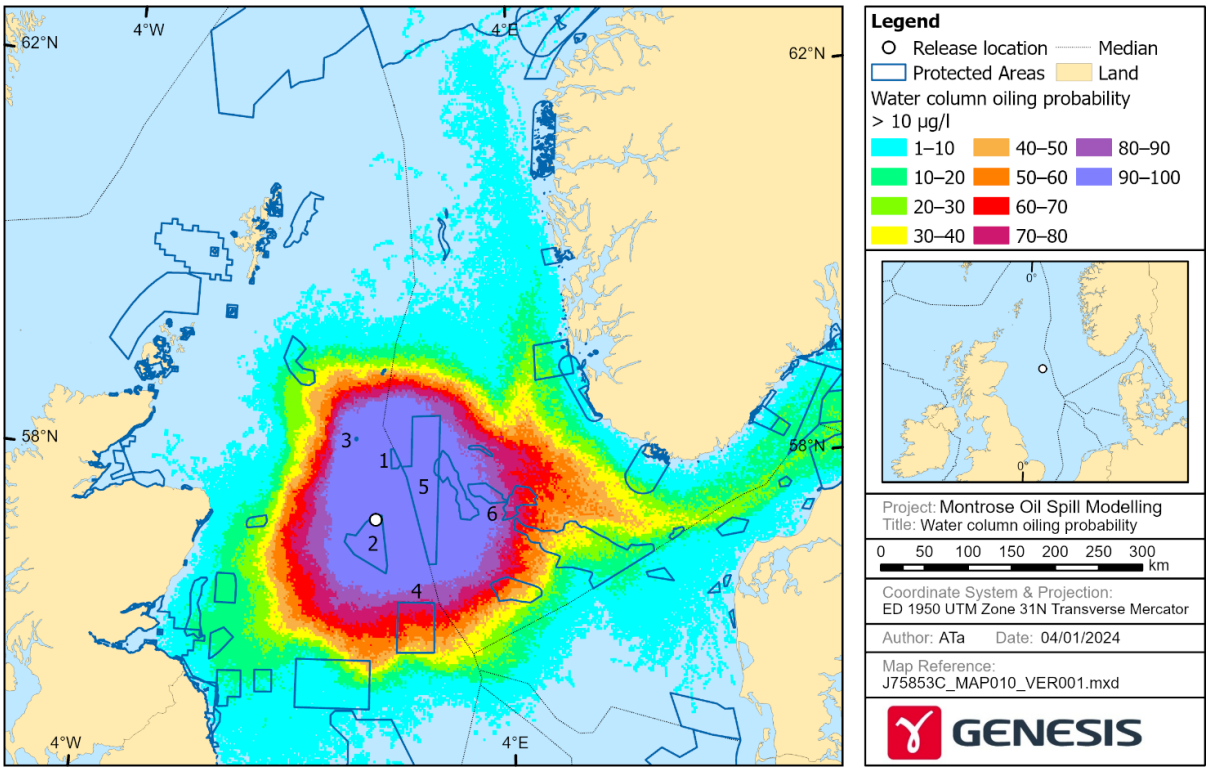


Figure 12-3: Probability of water column concentrations ≥ 10 ppb (stochastic) and offshore protected areas.

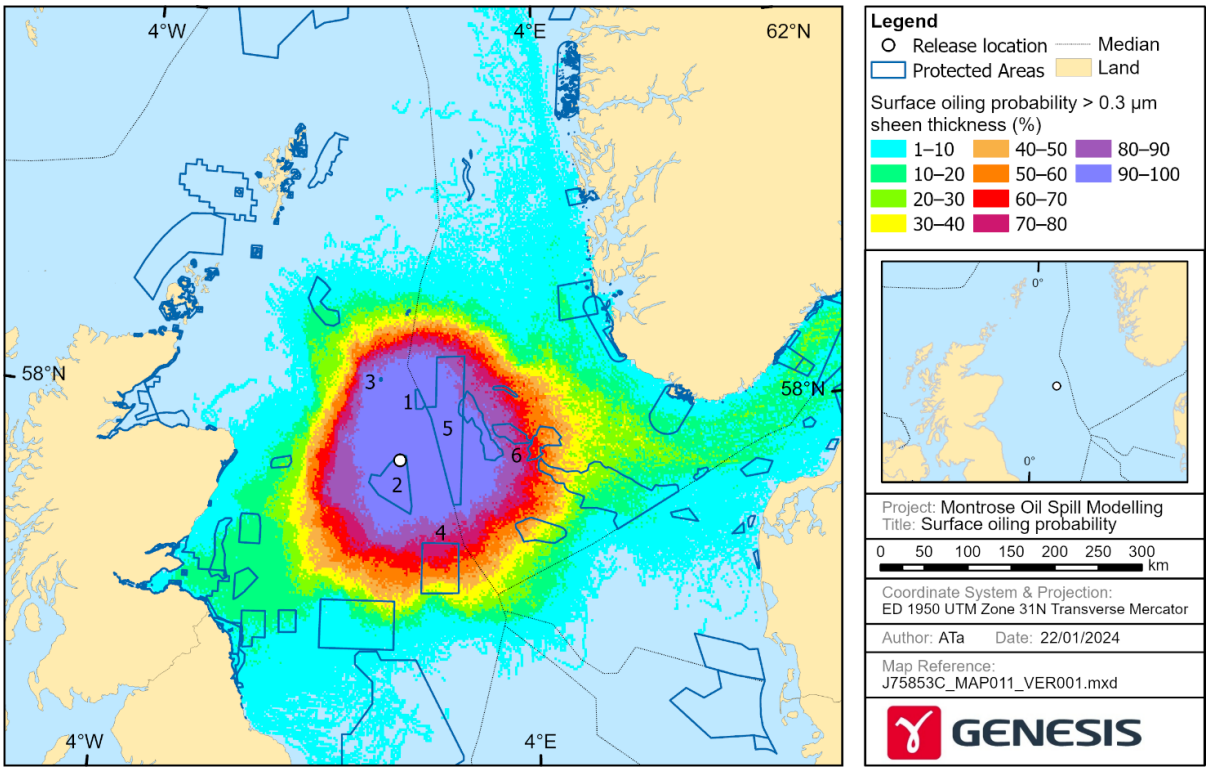


Figure 12-4: Probability of a surface sheen > 0.3 µm (stochastic) and protected areas.

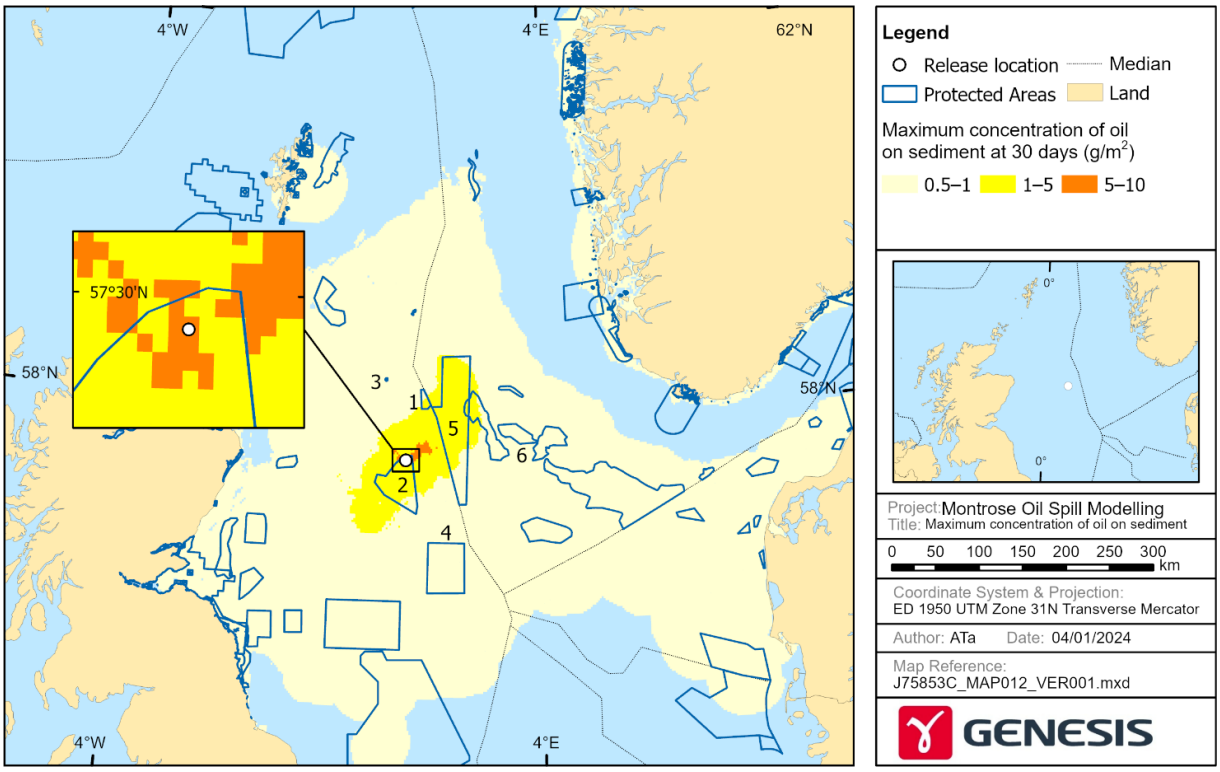


Figure 12-5: Maximum oil concentration in sediment (deterministic, 205 days) and offshore protected areas.

The only site designated for benthic/sediment features within the 451.8 km^2 area of seabed oiling (> 5 g/m^2) is the East of Gannet and Montrose Fields NCMPA. The area of the NCMPA where seabed oiling is > 5 g/m^2 equates to *c*. 5 % of the overall NCMPA area. *A. islandica* present in the NCMPA would therefore be susceptible to hydrocarbon deposition on sediments following a well blowout. The PMF 'Sea pens and burrowing megafauna in circalittoral fine mud' have also been observed within the NCMPA and, as benthic filter feeders, would also be susceptible to hydrocarbon deposition on sediments during a well blowout.

Given that the designated features of designated sites may be impacted, the Receptor Sensitivity is considered **High (C).** Due to the area of seabed that could be impacted within the designated sites, the Magnitude of Effect on offshore protected areas is considered **Major (4)**.

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Offshore Protected Areas	High	Major	High	Remote	Medium

12.3.10 Impact on Coastal/Nearshore Protected Areas

The probability of shoreline oiling, resulting from a well blowout, is low but could coincide with coastal protected areas (Figure 12-6 and Figure 12-7 and Table 12-6). For the worst-case shoreline oiling, approximately 98.8 km of the UK coastline would exceed the threshold of 0.1 kg/m^2.

Note that in the modelled deterministic scenario (worst case oil on shore) shown in Figure 12-7, no oil reaches any of the seven protected sites listed in Table 12-6 at concentrations over the 0.1 kg/m^2 threshold. That threshold is only exceeded along a short section of coast intersecting with the Buchan Ness to Collieston SPA and Ythan Estuary,

Sands of Forvie and Meikle Loch SPA (Figure 12-7) but the probability of that happening is less than 10 % (Figure 12-6).

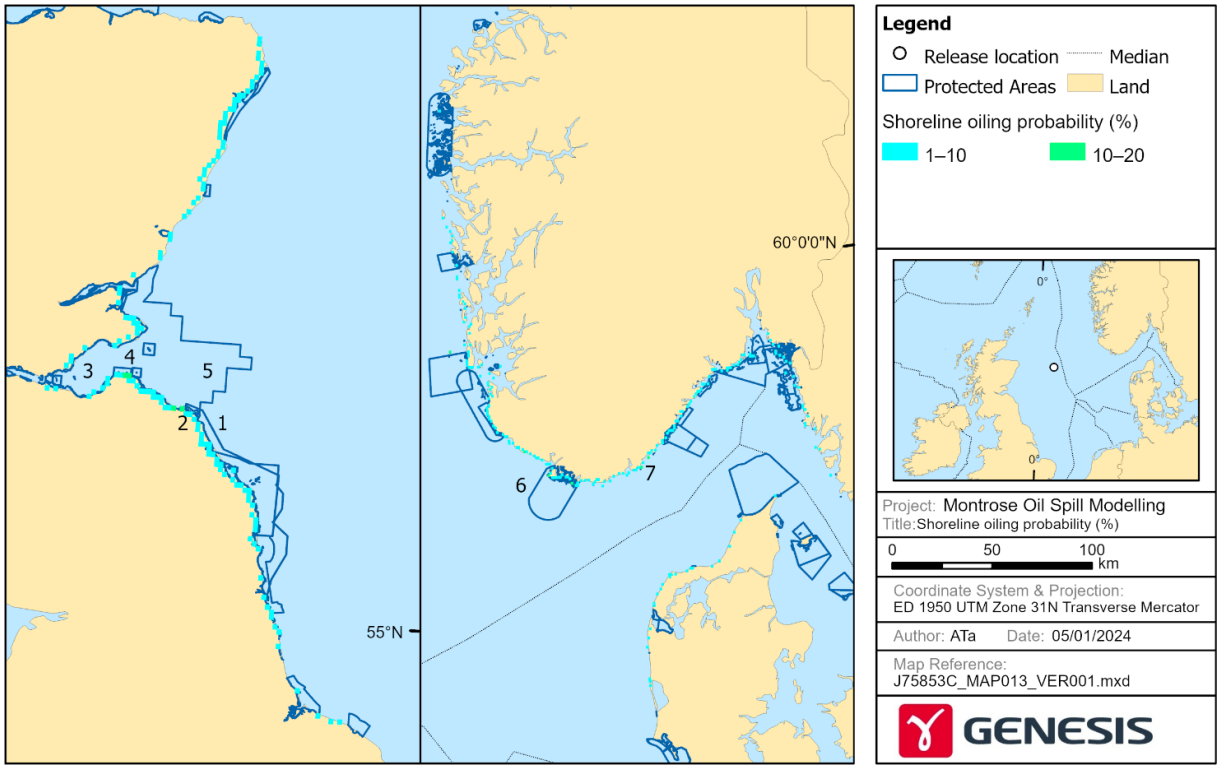


Figure 12-6: Probability of oil reaching the coast (stochastic) and coastal protected areas.

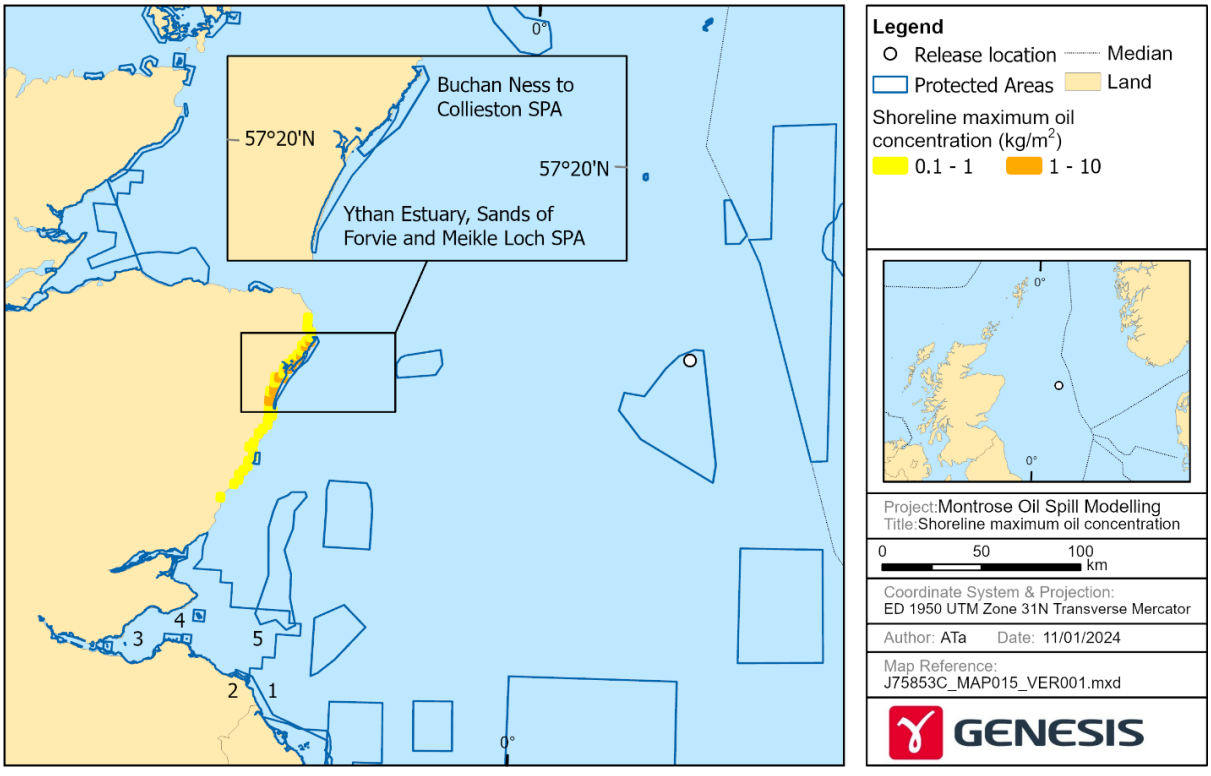


Figure 12-7: Concentration of oil at the coast (deterministic, 205 days) and coastal protected areas.

Table 12-6: Coastal protected areas with a > 10% probability of shoreline oiling (stochastic modelling).

Map Reference	Designation	Protected Area	Probability of shoreline oiling (%)	Protected features
1	SAC	Berwickshire and North Northumberland Coast	10	› Mudflats and sandflats not covered by seawater at low tide. › Large shallow inlets and bays. › Reefs. › Submerged or partially submerged sea caves. › Grey seal (*H. grypus*).
2	SPA	St Abb's Head to Fast Castle	11	› Guillemot (*Uria aalge*), breeding. › Kittiwake (*Rissa tridactyla*), breeding. › Herring gull (*Larus argentatus*), breeding. › Razorbill (*Alca torda*), breeding.
3	SPA	Firth of Forth	13	› Bar-tailed godwit (*Limosa lapponica*), non-breeding. › Cormorant (*Phalacrocorax carbo*), non-breeding. › Common scoter (*Melanitta nigra*), non-breeding. › Curlew (*Numenius arquata*), non-breeding.
4	SPA	Forth Islands	13	› Arctic tern (*Sterna paradisaea*), breeding. › Cormorant (*P. carbo*), breeding. › Common tern (*Sterna hirundo*), breeding. › Gannet (*Morus bassanus*), breeding.
5	SPA	Outer Firth of Forth and St Andrews Bay Complex	13	› Red-throated diver (*Gavia stellata*), non-breeding. › Slavonian grebe (*Podiceps auratus),* non-breeding. › Common eider (*Somateria mollissima*), non-breeding. › Long-tailed duck (*Clangula hyemalis*), non-breeding. › Common scoter (*M. nigra*), non-breeding. › Velvet scoter (*Melanitta fusca*), non-breeding. › Common goldeneye (*Bucephala clangula*), non-breeding. › Red-breasted merganser (*Mergus serrator*), non-breeding.

Map Reference	Designation	Protected Area	Probability of shoreline oiling (%)	Protected features
				› Non-breeding waterfowl assemblage (divers, grebe & ducks).
6	PVA	Listastrendene og Siragrunnen	14	› Passage of wintering birds. › Varied habitats.
7	Naturreservat	Lyngholmen	15	› Flora, fauna, habitats and landscapes.

Receptor Sensitivity of coastal and nearshore designated sites is considered to be **High (C)** due to the presence of protected habitats and/or species. The Magnitude of Effect of a blowout on these coastal or nearshore sites is considered **Minor (3)** given the relatively short lengths of coastline that would be impacted and the fact that oiling is not expected to exceed 0.1 kg/m^2. Note for a different set of metocean conditions it is possible that oil above the 0.1 kg/m^2 threshold would be exceeded in one of the protected sites listed Table 12-6, but the overall quantity of oil reaching the shore would be less than for the deterministic scenario modelled (given that scenario was selected as it resulted in the worst case oil on shore).

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Coastal and nearshore protected areas	High	Minor	Moderate	Remote	Low

12.3.11 Impact on Fisheries, Aquaculture and Shellfish Water Protected 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).

Fishing effort by UK vessels in the Montrose area is relatively Low when compared to other areas of the UKCS (Section 4.6.1). In addition, as of October 2025, there are restrictions on commercial fishing within the East of Gannet and Montrose Fields NCMPA (Scottish Government, 2025). Quantities of demersal mobile fishing landings may reduce in the future; given these restrictions there will be no dredge or beam trawling fishing in the Montrose project area.

Figure 12-8 shows the probability of onshore oiling and the location of aquaculture sites (Scottish Government NMPi). Although the probability of onshore oiling is low it does intersect with a number of aquaculture sites, particularly along the coast of Norway. The closest UK aquaculture sites are 176 km away (Section 4.6.6). There is a low probability that traces of hydrocarbons could reach the shoreline in the area of “Firth of Forth Lobster Hatchery” (European lobster).

The Receptor Sensitivity of aquaculture sites and Shellfish Water Protected Areas as receptors is considered **High (C)** given that fish present in aquaculture sites would be unable to swim away from spill and may therefore have a low capacity to absorb change without significant impact. However, as discussed given the low probability of shoreline oiling at significant concentrations, the Magnitude of Effect is considered **Serious (3)**.

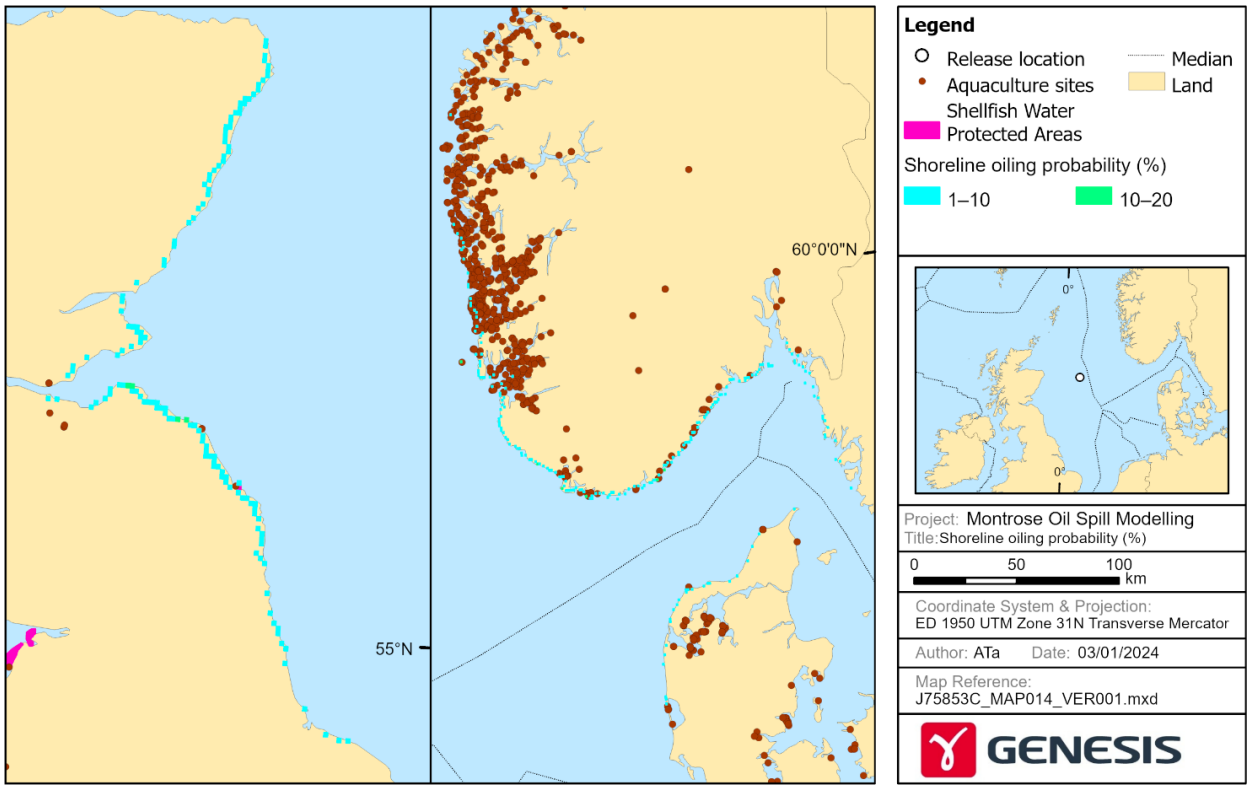


Figure 12-8: Probability of oil reaching the coast (stochastic) in relation to aquaculture sites and Shellfish Water Protected Areas.

Receptor	Receptor Sensitivity	Magnitude of Effect	Environmental Impact Significance	Likelihood	Environmental Risk
Fisheries, aquaculture and Shellfish waters	High	Serious	Moderate	Remote	Low

12.3.12 Transboundary and Cumulative Impacts

Probabilities of surface and water column oiling and arrival times across relevant median lines are given in Appendix C and summarised in Table 12-3. The probability of crude crossing international UK/Norway median line as a result of a well blowout is high throughout the year. Transboundary impacts have been taken into account in the impact assessments undertaken throughout Section 12.3.

In the unlikely event of a well blowout, approximately 930,000 m^3 of gas containing methane, ethane and carbon dioxide 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).

12.4 Major Environmental Incident Assessment

12.4.1 MEI Definition

The Offshore Installations (Safety Case etc.) Regulations 2015 (SCR, 2015) extends the evaluation of major accidents to include their potential consequences on the safety of personnel and the environment (described as a Major Environmental Incident (MEI)). The well blowout is considered to be a Major Accident Hazard (MAH) and was assessed for 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 assessment methodology (Chapter 5) considers the Magnitude of Effect, including the spatial extent or number/density of species that could be affected, and Receptor Sensitivity, that accounts for a number of criteria, largely aligned with Annex I of the Environmental Liability Directive 2004/35/EC, 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.

12.4.2 MEI Conclusion

Significance of impacts to different receptor categories is discussed in Section 12.3. The well blowout scenario has the potential to result in a large volume/area of the water column, sea surface and shoreline being impacted with potential impacts on several species and habitats.

The environmental impacts of a well blowout on seabirds and offshore protected sites were assessed as having the potential to disrupt the function and value of the resource/receptor with broader systemic (e.g. ecosystem or social well-being) consequences (Table 12-1). Accordingly, the impact on these two receptors were assessed as having the potential to result in a MEI under the Safety Case Regulations (SCR, 2015).

Table 12-7: Summary of Environmental Risk on receptors.

Receptor	Receptor Sensitivity	Magnitude of Effect	Impact Significance	Is Impact Considered to be Representative of an MEI? [1]
Water quality	Low	Major	Moderate	N/A
Sediment quality	High	Serious	Moderate	N/A
Plankton	Low	Serious	Moderate	N/A
Benthos	High	Major	Moderate	No[2]
Fish	Medium	Serious	Moderate	No[2]
Seabirds	High	Major	High	Yes[3]
Marine mammals	High	Serious	Moderate	No[2]
Offshore protected areas	High	Major	High	Yes[3]
Coastal and nearshore protected areas	High	Minor	Moderate	No[2]
Fisheries, aquaculture and Shellfish Water Protected Areas	High	Serious	Moderate	N/A

1. 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
2. No – determined that any adverse effects to protected species and natural habitats, will not affect their ability to reach or maintain favourable conservation status of such species or habitats
3. Yes - determined that any adverse effects to protected species and natural habitats, may affect their ability to reach or maintain favourable conservation status of such species or habitats

12.5 Natural Disasters

Some natural disasters could increase the risk of a major pollution event occurring at the Montrose Field. For example, an earthquake could lead to damage to the subsea infrastructure and potential loss of well control. The likelihood of an earthquake of sufficient magnitude on the UKCS to impact seabed infrastructure is considered extremely remote.

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 to the drilling rig more likely, but the rig has procedures in place for making safe and shutting down operations during extreme weather, along with emergency procedures in the case of rig damage, and a full loss of fuel inventory has been considered in the Montrose platform OPEP.

12.6 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; › A co-ordinated industry oil spill response capability will be available; and › Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue.
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; › 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 › A mandatory 500 m safety zone will be in place for the drilling rig and for the wells following completion; › Operational restrictions will be in place for visiting vessels in bad weather; › Simultaneous operations (SIMOPS) procedures will be in place; › Pipelines will have pressure monitoring and low pressure alarms; and › Oil spill control measures will be followed as outlined in the OPEP.

All wells in the UK are subject to well examination schemes as per the Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations (OSDR) 2015. The purpose is to provide assurance that the well is designed and constructed properly and is maintained adequately. This provides a scheme of quality control and quality assurance and incorporates current industry guidance. It is essential for the examination to demonstrate that the pressure boundary of the well is controlled throughout the well's life cycle and that the pressure containment equipment that forms part of the well is suitable for this purpose. Examination of planned well programmes and operations must be carried out by an independent and competent person. Independent examination ensures that 'Good Oilfield Practice' and company standards are incorporated during drilling and well intervention operations.

This contributes to risk reduction and prevention of loss of containment through application of the as low as reasonably practicable principle.

NEO NEXT+'s commitment to ensuring protection of the environment is set out in the corporate HSE policy (a copy of which is provided in Section 1.8). NEO NEXT+ have an EMS which meets the requirements of the International Standards Organisation (ISO) 14001 standard. The Company's EMS covers activities including exploration, drilling and production and will be applied to the proposed Montrose Infill Project. The EMS governs those aspects of the operations that can be controlled, such as discharges, and establishes a subsequent auditing process.

The activities associated with the proposed development are also covered in a project specific HSE Management Plan which ensures that the project is managed in such a way that all of NEO NEXT+'s HSE policies are adhered to throughout all phases of the proposed project. Particular emphasis will be paid to having a robust design, quality equipment, quality construction and operational best practices.

Oil spills can occur at any phase of a project, including drilling, completion, production and export. The following provides a high-level overview of proposed areas of planning and preparation that either reduce the probability and/or consequence of a spill/release, including failure of well control.

NEO NEXT+ will take measures to minimise the risk of a blowout through well design and well control measures. These include a well control barrier and BOP equipment.

In the event of a blowout, the drilling rig will try to disconnect from the well and move away from location. A second rig or intervention vessel would be mobilised to the location with the intention of placing a second BOP or a capping device on the flowing well or by drilling a relief well and re-establishing well control.

As a member of OSRL, NEO NEXT+ will have access to well capping devices to contain the well.

If primary and secondary well control is lost by way of a blowout and oil flows uncontrollably from the well to the environment, a relief well may be required to stop the flow of oil and bring the well back under control. A suitable rig would be sourced from the UK market. An inventory is maintained by NEO NEXT+ and their contractors to ensure that stocks of all materials required for a relief well are available at short notice. NEO NEXT+ has insurance provisions in place to cover well control/re-drill situations as well as legal liabilities, and the Company is a member of OPOL which provides rapid compensation to parties directly affected by an oil spill.

NEO NEXT+'s oil spill contingency plans will be fully documented in the Onshore and Montrose Complex OPEPs that will accompany the development and operational phases.

Applying the impact assessment methodology described in Chapter 5 and taking account of the mitigation measures listed above, the Environmental Risk of accidental hydrocarbon releases associated with the proposed development is considered to be **Low** to **Medium** overall. It is recognised that a well blow-out could result in a significant impact on some receptors, however with the application of the mitigation measures identified, the Likelihood of such an event occurring at the Montrose Field is considered **Remote** such that the overall Environmental Risk is considered 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.

13 Conclusions

A detailed assessment of the potential environmental impacts associated with the proposed Montrose Infill Project 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.

13.1 Environmental Effects

The potential impacts to the environment from all phases of the project were 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. 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 climate change and disturbance to the seabed, which are considered to be of **Moderate** Impact Significance.

One unplanned event (well blowout) was considered to range from Low to Medium Environmental Risk depending on the receptor considered. A well blowout has been identified as an MEI in relation to seabirds and offshore protected areas.

13.2 Minimising Environmental Impact

Additional assessment was undertaken for the planned activities and unplanned events initially identified as having a Moderate or High Impact Significance (Chapters 6 to 12). Following implementation of identified mitigation and control measures, all residual risks to the environment are considered to be as low as reasonably practicable.

The execution of the proposed Montrose Infill Project, incorporating the control measures identified in this ES, is not expected to have a significant impact on the environment.

13.3 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 13-1. These commitments will be integrated into the relevant project design, execution, and operational phases.

Table 13-1: Montrose Infill Project commitments.

Aspect	Commitments
Physical Presence	› Operations Notice 6 notification will be submitted prior to rig mobilisation; › A Vessel Traffic Survey (VTS) will inform a CtL application for the drilling rig; › A Collision Risk Management Plan will be produced, if determined to be required; › All vessels will adhere to COLREGS and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.; › The drilling rig will have a 500 m safety zone to mitigate any collision risk;

Aspect	Commitments
	❯ An ERRV will patrol the area during the drilling operations; ❯ The drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations; ❯ Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site; and ❯ All infrastructure will be laid within one of two 500 m exclusion/safety zones.
Emissions to Air	**Proposed Pre-Start Up Mitigation Measures** ❯ Inclusion of optimised energy efficiency and GHG emissions reduction in the rig selection and tendering process. ❯ Batch drilling and completion opportunities will be evaluated. These would reduce emissions through reduced logistical requirements and fluid handling efficiencies. ❯ The information gained from each well test will be assessed with a view to reducing the volumes of hydrocarbons to be flared during well testing for each subsequent production well. ❯ During flaring from well clean-up and testing operations, environmental conditions will be monitored, and a dedicated person will be assigned for full-time fire watch duty. ❯ The drilling rig and other project vessels will be subject to audits ensuring compliance with UK legislation. ❯ Vessel use will be optimised where possible by minimising the number of vessels required, and their length of time on site. ❯ Vessels will be operated where possible in modes that allow for economical fuel use. **Proposed Production Mitigation Measures** In accordance with the revised NSTA strategy, and associated Stewardship Expectation 11, as well as with the industry commitments within the NSTD, NEO NEXT+ will incorporate the following controls: ❯ Select, plan and execute NEO NEXT+'s emissions reduction and monitoring initiatives over a reasonable timescale in line with the Montrose Complex's ERAP. ❯ Where it is not considered reasonable to electrify, NEO NEXT+ is committed to pursue other power emissions reductions. ❯ With the proposed Montrose Infill Project and planned production post-2030, the goal of no routine flaring and venting through the provision of a new flare gas recovery system onboard the Montrose Complex is anticipated. ❯ Diesel use by the gas turbine generators (GTGs) onboard the BLP is limited to turnarounds and shutdowns and for plant re-start when fuel gas is unavailable. ❯ With the proposed Montrose Infill Project, continual monitoring and reviewing of emissions and carbon intensity of the Montrose Complex. The Montrose Complex's ERAP will continue to be reviewed for potential opportunities to further reduce emissions against the sector targets outlined in the NSTD These measures will help to ensure that opportunities for efficiency and reduction of atmospheric emissions, where not in conflict with safe operations, are identified, actioned as appropriate and reviewed.
Discharges to Sea	❯ Minimise use of vessels, through efficient journey planning;

Aspect	Commitments
	› The drilling rig used will be audited under NEO NEXT+'s Marine Operations and Vessel Assurance Standards and subject to rig recertification audits; › All vessels used will be MARPOL compliant; › Where technically feasible NEO NEXT+ will prioritise the selection of chemicals which are PLONOR, or chemicals with a lower RQ; › Preference will be given to skipping and shipping produced sand; › Produced water will be treated to reduce OiW content to below 30 mg/l; and › The discharges of any water based hydraulic fluids, sand or chemicals are regulated by the OPPC and/or OCR regulations and reported through the EEMS. As such, NEO NEXT+ will confirm that sampling, analysis, and reporting are undertaken in line with the regulations and permit conditions.
Seabed Disturbance	› Pre-deployment surveys will be undertaken to identify suitable locations for the anchors (if required); › Pipeline and umbilical route surveys will be undertaken; › The use of mattresses, grout bags, and contingency rock cover, will be minimised through optimal project design. › Anchors of the drill rig (if used) will be maintained under tension to minimise chain contact on seabed; › Cement volumes required will be planned and optimised; › Use of ROV for visual monitoring and pH monitoring during cementing jobs that allows stopping when cement is either observed or detected at seabed (to minimise excess cement); › Sea dye will be used to indicate when cement is approaching the surface; › The use of dynamically positioned vessels where possible will minimise anchor use; › Use of low toxicity chemicals in WBM sweeps; › Use of specialist contractors to minimise dropped objects; and › Lifting plans in place.
Underwater Noise	› A qualified, trained and equipped marine mammal observer (MMO) will be present during piling. The MMO will carry out a pre-piling survey of a 500 m mitigation zone and, if an animal 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; › Passive Acoustic Monitoring (PAM) will be employed during periods of low visibility and at night to detect marine mammal presence; and › Avoiding commencing piling at night or in poor visibility when marine mammals cannot reliably be detected. If this cannot be avoided, then PAM will be used; › Commitment to preparing a MMMP to summarise all mitigation measures.
Waste	› NEO NEXT+ will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle; › Existing asset and vessel WMPs will be followed; and

Aspect	Commitments
	› Only suitably permitted and licensed disposal yards / landfill sites will be used, in compliance with relevant legislation.
Accidental Events	› 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; › A co-ordinated industry oil spill response capability will be available; and › Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue.
	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; › 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
	› A mandatory 500 m safety zone will be in place for the drilling rig and for the wells following completion; › Operational restrictions will be in place for visiting vessels in bad weather; › Simultaneous operations (SIMOPS) procedures will be in place; › Pipelines will have pressure monitoring and low pressure alarms; and › Oil spill control measures will be followed as outlined in the OPEP.

13.4 Overall Conclusion

NEO NEXT+ is proposing further development of the existing Montrose Field by drilling additional wells into the Montrose reservoir. The Montrose Infill Project will involve a single drill centre located *c*. 700 m from the existing Montrose BLP, subsea tie-back, and platform modifications to the existing Montrose BLP. The Montrose Field is located in UKCS Blocks 22/17 and 22/18 in the CNS, *c*. 190 km from the Aberdeenshire coastline and c. 46 km from the UK/Norway median line. Given this is a tie-back within the existing Montrose Complex, hydrocarbon reservoirs at the Montrose field are well understood (based on the industry's history of drilling and field development in this area of the North Sea) and will be developed using proven technology incorporating current best practices and latest generation equipment.

A robust design, combined with effective operating practices and systems, implemented by a highly trained workforce, will ensure the proposed development does not result in any significant environmental, cumulative or

transboundary effects. Additional measures will also be in place during the operating phase to effectively respond to potential emergency scenarios.

The ES assesses the worst-case impact of the project on the environment and is therefore very conservative. Applying the mitigations measures identified, it is the conclusion of this ES that in terms of physical presence, discharges to sea, seabed disturbance, underwater noise, and waste; the proposed Montrose Infill Project can be completed without causing any significant environmental impacts.

The ES concludes that the proposed Montrose Infill Project will produce hydrocarbons with low GHGI relative to UK benchmarks and relative to imported sources. In isolation, and at a national level, GHG emissions during the production, and subsequent use of produced hydrocarbons from the proposed Montrose Infill Project are concluded to have a Minor Adverse impact on the climate that is Not Significant.

At a global level, the baseline cumulative impact on climate change from GHG emissions in the absence of the project is uncertain and dependent on the policies implemented and enforced by nation states to reduce GHG emissions. This could range from Minor Adverse and Not Significant (if all policies are effective in meeting the goals of the Paris Agreement) to Major Adverse and Significant if policies prove ineffective or insufficient. The proposed Montrose Infill Project will have no effect on the baseline impact magnitude or severity.

Table 13-2 summarises the short-term and long-term environmental impacts for the proposed Montrose Infill Development Project.

Table 13-2: Summary of the short-term and long-term environmental impacts for the Montrose Infill Development Project.

Short-term / Long-term	Aspect	Source / Activity	Conclusion
Short-term Impacts *Impacts occurring during drilling, installation, and commissioning activities*	Physical Presence	Physical presence of vessels and drilling rig during drilling and installation activities.	Taking account of the mitigation measures listed in Table 13-1 and given the recent fishing restrictions within the East of Gannet and Montrose Fields NCMPA, the Impact Significance of the physical presence of the vessels and drilling rig on other sea users is considered **Low**. In addition, given the very small proportion of overall available habitat that will be occupied temporarily, the environmental Impact Significance in relation to marine mammals, birds and fish is considered **Low**. The environmental and socio-economic impacts are therefore considered acceptable when managed within the controls and mitigation measures described. No significant residual effects on other sea users or marine mammals and birds are predicted.
	Discharges to Sea	Planned discharges to sea from drilling operations (drill cuttings, cement and associated chemicals, well clean-up and installation/ commissioning chemicals) impacting the water column.	Marine flora and fauna may be affected on a localised level but given NEO NEXT+ commitment to prioritise the use of chemicals which are PLONOR, or are of a HQ <1, the rapid dilution that will occur on discharge means that the Impact Significance of any discharges to the water column is considered **Low** such that any impacts of the chemicals discharged during subsea installation and commissioning on the water column are considered negligible.

Short-term / Long-term	Aspect	Source / Activity	Conclusion
	Seabed Disturbance	Interaction of drilling rig anchors and/or spud cans with seabed. In addition, re-settlement of suspended sediments over a wider area associated with anchors an /or spud cans and installation of subsea infrastructure.	Due to Project location within the East of Gannet and Montrose Fields NCMPA, presence of *A.islandica*, 'offshore subtidal sands and gravels' habitat, and fish species that are considered Scottish PMFs, 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. 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.
	Underwater Noise	Generation of underwater noise from piling of the subsea manifold (and drilling template if used), as well as drilling activities, use of perforation guns during well completion, rock placement activities (contingency), and vessel operations.	With the implementation of the mitigation measures identified in Table 13-1, the overall Impact Significance of the various underwater noise sources on marine mammals and fish in the area is considered **Low.** The impacts are therefore considered acceptable when managed within the additional controls and mitigation measures identified in Table 13-1.
Long-term Impacts *Impacts occurring during the lifetime of the proposed Montrose Infill Development Project*	Climate Change / Air Quality	Emissions of pollutants to air, which have local impact on air quality and global impact through climate change.	The ES concludes that the proposed Montrose Infill Project will produce hydrocarbons with low GHGI relative to UK benchmarks and relative to imported sources. In isolation, and at a national level, GHG emissions during the production, and subsequent use of produced hydrocarbons from the proposed Montrose Infill Project are concluded to have a **Minor Adverse** impact on the climate that is considered Not Significant under the ISEP guidance. At a global level, the baseline cumulative impact on climate change from GHG emissions in the absence of the project is uncertain and dependent on the policies implemented and enforced by nation states to reduce GHG emissions. This could range from **Minor Adverse** and Not Significant (if all policies are effective in meeting the goals of the Paris Agreement) to **Major Adverse** and Significant if policies prove ineffective or insufficient. The proposed Montrose Infill Project will have no effect on the baseline impact magnitude or severity. The proposed Project is in alignment overall with the UK Government strategy for transitioning to Net Zero GHG emissions by 2050.

Short-term / Long-term	Aspect	Source / Activity	Conclusion
	Physical Presence	Long-term presence of the subsea infrastructure, pipelines, umbilical and associated protection / stabilisation material on the seabed.	Taking account of the mitigation measures listed in Table 13-1, and given the recently introduced fishing restrictions and placement of all infrastructure within 500 m exclusion/safety zones, the physical presence of the subsea infrastructure associated with the proposed Montrose Infill Project is considered to be of a **Low** socio-economic Impact Significance overall. 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 physical presence of the subsea infrastructure associated with the proposed Montrose Infill Project is considered to be of a **Low** environmental Impact Significance in relation to marine mammals and fish. No significant residual effects on marine mammals and fish are predicted.
	Discharges to Sea	Planned discharges to sea during production from produced water and associated chemicals impacting the water column.	Given that: › the produced water system is designed to reduce oil content to a target of below 30 mg/l oil in water or less (monthly average); › the addition of the Montrose Infill wells to the existing produced water discharges will not result in an order of magnitude increase as production from other fields will be "backed out" in order to maintain the produced water rate within the design envelope of the Montrose Complex; › the proposed Infill wells will use the same chemicals, treatment process and dilution rate as currently used at the Montrose Complex; and › discharges will mix with seawater and be dispersed by local currents, the potential impacts to water quality are negligible and Impact Significance is considered to be **Low**. It is unlikely that fish or marine mammal species will be directly impacted by produced water discharges to sea due to their ability to avoid the point of discharge. It is considered that the existing produced water treatment equipment on Montrose represents BAT and NEO NEXT+ remains committed to ensuring that the principles of BAT and BEP continue to be applied to the treatment and discharge of produced water.
	Seabed Disturbance	Permanent installation of subsea infrastructure on seabed, formation of cement plateau, deposition of drill cuttings discharges, spud can / anchor	Installation of subsea infrastructure (including stabilisation and protection materials) and formation of cement deposits on the seabed will result in a permanent impact to the seabed within the East of Gannet and Montrose NCMPA, resulting in a change of habitat at a localised scale. The Impact Significance of permanent seabed disturbance on habitats and benthic communities is considered **Moderate**. In terms of drill cuttings, the area over which 5 % of species are at risk 10 years post drilling is significantly small, therefore, resulting Impact Significance is considered **Moderate**.

Short-term / Long-term	Aspect	Source / Activity	Conclusion
		depressions from drilling rig remaining on the seabed.	Any mortality caused to individual *A. islandica* specimens as a result of the proposed activities is not considered significant given the relatively limited area of impact. In addition, the area of the 'offshore subtidal sands and gravels' habitat within the NCMPA that will be permanently impacted by the proposed Project is 0.045 % in total, which represents a relatively small proportion of the overall habitat area.
	Waste Management	Waste generation from vessels, drilling, installation and commissioning, and production going to landfill (finite resource).	All wastes will be properly segregated for management in line with the waste hierarchy in accordance with NEO NEXT+'s WMP and Controlled Waste Transfer Notes will be completed. NEO NEXT+ recognise landfill sites as a finite resource and therefore this is a long-term impact, however, as the majority of waste will be recycled and the vessels / platform will have a WMP in place, with the application of the above control measures, the Impact Significance is considered **Low** such that any environmental impacts associated with waste production are considered to be negligible.

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Appendix A. Scotland's National Marine Plan and Marine Strategy Framework Directive

A.1 Scotland's National Marine Plan

Scotland's National Marine Plan (NMP) (Marine Scotland, 2015) covers the management of both Scottish inshore waters (out to 12 nm) and offshore waters (12 to 200 nm). The aim of the NMP is to help ensure the sustainable development of the marine area through informing and guiding regulation, management, use and protection of the NMP areas. The activities associated with the proposed Montrose Infill Project have been assessed against each of the NMP general policies, details of which can be found in Table A-1.

Table A-1: The proposed Montrose Infill Project assessed against Scotland's NMP general policies.

Scotland's NMP General Policy Number	Applicable?	Assessment Against Policy
GEN 1 General planning principle		
There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan.	✓	The proposed project is an expansion to an existing field. The EIA assesses potential impacts to the environment and to other sea users.
GEN 2 Economic benefit		
Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan.	✓	The proposed project will provide jobs and tax revenues to the economy.
GEN 3 Social benefit		
Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan.	✓	The EIA considers impacts to other sea users in decision making e.g. fisheries and pipelines. Lifecycle of the project is assessed for environmental and economic implications.
GEN 4 Co-existence		
Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision making processes, when consistent with policies and objectives of this Plan.	✓	The EIA process involved consultation with other sea users (SFF).
GEN 5 Climate change		
Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.	✓	Impact on climate change is considered in detail in Chapter 7 (includes an assessment of emissions from use of end product).
GEN 6 Historic environment		
Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.	✓	A number of surveys have been carried out and used to support the EIA. EIA takes cognisance of the wrecks in the area.
GEN 7 Landscape/seascape		
Marine planners and decision makers should ensure that development and use of the marine	✓	Not applicable for subsea infrastructure. Design of topsides modifications to the Montrose BLP

Scotland's NMP General Policy Number	Applicable?	Assessment Against Policy
environment take seascape, landscape and visual impacts into account.		will take into account feedback received from the NLB during ES Scoping.
GEN 8 Coastal process and flooding		
Developments and activities in the marine environment should be resilient to coastal change and flooding and not have unacceptable adverse impact on coastal processes or contribute to coastal flooding.	×	Offshore development.
GEN 9 Natural heritage		
Development and use of the marine environment must: › Comply with legal requirements for protected areas and protected species. › Not result in significant impact on the national status of Priority Marine Features. › Protect and, where appropriate, enhance the health of the marine area.	✓	Environmental surveys have been undertaken in the area. Design and installation method of the subsea infrastructure was informed by these surveys.
GEN 10 Invasive non-native species		
Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.	✓	All vessels will follow IMO regulations. All vessels, including the drilling rig, will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award.
GEN 11 Marine litter		
Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.	✓	Contractor management plans will be in place. All vessels will follow IMO requirements.
GEN 12 Water quality and resource		
Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, MSFD or other related Directives apply.	✓	Discharges to sea have been identified and assessed. The proposed project will not result in any measurable deterioration of water quality in the area.
GEN 13 Noise		
Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.	✓	Impacts of the noise generated from the piling of the subsea manifold have been assessed. Results show that with the implementation of JNCCs standard mitigation measures the likelihood of a permanent threshold shift occurring is low for all the marine mammal hearing groups. The appropriate mitigation measures will be adopted in relation to the piling as well as vessel and drill rig noise.
GEN 14 Air quality		
Development and use of the marine environment should not result in the deterioration of air quality	✓	Emissions to air quantified in the EIA. Assessment concludes that they will present a low

Scotland's NMP General Policy Number	Applicable?	Assessment Against Policy
and should not breach any statutory air quality limits.		environmental risk to air quality the duration of which will be minimised as far as possible.
GEN 15 Planning alignment A		
Marine and terrestrial plans should align to support marine and land-based components required by development and seek to facilitate appropriate access to the shore and sea.	×	Offshore project.
GEN 16 Planning alignment B		
Marine plans should align and comply where possible with other statutory plans and should consider objectives and policies of relevant non-statutory plans where appropriate to do so.	×	Applies to inshore waters only.
GEN 17 Fairness		
All marine interests will be treated with fairness and in a transparent manner when decisions are being made in the marine environment.	×	Competent Authority responsibility.
GEN 18 Engagement		
Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes.	✓	The EIA is subject to public and informal consultations. A copy of the ES and the public notice have been made publicly available. A Scoping Document was issued, and engagement meetings were held with JNCC and OPRED.
GEN 19 Sound evidence		
Decision making in the marine environment will be based on sound scientific and socio–economic evidence.	✓	Environmental baseline prepared with reference to available literature and site-specific survey data.
GEN 20 Adaptive management		
Adaptive management practices should take account of new data and information in decision making, informing future decisions and future iterations of policy.	✓	NEO NEXT+'s decision making takes into account best understanding of the marine environment through surveys and using latest available scientific data.
GEN 21 Cumulative impacts		
Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.	✓	Cumulative impacts are considered in the EIA and are considered proportionate to the size of the project.

A.2 Marine Strategy Framework Directive (MSFD)

The aim of the European Union's Marine Strategy Framework Directive (MSFD) is to protect the marine environment across Europe more effectively. The MSFD outlines a transparent, legislative framework for an ecosystem-based approach to the management of human activities which supports the sustainable use of marine goods and services. The overarching goal of the Directive was to achieve 'Good Environmental Status' (GES) by 2020 across Europe's marine environment. Note following Brexit, the UK has made amendments to the Marine Strategy Regulations 2010, which transpose the requirements of the EU's Marine Strategy Framework Directive into domestic law, so that they continue to be effective now that the UK is no longer part of the EU.

The MSFD does not state a specific programme of measures that Member States should adopt to achieve GES, except for the establishment of MPAs. The MSFD does however outline 11 high level descriptors of GES in Annex I of the Directive. The activities associated with the proposed Montrose Infill Project have been assessed against each of the GES descriptors details of which can be found in Table A-2.

Table A-2: The proposed Montrose Infill Project assessed against the MSFD GES descriptors.

Marine Strategy Framework Directive: Good Environmental Status Descriptors	Applicable?	Assessment Against Descriptor
GES 1		
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.	✓	Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure informed by these surveys.
GES 2		
Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.	✓	Linked to GEN 10. All vessels will follow IMO regulations. All vessels, including drilling rig, will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award.
GES 3		
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.	✓	Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure informed by these surveys.
GES 4		
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.	✓	Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure will be informed by these surveys.
GES 5		
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.	✓	Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure will be informed by these surveys.
GES 6		
Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are	✓	Linked to GEN 9. Environmental surveys undertaken in the project area. Design and

Marine Strategy Framework Directive: Good Environmental Status Descriptors	Applicable?	Assessment Against Descriptor
safeguarded and benthic ecosystems, in particular, are not adversely affected.		installation method of the subsea infrastructure will be informed by these surveys.
GES 7		
Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.	✓	Linked to GEN 21. Seabed disturbance and potential impact on marine ecosystems assessed in EIA.
GES 8		
Concentrations of contaminants are at a level not giving rise to pollution effects.	✓	Linked to GEN 12. The proposed project will not result in the deterioration of water quality in the Montrose field area.
GES 9		
Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.	✓	Linked to GEN 12. The proposed project will not result in the deterioration of water quality in the project area.
GES 10		
Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	✓	Linked to GEN 11. Contractor management plans will be in place. All vessels will follow IMO requirements.
GES 11		
Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.	✓	Linked to GEN 13. Piling of the subsea manifold was identified as having the potential to be a significant source of marine noise, and therefore this was modelled and the severity was assessed. Results show that with the implementation of JNCCs standard mitigation measures the likelihood of a permanent threshold shift occurring is low for all the marine mammal hearing groups. The appropriate mitigation measures will be adopted as required.

A.3 Oil and Gas Marine Planning Policies

Objectives and policies for the Oil and Gas sector should be read subject to those set out in the NMP and the MSFD. It is recognised that not all of the objectives can necessarily be achieved directly through the marine planning system, but they are considered important context for planning and decision making. The proposed project activities have been assessed against the oil and gas marine planning policies, details of which can be found in Table A-3.

Table A-3: The proposed Montrose Infill Project assessed against the Oil and Gas Marine Planning Policies.

Oil and Gas Marine Planning Policies	Applicable?	Assessment Against Policy
Oil & Gas 1		
The Scottish Government will work with DESNZ, NSTA and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of Best Available Technology (BAT) and Best Environmental Practice. Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.	✓	Environmental risks addressed/assessed where necessary in the EIA.
Oil & Gas 2		
Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process.	×	The project is an expansion of the existing Montrose Field with all wells being tied back to existing topsides facilities on the Montrose BLP. Future options such as carbon capture and storage and hydrogen production have been considered in the Net Zero chapter.
Oil & Gas 3		
Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints.	✓	The Montrose Field is an offshore development. Seabed disturbance and physical presence of the infrastructure have been assessed.
Oil & Gas 4		
All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance.	×	A new topside module is being added to the existing Montrose BLP. However, given that it is a modification to an existing installation, and navigational lighting will be updated (where required), this policy is considered not applicable.
Oil & Gas 5		
Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.	✓	Existing Montrose OPEP and Safety Case will be updated to incorporate the proposed project. A drilling OPEP Communications Interface Plan (CIP) will be in place during drilling operations.

Oil and Gas Marine Planning Policies	Applicable?	Assessment Against Policy
Oil & Gas 6		
Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive.	✓	Existing Montrose OPEP and Safety Case will be updated to incorporate the proposed project. A drilling OPEP CIP will be in place during drilling operations. In addition, stochastic modelling and MEI assessment will be undertaken as well as NSTA notifications and rig OPEP drills.

Appendix B: ENVID Results

Montrose Infill Project Environmental Statement
Appendix B: ENVID Table

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
Node 1: Vessel Use During Drilling, Installation, Topside Modifications and Commissioning										
1	**Physical presence of vessels**	Tugs, Anchor Handling Vessels (AHV), supply vessels, Construction Support Vessels (CSV), Dive Support Vessel (DSV), rock dumping vessel (if required). Support for survey, construction, installation and topside modifications. Note: Production vessels are covered under Node 5.	Receptor: Other sea users. Navigation hazard, and restriction of fishing operations.	Optimise vessel use. Ongoing consultation with SFF for all operations including surveys. Notice to mariners prior to operations starting. Vessel Traffic Survey.	A	1	Low	N/A	N/A	Fishing grounds - comprising up to 0.1% of fishing effort by UK vessels. UK fishing industry and vessels in the area have the capacity to absorb change without impact therefore Receptor Sensitivity is considered to be **Low (A)**. The Magnitude of Effect on fishermen is considered **Negligible (1)** given recent fishing restrictions within the East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA). The overall Impact Significance is therefore considered **Low**.
2			Receptors: Birds and marine mammals. Possible behavioural changes in marine mammals e.g. could be attracted to the vessel 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.	Optimise vessel use.	B	2	Low	N/A	N/A	Marine mammals sighted in the project area include harbour porpoise (Annex II), bottlenose dolphin (Annex II), killer whale, minke whale, Risso's dolphin, white-beaked dolphin, white-sided dolphin, and grey seal (Annex II). Given the presence of these Annex II species and the fact that cetaceans are considered a European Protected Species (EPS), Receptor Sensitivity is considered to be **Medium (B)**. The Central North Sea is a busy shipping area and has well developed fishing and oil and gas industries, 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). The Magnitude of Effect on marine mammals is therefore considered **Minor (2)** such that the Impact Significance of vessels on marine mammals is considered **Low**. A number of seabird species are found in the Montrose area and given that some of the seabirds that occur in the area are qualifying features of Special Protection Areas (SPAs) with marine components along the Scottish coastline, Receptor Sensitivity of seabirds is considered **Medium (B)**. Though evidence suggests that the presence of the vessels could cause some bird species to be displaced from foraging areas, the very small proportion of overall available habitat that will be occupied by the vessels means the impact is not considered to be noticeable. In addition, given 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 **Minor (2)** such that the Impact Significance of vessels on birds is considered **Low**.
3	**Emissions to Air from vessels**	Fuel combustion emissions from vessels (CO_2, CO, SOx, NOx, etc.) and helicopter flights for vessel change overs.	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the Central North Sea).	Use of low-sulphur fuel. Minimise use of vessels, through efficient journey planning and potential use of hybrid supply vessels. Review vessel Common Marine Inspection Documents (CMID) as part of vessel assurance (evidence of maintenance). UK Air Quality Standards not exceeded. Vessels will be MARPOL compliant. Optimise helicopter transfers. Where possible Montrose supporting vessels will be used to support the drill rig.	D	1	Low	N/A	N/A	Note: Life-cycle GHG emissions impact assessment follows the approach set out by the Institute of Sustainability & Environmental Professionals (ISEP) (formerly the Institute of Environmental Management & Assessment (IEMA)) in its guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022) and aligns with OPRED's supplementary guidance for assessing the effects of downstream scope 3 emissions on climate from offshore oil and gas projects (OPRED, 2025). The methodology is further detailed in Chapter 7. The impact assessment methodology detailed in Chapter 5 and used in the ENVID does not easily lend itself to assessing climate change, with the sensitivity of climate change as a receptor being considered **Very High (D)** in line with 2014 Climate Change Report produced by the Intergovernmental Panel on Climate Change (IPCC, 2014). NEO NEXT acknowledges that the atmospheric emissions associated with the use of vessels will contribute to climate change, however the relatively short duration of the vessel campaigns, means the Magnitude of Effect of the incremental increase in emissions to the atmosphere as a result of the vessel
4			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low	N/A	N/A	As the installation activities will take place offshore the Receptor Sensitivity of air quality 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**.
5	**Discharges to Sea**	Vessel sewage/food waste, ballast water and biofouling.	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.	Minimise use of vessels, through efficient journey planning. Review vessel CMID as part of vessel assurance. Vessels will be MARPOL compliant. All contracted vessels will originate from countries adhering to the International Maritime Organisation (IMO) Convention. 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. As part of the Company's auditing process, only vessels adhering to the IMO 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Species will be used. All member states of IMO are signed up to these guidelines.	A	1	Low	N/A	N/A	Given the open nature of the Central North Sea, Receptor Sensitivity of water quality 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**.

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
6	**Seabed Disturbance**	Interaction of vessels with the seabed i.e. dynamic positioning.	Receptors: Benthic flora and fauna.	The use of dynamically positioned vessels where possible will minimise anchor use.	C	1	Low	N/A	N/A	Given the proposed Project location within the East of Gannet and Montrose Fields NCMPA and likely presence of *A.islandica* , and considering their sensitivity to abrasion and penetration caused by items temporarily coming into contact with the seabed, Receptor Sensitivity is considered **High (C)**. Support vessels will by dynamically positioned which at the water depths within the Project location is not expected to have an impact on the seabed or cause any sediment suspension. Magnitude of Effect is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
7	**Underwater Noise**	General vessel noise including dynamic positioning.	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.	Minimise use of vessels, through efficient journey planning and potential use of hybrid supply vessels.	B	1	Low	N/A	N/A	As described above, a number of marine mammals are known to occur in the area, some of which are Annex II species and EPS, such that Receptor Sensitivity is considered **Medium (B)**. The Central 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. 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**.
8	**Waste**	General operational waste.	Receptor: Landfill take. Waste to landfill.	Compliance with MARPOL requirements. NEO NEXT 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.	A	1	Low	N/A	N/A	Receptor Sensitivity of landfill is considered **Low (A)** as landfill options are considered abundant. MARPOL Annex V applies to all ships/vessels and generally prohibits the discharge of all 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. NEO NEXT recognise landfill sites as a finite resource, however as the vessels will have 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**.
9	**Use of Resources**	Fuel for power generation.	Receptor: Resource use. Energy use.	MARPOL compliant. Review vessel CMID as part of vessel assurance (evidence of maintenance). Optimise vessel use.	A	1	Low	N/A	N/A	Receptor Sensitivity of fuel availability is considered **Low (A)**. NEO NEXT 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**.
10	**Unplanned Events**	Helicopter crash. Loss of helifuel to sea.	Receptor: Marine flora and fauna. Water quality deterioration impacting on marine flora and flora.	Auditing of company to ensure helicopter maintenance etc.	B	1	Low	Remote	Low	As described above, a number of marine mammals are known to occur in the area, some of which are Annex II species and EPS, such that Receptor Sensitivity is considered **Medium (B)**. The quantities of helifuel are *c.* 1,200-1,600 litres, which is less than vessels. The Magnitude of Effect on marine mammals and other fauna is considered **Negligible (1)** given that any spilled helifuel is expected to evaporate rapidly and not reach any coastlines given the limited volumes. With the application of standard industry mitigation the Likelihood of a helicopter crash occurring is considered **Remote** therefore the Environmental Risk is considered to be **Low**.
11		Minor chemical / hydrocarbon spill from vessels.	Receptor: Water quality. Water quality deterioration.	Vessel SOPEPs in place. Vessel assurance programme in place. Optimised quantities of chemicals procured & stored on board. 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. Best practise bunkering procedures.	A	2	Low	Unlikely	Low	Given the relatively open nature of the Central North Sea, the Receptor Sensitivity of water quality is considered **Low (A)**. 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 **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**.
12		Major hydrocarbon/ chemical spillage (i.e. vessel collision and loss of containment).	Receptor: 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.	500 m zone in place. ERRV at Montrose platform; approved use of dispersants on stand-by vessel. Emergency response plans in place including vessel SOPEPs. OPEP in place.	C	2	Moderate	Unlikely	Medium	Given that the activities will take place within the East of Gannet and Montrose Fields NCMPA, Receptor Sensitivity of marine flora and fauna is considered **High (C)**. It is expected that in the event of a loss of fuel inventory from vessels, some will evaporate. What portion evaporates wil depend on whether the vessel operates using marine diesel, or very low sulphur fuel oil (VLSFO) or ultra low sulphur fuel oil (ULSFO). The ENVID conservatively assumes the vessel will use VLSFO or ULSFO in which instance evaporation rates are around 5%. Given the offshore location, very little to no beaching is likely, such that the Magnitude of Effect is considered **Minor (2)**. With the application of standard industry mitigation the Likelihood of a spill occurring is considered **Remote**, therefore the Environmental Risk is considered to be **Moderate**.
Node 2: Drilling Operations										

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
13	**Physical Presence of drilling rig (semi-submersible or Heavy Duty Jack-up (HDJU))**	Physical presence of semi-submersible or HDJU drilling rig.	Receptor: Other sea users. Navigation hazard, and restriction of fishing operations.	Kingfisher and MoD; other users of the area will be notified. HDJU will have marking and lighting as per the Standard Marking Schedule for Offshore Installations. A notice to mariners will be sent to inform of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the rig. Operating within 500 m zones.	A	1	Low	N/A	N/A	Fishing grounds - comprising up to 0.1% of fishing effort by UK vessels. UK fishing industry and vessels in the area have the capacity to absorb change without impact therefore Receptor Sensitivity is considered to be **Low (A)**. The Magnitude of Effect on fishermen is considered **Negligible (1)** given recent fishing restrictions within the East of Gannet and Montrose Fields NCMPA and the drilling rig will operate within 500 m zones that will be applied prior to rig mobilisation. The overall Impact Significance is therefore considered **Low**.
14			Receptors: Birds and marine mammals. Possible behavioural changes in marine mammals e.g. could be attracted to the drilling rig or may move away from the area. The drilling rig also have the potential to cause displacement of seabirds from foraging habitat and may cause flying birds to detour from their flight routes.	Lighting will be minimised as far as practicable. The rig will be located in already industrialised area with a lot of other vessels present in the area - there will be no new impacts associated with these on the marine mammals and birds.	B	2	Low	N/A	N/A	As described above, a number of marine mammals are known to occur in the area, some of which are Annex II species and EPS, such that Receptor Sensitivity is considered **Medium (B)**. The Central North Sea is a busy shipping area and has well developed fishing and oil and gas industries, such that marine mammals in the region are habituated to the presence of vessels and offshore installations. The Magnitude of Effect on marine mammals is therefore considered **Minor (2)** such that the Impact Significance of the physical presence of the drilling rig on marine mammals is considered **Low**. A number of seabird species are found in the Montrose area and given that some of the seabirds that occur in the area are qualifying features of Special Protection Areas (SPAs) with marine components along the Scottish coastline, Receptor Sensitivity of seabirds is considered **Medium (B)**. Given existing oil and gas vessel activity in the area, it is expected that the impact of the drilling rig on bird migration routes (e.g. they could be attracted to the rig lights at night)is not significant. Therefore, the Magnitude of Effect on birds is considered **Minor (2)** such that the Impact Significance of vessels on birds is considered **Low**.
15	**Emissions to Air**	Exhaust emissions from drilling operations (i.e. burning of diesel).	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the Central North Sea).	A rig Health, Safety and Environment Management System audit will be carried out as part of awarding contract (including planned maintenance system implementation). UK Air Quality Standards not exceeded. Wells will be batch drilled to reduce overall schedule. Use of HDJU as opposed to semi-sub also reduces drilling duration (less time waiting on weather delays).	D	1	Low	N/A	N/A	As above, the impact assessment methodology used to assess atmospheric emissions within the ES is further detailed in Chapter 7. As above, Receptor Sensitivity of climate change is considered **Very High (D)**. NEO NEXT acknowledges that the atmospheric emissions associated with the use of the drilling rig will contribute to climate change, however the relatively short duration of the drilling campaign, means the Magnitude of Effect of the incremental increase in emissions to the atmosphere from the drilling activities is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
16			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low	N/A	N/A	As the drilling activities will take place offshore the Receptor Sensitivity of air quality is considered **Low (A)**. The relatively short duration of the drilling campaigns, means the Magnitude of Effect of the rig emissions on air quality is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
17		Flaring resulting in release of CH_4, CO_2, SOx, NOx, VOC, NOx and particulates.	Receptor: Climate change. Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the Central North Sea).	Green burners. No extended well tests. UK Air Quality Standards not exceeded. Planned flaring during well test kept as small as practicable.	D	1	Low	N/A	N/A	As above, the impact assessment methodology used to assess atmospheric emissions within the ES is further detailed in Chapter 7. As above, Receptor Sensitivity of climate change is considered **Very High (D)**. NEO NEXT acknowledges that the atmospheric emissions associated with flaring will contribute to climate change, however the relatively short duration of flaring activities, means the Magnitude of Effect of the incremental increase in emissions to the atmosphere from the drilling activities is considered **Negligible (1)** such that the overall Impact Significance is
18			Receptor: Air quality. Possible reduction in local air quality.		A	1	Low	N/A	N/A	As the drilling activities will take place offshore the Receptor Sensitivity of air quality is considered **Low (A)**. The short duration of the flaring activities, means the Magnitude of Effect of the rig emissions on air quality is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
19	**Discharges to Sea**	Deliberate discharge to sea from drilling operations. Water-based mud (WBM) and Low Toxicity Oil Based Mud (LTOBM) cuttings, brine, cementing chemicals and clean up chemicals all required in the drilling process.	Receptor: Marine flora, fauna and habitat. Disturbance to seabed impacting on benthic species (e.g. ocean quahog and deep sea muds)	Chemical selection process will aim to select the lowest toxicity chemicals for a given technical requirement. Chemical use and discharge will be assessed in drilling operations MAT. Cement use will be minimised by good operating practice. No additional project-specific mitigation measures can be identified. Conductor cement will end up on the seabed - cement returns will be monitored with the use of dye. WBM cuttings from tophole sections to be discharged to the seabed. Base case is that LTOBM contaminated cuttings will be treated thermally on board the rig prior to discharge to water column - contingency to skip and ship.	C	2	Moderate	N/A	N/A	During the drilling phase, drill cuttings contaminated with WBM and associated chemicals will be discharged to sea. LTOBM contaminated cuttings will be thermally treated prior to discharge; or skipped and shipped as contingency. As drilling will take place within the East of Gannet and Montrose Fields NCMPA and likely presence of *A.islandica* , as well as fish species that are considered Scottish PMFs, Receptor Sensitivity is considered **High (C)**. Modelling of the drill cuttings discharged has been conducted using SINTEF's DREAM (Dose-related Risk and Effect Assessment Model) and assesses the depositional thickness on the seabed, particle size change, toxicity, oxygen depletion, predicted recovery of sediments and suspended solids in the water column. Results are presented in Appendix E. The drill cuttings modelling has found there is unlikely to be significant environmental impacts from localised drilling, therefore the Magnitude of Effect is considered **Minor (2)** such
20			Receptor: Marine flora and fauna. Impact on species occurring in the water column		B	1	Low	N/A	N/A	Receptor Sensitivity is considered **Medium (B)** due to PMF species occurring in the area. The Magnitude of Effect of drilling related discharges on receptors in the water column is considered **Negligible (1)** given that they 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**.
21		Domestic sewage from rig.	Receptor: Water quality. Water quality deterioration.	Comply with MARPOL 73/78 Annex IV.	A	1	Low	N/A	N/A	Given the open nature of the Central North Sea, the Receptor Sensitivity of water quality is **Low (A)**. As MARPOL compliant, the Magnitude of Effect of any discharges is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
22		Food waste.			A	1		N/A	N/A	

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
23		Discharge of hydrocarbons/ chemicals to sea i.e. from machinery space drainage.		Adherence to OPPC Regulations.	A	1	Low	N/A	N/A	Given the open nature of the Central North Sea, the Receptor Sensitivity of water quality is **Low (A)**. Discharges will be in line with permitted limits and regulated and therefore the, the Magnitude of Effect of any discharges is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
24	**Seabed Disturbance**	Impacts associated with drill cutting discharges have been assessed in Discharges to Sea.								
25		Interaction of semi-submersible drilling rig anchors or HDJU contingency anchors and spud cans with seabed.	Receptors: Benthic flora and fauna. Placement of drilling rig anchors and anchor lines will result in a temporary seabed impact and potentially leave depressions on the seabed.	Anchors of the drill rig (if used) will be maintained under tension to minimise chain contact on seabed.	C	2	Moderate	N/A	N/A	Given the proposed Project location within the East of Gannet and Montrose Fields NCMPA and likely presence of *A.islandica* , and considering their sensitivity to abrasion and penetration caused by items temporarily coming into contact with the seabed, 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**.
26		Cement plateau on seabed as result of cementing the top hole sections. Wells are c .13-17 m apart and so worst case is that cement patios will all join up with one	Receptor: Marine flora and fauna. Disturbance to seabed impacting on benthic species.	Visual monitoring of cement operations. Dye added to cement and ROV visual monitoring. Post-drilling survey.	C	2	Moderate	N/A	N/A	Given the proposed Project location within the East of Gannet and Montrose Fields NCMPA and likely presence of *A.islandica* , and considering their sensitivity to abrasion and changes in substrate (hard substrate being introduced so soft substrate environment), Receptor Sensitivity is considered **High (C)**. Given the cement patios from the wells are likely to join together, the Magnitude of Effect on benthic fauna and flora of the cement discharged at the seabed is considered to be **Minor (2)**, such that the overall Impact Significance is considered **Moderate**.
27	**Noise**	Use of perforation guns during well completion.	Receptor: fish and marine mammals	Would be carried out a minimum of 2,400 m (c . 7,900 ft). Given depth below seabed no impacts anticipated.	B	1	Low	N/A	N/A	Receptor (marine mammals) Sensitivity is considered **Medium (B)**, however given depth at which the charges would be used, the Magnitude of Effect is considered **Negligible (1)** such that the Impact Significance is considered **Low**.
28	**Noise**	Noise and vibration from drilling rig engines and machinery.	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. The wells are likely to be drilled in batches, there minimising the overall drilling time.	B	1	Low	N/A	N/A	Receptor (marine mammals) Sensitivity is considered **Medium (B)**. The Central 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 rig engine 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**.
29	**Waste**	General rig waste. Drilling rigs generate a number of wastes during routine operations including waste oil, chemical and oil contaminated water, scrap metal, etc.	Receptor: Use of landfill. Land take from use of landfill. Waste transportation and disposal.	Wastes will be minimised by use of appropriate procurement controls. All wastes to be properly segregated for recycling / disposal / treatment. Waste will be dealt with in accordance with regulatory requirements. Monthly reporting of waste sent to shore; Waste Management Plan and Waste Record Book; Waste management Duty of Care will be part of the rig audit. Targets and KPIs. Adhere to waste hierarchy. Contractor assurance process to ensure all of the above.	A	1	Low	N/A	N/A	Sensitivity of landfill as a receptor is considered **Low (A)** as landfill options are considered abundant. NEO NEXT recognise landfill sites as a finite resource, however as the majority of waste will be reused/ recycled and 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**.
30	**Use of Resources**	Fuel used for power generation.	Receptor: Resource use. Energy use.	Use of jack-up rig results in decreased diesel use. Rig Health, Safety & Environmental Management System audit.	A	1	Low	N/A	N/A	Receptor Sensitivity of fuel availability as a receptor is considered **Low (A)** as it is abundant. NEO NEXT recognise that hydrocarbon-based fuel is a finite resource, however given the relatively short duration of the proposed drilling activities the Magnitude of Effect of fuel use is considered **Negligible (1)** such that the Impact Significance is considered **Low**.
31		Utilities.	Receptor: Resource use. Use of freshwater.	No mitigation measures identified.	A	1	Low	N/A	N/A	Receptor Sensitivity of the use of freshwater, materials and chemicals 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**.
32		Materials for well construction.	Receptor: Resource use. Use of materials such as steel.	Well design optimisation.	A	1	Low	N/A	N/A	
33		Drilling mud components and chemicals.	Receptor: Resource use. Use of chemicals.	Materials selection. Chemical use minimised where possible. The chemical use will be recorded and monitored as per the Chemical Permit quantities. WBM will be recycled and reused during drilling operations.	A	1	Low	N/A	N/A	
34		Well clean-up.	Receptor: Resource use. Use of brine and other chemicals/ hydrocarbons.		A	1	Low	N/A	N/A	

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
35	**Unplanned Events**	During clean-up operations and well testing there is the potential for flare drop-out (unburned hydrocarbons) to fall on to the sea surface and form an oily slick.	Receptor: Marine flora and fauna. Water quality deterioration impacting on marine flora and flora.	Use of high efficiency burners. Visual monitoring for the detection of any sheen. Start-up of flare during daylight hours. Evergreen flaring technology - zero flare drop out. Clean-up flow-back test will be included in an Oil Discharge Permit and flare atmospheric emissions calculated.	B	1	Low	Possible	Low	As described above, a number of marine mammals are known to occur in the area, some of which are Annex II species and EPS, such that Receptor Sensitivity is considered to be **Medium (B)**. The Magnitude of Effect on marine mammals of small discharges is considered to be **Negligible (1)** given that they 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**. The Likelihood of a flare dropout occurring is considered **Possible** and the Environmental Risk is considered to be **Low**. The Likelihood of hazardous drainage water discharge occurring is considered **Unlikely** and the environmental risk is considered to be **Low**.
36		Deck drains. Discharge of hazardous drainage water.		Deck hazardous drainage (slops) and contaminated stormwater will be directed to the slops tank. Spill kit availability, premobilisation audit, bunding and containment for chemical storage.	B	1	Low	Unlikely	Low	
37		Loss of containment of LTOBM during bunkering.		Good hose management and preventive maintenance. Spill kit availability, premobilisation audit, bunding. Bunkering procedures will be developed and followed in line with Best Practice Guidance. Visual monitoring during bunkering.	B	2	Low	Unlikely	Low	As described above, a number of marine mammals are known to occur in the area, some of which are Annex II species and EPS, such that their Receptor Sensitivity is considered to be **Medium (B)**. Cod is identified in the area is listed as an IUCN 'Vulnerable' species, therefore their Receptor Sensitivity is considered **Medium (B)**. Given these species are mobile and able to move away from releases and that any releases of WBMs during bunkering operations would be rapidly dispersed and diluted by currents the Magnitude of Effect 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**. Magnitude of Effect considered **Minor (2)** (higher than helicopter) and it is assumed that the transfer would be ceased from at least 2.3 m^3 per minute / 2,300 litres a minute.
38		Bunkering. Release of hydrocarbons/ chemicals to sea.	Receptor: Fish and marine mammals. Water quality deterioration impacting on marine flora and flora.	Maintenance and procedures. Approved OPEP in place. A rig Health, Safety and Environment Management System audit ensured contractor has procedure in place to deal with a spill. For local response, dispersant available on board standby vessel. Bunkering procedures will be developed and followed in line with Best Practice Guidance. Continuous visual monitoring during bunkering - which is carried out during daylight hours.	B	2	Low	Unlikely	Low	
39		Dropped object resulting in interaction with seabed.	Receptor: Marine flora and fauna and other sea users. Loss of seabed habitat, smothering of benthic organisms, fishing snag hazard. Impact on existing seabed oil and gas infrastructure.	Risk assessment prior to equipment transfer. 500 m zone will remain in place.	C	1	Low	Unlikely	Low	As within an NCMPA, the Receptor Sensitivity of the seabed in the vicinity of the wells is considered **High (C)**. The Magnitude of Impact of a dropped object is considered **Negligible (1)** such that the Impact Significance is considered **Low**. Likelihood of an object being dropped during drilling activities is considered **Unlikely**, such that the Environmental Risk is considered **Low**.
40		Major loss of drilling rig fuel inventory. Hydrocarbon release to sea.	Receptor: Water quality. Water quality deterioration.	Exclusion zone in place. ERRV and Standby vessels on site; approved use of dispersants. HDJU will have marking and lighting as per the Standard Marking Schedule for Offshore Installations. Notice will be sent to SSF of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the HDJU.	C	2	Moderate	Unlikely	Medium	Given that the activities will take place within the East of Gannet and Montrose Fields NCMPA, the Receptor Sensitivity of marine flora and fauna as a receptor is considered **High (C)**. Would expect most diesel to evaporate with none reaching coastlines such that the Magnitude of Effect is considered **Minor (2)**. With the application of standard industry mitigation the Likelihood of a spill occurring is considered **Remote** therefore the Environmental Risk is considered to be **Low**.
41		Blowout. Uncontrolled hydrocarbon flow to surface.	Receptor: Marine mammals, birds and fish Water quality deterioration impacting on marine flora and flora.	Well design and planning. Drill contractor/ NEO NEXT 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. Approved OPEP in place. Containment and drainage facilities inspected as part of rig Health, Safety and Environment Management System audit. Member of OSRL and OPOL.	C	4	High	Remote	Medium	As it is possible that a well blowout could result in oil reaching coastlines Receptor Sensitivity is considered **High (C)**. As the proposed wells are free flowing (i.e. chance of a blowout in the event of a loss of well control), the Magnitude of Effect is considered **Major (4)**. 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**.
Node 3: Platform Modifications										
42	**Physical Presence of the Platform**	Platform modifications.	Receptor: Other sea users.	New reception facilities will be housed on the existing platform. If the new module extrudes beyond the existing structure, navigational lighting will be adjusted (as required) to ensure that the platform continues to comply with the Standard Marking Schedule for Offshore Installations.	A	1	Low	N/A	N/A	Fishing grounds - comprising up to 0.1% of fishing effort by UK vessels. Vessel activity in the area is considered low/very low. UK fishing industry and shipping in the area have the capacity to absorb change without impact therefore their Receptor Sensitivity is considered to be **Low (A)**. The Magnitude of Effect on fishermen/ other vessels is considered Low (1) given the extent of the proposed modifications and mitigations proposed and recent fishing restrictions within the East of Gannet and Montrose Fields NCMPA. The overall Impact Significance is therefore considered **Low**.
43	**Emissions to Air**	Emissions from vessels captured in Node 1.								

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
44	**Discharges to Sea**	Discharges from vessels captured in Node 1.								
45	**Seabed Disturbance**	Not applicable because: no anchored vessels; no requirement for a flotel; and new facilities added to existing topsides.								
46	**Noise**	Noise associated with installation vessels is captured in Node 1.								
47	**Waste**	General vessel waste is covered under Node 1 Vessel Use.								
48		Scrap metal, other construction materials. Installation generates a number of wastes during routine operations including scrap metal, wooden crates etc.	Receptor: Use of landfill. Land take from use of landfill. Waste transportation and disposal.	Waste minimisation. All wastes to be properly segregated for recycling / disposal onshore. Waste will be dealt with in accordance with regulatory requirements. Adherence to waste hierarchy. All waste captured in line with current practises on Montrose BLP. NORM waste to be managed by disposal.	A	1	Low	N/A	N/A	Receptor Sensitivity of landfill is considered **Low (A)** as landfill options are considered abundant. NEO NEXT recognise landfill sites as a finite resource, however as 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 considered to be **Negligible (1)** and the Impact Significance is considered **Low**.
49	**Use of Resources**	Fuel use associated with platform installation vessels and helicopter trips is covered under Node 1 Vessel Use.								
50		Materials for installation of platform modifications.	Receptor: Resource use e.g. steel for lifting points, support framework for topsides lifting.	Plant optimisation, jacket and topsides will be recycled at end of field life.	A	1	Low	N/A	N/A	Receptor Sensitivity of the use of steel as a receptor is considered **Low (A)** as supply is considered relatively abundant such that the Magnitude of Effect is considered **Negligible (1)** and the Impact Significance is considered **Low**.
51	**Unplanned Events**	Loss of vessel fuel due to collision is covered under Node 1 Vessel Use.								

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
52		Major dropped objects e.g. module.	Receptor: Marine flora and fauna. Loss of seabed habitat, smothering of benthic organisms.	Dropped objects retrieved where possible. Use of specialist installation contractor. Risk assessment prior to equipment transfer.	C	1	Low	Unlikely	Low	As within East of Gannet and Montrose Fields NCMPA, the Receptor Sensitibity of the seabed in the vicinity of the wells is considered **High (C)**. The Magnitude of Effect of a dropped object is considered **Negligible (1)** such that the Impact Significance is considered **Low**. Likelihood of an object being dropped during drilling activities is considered **Unlikely**, such that the Environmental Risk is considered **Low**.
53		Major dropped objects impacting on live lines.	Receptor: Marine flora and fauna, fisheries, marine mammals, water quality.	Conformance with LOLER (Lifting Operations and Lifting Equipment Regulations) standards.	C	4	High	Remote	Medium	As within East of Gannet and Montrose Fields NCMPA, the Receptor Sensitibity of the seabed in the vicinity of the wells is considered **High (C)**. The Magnitude of Effect of a dropped object impacting on live lines and resultant hydrocarbon release is considered **Major (4)** such that the Impact Significance is considered **High**. Conformance with LOLER standards means the Likelihood of such a dropped object is considered **Remote**.
Node 4: Subsea Installation										
54	**Physical Presence of Subsea Infrastructure**	Presence of installation vessels is covered under Node 1 Vessel Use.								
55		Physical presence of subsea infrastructure (Subsea manifold, drilling template and/or Xmas trees, mattresses, grout bags, contingency rock, spools, umbilical jumpers). Includes one crossing within existing Montrose 500 m zone (grout bags and mattresses).	Receptor: Fisheries. Navigation hazard, restriction of fishing operations, snagging risk to fishing nets.	500 m around the drill centre. Minimise number of mattresses where possible. Shortest feasible routes used. Consent to Locate will be in place as part of drilling permit for all permanent and temporary deposits.	A	1	Low	N/A	N/A	Fishing grounds - comprising up to 0.1% of fishing effort by UK vessels. UK fishing industry and vessels in the area have the capacity to absorb change without impact therefore Receptor Sensitivity is considered to be **Low (A)**. All infrastructure will be laid within 500 m zones. As only one new 500 m zone being added (part of which will overlap with the existing 500 m zone at Montrose) and taking account of the recent fishing restrictions within East of Gannet and Montrose Fields NCMPA, the Magnitude of Effect on fisheries is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
56			Receptor: Marine flora and fauna. Disturbance to seabed impacting on benthic species.		C	2	Moderate	N/A	N/A	As within the East of Gannet and Montrose Fields NCMPA, which is designated for the PMFs *A.islandica* (and their supporting habitat) and offshore deep sea muds, the Receptor Sensitivity of benthic flora and fauna is considered **High (C)**. The Magnitude of Effect on benthic species from installation activities is considered to be **Minor (2)** given that the habitats are not unique to the Central North Sea such that the Impact Significance is considered **Moderate**.
57	**Emissions to Air**	Atmospheric emissions associated with the subsea infrastructure installation vessels including helicopters are covered under Node 1 Vessel Use.								
58	**Discharges to Sea**	Discharges to sea associated with the subsea infrastructure installation vessels are covered under Node 1 Vessel Use.								
59		Hydro/leak testing. Only discharge if there is an actual leak (low likelihood). Possibly biocide treated seawater from line flooding	Receptor: Water quality. Water quality deterioration.	Chemical selection process will aim to select the lowest toxicity chemicals for a given technical requirement. Line will be filled with MEG or inhibited seawater. Possible biocide sticks. Leak testing from installation rather than DSV if possible. Discharge of fluids, will follow procedures which will minimise environmental impact. Chemical use and discharge assessed in the flowline operation MATs.	A	1	Low	N/A	N/A	Given the open nature of the Central North Sea, the Receptor Sensitivity of water quality is considered **Low (A)**. Chemicals will be PLONOR where possible and disperse rapidly due to currents, the Magnitude of Impact of any discharges is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
60		Dewatering of the flowline prior to commencement of production - fluids back to platform for discharge to sea (treated seawater)			A	1	Low	N/A	N/A	
61		Release of chemicals and hydraulic fluid during tree valve and manifold commissioning operations			A	1	Low	N/A	N/A	

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
62	**Seabed Disturbance**	Physical presence of flowlines.	Receptor: Marine flora and fauna. Seabed disturbance, loss of habitat, temporary suspended solids, loss of benthic organisms and PMFs.	Flowline route surveys. Minimising flowline route length - temporary along the line lengths as they will be trenched and buried. Volume of stabilisation materials will be minimised as much as possible (mattresses preferred option over rock placemenet). Post-drilling survey.	C	2	Moderate	N/A	N/A	Given the proposed Project location within the East of Gannet and Montrose Fields NCMPA and likely presence of *A.islandica* , and considering their sensitivity to the permanent seabed disturbance planned as part of the proposed Project (introduction of hard substrate to soft sediment), Receptor Sensitivity is considered **High (C)**. Taking account of the widespread distribution of *A. islandica* across the CNS, any mortality caused to individual specimens as a result of the proposed activities is not considered significant given the relatively limited area of impact. The Magnitude of Impact of permanent seabed disturbance on habitats and benthic communities within the area 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, the Impact Significance of permanent seabed disturbance on habitats and benthic communities is considered **Moderate**.
63	**Underwater Noise**	Noise associated with subsea installation vessels is captured in Node 1.								
64		Piling of manifold	Receptor: Marine mammals and fish.	Adherence to JNCC protocols.	B	2	Low	N/A	N/A	As described above, a number of marine mammals are known to occur in the area, some of which are Annex II species and EPS, whilst many fish species are identified to be PMFs such that Receptor Sensitivity is considered to be **Medium (B)**. The Central 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 piling noise. Any impacts from piling 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. Despite this, physical impacts may occur if marine mammals or fish are within close proximity to the piling source. The Magnitude of Effect of underwater noise on marine mammals and fish is therefore considered to be **Minor (2)** such that the Impact Significance is considered **Low**. Underwater Noise Modelling has been conducted to support the impact assessment (Appendix D).
65	**Waste**	General vessel waste is covered under Node 1 Vessel Use.								
66		General waste from flowline and installation of infrastructure. Flowline and installation generate a number of wastes during routine operations including scrap metal, wooden crates etc.	Receptor: Use of landfill. Land take from use of landfill. Waste transportation and disposal.	Waste management procedures to be followed. Waste will be dealt with in accordance with regulatory requirements. Contractors Assurance process to ensure the above.	A	1	Low	N/A	N/A	Receptor Sensitivity of landfill as a receptor is considered **Low (A)** as landfill options are considered abundant. NEO NEXT recognise landfill sites as a finite resource, however as 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 considered to be **Negligible (1)** and the Impact Significance is considered **Low**.
67	**Use of Resources**	Fuel use associated with subsea infrastructure installation vessels is covered under Node 1 Vessel Use.								
68		Construction of flowlines and other subsea infrastructure.	Receptor: Resource use (e.g. steel).	Scrap metal wastes to be properly segregated for recycling / disposal onshore. Company policy to minimise materials use. Chemical use minimised where possible.	A	1	Low	N/A	N/A	Receptor Sensitivity of the use of materials (steel) and chemicals is considered **Low (A)** as all are considered abundant. Given the abundance of these resources the Magnitude of Effect of materials and chemicals use is considered **Negligible (1)** such that the Impact Significance of resource use during subsea installation is considered **Low**.
69		Chemical use including seawater inhibitors during flowline commissioning.	Receptor: Resource use Use of chemicals.	Chemical use minimised where possible. Chemical use is tracked and monitored against the quantities on CP.	A	1	Low	N/A	N/A	
70	**Unplanned Events**	Unplanned events impacting on the subsea infrastructure after production has commenced are considered under Production.								
Node 5: Commissioning and Production										
71	**Physical Presence**	Vessel use.	No change to existing.							
72	**Emissions to Air**	Regular supply vessels to the installation and periodic maintenance and inspection will require vessels. Power generation	No change to existing.							
73		Helicopter movements.	No change to existing.							
74		Power generation from essential systems diesel generator.	Receptor: Climate change	PPC and ETS permits will be in place. The PPC permit will asses the impacts from air emissions associated with any additional power generation resulting from the additional wells. Use of the diesel generator will be minimised where possible, with regular maintenance to ensure optimal operation.	D	2	Moderate	N/A	N/A	As above, the impact assessment methodology used to assess atmospheric emissions within the ES is further detailed in Chapter 7. As above, Receptor Sensitivity of climate change is considered **Very High (D)**. NEO NEXT acknowledges that the potential additional power generation as a result of the additional wells will contribute to climate change, however the change is not considered to be significant, therefore the Magnitude of Effect is considered **Minor (2)** such that the overall Impact Significance is considered **Moderate**. The Emissions Reduction Action Plan (ERAP) will be updated to identify how emissions can be reduced.

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
75		Process flaring and blowdown. Flaring resulting in emission of various air pollutants.	Receptor: Climate change	Infrequent occurrence. No incremental flaring is anticipated as a result of bringing online Montrose Infill wells. This impact assessment assumes that flare gas recovery would be implemented from 2026 on the Montrose Complex should the proposed Montrose Infill Development come online. Flare gas recovery will reduce the emissions from flaring from the Montrose	D	1	Low	N/A	N/A	As above, the impact assessment methodology used to assess atmospheric emissions within the ES is further detailed in Chapter 7. As above, Receptor Sensitivity of climate change is considered **Very High (D)**. As there will be no incremental flaring as a result of the Montrose Infill wells, and flare gas recovery to be implemented from 2026 would reduce flaring emissions, the Magnitude of Effect from flaring is considered **Negligible (1)** such that the overall Impact Significance is considered **Low.**
76		Flowline depressurisation (e.g. for hydrate risk mitigation during long term shutdown (*c* . > 1 day))	Receptor: Climate change	Infrequent occurrence. Establish minimum no touch time.	D	1	Low	N/A	N/A	As above, the impact assessment methodology used to assess atmospheric emissions within the ES is further detailed in Chapter 7. As above, Receptor Sensitivity of climate change is considered **Very High (D)**. NEO NEXT acknowledges that the atmospheric emissions associated with flowline depressurisation will contribute to climate change, however its infrequent occurrence and enforcing a minimum no touch time means the Magnitude of Effect is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
77		Venting from platform drain tanks, fuel tanks, etc.	Receptor: Climate change	Venting will be minimised where possible. Current venting rates on the Montrose Complex are anticipated to remain unchanged following the addition of the Montrose Infill wells.	D	1	Low	N/A	N/A	As above, the impact assessment methodology used to assess atmospheric emissions within the ES is further detailed in Chapter 7. As above, Receptor Sensitivity of climate change is considered **Very High (D)**. As current venting rates on the Montrose Complex will be unchanged by the addition of the Montrose Infill wells, the Magnitude of Effect from the addition of the Montrose Infill wells is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
78		Well intervention vessel emissions resulting in emission of various gases.	Receptor: Climate change	Well intervention is expected to be one scale squeeze per year.	D	1	Low	N/A	N/A	As above, the impact assessment methodology used to assess atmospheric emissions within the ES is further detailed in Chapter 7. As above, Receptor Sensitivity of climate change is considered **Very High (D)**. NEO NEXT acknowledges that the atmospheric emissions associated with well intervention vessels will contribute to climate change, however, given that only once annually a vessel will come and do a scale squeeze over a 48 hr period, the Magnitude of Effect is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**.
79		Fugitive emissions.	No change to existing.							
80	**Discharges to Sea**	Domestic sewage from installation and support vessels.	No change to existing.							
81		Food waste from installation and support vessels.	No change to existing.							
82		Produced water discharge (and associated hydrocarbons, production chemicals, NORM and naturally occurring heavy metals).	Receptor: Water quality. Water quality deterioration.	Actual produced water from the wells will include formation and seawater components. The Montrose Infill production will make use of existing ullages available in the BLP produced water. Volume of produced water discharge will increase but oil in water concentration will not be threatened.	A	1	Low	N/A	N/A	Given the open nature of the Central North Sea, the Receptor Sensitivity of water quality is considered **Low (A)**. As oil in water content will be < 30 mg/l, the Magnitude of Effect is considered **Negligible (1)** and Impact Significance is **Low**.
83		Drainage water. Potential for oily discharge during release of drainage water.	No change to existing.							
84	**Seabed Disturbance**	No planned additional seabed disturbance associated with production.								
85	**Noise**	No change to existing.								
86	**Waste**	No change to existing.								
87	**Use of Resources**	Production chemicals.	Receptor: Resource use. Use of chemicals.	Chemical use minimised where possible. Production chemicals are covered by PRA/46 CP.	A	1	Low	N/A	N/A	Receptor Sensitivity of chemical availability is considered **Low (A)**. The use of chemicals will be minimised as far as practicable however due to the development having a Cessation of Production (CoP) date in 2035, the Magnitude of Effect is considered **Negligible (1)** such that the Significance is **Low**.

Row	Aspect	Source/ Activity	Receptors and Potential Impacts	Standard Industry Mitigation	Sensitivity	Magnitude	Significance	Likelihood (unplanned)	Environmental Risk (unplanned)	Notes on Scoring/Actions/ Comments
88	**Unplanned Events**	Minor chemical/ hydrocarbon spills.	No change to existing.							
89		Major loss of containment as a result of topsides rupture (hydrocarbons).	No change to existing.							
90		Leaks or ruptures from bunkering (diesel).	No change to existing.							
91		Dropped objects resulting in disturbance to seabed.	No change to existing.							
92		Dropped objects resulting in damage to subsea infrastructure and small hydrocarbon releases	No change to existing.							
93		New flowline rupture.	Receptor: Marine flora and fauna.	Structure protection will be implemented to prolong the life of the equipment. CRA (Corrosion Resistant Alloy) flowlines. Flowline routes added to admiralty charts, Kingfisher database, etc. New flowlines within 500 m zone so no fishing interaction. Flowline material selection will ensure minimal degradation. Corrosion rates are very low so the risk of through wall corrosion is minimal.	C	2	Moderate	Remote	Low	Given that the activities will take place within the East of Gannet and Montrose Fields NCMPA, the Receptor Sensitivity of marine flora and fauna as a receptor is considered **High (C)**. The Magnitude of Effect is considered **Minor (2)** given that a flowline rupture may result in localised changes to the receptor. With the application of standard industry mitigation the Likelihood of a rupture occurring is considered **Remote** therefore the Environmental Risk is considered to be **Low**.
94		Export flowline rupture.	No change to existing.							
95		Snagging or dragging of new subsea infrastructure - impact on fishermen.	Receptor: Other Sea users.	Marked on all admiralty charts and on Kingfisher database, SFF etc. Safety zones at installation ends. Subsea infrastructure may be covered with mattresses within 500m zone as the preferred option.	A	2	Low	Remote	Low	UK fishing industry Receptor Sensitivity is considered to be **Low (A)**. All infrastructure will be laid within 500 m zones. As only one new 500 m zone being added (part of which will overlap with the existing 500 m zone at Montrose) and taking account of the recent fishing restrictions within East of Gannet and Montrose Fields NCMPA, the Magnitude of Effect on fisheries is considered **Negligible (1)** such that the overall Impact Significance is considered **Low**. Given the new fishing restrictions, the Likelihood of snagging is **Remote** and overall Environmental Risk is **Low**.
96		Release of hydrocarbons due to vessel collision with platform.	No change to existing.							
97		Helicopter crash. Loss of helifuel to sea after crash.	No change to existing.							

Appendix C: Hydrocarbon Spill Modelling

REPORT

Oil Spill Modelling Report

Prepared for: **NEO NEXT+**

Prepared by: **Genesis Energies**
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Project Title: **Montrose Infill Project Environmental Statement**
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Client Document No.: RP-MO0786-HS-0347

Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval
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C	24/01/2024	Update to address client comments	[redacted]	[redacted]	[redacted]	
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ABBREVIATIONS

%	Percent
°C	Degrees centigrade
°F	Degrees Fahrenheit
µm	Micrometre
3D	Three-dimensional
BEIS	Department for Business, Energy & Industrial Strategy)
CNS	Central North Sea
cP	Centipoise
DESNZ	Department for Energy Security and Net Zero (formerly BEIS)
ECMWF	European Centre for Medium-Range Weather Forecasts
ES	Environmental Statement
g	Gram
g/m^2	Grams per square metre
HYCOM	Hybrid Coordinate Ocean Model
ITOPF	International Tanker Owners Pollution Federation
kg/m^2	Kilograms per square metre
km	Kilometres
km^2	Square kilometre
km^3	Cubic kilometre
m	Metre
m^2	Square metre
m^3	Cubic metre
m^3/day	Cubic metre per day
mg/kg	Milligrams per kilogram
mm	Millimetre
NOEC	No Observed Effect Concentration
OPEP	Oil Pollution Emergency Plan
OSCAR	Oil Spill Contingency and Response
OSPAR	Oslo and Paris Convention
PNEC	Predicted No Effect Concentration
ppb	Parts per billion
ppt	Parts per thousand

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psia	Pounds per Square inch Absolute
t	Tonnes
t/m^3	Tonnes per cubic metre
TPH	Total Petroleum Hydrocarbons
UKCS	United Kingdom Continental Shelf
UKOOA	UK Offshore Operators Association

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EXECUTIVE SUMMARY

In line with regulatory requirements, modelling of the worst-case release of crude oil from the proposed Montrose Infill Project was undertaken to inform the Montrose Infill Project Environmental Statement (ES) in terms of potential environmental impacts and mitigation measures.

All the figures provided in this report show the worst-case outputs from the modelling scenario, assuming no intervention. In reality, the likelihood of a spill is extremely low given the existing controls in place during drilling and, in the unlikely event that a spill did take place, the extent of that spill would be expected to be significantly lower than shown in this report taking into consideration mitigation measures that will be in place.

Stochastic (probabilistic) and deterministic modelling was undertaken using the Oil Spill Contingency and Response (OSCAR) model developed by Sintef.

The worst-case release of crude is considered to be a well blow out at surface with a duration of 175 days and a declining blowout rate ranging from 4,681.1 m^3/day at the start of the blowout, to 941.8 m^3/day on day 175.

The primary aims of this modelling study were to understand:

- The probability of hydrocarbons accumulating on the sea surface, in the water column and reaching the shoreline;
- Where hydrocarbon concentrations could exceed certain thresholds on the sea surface, water column, on shore and in sediments; and
- The minimum time taken for hydrocarbons to reach the shoreline.

Ocean currents data were sourced from the Hybrid Coordinate Ocean Model (HYCOM) and wind data sets were obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF). Other environmental factors and conditions, such as ocean temperature and salinity, were obtained from the Scottish Government's National Marine Plan interactive (Berx, B. and Hughes, S., 2009).

The modelling concludes that there is low probability of oil reaching the coastline of the UK (13%) with a minimum arrival time of 14.4 days and Norway (15%) with a minimum arrival time of 15.7 days. The thresholds for surface sheen thickness, shoreline oiling, hydrocarbon concentration in the water column and hydrocarbon concentration in seabed sediment are all exceeded over relatively large areas/volumes. This was expected given that the scenario simulates a worst-case hydrocarbon release. A summary of the modelling results is presented in Table 1-1.

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Table 1-1: Summary of modelling results.

Modelling parameter	Crude oil inventory release
Minimum time to beaching [a]	14.3 days
Area of sea surface impacted by oil with thickness > 0.3 µm [b]	72,874 km^2
Volume of water column impacted by oil at concentrations > 10 ppb [b]	4,740 km^3
Area of seabed sediment impacted at > 5 g/m^2 [b]	451.8 km^2
Length of coastline impacted by oil at concentration > 100 g/m^2 [b]	98.8 km
Maximum mass of oil on shore [b]	461 t

[a] Values extracted from stochastic simulation.

[b] Values extracted from deterministic simulation.

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1.0 INTRODUCTION

NEO NEXT+ propose to redevelop the Montrose field which is located in UK Continental Shelf (UKCS) Blocks 22/17 and 22/18 in the Central North Sea (CNS). Further information on the location of the Montrose field can be found in Section 1 of the main ES.

This report documents the oil spill modelling carried out to determine the environmental risk associated with an accidental release of crude oil resulting from a blow out at proposed well MRH. A single worst-case scenario was modelled:

- Release of crude at a maximum rate of 195.1 m^3 /hr (4,681.1 m^3/d), declining to 39.2 m^3 /hr (941.8 m^3/d) over a period of 175 days.

Note that these are modelled rates based on predicted rates provided by NEO NEXT+. However, in order to model a declining rate some simplifications are required as explained in Section 3.1.

The spill scenario was modelled using the Oil Spill Contingency and Response (OSCAR, version 14.1.0) 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.

The results of the modelling have been used to inform the Environmental Statement (ES) (see Chapter 12). This report only presents the potential magnitude of the spill in terms of either probabilities (likelihood of a spill reaching a particular area) and extent (volume, area, thickness etc for a specific set of worst-case meteorological conditions) and makes no assessment of the potential environmental impact. This is assessed in Chapter 12. Worst-case results are presented, assuming no intervention, therefore in the unlikely event that a spill did happen and taking into consideration barriers and controls in place, it is likely that the magnitude of the spill would be lower than modelled.

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2.0 OVERVIEW OF MODELLING METHODOLOGY

When crude oil is 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 crude oil are dependent on the chemical and physical properties of the oil, and the physico-chemical changes to which the oil is subjected. These vary depending on the oil 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 oil is subjected to after being released at sea. These processes are all modelled in 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:

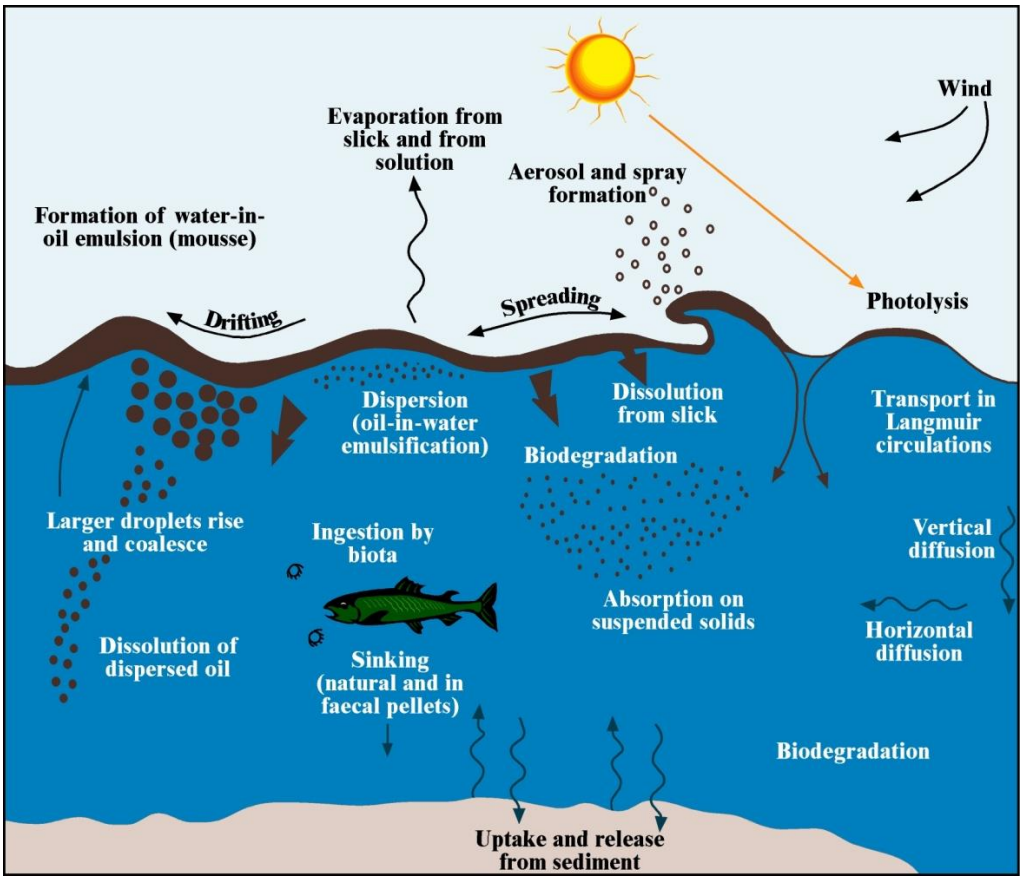
- The probability of oil above a predefined threshold appearing on the sea surface;
- The probability of oil above a predefined threshold being present throughout the water column; and
- The probability of oil arriving on the shoreline.

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 oil 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 are summarised in Table 3-1. The OSCAR modelling parameters adopted for this study are outlined in Table 3-2.

The release of the crude inventory from the well drilling operation is assumed to occur on the sea surface with a release duration of 175 days. This results in a total modelled release of 238,469 m^3. This is based on the estimated time taken to mobilise a drilling rig and to drill a relief well.

The model assumed no intervention (i.e., no response efforts were included in the modelling, in line with Oil Pollution Emergency Plan (OPEP) guidance, BEIS, 2022). The results in terms of estimated impacts can therefore be considered conservative.

A declining flow rate was simulated in the model. However, the model is unable to simulate a continuously declining flow rate, therefore the release duration was divided into discrete periods and an average release rate for that period was used. During the early part of the simulation when the rate is declining rapidly rates were averaged over a single day whereas in the latter part of the simulation when the rate is declining much more slowly, rates were averaged over longer periods (up to 25 days).

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Table 3-1: Scenario release parameters.

Release location			Release depth (m below sea level)[1]
57° 27' 27.71" N 1° 23' 9.85" E (WGS84)			0.5
57° 27' 30.47" N 1° 23' 15.47" E (ED50)			
Modelled Release rate (m^3/d)[2]	**Release duration (days)**	**Total release (m^3)**	**Release temperature (°C)**
4,681.1	1	4,681	103.2
3,955.7	1	3,956	103.0
3,529.2	1	3,529	102.8
3,222.5	1	3,223	102.6
2,966.7	1	2,967	102.4
2,532.8	5	12,664	102.2
2,213.6	5	11,068	102.0
2,031.9	5	10,160	101.6
1,822.7	10	18,227	101.1
1,627.8	10	16,278	100.6
1,493.6	10	14,936	100.2
1,387.6	10	13,876	99.7
1,299.5	10	12,995	99.2
1,227.5	10	12,275	98.7
1,169.7	10	11,697	98.2
1,102.0	20	22,041	97.8
1,033.9	20	20,678	97.6
983.7	20	19,674	97.4
941.8	25	23,545	97.2
TOTAL	**175**	**238,469**	-

[1] Constant release depth throughout all simulations.
[2] Detailed declining rates provided in Annex A.

Table 3-2: OSCAR modelling parameters.

Modelling parameter		Crude inventory release
Model duration (days)		205[1]
Model time step (hours)		1
Output interval (hours)		3
Grid resolution (cell size)	Cell size	2,000 m × 2,400 m
	Grid size	1,000 km × 1,200 km
	Depth (m)	400
Number of particles	Liquid/ Solid	20,000
	Dissolved	20,000
	Gas	50

1 Model duration is based on 175 days spill duration plus 30 days to allow for dispersion following the end of the spill.

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It is normal to run scenarios for the entire duration of the spill, and for sufficient time afterwards to determine the behaviour and location of the oil, before taking a view on whether this poses a risk to receptors. Often some dispersed and surface oil remains 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. Thirty days model duration following the end of the blow out allows for sufficient dispersion to take place.

3.2 Hydrocarbon Properties

OSCAR includes a database that contains various oil types. A suitable analogue was selected from this database to represent the Montrose crude. North Star (Sintef) was selected based on its properties as shown in Table 3-3.

The North Star analogue has similar wax and asphaltene content to that of Montrose reservoir oil and is not expected to emulsify in the marine environment (typically emulsification happens for oils >0.5% asphaltene content). Viscosity and specific gravity are also a good match.

Table 3-3: Montrose oil properties and selected OSCAR analogues.

Property	Montrose Crude	North Star
API (°)	41.06	42
Specific gravity (at 60°F, 14.7 psia, stock tank conditions)	0.821	0.816
Viscosity (cP) (at 13°C, 14.7 psia)	9.94	10
Pour Point (°C)	-	-39
Asphaltene content (% weight)	0	0.002
Wax content (% weight)	5.3	5.9

3.3 Bathymetry

The bathymetry data used in the OSCAR model is Sea Topo 8.2 as supplied by Sintef with the OSCAR model.

3.4 Metocean Data

3.4.1 Ocean Currents

Three-dimensional ocean currents data for the region was obtained from the Hybrid Coordinate Ocean Model (HYCOM) covering the years 2009–2013. The dataset contains three-dimensional (3D) ocean currents with a temporal resolution of one day, in other words the currents change speed and direction at daily intervals.

3.4.2 Winds

Wind data sets have been obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF) for the same period as the currents were used. OSCAR uses wind data to generate waves for surface turbulent mixing processes.

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3.4.3 Ocean Temperature and Salinity

Annual average salinity and temperature values were obtained from the Scottish Government's National Marine Plan interactive (Berx & Hughes, 2009):

- Surface water temperature: 9.5°C
- Bottom water temperature: 7.5°C
- Salinity: 35.0 ppt

3.5 Model Uncertainties

There are uncertainties associated with simulation of oil spills). Results should be treated as indicative and used to draw conclusions at a high level.

3.5.1 Oil Characterisation

Oil weathering properties have been adopted from an analogue which is closest to the Montrose crude properties provided. North Star (Sintef) was selected as a suitable analogue based on its properties as shown in Table 3-3. The match is considered representative for the purposes of this assessment.

3.5.2 Metocean Data

Currents and wind data used here are modelled for the years 2009–2013. 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 oil spill to aid the response effort. However, for the purposes of this modelling exercise, which uses currents and winds across multiple years to calculate probabilities, the variation is considered acceptable.

3.6 Output Thresholds

The OSCAR model can track the routing and destination of oil in smaller and smaller concentrations and masses (over time and space), beyond the point where oil represents a significant risk or is 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 oil and to concentrations in the water column. The thresholds adopted in the modelling are discussed in the following sections.

3.6.1 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 (see Table 3-4). Oil at thicknesses below this value becomes unlikely to be visible in many conditions and oil thicknesses lower than 0.04 µm are considered "not visible" even under good conditions. The Department for Energy Security and Net Zero (DESNZ), formerly the Department for Business, Energy & Industrial Strategy (BEIS) Oil Pollution Emergency Plan (OPEP) guidelines (2022) for the UKCS state that oil spill model

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results must be displayed to a minimum oil thickness of 0.3 µm and therefore out of best practice this threshold has been adopted.

Table 3-4: 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

Source: Bonn agreement (2016)

3.6.2 Oil in Water Concentration

A range of standards for concentration of oil in water have been considered, which are summarised in Table 3-5.

Table 3-5: Standards for oil 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 oil in seawater (in the water column) concentration above 10 ppb 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 ppb is considered conservative given it is at the lower end of the range of standards shown in Table 3-5.

3.6.3 Shoreline Oil Concentration

No threshold has been applied within the model to the shoreline oil density as in the interest of transparency it is considered best practice to report all shoreline oiling (however small) in the results.

3.6.4 Oil in Sediment

No threshold has been applied to sediment concentrations in the model.

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4.0 RESULTS AND DISCUSSION

This section presents the results obtained from the OSCAR simulations for the worst-case scenario detailed in Table 3-1. Both stochastic and deterministic simulation results are presented. The stochastic simulations comprised 100 individual deterministic simulations, which were evenly spread throughout the four years of ocean currents and wind data. Based on the results from the stochastic simulations, a deterministic simulation was undertaken. The time period for the deterministic simulation was selected to highlight the worst-case mass of oil arriving on shore.

The stochastic simulations allow probabilities of oil reaching specific coastlines or crossing median lines to be derived based on a wide range of metocean conditions.

The deterministic simulation allows oil deposition on the seabed, maximum surface area coverage and maximum concentration of oil in the water column to be estimated for a single set of metocean conditions (even though those metocean conditions may not be the most likely conditions). In the unlikely event of a spill, modelling would be repeated using the metocean conditions existing at the time of the spill to allow more realistic predictions of oil behaviour.

Calculations of maxima (for oil at the sea surface and oil in the water column) are reported as the total area impacted over the duration of the simulation and do not represent a single instance in time (they represent the swept path).

Mass balance figures are obtained from the deterministic simulation rather than the stochastic simulations to include the concentration of oil in the sediment (oil deposition in the seabed is not calculated in stochastic simulations) and maximum sheen thicknesses on the sea surface.

As noted in the introduction, the results presented here are focused solely on the potential magnitude of the spill and how the oil behaves within the marine environment. The actual assessment of environmental impacts (i.e. potential impact on birds, marine mammals *etc*.) is undertaken in Chapter 12 of the ES.

4.1 Destination of Hydrocarbons (Mass Balance)

Figure 4-1 shows the mass balance over time both as (A) tonnes and as (B) a percentage. Mass balance plots in Figure 4-1 show that, at the end of the simulation (at day 205) the mass balance of spilled crude was:

- Evaporated: 46.9% (96,750 t);
- Biodegraded: 24.0% (49,520 t);
- Water column: 5.6% (11,450 t);
- Sea surface: 0.03% (70 t);
- Shoreline: 0.1% (280 t);
- Sediment: 22.5% (46,350 t);
- Outside model grid: 0.8% (1,707 t).

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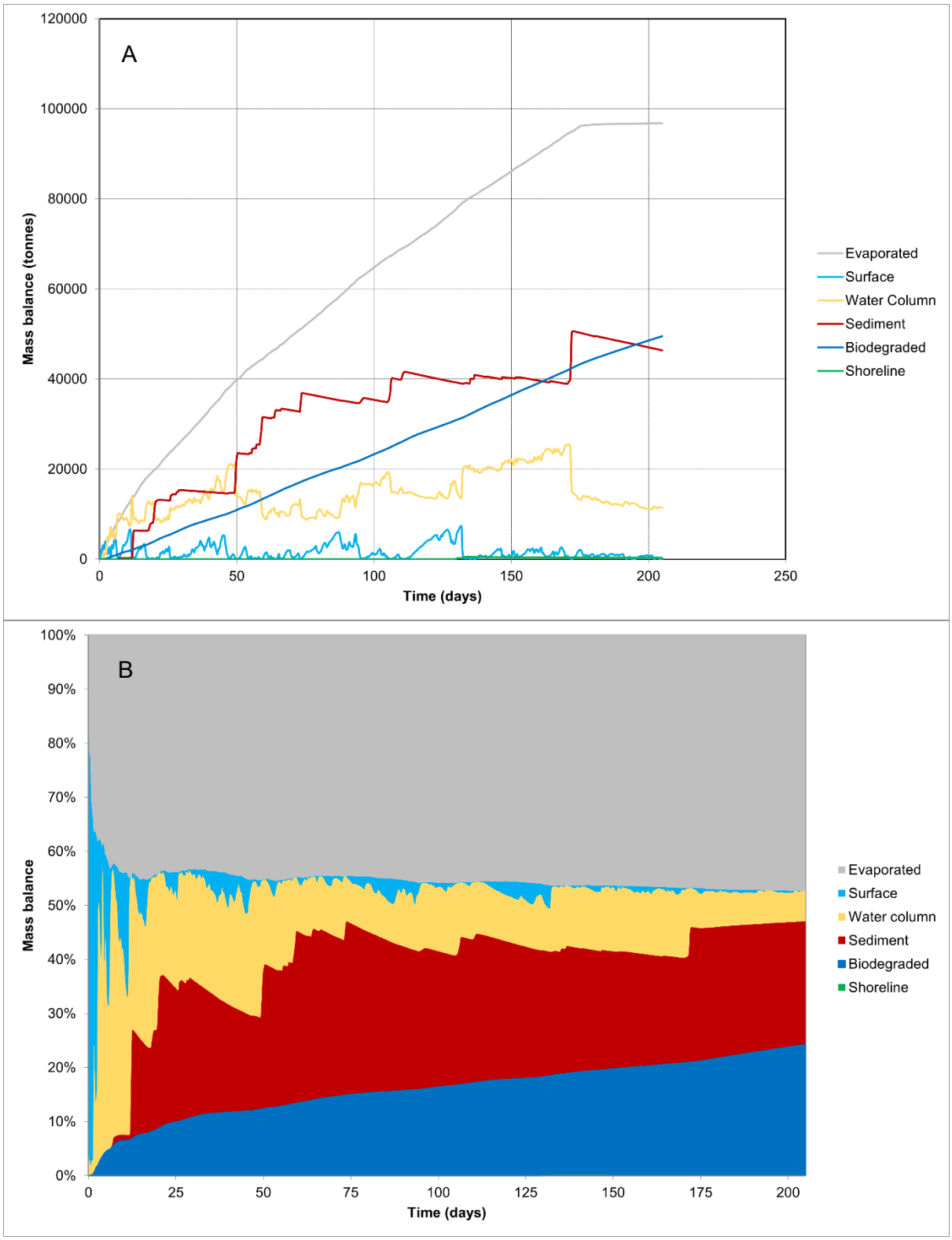


Figure 4-1: Mass Balance (deterministic) by mass (A) and percentage of total release (B).

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4.2 Oil on the Sea Surface

The probability of a visible surface sheen with a thickness ≥ 0.3 µm is shown in Figure 4-2, based on results from the stochastic simulation. This visible surface sheen could extend to a maximum distance of *c.* 172 km with a 50% probability.

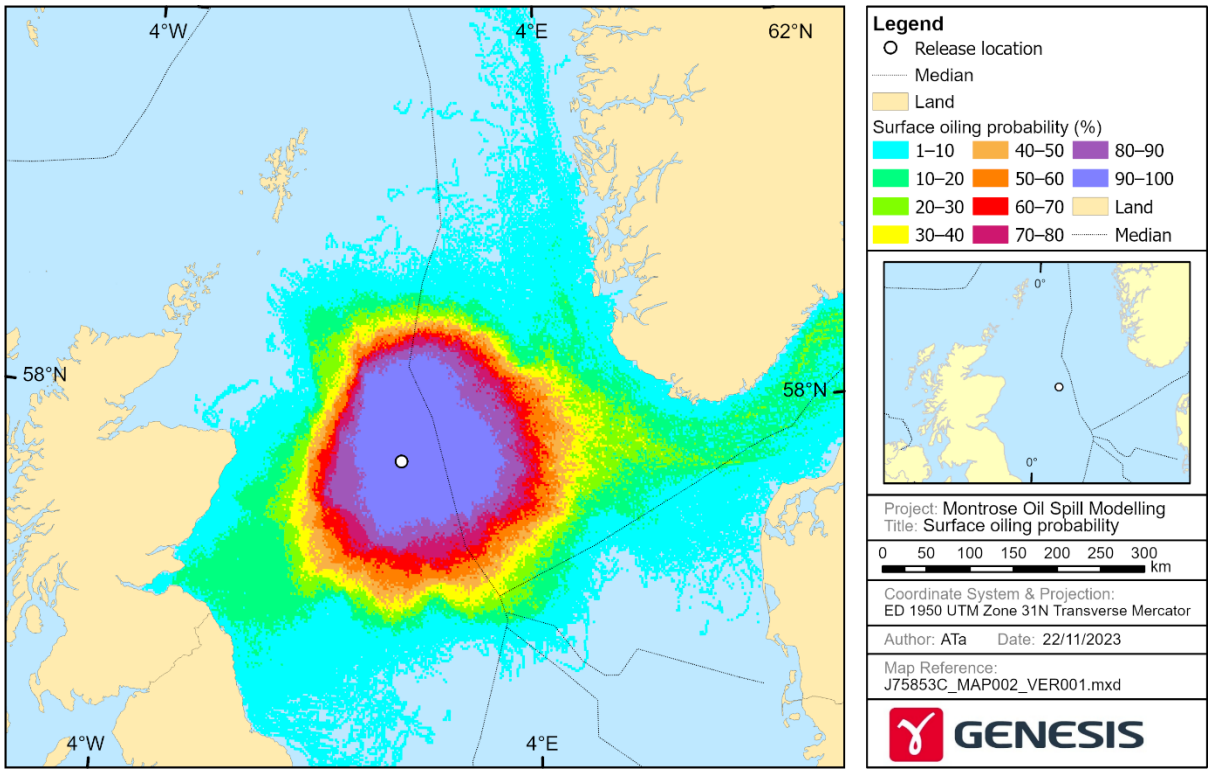


Figure 4-2: Probability of a surface sheen > 0.3 µm (stochastic).

The minimum arrival time of oil on the sea surface is shown in Figure 4-3. The modelled spill reaches the UK-Norway median line, with a maximum probability of 100% and a minimum arrival time of 1.1 days. Probabilities and minimum arrival times for all relevant median lines are shown in Figure 4-3 and Table 4-1.

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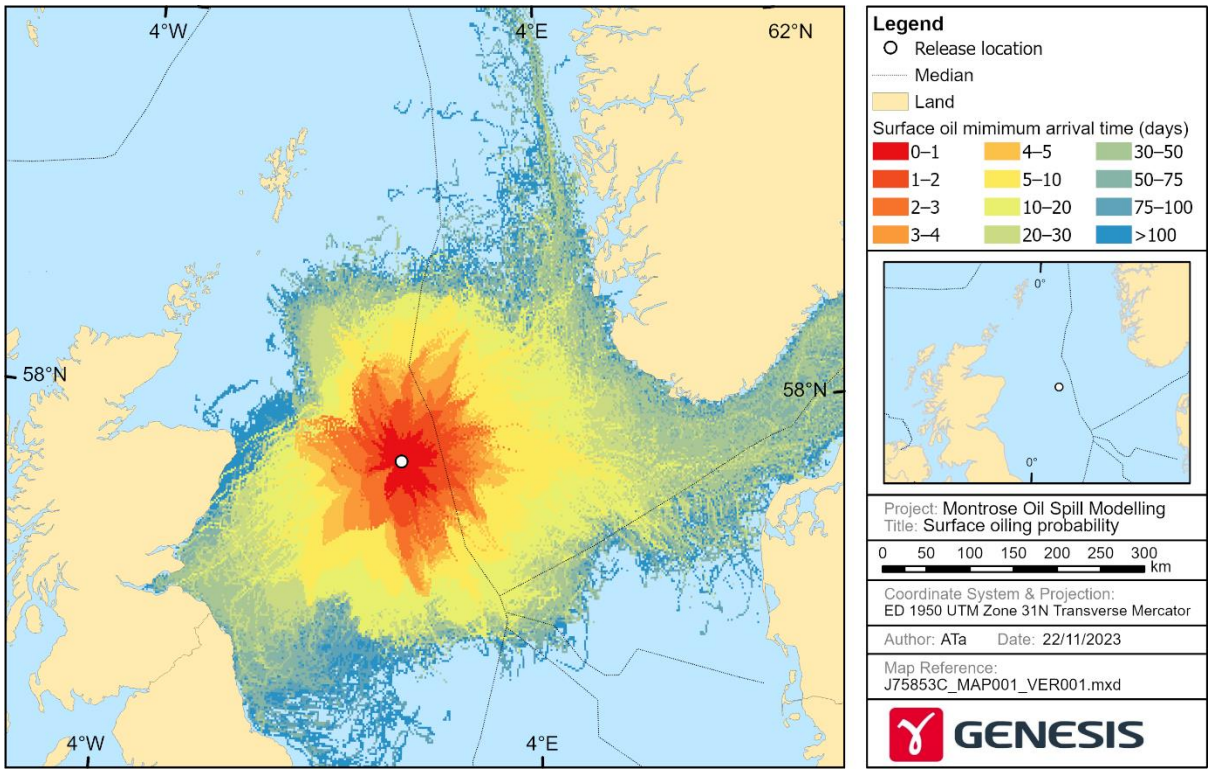


Figure 4-3: Minimum arrival time of a surface sheen > 0.3 µm (stochastic).

Table 4-1:Probability and minimum time of arrival of surface sheen > 0.3 µm to median lines.

Location	Probability (%)	Minimum time of arrival (days)
UK-Norway	100	1.1
UK-Denmark	33	15.5
UK-Germany	19	12.7
UK-Netherlands	8	16
Norway-Denmark	32	11.5
Germany- Denmark	22	13.5
Germany – Netherlands	8	16.75

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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 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 72,874 km^2. The maximum thickness estimated anywhere at the sea surface is 0.7 µm (0.0007 mm).

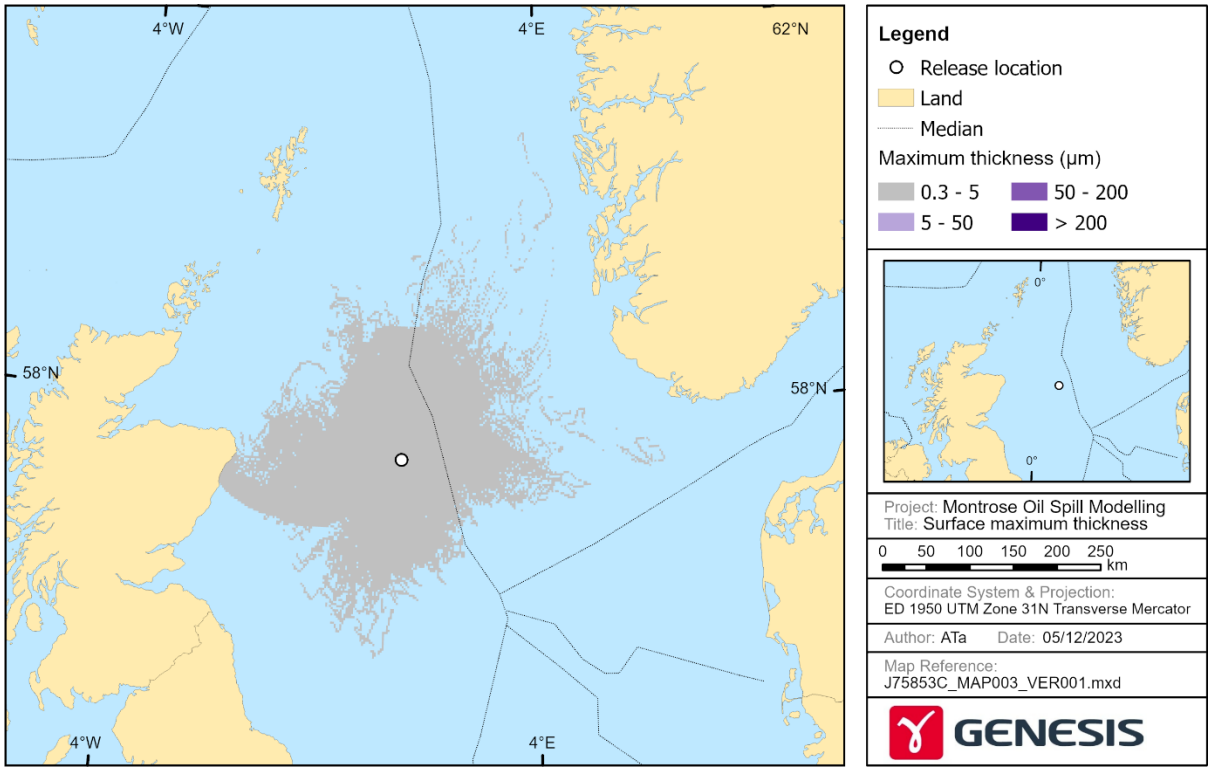


Figure 4-4: Thickness of oil at sea surface (deterministic, swept path).

4.3 Shoreline Stranding of Oil

The probability of shoreline oiling is shown in Figure 4-5 and the minimum time of arrival of oil to shore is shown in Figure 4-6. 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 there is low probability of oil reaching the coastline of the UK (13%) with a minimum arrival time of 14.3 days and Norway (15%) with a minimum arrival time of 15.7 days.

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Table 4-2:Probability and minimum time of arrival to shore (stochastic).

Location	Probability (%)	Minimum time of arrival (days)
Northeast Scotland	6	14.3
Eastern Scotland	13	14.4
Southern Scotland	12	22.9
Northumberland and Tyne and Wear	9	34.2
Tees Valley and Durham	1	49.3
Denmark	4	25.9
Sweden	2	45.1
Western Norway	15	15.7
Eastern Norway	8	33.8
Southern Norway	15	35.0

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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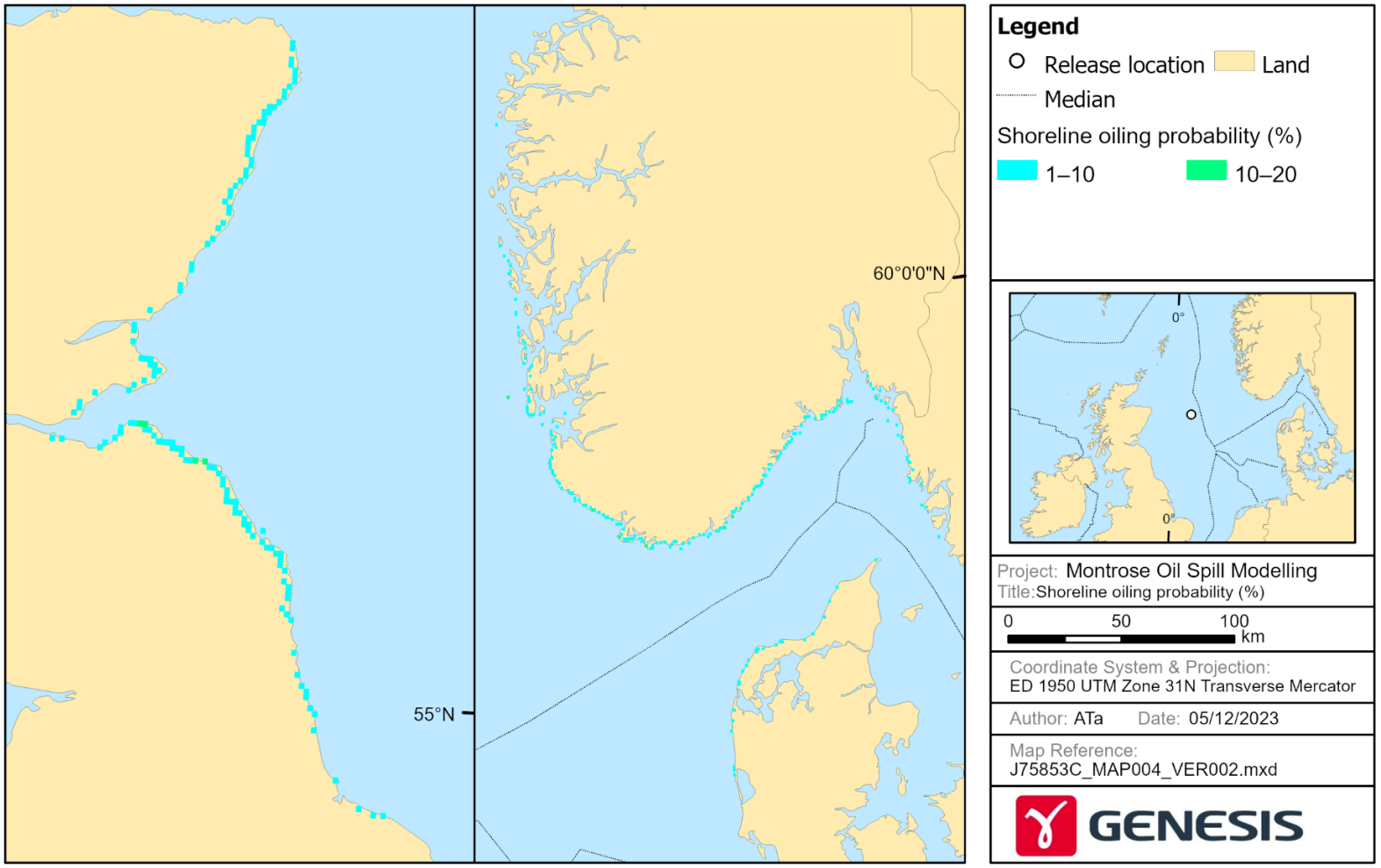


Figure 4-5: Probability of oil reaching the coast (stochastic).

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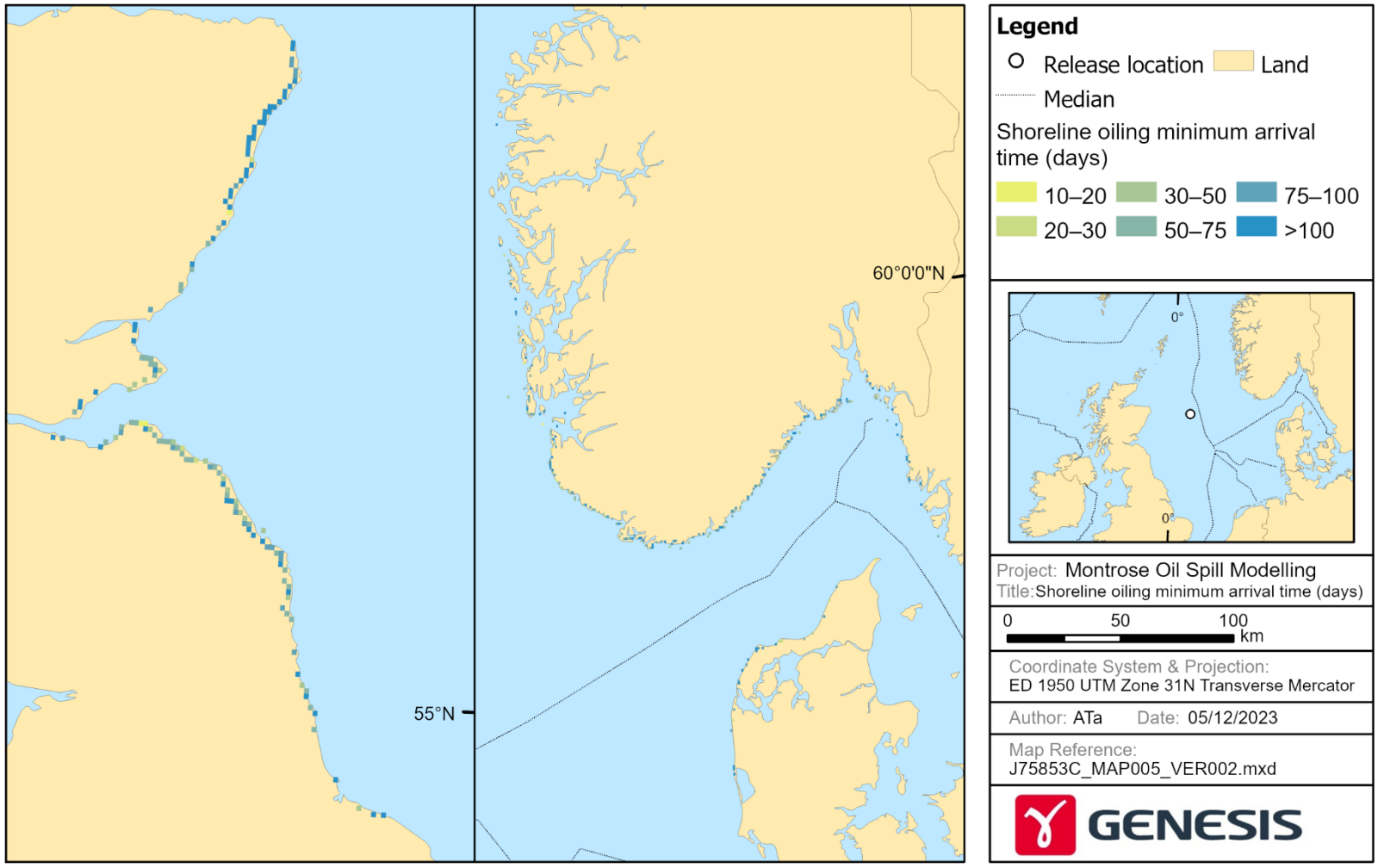


Figure 4-6: Minimal arrival time for oil to reach the coast (stochastic).

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To allow an assessment of impacts when reviewing model outputs, 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 model estimates that, by the end of the simulation (205 days), approximately 98.8 km of the UK coastline would have a mass of oil of more than 0.1 kg/m^2, which is above the threshold of 100 g/m^2 where impacts are considered to be potentially significant. The maximum mass of oil landed onshore from this scenario is 461 t (for timestep 133.1 days). This reduces to 280 t after 205 days. As noted from the stochastic modelling, there is a low probability of this scenario happening given prevailing metocean conditions in the North Sea.

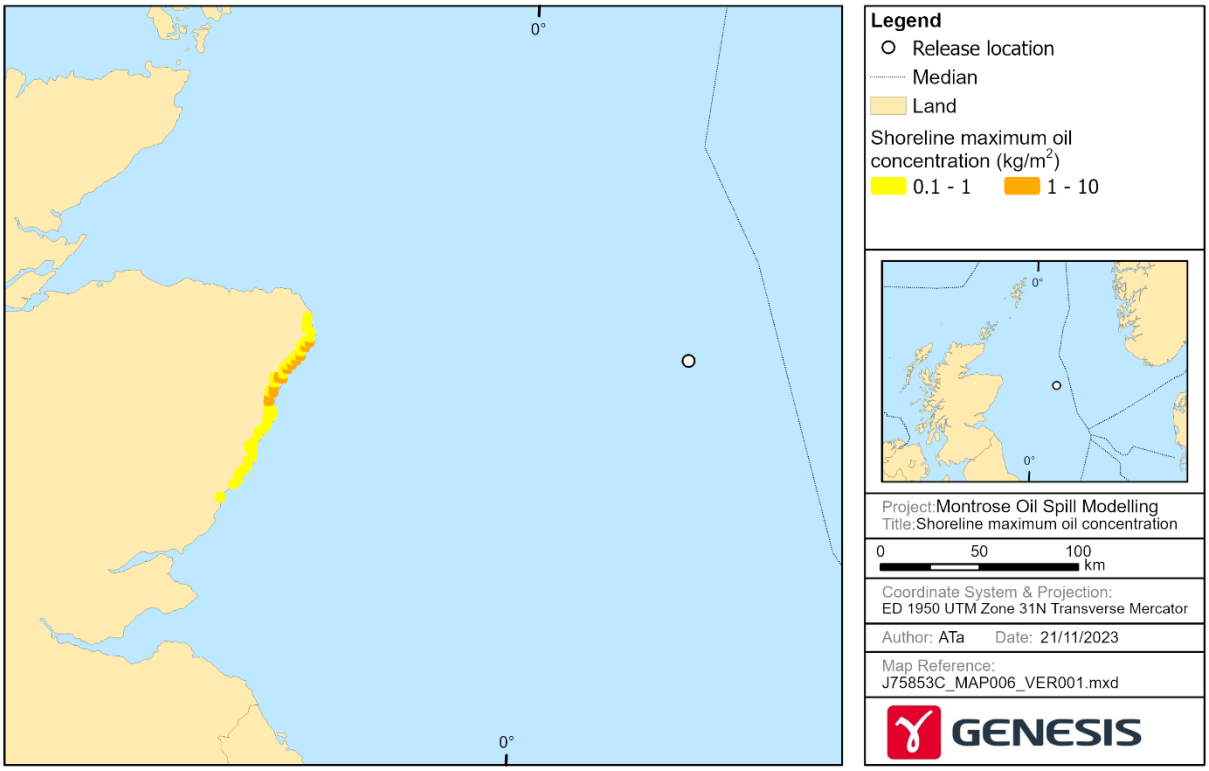
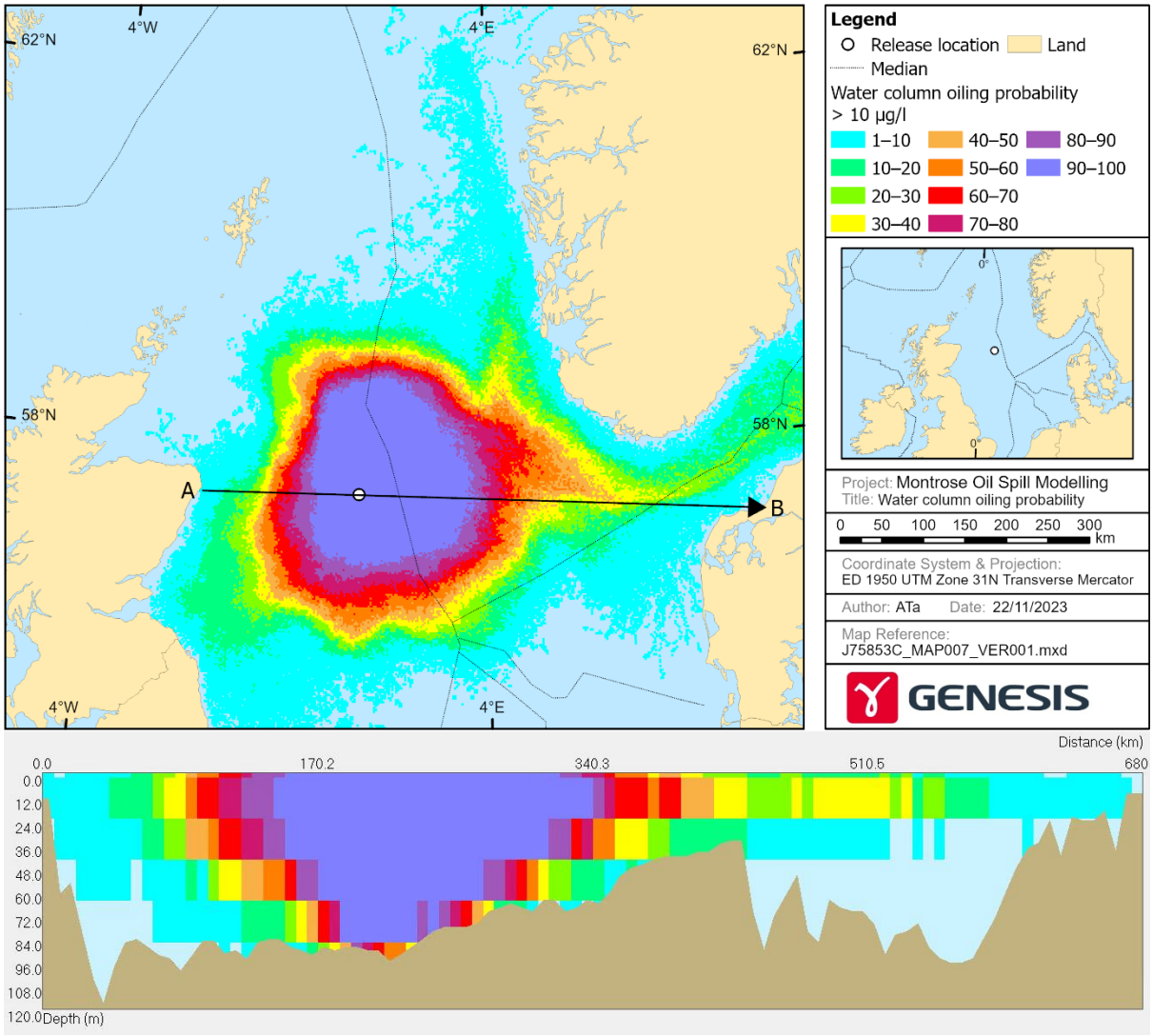


Figure 4-7: Concentration of oil at the coast (deterministic, 205 days).

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4.4 Water Column Concentrations

The probabilities of hydrocarbon concentrations ≥ 10 ppb (see Section 3.6.2) in the water column are shown in Figure 4-8. The simulation estimated that water column concentrations above the threshold of 10 ppb could occur up to a maximum distance of approximately 270 km and depth of approximately 90 m with a probability of ≥ 50%.



Note: Points A and B denote approximate start and finish of the cross-section (approximate distance 680 km).

Figure 4-8: Probability of water column concentrations ≥ 10 ppb (stochastic).

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A deterministic simulation was run to further assess the impact to the water column. Figure 4-9 shows the maximum total water column 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 concentrations ≥ 10 ppb oil concentration would be approximately 4,740 km^3.

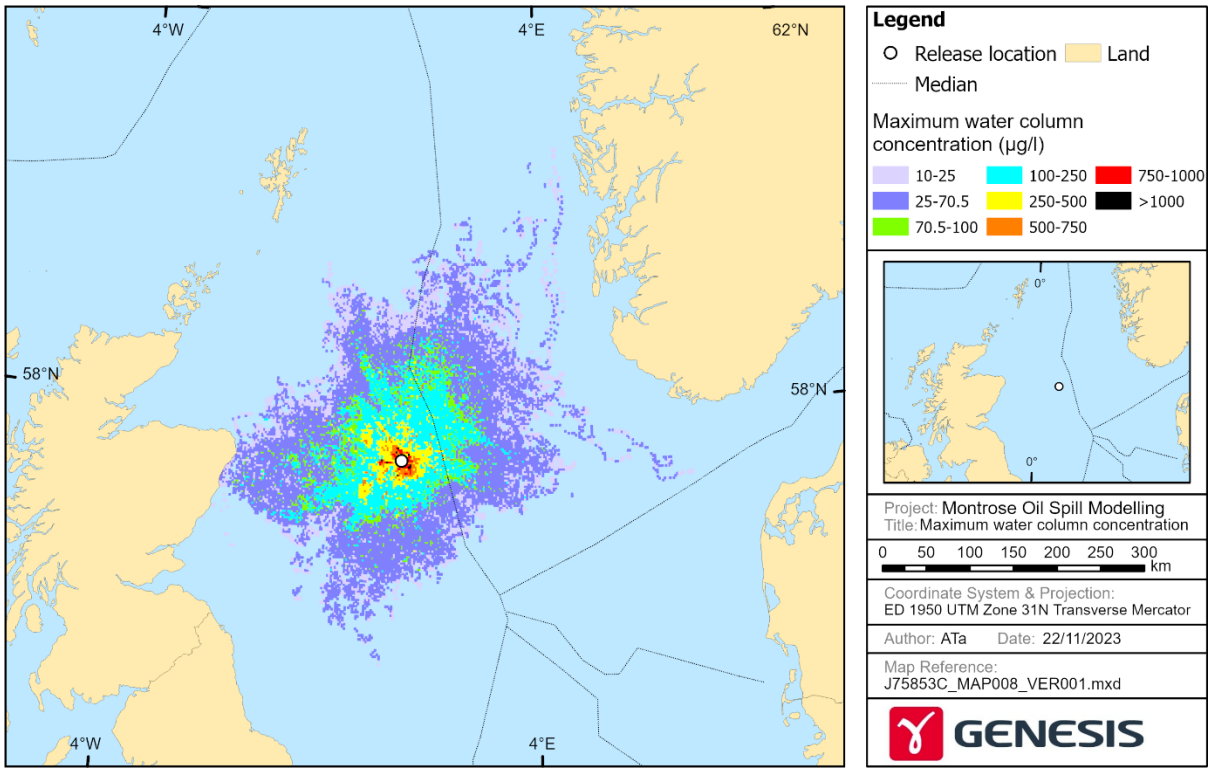


Figure 4-9: Maximum oil concentration in water column (deterministic, swept path).

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4.5 Deposition of Oil on Sediment

To allow an assessment of impacts when reviewing model outputs, 50 mg/kg (50 ppm) 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 (UKOOA, 1999) in the context of oil-based mud contamination. Given that deposition will distribute vertically through the surface of the seabed, this equates 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.

The deterministic simulation estimated that the concentration of oil on the seabed exceeded the threshold of 5 g/m^2 over an area of 451.8 km^2.

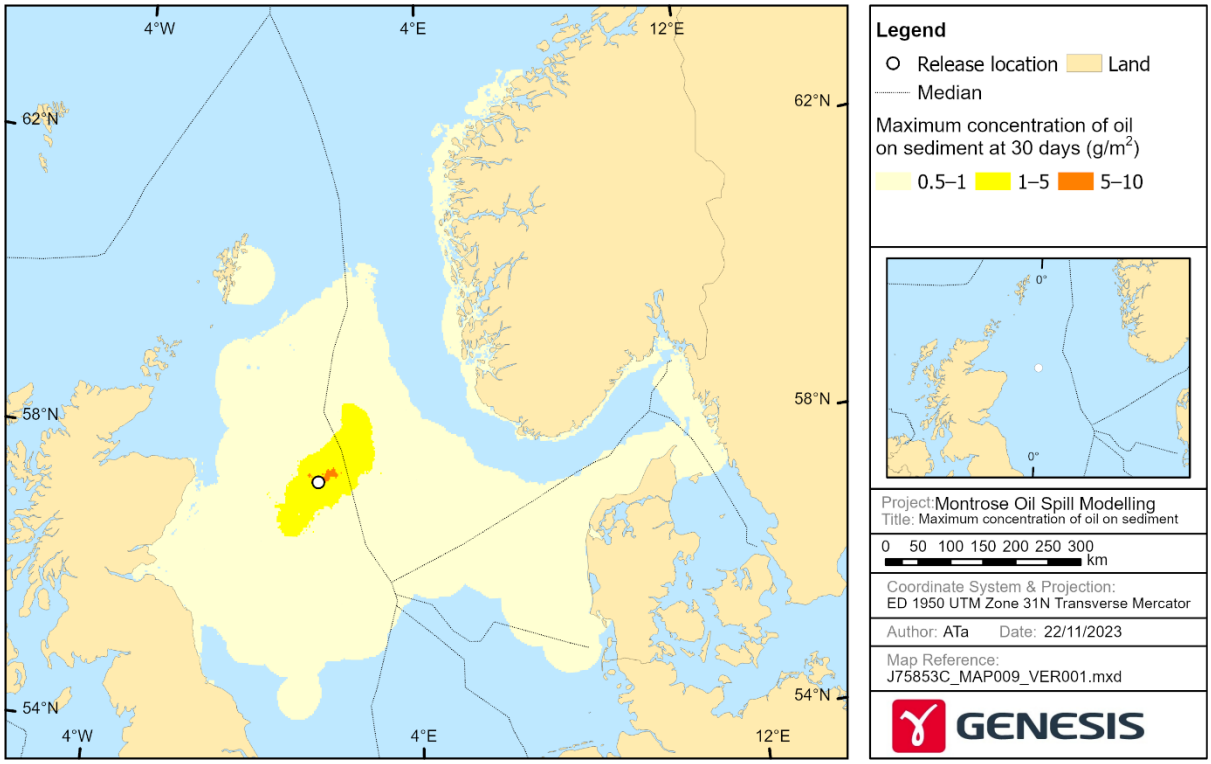


Figure 4-10: Maximum oil concentration in sediment (deterministic,205 days).

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5.0 CONCLUSION

A combination of stochastic (probabilistic) and deterministic modelling was undertaken for a declining flow rate. The modelling undertaken represents a potential worst-case scenario in terms of oil released as it assumes no intervention for 175 days and uses conservative model inputs. Furthermore, the deterministic scenario looks at the worst-case oil onshore scenario (i.e. using meteorological conditions resulting in oil reaching the UK coast, which in reality rarely happens).

A summary of the main simulation outputs is detailed in Table 5-1. The model estimated that there is a low probability that oil will reach the coastlines of the UK (13%) and Norway (15%).

In the unlikely event that a blowout did happen, the thresholds for surface sheen thickness, shoreline oiling, hydrocarbon concentration in the water column would all be exceeded over relatively large areas/volumes. This was expected given that the scenario simulates a worst-case hydrocarbon release. The sediment threshold would be exceeded over a limited area.

Table 5-1: Summary of simulation outputs.

Variable	Environmental Fraction		Surface Well Blowout
Release volume over whole simulation			238,469 m^3
% total oil in environmental fraction; (end of deterministic simulation)	Sea surface		0.03%
	Shoreline		0.1%
	Water Column		5.6%
	Sediment		22.5%
	Atmosphere		46.9%
	Biodegraded		24.0%
Total oil (tonnes) in environmental fraction; (end of deterministic simulation)	Sea surface		70 t
	Shoreline		280 t
	Water Column		11,450 t
	Sediment		46,350 t
	Atmosphere		96,750 t
	Biodegraded		49,250 t
Extent above thresholds (deterministic simulations)	**Fraction**	**Thresholds**	
	Sea surface	0.3 µm	72,874 km^2
	Shoreline	0.1 kg/m^2 (100 g/m^2)	98.8 km
	Water column	10 µg/l	4,740 km^3
	Sediment	5 g/m^2	451.8 km^2
Shoreline oiling maximum probability (%, stochastic)	Northeast Scotland		6%
	Eastern Scotland		13%
	Southern Scotland		12%
	Northumberland and Tyne and Wear		9%
	Tees Valley and Durham		1%

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Variable	Environmental Fraction	Surface Well Blowout
	Denmark	4%
	Sweden	2%
	Western Norway	15%
	Eastern Norway	8%
	Southern Norway	15%
Maximum probability of crude/oil on the surface crossing median lines (%, stochastic)	UK-Norway	100%
	UK-Denmark	33%
	UK-Germany	19%
	UK-Netherlands	8%
	Norway-Denmark	32%
	Germany- Denmark	22%
	Germany - Netherlands	8%
Note: 0.8% of oil goes outside model grid.		

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7.0 ANNEX

Days	High Case Declining Rates (stb/d)	Time periods associated with modelling	Duration associated with modelling	Declining rates for use in modelling (stb/d)	Declining rates for use in modelling (m^3/d)
1	29,443.41	1	1	29,443.41	4,681.13
2	24,880.47	2	1	24,880.47	3,955.68
3	22,198.16	3	1	22,198.16	3,529.23
4	20,268.83	4	1	20,268.83	3,222.49
5	18,660.10	5	1	18,660.10	2,966.72
6	17,407.63	6 - 10	5	15,930.84	2,532.80
7	16,458.10				
8	15,734.90				
9	15,242.58				
10	14,811.01				
11	14,474.90	11 - 15	5	13,923.06	2,213.59
12	14,173.94				
13	13,910.72				
14	13,650.03				
15	13,405.71				
16	13,176.36	16 - 20	5	12,780.25	2,031.90
17	12,977.49				
18	12,776.86				
19	12,582.43				
20	12,388.11				
21	12,203.02	21 - 30	10	11,464.18	1,822.66
22	12,020.14				
23	11,846.37				
24	11,677.04				
25	11,515.87				
26	11,358.87				
27	11,210.51				
28	11,068.01				
29	10,933.72				
30	10,808.22				
31	10,692.71	31 - 40	10	10,238.62	1,627.81
32	10,578.06				
33	10,474.40				
34	10,370.45				
35	10,273.94				
36	10,178.85				

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Days	High Case Declining Rates (stb/d)	Time periods associated with modelling	Duration associated with modelling	Declining rates for use in modelling (stb/d)	Declining rates for use in modelling (m^3/d)
37	10,086.89				
38	9,996.01				
39	9,910.02				
40	9,824.91				
41	9,741.82	41 - 50	10.00	9,394.57	1,493.62
42	9,659.36				
43	9,580.03				
44	9,500.99				
45	9,424.08				
46	9,348.83				
47	9,277.12				
48	9,206.34				
49	9,136.78				
50	9,070.32				
51	9,004.46	51 - 60	10.00	8,727.71	1,387.60
52	8,939.53				
53	8,877.02				
54	8,815.10				
55	8,754.11				
56	8,695.19				
57	8,635.50				
58	8,576.16				
59	8,518.47				
60	8,461.57				
61	8,405.93	61 - 70	10.00	8,173.91	1,299.55
62	8,351.39				
63	8,298.40				
64	8,246.06				
65	8,194.86				
66	8,144.72				
67	8,095.72				
68	8,047.48				
69	8,000.30				
70	7,954.24				
71	7,909.16	71 - 80	10.00	7,720.95	1,227.53
72	7,864.76				
73	7,821.31				

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Days	High Case Declining Rates (stb/d)	Time periods associated with modelling	Duration associated with modelling	Declining rates for use in modelling (stb/d)	Declining rates for use in modelling (m^3/d)
74	7,778.96				
75	7,737.39				
76	7,696.59				
77	7,657.14				
78	7,618.81				
79	7,581.19				
80	7,544.23				
81	7,508.31	81 - 90	10.00	7,357.35	1,169.72
82	7,473.14				
83	7,438.89				
84	7,405.02				
85	7,371.50				
86	7,338.58				
87	7,306.28				
88	7,274.87				
89	7,243.80				
90	7,213.09				
91	7,182.93	91 - 110	20.00	6,931.60	1,102.04
92	7,153.33				
93	7,124.55				
94	7,096.05				
95	7,067.90				
96	7,040.70				
97	7,013.87				
98	6,988.13				
99	6,962.62				
100	6,937.29				
101	6,912.32				
102	6,887.75				
103	6,863.82				
104	6,840.03				
105	6,816.39				
106	6,793.08				
107	6,770.14				
108	6,748.23				
109	6,726.95				
110	6,705.85				

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Days	High Case Declining Rates (stb/d)	Time periods associated with modelling	Duration associated with modelling	Declining rates for use in modelling (stb/d)	Declining rates for use in modelling (m^3/d)
111	6,684.19	111 - 130	20.00	6,503.09	1,033.91
112	6,662.58				
113	6,641.44				
114	6,620.66				
115	6,600.32				
116	6,580.52				
117	6,561.28				
118	6,542.76				
119	6,524.68				
120	6,506.68				
121	6,489.00				
122	6,471.63				
123	6,454.63				
124	6,437.95				
125	6,421.15				
126	6,404.58				
127	6,388.26				
128	6,372.23				
129	6,356.58				
130	6,340.74				
131	6,325.18	131 - 150	20.00	6,187.25	983.69
132	6,309.80				
133	6,294.63				
134	6,279.87				
135	6,264.88				
136	6,250.09				
137	6,235.46				
138	6,221.00				
139	6,206.93				
140	6,192.56				
141	6,178.35				
142	6,164.28				
143	6,150.35				
144	6,136.79				
145	6,122.94				
146	6,109.22				
147	6,095.62				

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Days	High Case Declining Rates (stb/d)	Time periods associated with modelling	Duration associated with modelling	Declining rates for use in modelling (stb/d)	Declining rates for use in modelling (m^3/d)
148	6,082.18				
149	6,069.09				
150	6,055.70				
151	6,042.45	151 - 175	25.00	5,923.76	941.80
152	6,029.31				
153	6,016.32				
154	6,003.66				
155	5,990.72				
156	5,977.91				
157	5,965.26				
158	5,952.79				
159	5,940.65				
160	5,928.26				
161	5,916.00				
162	5,903.87				
163	5,891.93				
164	5,880.28				
165	5,868.37				
166	5,856.57				
167	5,844.88				
168	5,833.36				
169	5,822.11				
170	5,810.59				
171	5,799.17				
172	5,787.85				
173	5,776.68				
174	5,765.81				
175	5,754.67				
Note: The modelled rates are calculated from the average rate across the time periods shown.					

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Appendix D: Underwater Noise Modelling

REPORT

Underwater Noise Modelling Report

Prepared for: **NEO NEXT+**

Prepared by: **Genesis Energies**
www.genesisoilandgas.com

Project Title: **Montrose Infill Project Environmental Statement**
Document/Rev No: J75853C-Y-RT-24006/0
Client Document No.: RP-MO0786-HS-0349

Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval
1A	27/11/2023	Issued for internal review	[redacted]	[redacted]		
A	06/12/2023	Issued for client review	[redacted]	[redacted]	[redacted]	
B	24/01/2024	Update to address client comments	[redacted]	[redacted]	[redacted]	
C	21/02/2024	Issued for use	[redacted]	[redacted]	[redacted]	
0	03/12/2024	Final for inclusion in ES (edited to amend Company name)	[redacted]			

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GENESIS

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ABBREVIATIONS

°C	Degrees centigrade
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 square metre square second
EMODnet	European Marine Observation Data network
FARAM	Faunal Acoustic Risk Assessment Model
g/kg	Grams per kilogram
HESS	High Energy Seismic Survey
HF	High Frequency
Hz	Hertz
JNCC	Joint Nature Conservation Committee
kg/m^3	Kilograms per cubic metre
kJ	Kilojoule
km	Kilometre
km^2	Square kilometre
LF	Low Frequency
m	Metre
m/s	Metres per second
MF	Mid Frequency
MMO	Marine Mammal Observer
ms	Milliseconds
NMFS	National Marine Fisheries Service
PAM	Passive Acoustic Monitoring
PTS	Permanent Threshold Shift
RAM	Range-dependent Acoustic Model
rms	Root Mean Square
SEL	Sound Exposure Level
SPL	Sound Pressure Level
UTM	Universal Transverse Mercator
VHF	Very High Frequency
WOA	World Ocean Atlas

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1.0 INTRODUCTION

1.1 Project Background

As part of the Montrose Infill Project, piling will be required for the installation of the manifold. Underwater noise due to piling has the potential to impact marine receptors. The location of the manifold is shown in Figure 1-1.

This report presents underwater noise modelling results for assessing potential impacts that the manifold piling may have on marine mammals and fish in the region of the project location.

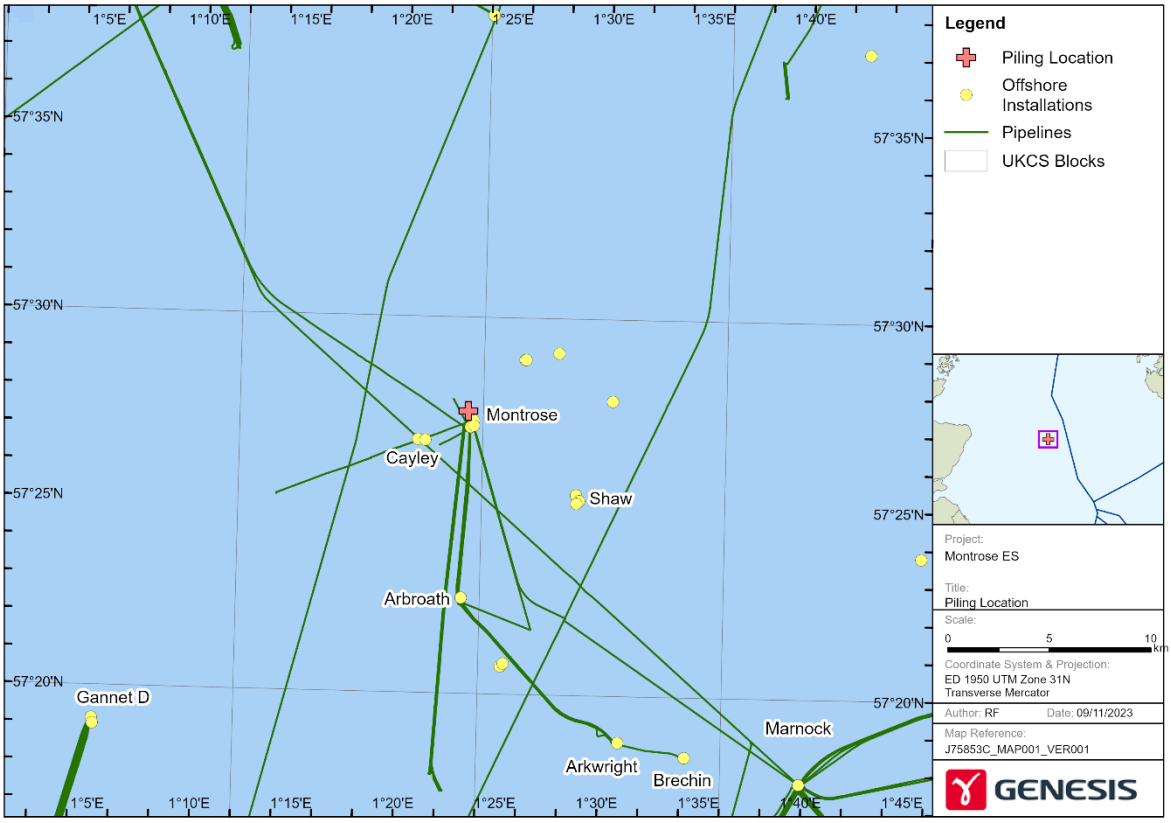


Figure 1-1: Montrose proposed manifold location.

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1.2 Manifold Piling

Details of the modelled piling scenario are shown in Table 1-1. Four manifold piles will be installed, with each pile being 26 metres (m) in length and driven to a required penetration depth of 22 m. It has been assumed that each pile will be installed in approximately 4 hours, and that a maximum of four piles will be installed in a single day. The maximum hammer energy used throughout the piling will be 90 kJ. In the modelling it has been assumed that the impact hammer will commence at a soft start hammer energy of 9 kJ (which is 10% of the maximum hammer energy) for a duration of 20 minutes.

Table 1-1: Details of modelled piling scenario.

Parameter	Value
Number of piles to be installed	4
Duration to install a single pile	4 hours
Maximum number of piles installed in any 24-hour period	4
Pile diameter	0.61 m
Pile length	26 m
Pile penetration depth	22 m
Soft start hammer energy	9 kJ
Soft start duration	20 minutes
Maximum hammer energy	90 kJ

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2.0 MODELLING METHODOLOGY

This section discusses the modelling methodology adopted to estimate potential impacts from the manifold piling associated with the Montrose Infill Project.

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 manifold for the Montrose Infill Project. 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 piling will commence with a soft start where the hammer operates at 10% of the maximum hammer energy (i.e., at 9 kJ). The soft start is assumed 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 assumed to be periodically increased until maximum 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.

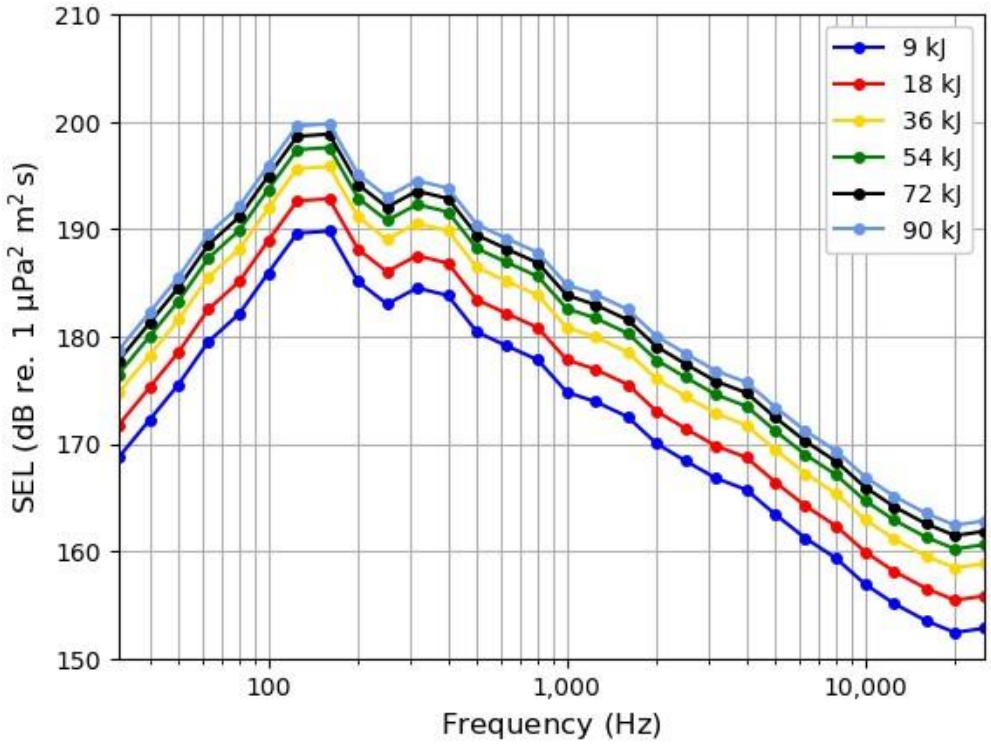


Figure 2-1: Third octave band SEL spectra used in the piling modelling.

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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. The maximum blow rate of 46 blows/minute is based on the blow rate of an IHC S-90 hammer (IHC Merwede, 2023).

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 µPa^{2}m^{2}s)
9	20	10	221.0	195.0
18	10	46	224.0	199.0
36	10	46	227.0	202.0
54	10	46	228.8	203.8
72	10	46	230.0	205.0
90	180	46	231.0	206.0

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 (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;

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- 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 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. The ray tracing method that has been used for modelling higher frequencies is the Bellhop Gaussian beam ray tracing model (Porter and Liu, 1994).

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 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. Bathymetry around the piling location varies from 60 to 150 m.

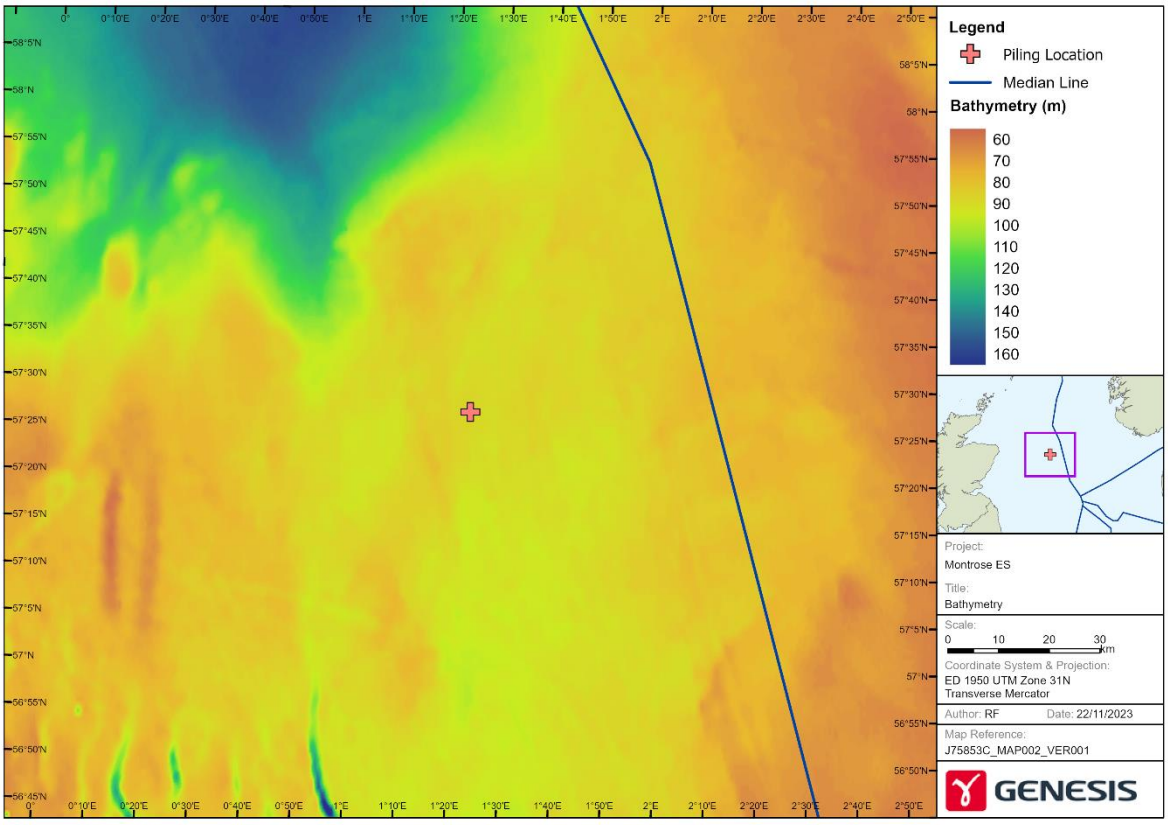


Figure 2-2: Bathymetry in the region of the manifold piling location.

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2.2.3.2 Seabed Properties

FARAM accounts for attenuation effects due to interactions with the seabed. Sediments in the region of the manifold 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).

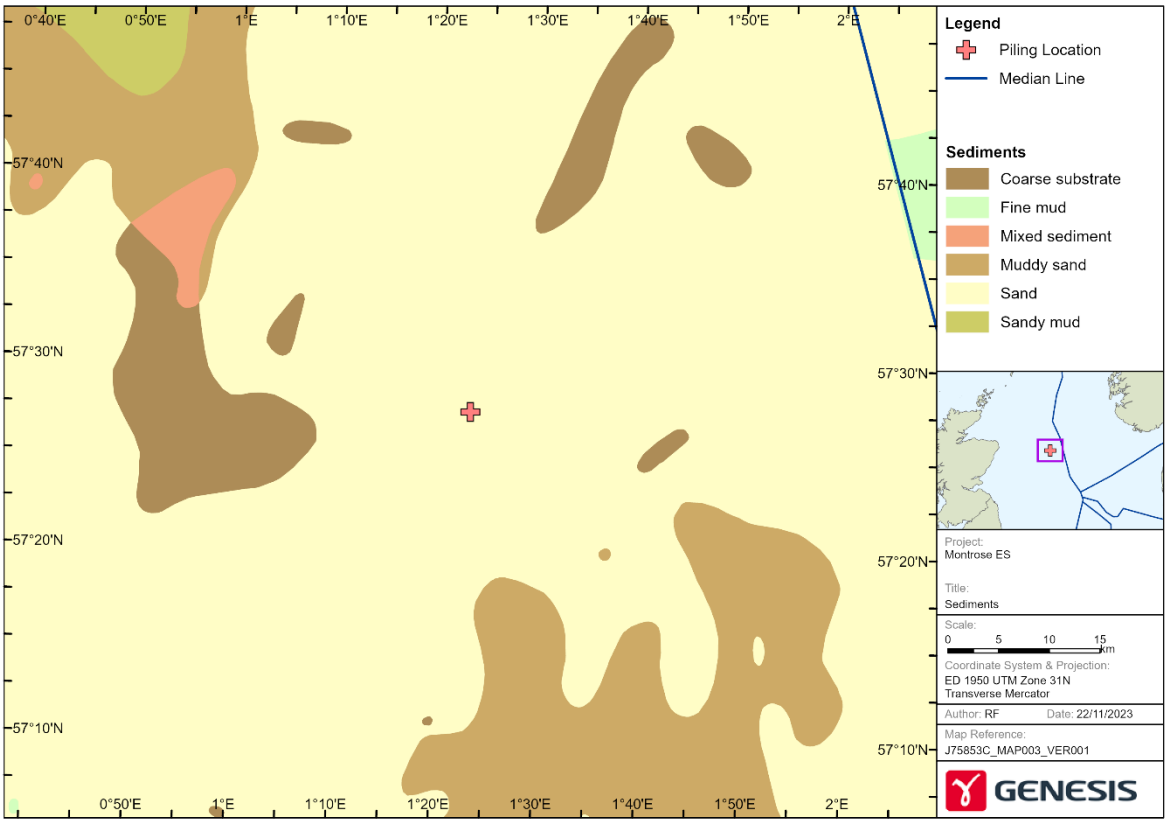


Figure 2-3: Sediments in the region of the manifold piling location.

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 (WOA, 2013) database. Example temperature, salinity, and sound speed profiles used in the modelling are shown in Figure 2-4.

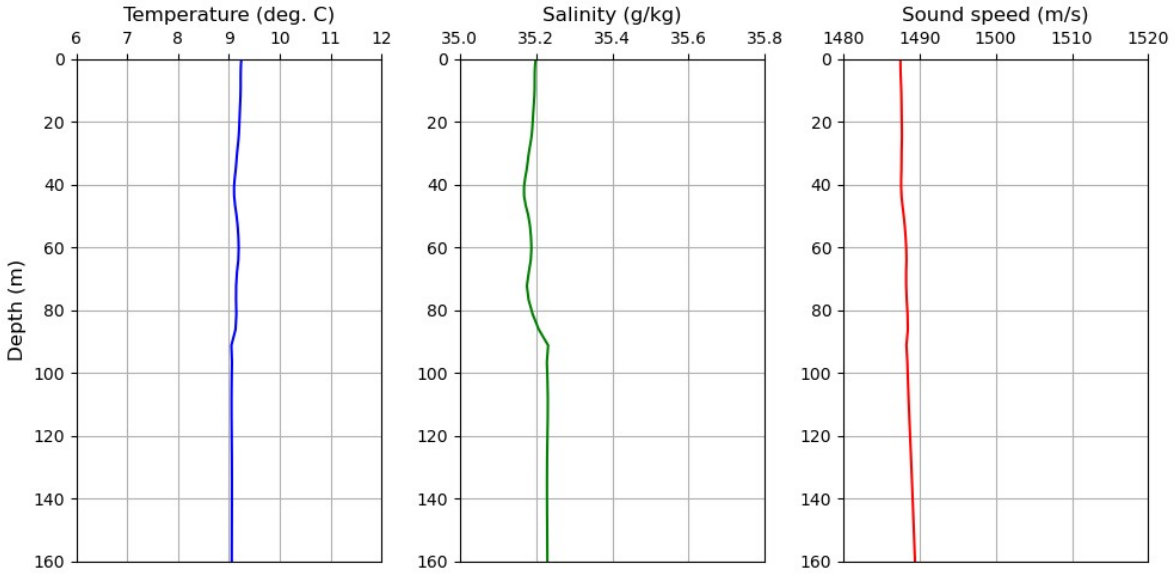


Figure 2-4: Example temperature, salinity, and sound speed depth profiles used in the modelling.

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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), 2018; 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 permanent threshold shift (PTS) and behavioural disturbance. PTS 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 PTS

Thresholds for PTS have been suggested by NMFS (2018) and Southall *et al.* (2019). The PTS thresholds proposed by NMFS (2018) and Southall *et al.* (2019) are based on the most recent studies and are recognised as appropriate criteria for assessing potential impacts to marine mammals from underwater noise.

Both NMFS (2018) and Southall *et al.* (2019) proposed grouping marine mammals into different hearing groups for assessing potential impacts. NMFS (2018) group marine mammals into low-frequency (LF) cetaceans, mid-frequency (MF) cetaceans, high-frequency (HF) cetaceans, phocid pinnipeds, otariid pinnipeds, and sirenians. Southall *et al.* (2019) proposed equivalent hearing groups but named the cetaceans groups as LF cetaceans, HF cetaceans, and very high-frequency (VHF) cetaceans. Despite the difference in naming, the hearing groups proposed by NMFS (2018) and Southall *et al.* (2019) are equivalent and include the same marine mammal species. Furthermore, the PTS thresholds proposed by NMFS (2018) and Southall *et al.,* (2019) are identical. The PTS thresholds proposed by NMFS (2018) and Southall *et al.* (2019) 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; Waggitt *et al.,* 2019; Russell *et al.,* 2017) are also shown in Table 3-1 categorised according to the different hearing groups.

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Table 3-1: Marine mammal hearing groups and PTS thresholds.

Hearing Group		Species [1]	PTS Threshold	
NMFS (2018)	Southall *et al.* (2019)		Zero-to-peak SPL (dB re 1 µPa)	Cumulative SEL (dB re 1 µPa²s)
LF cetaceans	LF cetaceans	**Minke whale**	219	183
MF cetaceans	HF cetaceans	Bottlenose dolphin, killer whale, Risso's dolphin, **white-beaked dolphin, Atlantic white-sided dolphin**	230	185
HF cetaceans	VHF cetaceans	**Harbour porpoise**	202	155
Phocid pinnipeds	Phocid pinnipeds	**Grey seal**, harbour seal	218	185

[1] Species listed are the most sighted marine mammal species in the North Sea (Gilles *et al.*, 2023; Waggitt *et al.*, 2019; Reid *et al.*, 2003; Russell *et al.*, 2017). Species highlighted in **bold** are those that are more likely to be present in the region of the project area.

The PTS 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 PTS is considered to potentially occur when either of the thresholds are exceeded (NMFS, 2018; Southall *et al.,* 2019). 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 proposed by NMFS (2018) and Southall *et al.* (2019) for the different marine mammal hearing groups are the same and are shown in Figure 3-1 (note that the Southall *et al.* (2019) nomenclature is used in this figure).

In the remainder of this report, the Southall *et al.* (2019) terminology with regards to the naming of marine mammal hearing groups is used. However, it is important to note that the NMFS (2018) threshold values and auditory weighting functions are the same for the comparative groups as those proposed in Southall *et al.* (2019). Therefore, the adoption of the Southall *et al.* (2019) guidance or NMFS (2018) guidance provides the same impact assessment results.

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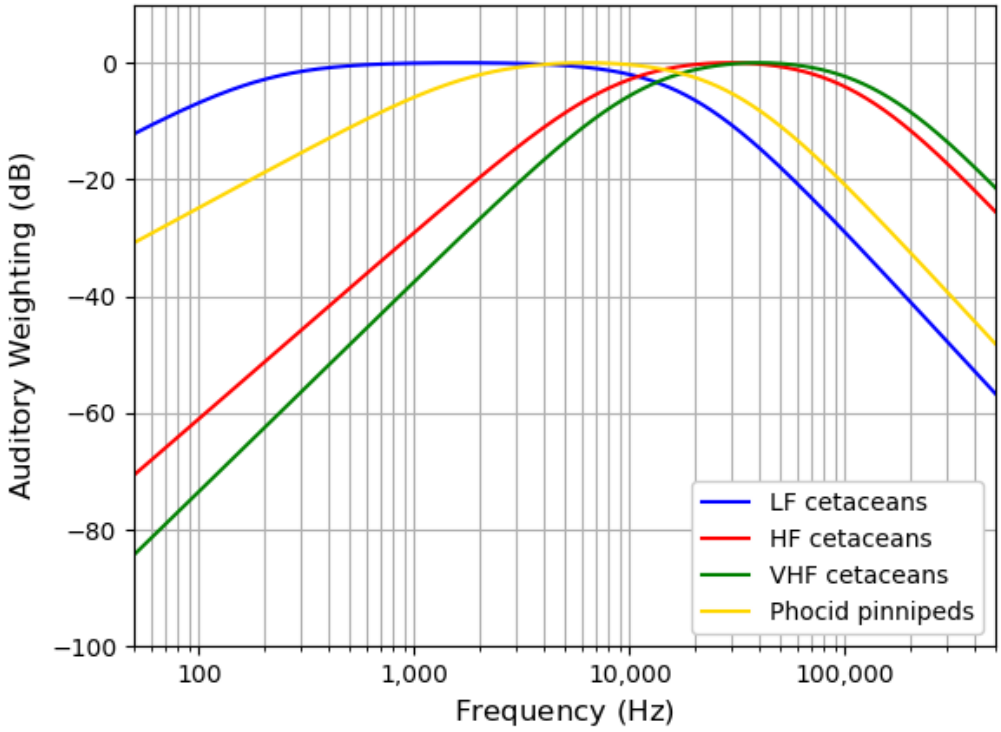


Figure 3-1: Auditory weighting functions for different marine mammal hearing groups.

3.1.2 Disturbance

Thresholds for behavioural disturbance to marine mammals are less well defined compared to PTS 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 (2018) and Southall *et al*. (2019) did 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 145 dB re 1 μPa^2s. 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^2s and that displacement of harbour porpoise at SELs below 145 dB re 1 μPa^2s 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-

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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 manifold 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 PTS 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; NMFS, 2018). 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	Species common in the survey area	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	Lemon sole and plaice	213	219
Fishes with swim bladder involved in hearing	Herring	207	207
Fishes with swim bladder not involved in hearing	Angler fish, blue whiting, cod, European hake, haddock, horse mackerel, ling, mackerel, *nephrops*, Norway pout, sandeel, spotted ray, spurdog and whiting[1]	207	210
Eggs and larvae	Cod, lemon sole, mackerel, *nephrops*, Norway pout, plaice and sandeel (spawning areas, other species listed above have nursery areas within project area)	207	210

1 Insufficient information available to confirm whether or not the swim bladder is involved in hearing or not.

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3.2.2 Behavioural Disturbance

Documented disturbance effects of underwater noise 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). Despite some documented behavioural disturbance effects, there are no well-established criteria or thresholds for assessing behavioural disturbance to fish from underwater noise. In fact, it was concluded by Popper *et al*. (2014) that there lacked sufficient evidence to recommend specific thresholds that correspond to behavioural disturbance for fish. Therefore, a quantitative assessment of behavioural disturbance to fish is not considered in this report.

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 (4 wells x 4 hours), 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 a quantitative 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 a quantitative 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 PTS

Received noise levels from piling of the manifold have been predicted in terms of unweighted zero-to-peak SPL to identify potential areas where the instantaneous onset of PTS may occur to marine mammals. Figure 4-1 shows the predicted zero-to-peak SPL with the hammer operating at maximum energy of 90 kJ. The contours in Figure 4-1 highlight the zero-to-peak SPL thresholds for the potential onset of PTS to marine mammals.

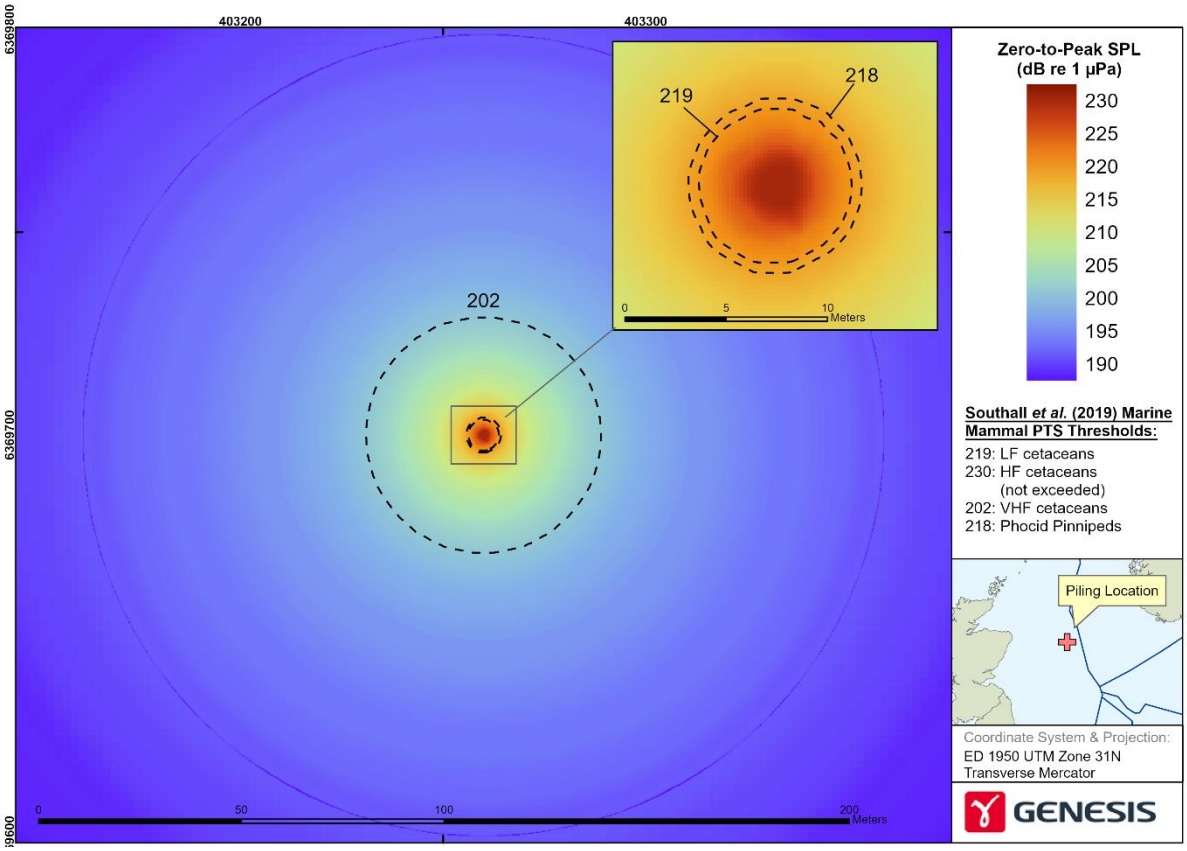


Figure 4-1: Predicted zero-to-peak SPL received by marine mammals during piling with the hammer operating at maximum energy of 90 kJ.

The predicted maximum distances where the zero-to-peak SPL thresholds for PTS 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 PTS 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. With this mitigation measure in place, the probability of zero-to-peak SPLs generated during the piling causing PTS to marine mammals is predicted to be low.

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Table 4-1: Predicted maximum distances from the piling location where the zero-to-peak SPL thresholds for PTS onset to marine mammals are exceeded.

Marine Mammal Hearing Group	Zero-to-peak SPL PTS Threshold (dB re 1 µPa)	Maximum Distance to Threshold Exceedance (m) [1]
LF cetaceans	219	3
HF cetaceans	230	Not exceeded
VHF cetaceans	202	30
Phocid pinnipeds	218	4
[1] Predicted distances have been rounded up to the nearest 1 m.		

The cumulative SEL received by marine mammals during piling has been predicted and compared to the PTS 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 9 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 Southall *et al.* (2019), 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. 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 PTS 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 PTS thresholds after they swim away are shown in Table 4-2. The modelling predicts that the PTS thresholds will not be exceeded for any marine mammals during piling assuming that they swim away from the piling location at a minimum 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. A 500 m mitigation zone and associated mitigation measures (e.g., marine mammal observers (MMOs), PAM and Marine Mammal Mitigation Protocol (MMMP)) is expected to be sufficient to mitigate against PTS occurring to any marine mammals.

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Table 4-2: Predicted maximum 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 PTS threshold when they swim away at different swim speeds.

Marine Mammal Hearing Group	Cumulative SEL Threshold for PTS (dB re 1 µPa^{2}s)	Swim Speed (m/s)	Maximum Distance to Threshold Exceedance (m) [1]
LF cetaceans	183	1.5	Threshold not exceeded
HF cetaceans	185	1.5	Threshold not exceeded
VHF cetaceans	155	1.5	Threshold not exceeded
Phocid pinnipeds	185	1.5	Threshold not exceeded

4.1.2 Disturbance

As discussed previously, 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 manifold with the hammer operating at maximum hammer energy of 90 kJ. The contours highlighted in Figure 4-2 signify the thresholds that have been adopted for assessing potential disturbance to all marine mammals.

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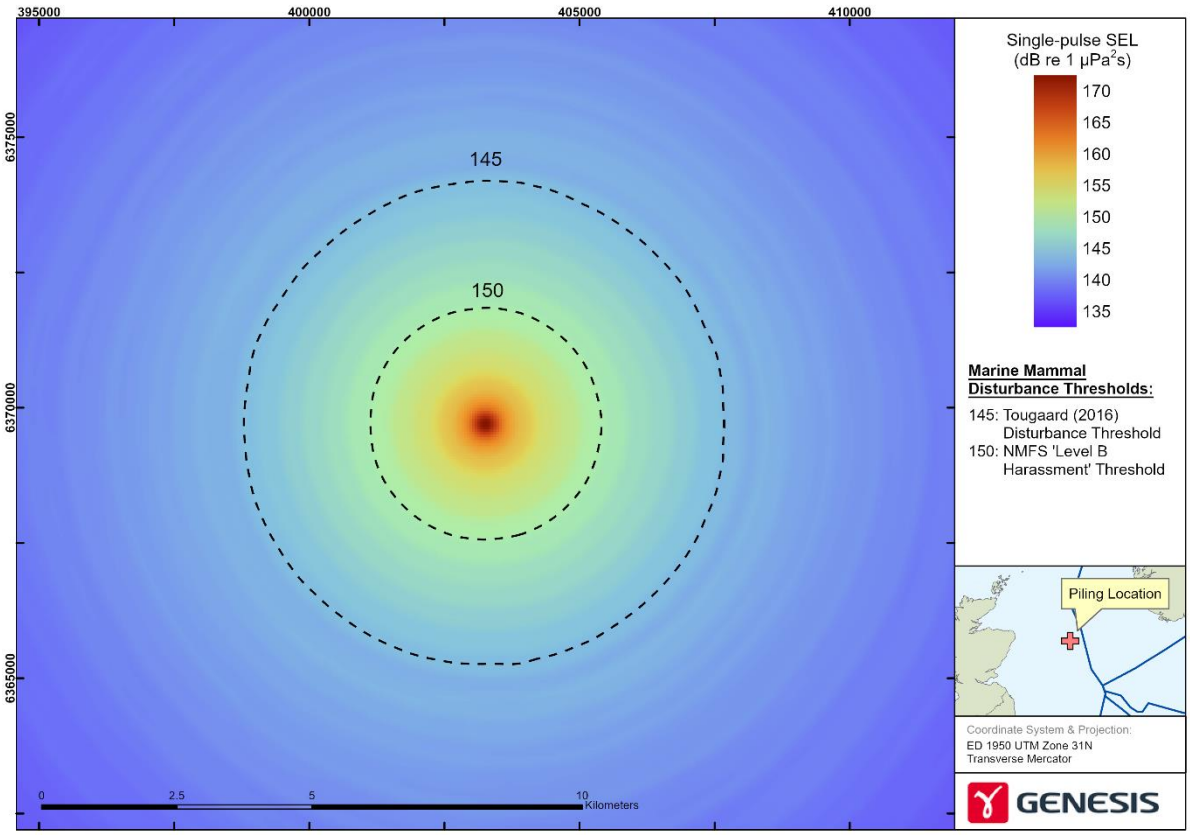


Figure 4-2: Predicted unweighted SEL received by marine mammals during piling with the hammer operating at maximum energy of 90 kJ.

Table 4-3 summarises the predicted distances and areas where behavioural disturbance might occur to marine mammals from the manifold piling. The NMFS 'Level B Harassment' threshold suggests that disturbance to marine mammals could occur at a distance of 2 km, whilst the Tougaard (2016) threshold suggests that disturbance could occur out to 4 km.

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 Montrose Infill 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.

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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 (km) [1]	Area of Threshold Exceedance (km²) [2]
NMFS 'Level B Harassment' criteria for behavioural disturbance to all marine mammals	150 [3]	2	14
Tougaard (2016) criteria for behavioural disturbance to all marine mammals	145	4	62

[1] Predicted distances have been rounded up 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.

4.2 Fish

4.2.1 Injury

To quantitatively assess any potential injury to fish and fish eggs and larvae from the manifold 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.

Figure 4-3 shows the predicted zero-to-peak SPL with the hammer operating at the maximum hammer energy of 90 kJ. The contours in Figure 4-3 highlight the Popper *et al*. (2014) zero-to-peak SPL thresholds for potential injury to fish species and fish eggs and larvae.

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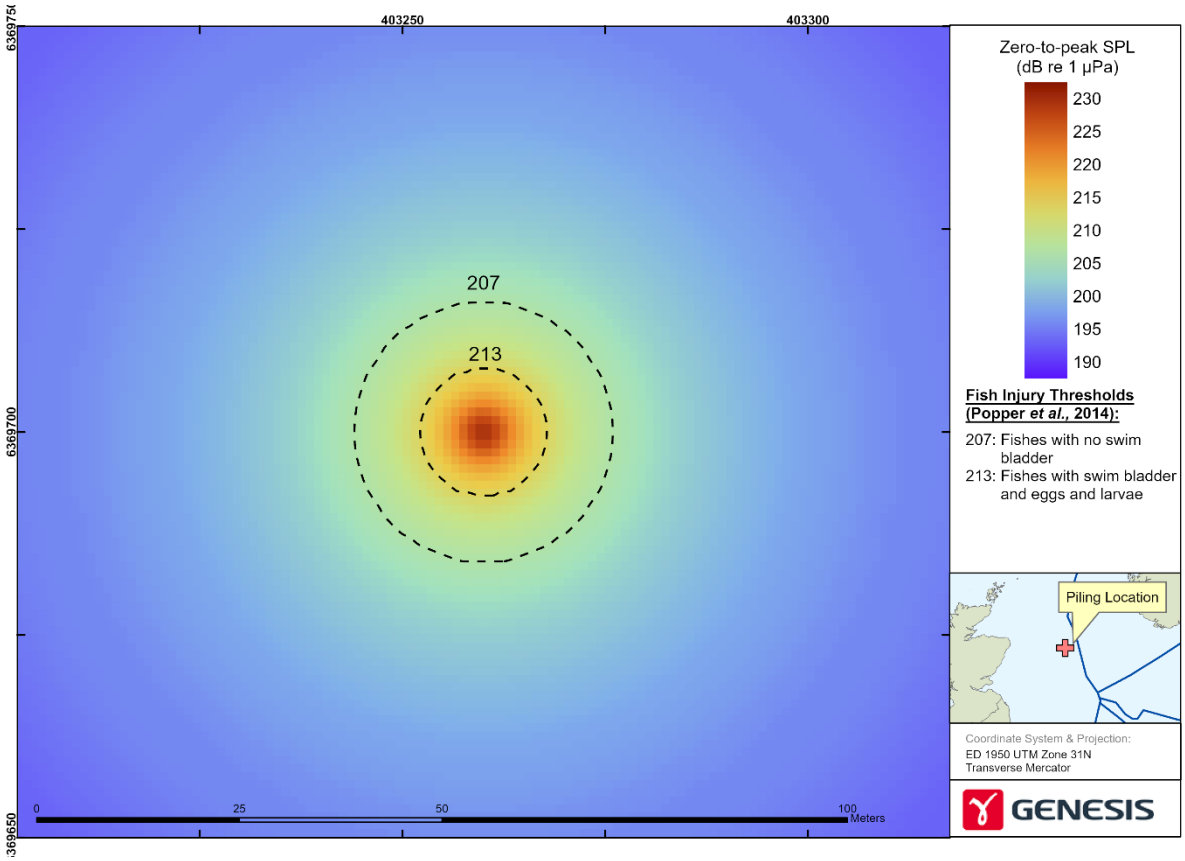


Figure 4-3: Predicted zero-to-peak SPL received by fish during piling with the hammer operating at maximum energy of 90 kJ.

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 4-4. 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 20 m from the piling location (as listed in Table 3-3). 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 throughout the piling. 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 4-5. 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 90 m from the piling location. However, given the relatively small impact area compared to the large

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spawning grounds in the North Sea, it is not expected that the piling operations associated with the Montrose Infill Project will have a significantly adverse effect on any spawning fish.

Table 4-4: Predicted maximum 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	10
Fishes with swim bladder involved in hearing	207	20
Fishes with swim bladder not involved in hearing	207	20
Eggs and larvae	207	20
[1] Predicted distances have been rounded up to the nearest 10 m.		

Table 4-5: Predicted maximum 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 Injury Threshold (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	Threshold not exceeded
Fishes with swim bladder involved in hearing	207	0.5	Threshold not exceeded
Fishes with swim bladder not involved in hearing	210	0.5	Threshold not exceeded
Eggs and larvae	210	Stationary	90
[1] Predicted distances have been rounded up to the nearest 10 m.			

4.2.2 Disturbance

A quantitative assessment of behavioural disturbance to fish could not be conducted since there are no well-established disturbance thresholds for fish. However, 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 disturbance to fish is expected to be of a short duration and therefore it is concluded that the Montrose Infill Project piling will not have a significant impact on any fish species.

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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 MMO should be present and dedicated to the observation of marine mammals. The MMO should carry out a 30 minute 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 MMO 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 assessing the potential impacts that piling associated with the Montrose Infill Project may have on marine mammals and fish species and fish eggs and larvae. The modelling results were used to assess any potential impacts to marine mammals based on a comparison of estimated noise levels with the Southall *et al.* (2019) thresholds for potential PTS 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 modelling results indicate that the likelihood of marine mammals being exposed to noise levels that may cause PTS 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 modelling predicts that behavioural disturbance to marine mammals could potentially occur at 2 – 4 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 Montrose Infill Project will have any long-term significant effects on any marine mammal populations.

The modelling results indicate that injury to fish species and fish eggs and larvae during the piling will be localised to small areas (within 30 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 more 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 Montrose Infill Project piling activities will not have a significant impact on marine mammals, fish, and fish eggs and larvae.

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Appendix E: Drill Cuttings Modelling

REPORT

Drill Cuttings Modelling Report

Prepared for: **NEO NEXT+**

Prepared by: **Genesis Energies**

www.genesisenergies.com

Project Title: **Montrose Infill Project Environmental Statement**

Document/Rev No: J75853C-Y-RT-24005/A

Client Document No.: RP-MO0786-HS-0348

Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval
A	07/12/2025	Issued for Client Review	[redacted]	[redacted]	[redacted]	
For tracking purposes: Note document number used on original report for modelling of four wells. That report superseded with this five well scenario.						

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ABBREVIATIONS

'	Minute
"	Second/Inch
%	Percent
‰	Parts per thousand
<	Less Than
>	More 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
CNS	Central North Sea
DREAM	Dose-related Risk and Effects Assessment Model
ED	European Datum
ES	Environmental Statement
HYCOM	Hybrid Coordinate Ocean Model
kg/m^3	Kilogram per cubic metre
km	Kilometre
km^2	Square kilometre
km^3	Cubic kilometre
LC_{50}	Lethal Concentration 50 %
LTOBM	Low toxicity oil based mud
m	Metre
MEMW	Marine Environmental Modelling Workbench

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mm	Millimetre
NCEP	National Centre for Environmental Prediction
NMPi	National Marine Plan interactive
NOEC	No Observed Effect Concentration
OBM	Oil-based mud
OOC	Oil on cuttings
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
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
PSD	Particle Size Distribution
SDS	Safety data sheet
t	Tonnes
t/hr	Tonnes per hour
TCC	Thermo mechanical cuttings cleaner
TWMA	Total Waste Management Alliance
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UTM	Universal Transverse Mercator
WBM	Water-Based Mud
WGS84	World Geodetic System 1984

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1 INTRODUCTION

The Montrose Field is an oil field, located on the UK Continental Shelf (UKCS) in Block 22/17 in the Central North Sea (CNS) and lies *c.* 190 km east of the Aberdeenshire coastline and *c.* 46 km west of the UK/Norway median line (Figure 1-1).

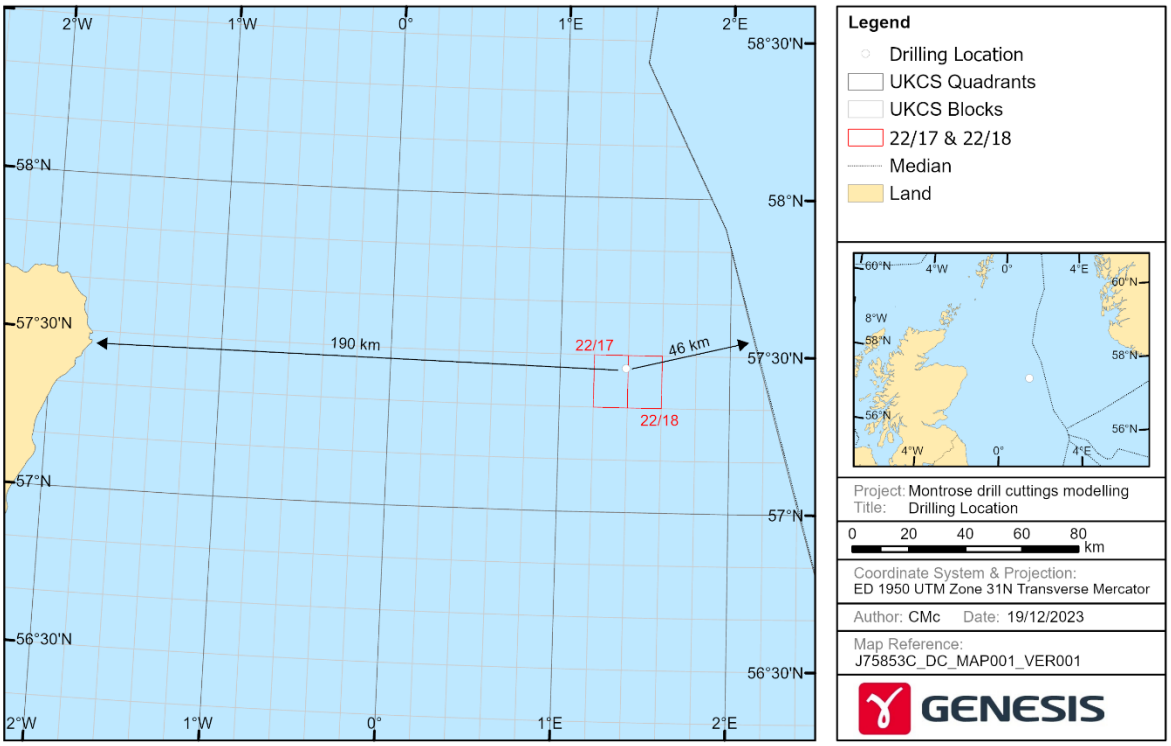


Figure 1-1: Drilling Location

NEO NEXT+ are planning to drill five subsea wells from a single drill centre location. 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 the cuttings from these wells. The drill cuttings modelling results presented in this technical note have been used to inform the Environmental Statement (ES).

Drill cuttings modelling was used to predict the fate of discharged cuttings from the wells in terms of:

1) Depositional thickness on the seabed;
2) Environmental risk to the seabed resulting from burial thickness, grain size change, toxicity and pore water oxygen depletion; and
3) Environmental risk in the water column resulting from toxicity and particle stresses.

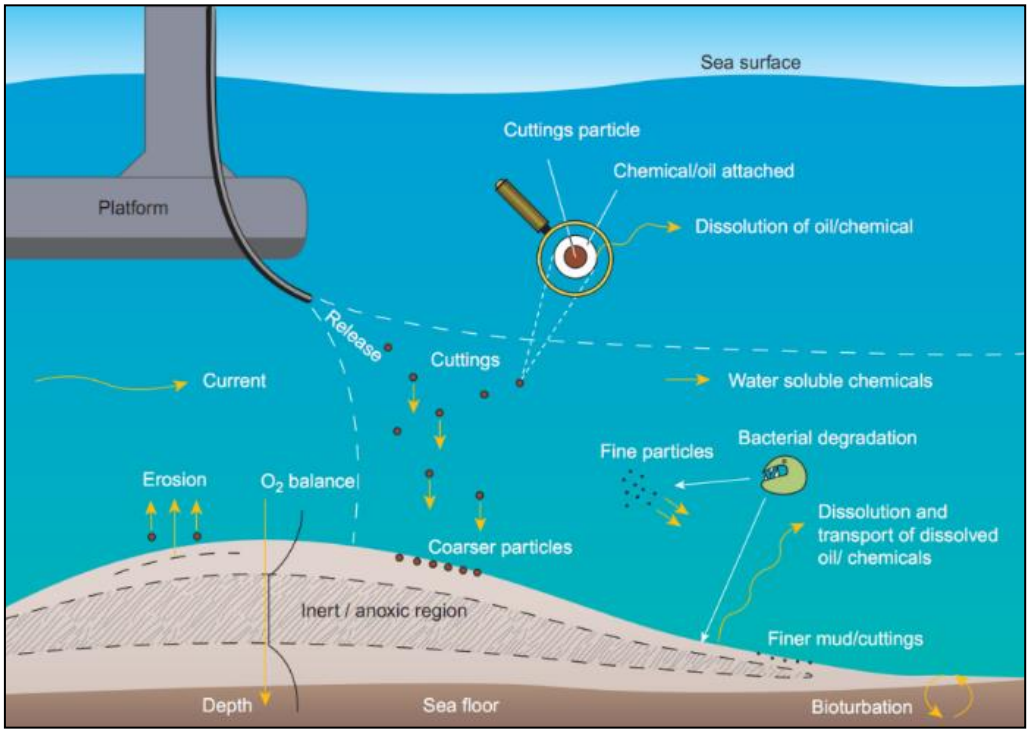
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2 OVERVIEW OF THE MODELLING METHODOLOGY

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 14.1.0. 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 platform.

Figure 2-1: Processes involved in the DREAM model

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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 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).

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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 uses the change in median grain size to represent the overall changes in sediment characteristics.

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3 MODEL INPUT DATA

3.1 Metocean Data

3.1.1 Currents and Winds

The study draws on six months of three-dimensional water column current data (daily resolution) obtained from the Hybrid Coordinate Ocean Model (HYCOM), spanning March – August 2010. which covers the most quiescent (and hence, worst-case) months (May – June). Further information is given in Section 3.6.1 regarding model uncertainties.

The study draws on six months of two-dimensional wind data obtained from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR), spanning March – August 2010.

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). March – August averages for the area were used to align with the current data.

The average sea temperature varies from 6.32°C at the seabed to 8.94°C at the sea surface. Salinity variation in the water column is minimal and an average value of 35.0‰ 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 well are predominantly very fine sand (GEOxyz., 2023), with a median background sediment grain size of 0.1 mm.

3.4 Well Design and Drilling Discharges

Cuttings are discharged from each drilled section of the well. The model inputs include:

- The well locations;

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- The well design and geometry of each section (a single well design with the largest sections volume has been assumed for all five wells as the worst-case cuttings discharge scenario);
- The mass of the mud components discharged from each section; and
- An assumed drilling schedule showing the likely drilling duration per section.

3.4.1 Wells and Discharge Locations

The wells will be drilled from a single drill center at the coordinates shown in Table 3-1.

Table 3-1: Drilling Coordinates

Well	Longitude	Latitude
1	1° 23' 15.503" E	57° 27' 30.053" N
Contingency well 1	1° 23' 14.723" E	57° 27' 30.043" N
2	1° 23' 15.483" E	57° 27' 30.506" N
Contingency well 2	1° 23' 14.703" E	57° 27' 30.496" N
3	1° 23' 16.282" E	57° 27' 30.063" N
Contingency well 3	1° 23' 17.062" E	57° 27' 30.073" N
4	1° 23' 16.264" E	57° 27' 30.483" N
Contingency well 4	1° 23' 17.043" E	57° 27' 30.493" N
5	1° 23' 16.245" E	57° 27' 30.903" N
Contingency well 5	1° 23' 17.025" E	57° 27' 30.913" N
Surface release location for the treated LTOBM contaminated cuttings	1° 23' 9.847" E	57° 27' 27.711" N
Coordinates are provided in World Geodetic System 1984		

3.4.2 Well Design

The well design comprises five sections as summarised in Table 3-2. The first two sections will be drilled using water-based mud (WBM) and discharged directly to the seabed from the wellbore drilling process at 1 m above seabed (before the riser is installed). Low toxicity oil-based mud (LTOBM) will be used for the subsequent three sections of the well and the resulting cuttings are lifted up through the riser and treated at the drill rig using a thermo-mechanical cuttings cleaner (TCC) prior to being discharged at the sea surface via a cuttings discharge hose below the rig. All wells assume the same design and represent a worst-case scenario.

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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
42	85	WBM	Seabed
26	402	WBM	
17.5	722	LTOBM	Sea surface
12.25	4,030	LTOBM	
8.5	1,325	LTOBM	

The following contingencies have been included in the modelling and confirmed with the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) (email confirmation from OPRED, received 24/11/2023):

- Requirement for re-spuds for each well in the event of unplanned shallow hazards, i.e., additional WBM cuttings discharge from 42” and 26” sections x 5;
- Requirement for additional shallow sidetracks (on the lower two sections) for each well in the event of unplanned geological findings or critical equipment failure i.e., additional LTOBM cuttings discharge from the 12.25” and 8.5” sections x 5.

3.4.3 Thermal Desorption Process

During thermal desorption cuttings are heated to the distillation temperature of the base oil and this temperature is maintained until all the oil is vapourised. Thermal desorption units typically use a TCC, also known as a hammermill (RotoMill™) system, which uses a series of hammer arms mounted on a central drive shaft rotating at high speed in a process chamber. Friction from the hammers and cuttings generates enough heat (240°C to 260°C) to evaporate the water and then the oil from the cuttings. The oil can then be condensed and separated for recovery/recycling.

In accordance with RotoMill™ performance data, the processed powder typically contains 0.1% or less of hydrocarbon (i.e either. LTOBM or a combination of LTOBM and reservoir oil) content by weight (Kirkness *et al.,* 2008) and can be discharged. A value of 1% oil on cuttings (OOC) was used in this assessment in line with the regulatory requirements of 1% OOC and is considered a worst-case based on previous wells. Only part of the 8.5’’ section will encounter reservoir oil.

The recovered water has a hydrocarbon content of less than 30 mg/l and can also be discharged (the water is sampled and discharged separately from the cuttings and is not part of this modelling report).

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An overview of the RotoMill™ process is shown in Figure 3-1. The RotoMill™ can process cuttings at speeds of up to 10 t/hr (TWMA, 2019), though rates of 8 t/hr are more typical.

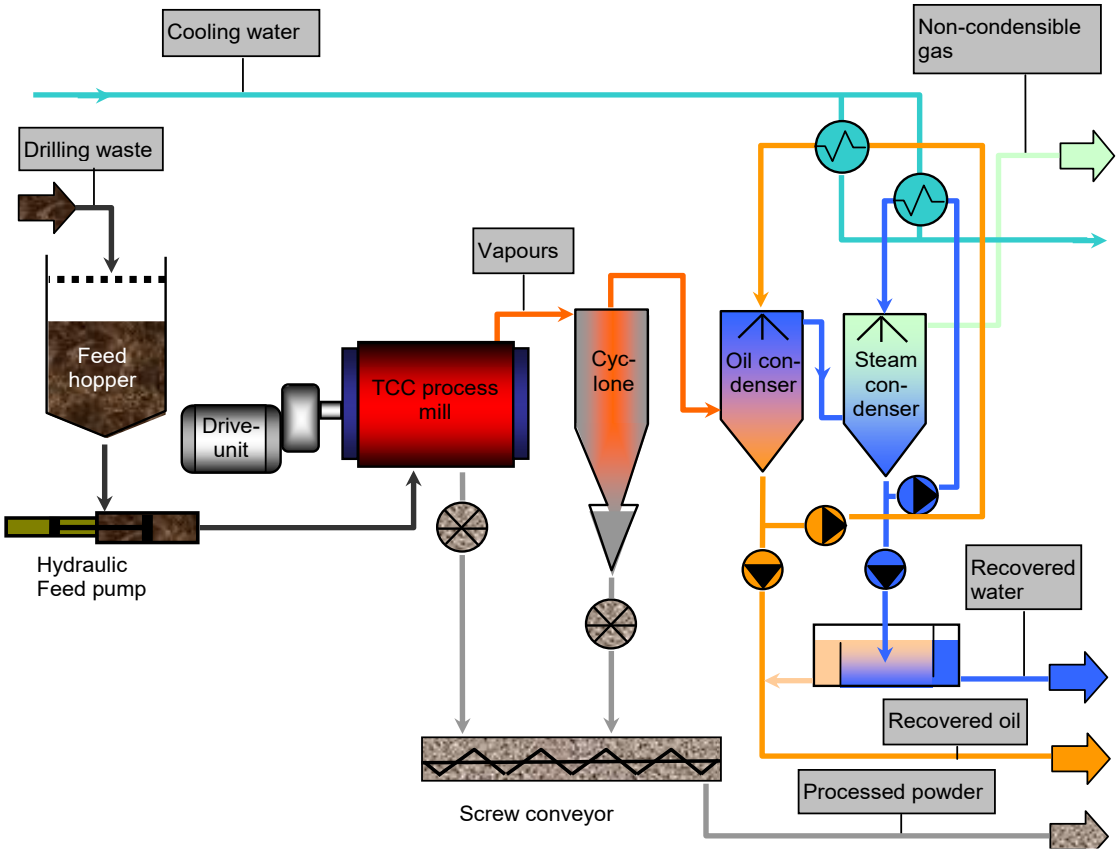


Figure 3-1: Schematic showing RotoMill™ process

3.4.4 Mud Components

A summary of mud compositions and the discharged components is shown in Table 3-3.

Table 3-3:Drilling fluid components modelled for each section per well

Section Diameter[1] (")	Rock Cuttings (t)	Bentonite[3] (t)	Barite[3] (t)	Total solids discharged from RotoMill™ (t)	Base Oil on solids discharged from RotoMill™ [2] (t)	Reservoir oil on solids discharged[2] (t)
42	237.04	90	170	--	-	-
26	429.62	180	270	-	-	-
Total	666.66	270	440	-	-	-
17.5	295.78	0	16	312	2.96	N/A
12.25	808.98	0	15	824	4.85	N/A
8.5	128.06	0	8.5	137	0.64	0.64
Total	1232.82	0	39.5	1273	8.45	0.64

Notes:

[1] Sections 42” & 26” include a 30% well bore washout, remaining sections include 10% well bore washout

[2] Oil on solids based on 1% cuttings weight as discussed in section 3.4.3. For the 8.5” section this is split evenly between base oil and reservoir oil (0.5% each).

[3] The mass of Bentonite and Barite is based on previous Shaw-SHC well drilling.

The base oil for the LTOBM is Saraline 185V used in the lower three sections. Its physico-chemical and toxicological properties were obtained from the safety data sheet (SDS) supplied by NEO NEXT+ and are shown in Table 3-4. These properties were entered into the DREAM component database.

The PNEC is calculated by dividing the lowest short-term Lethal Concentration 50% (LC_{50}) or long-term No Observed Effect Concentration (NOEC) value by an appropriate assessment factor, which is the established approach for assessing chemical toxicity under the OSPAR Harmonised Mandatory Control System (OSPAR, 2014). The assessment factors reflect the degree of uncertainty in extrapolation from laboratory toxicity test data for a limited number of species to the 'real' environment. The greater the uncertainty, the higher the assessment factor used. Under the UK Risk Based Approach Programme for the management of produced water discharges from offshore installations, an assessment factor of 1,000 is recommended as a conservative approach to assessing the risk due to these discharges (BEIS, 2020). This was the approach used to derive the PNECs for the LTOBM. The PNEC value of 100 µg/l (including a 1,000 assessment factor) is relatively high, suggesting Saraline 185V has a relatively low level of toxicity.

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Table 3-4: Toxicity and physico-chemical data for base oil (Saraline 185V)

Component Name	PNEC (µg/l)	Biodegradation (%, days)	Density (kg/m^3)	Soluble?	Vapour pressure (atm)	logPow
Saraline 185V	100	80, 28	780	negligible	$9.9x10^{-4}$	>6.5

Source: Safety Data Sheet, Shell GTL Saraline 185V (as provided by NEO NEXT+).

3.4.5 Added Chemicals and Reservoir Oil

Table 3-5 summarises the chemicals used for the top two well sections and the key physico-chemical and toxicological properties of those chemicals are summarised in

Table 3-6. A number of chemicals are added to the LTOBM. However, these are assumed to be destroyed by the RotoMill™ (Vik *et al*., 2014) and have therefore not been included in the RotoMill™ discharge and are not shown in Table 3-5. Vik *et al.* investigated the chemical and ecotoxicity of treated oil based mud (OBM) cuttings by carrying out detailed tests on four treated cuttings' samples. They concluded that the environmental risk associated with discharges of thermally treated OBM cuttings corresponds to that seen with discharges of water-based mud (WBM) cuttings. The levels of oil, polycyclic aromatic hydrocarbons, and metals are expected to be similar to those in WBM cuttings and chemical pollution is expected to have a negligible effect on pelagic and benthic organisms. No information is given in the report in relation to specific chemicals present in the LTOBM.

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 3-5 Drilling chemicals used in top well sections

Chemical (t)	Section		
	42"	26"	Total
DUO-VIS	6	7	**13**
FLO-VIS PLUS	5	5	**10**
DEFOAM PLUS NS	1	1	**2**
MB-5111	2	2	**4**
Nuosept®78	2	2	**4**
SOBO S GOLD 08	3	3	**6**

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Table 3-6 Physical, chemical and toxicological properties[1]

Component Name	PNEC (µg/l)	Biodegradation		Density (kg/m^3)	Vapour pressure (atm)[2]	logPow[3]
		Percent (%)	days			
DUO-VIS	207	49	28	1.5	-	-0.67
FLO-VIS PLUS	207	49	28	1.5	-	-0.84
DEFOAM PLUS NS	104.8	40.1	28	0.95	-	-
MB-5111	2.9419	68	21	1.186	$9.9x10^{-3}$	-0.6
Nuosept®78	2.4016	99.99	21	1.14	0.015	-4.05
SOBO S GOLD 08	11.88	-	-	1.05	-	-

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).

Reservoir oil has been included in the model scope for the 8.5” section where drilling passes through the reservoir. The oil fraction of C20-C25 was selected to represent reservoir oil in the model. This is conservative in respect to toxicity with a chronic PNEC of 5 µg/l. As the cuttings of these sections are processed through the RotoMill™, a value of 0.5% reservoir oil on cuttings (the other 0.5% is base oil) was used in this assessment as discussed in Section 3.4.3 for the base oil.

3.4.6 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. When the cuttings are passed through the thermal desorption unit they are ground down to a much finer size than standard drill cuttings. The PSD was previously determined for the TWMA RotoMill™ desorption unit for typical North Sea cuttings. The results are shown in Appendix A and were used to develop a PSD for the cuttings discharged from the lower sections of each well. Table 3-7 and Table 3-8 summarise the cuttings PSDs used in the model.

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Table 3-7: 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 2000 µm ~35%	60–100	10	60
	100–400	10	70
	400–1000	10	80
Gravel 2000 to 6000 µm ~15% Cobbles >6000 µm (% included in gravel)	1000–4000	10	90
	4000–7000	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.

Table 3-8: Cuttings PSD for lower well sections after thermal desorption (TWMA, 2018)

Approximate% In Each Size Class[1]	Size Interval (µm)	Fraction[2] (%)	Cumulative Fraction (%)
Fines (silt/clay) Up to 62.5 µm ~75%	< 1	10	10
	1–3	10	20
	3–5	10	30
	5–8	10	40
	8–16	10	50
	16–25	10	60
	25–45	10	70
	45–71	10	80
Sand 62.5 µm to 2000 µm ~25%	71–159	10	90
	159–564	10	100

Notes:

[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.

[2] Fractions have been rounded to nearest 5 %.

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3.4.7 Drilling Schedule

The proposed drilling programme for five wells including contingency re-spuds and sidetracks may extend up to a period of approximately 365 days (this takes any possible delays into consideration so drilling will not be continuous during this time). Of this there will be approximately 258 days of drilling.

The modelled batch drilling schedule is shown in Table 3-9 and is compressed compared to the actual drilling time to optimise model run time. The modelled schedule is based on the following assumptions:

- Drilling durations for the two tophole sections were calculated by the model based on section length;
- Discharge durations for the lower hole sections are not based on drilling rate. They were calculated based on the mass of cuttings requiring treatment and assuming a RotoMill™ treatment rate of 8 t/h;
- The cuttings in the Rotomill™ are processed consecutively and discharged concurrently, whereas in reality they would be processed and discharged in batches;
- It is assumed that the well sections will be drilled in batches, i.e. first all 42'' sections will be drilled; then all 26'' sections and a re-spud (if any); then all 17.5'' sections; then all 12.25'' sections; and finally 8.5'' sections and a sidetrack (if any).
- In total, the cuttings volume has been calculated based on 5 x maintracks; 5 x contingency re-spuds of the two upper sections; and 5 x mechanical sidetracks of the two lower sections; 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 215 days.

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Table 3-9: Modelled drilling sequence and schedule

Discharge type	Section diameter (“)	Discharge duration - including continegencies (days)
Direct discharge *	42	4.7
	26	22.3
Via TCC (RotoMill™) **	17.5	10.0
	12.25	93.3
	8.5	7.9
Total including all contingencies:		**209.2**
Total model run time (+ five days)		**215**

* Note 1: Two upper sections will be drilled without a riser and WBM will be discharged overboard.

**Note 2: Three lower sections will be drilled with OBM. Should RotoMill™ be unavailable, the cuttings will be skipped and shipped to shore.

The wells will take significantly longer to be drilled in reality than in the model and allow more time for dispersion between discharges from individual sections. The model set up is 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.

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 grids 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 3-10.

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Table 3-10: Model configuration

Aspect	Domain Size	Cell Size	Time Step	Model Duration	Sediment risk model?
Water column	100 km × 100 km	100 m × 100 m	30 mins	215 days	Not included
Seabed (risk)	2 km × 2 km	20 m × 20 m	90 mins	215 days plus 10 years[1]	Included
Seabed (thickness)	2 km × 2 km	20 m × 20 m	90 mins	215 days	Not included

[1] Main DREAM model runs for 215 days using timestep shown, followed by the sediment 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 March which covers the worst-case months (May – June) where currents are weakest. 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 was derived from the burial sensitivity of 33 species (Smit *et al.*, 2006 and Kjeilen Eilersten *et al.*, 2004).

3.6.3 Oil Sheen

DREAM does not model the formation of oily sheens on the sea surface. This process is modelled using OSCAR (Oil Spill Contingency And Response), another model under the MEMW suite. Therefore, the absence of a sheen as a result from this drilling discharge cannot be verified with modelling in DREAM alone. However, given the high value of the partition coefficient for the oil on cuttings, most of the oil is retained on cuttings particles and an oil sheen is unlikely to form. The oil is expected to slowly break down over time due to weathering etc.

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4 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 or swept path; 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 of 373 mm, in the immediate vicinity of the wells, reducing rapidly with distance (Figure 4-1 and Figure 4-2). 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 sidetracks. A maximum of one contingency re-spud and one mechanical sidetrack would be attempted, in total, during the actual drilling programme.

Significant thicknesses in relation to environmental risk (over 6.5 mm, see Section 2.2) are predicted to occur over an area of 0.17 km^2 (up to approximately 333 m from the discharge locations). *Nephrops* are known to be tolerant to burial depths of at least 5 cm and thicknesses of over 5 cm are predicted to occur over an area of 0.09 km^2 (up to approximately 277 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 0.01 km^2 (up to approximately 122 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, this is discussed in Section 4.3.

Very fine particles (<0.5 mm grain size) will spread over much larger distances, extending beyond the model domain. The distribution of these very fine particles does not change significantly over time.

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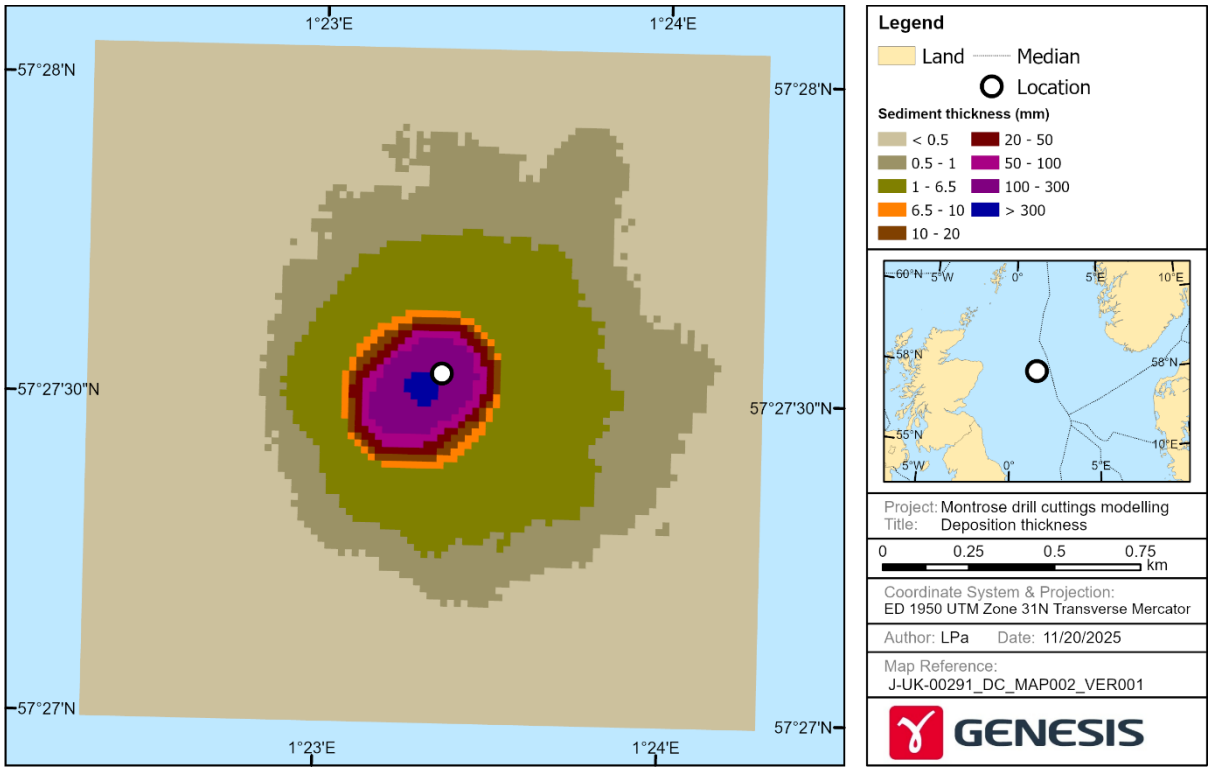
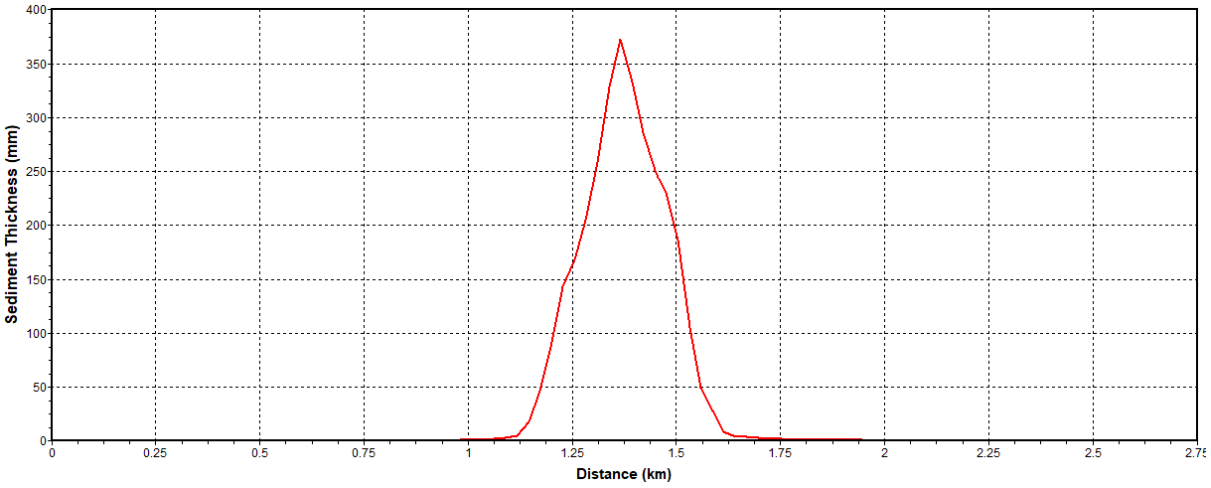


Figure 4-1: Deposition thickness around the drilling locations at the end of drilling



Note: Coordinates of cross section: start point (1°22'14"E, 57°26'57"N) and end point (1°24'11"E, 57°28'00"N)

Figure 4-2: Southwest to northeast cross section of deposition thickness at the end of drilling

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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;
- 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 total combined risk around the drilling location.

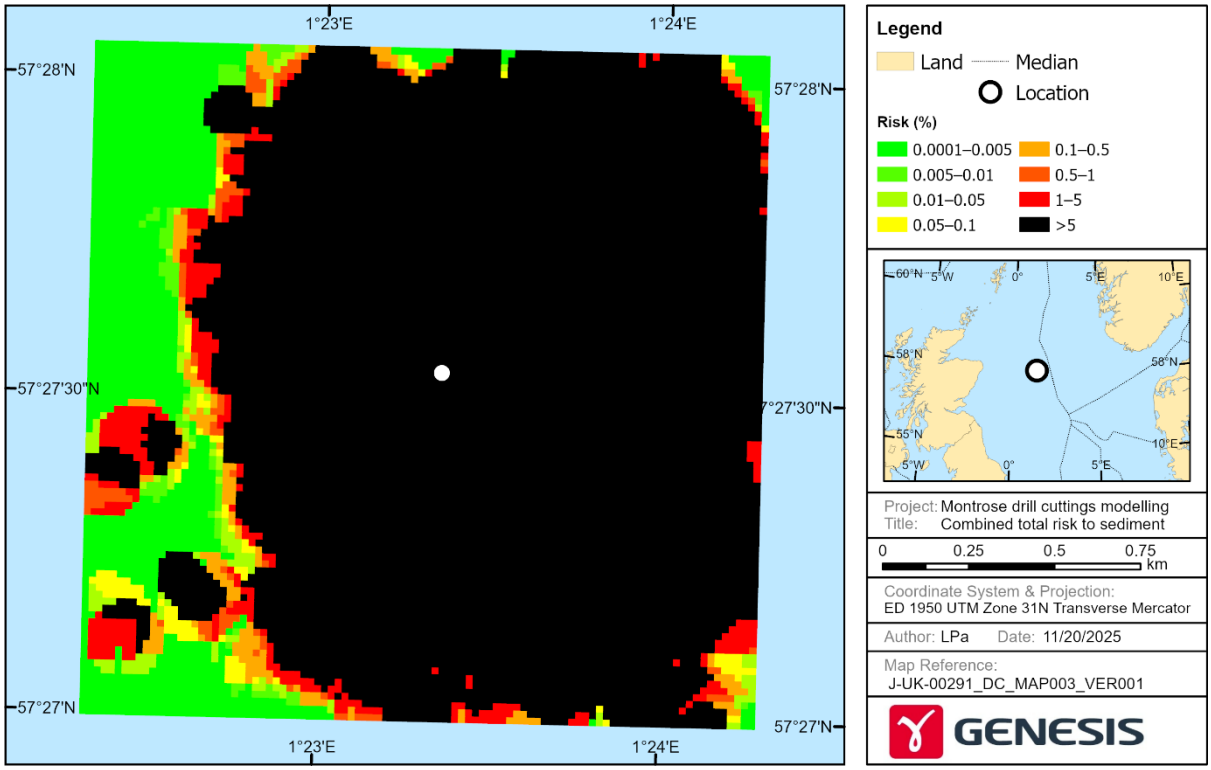


Figure 4-3: Predicted total combined risk to sediments (swept path)

The contribution to the combined risk can be broken down to establish which stressors are the key contributors. This is shown in Figure 4-4.

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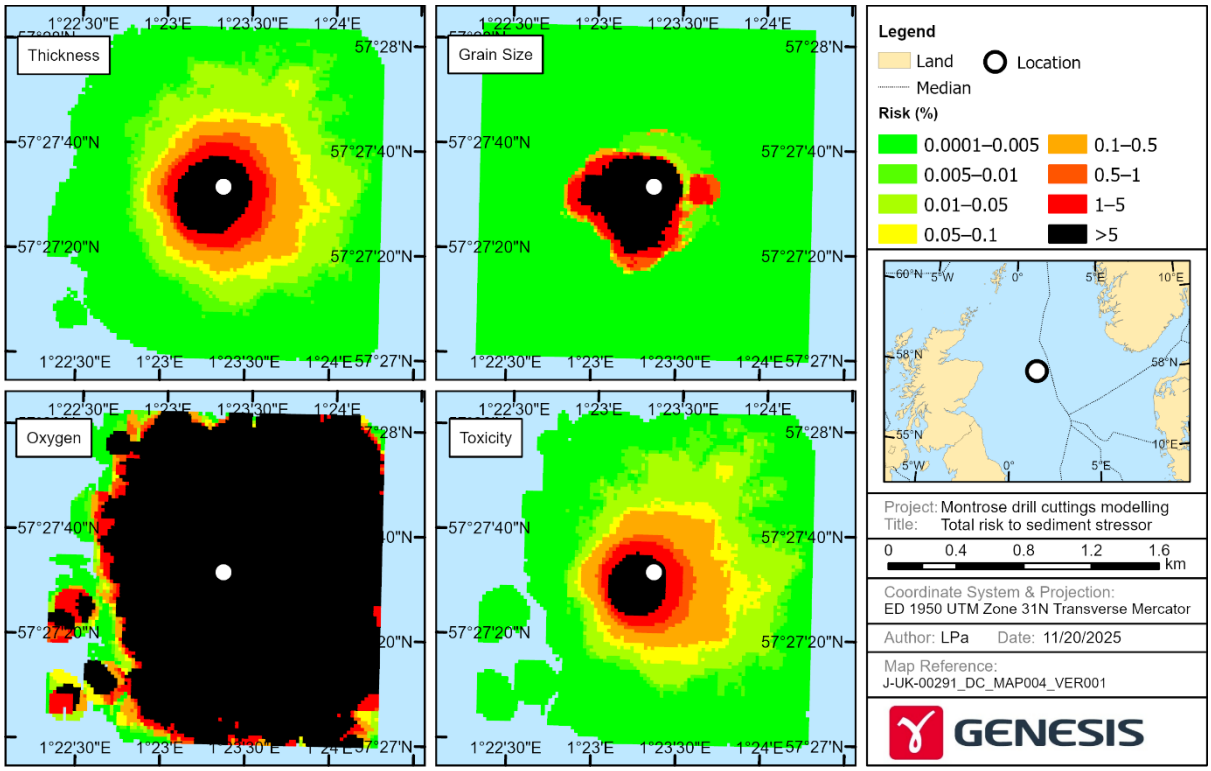


Figure 4-4: Predicted total risk contributions from individual seabed stressors (swept path)

Time-averaged contributions to risk are summarised in Figure 4-5 and Figure 4-6. The main contributor to the risk is oxygen depletion (84.95%). Burial thickness and grain size change contribute to 8.48% and 5.72% respectively. The toxicity is made up of reservoir oil and base oil (Saraline V185) (there is no contribution from the discharged chemicals as they are all readily soluble in water) and contributes just 0.85% to the overall risk.

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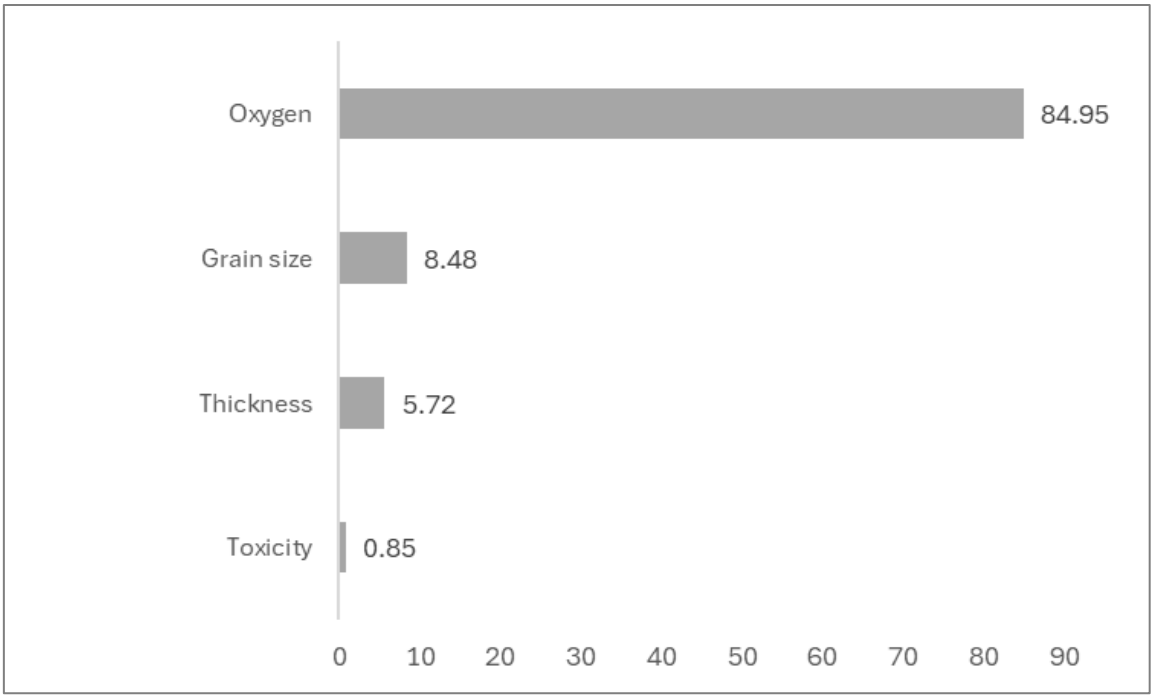


Figure 4-5: Weighted contributions to time-averaged risk

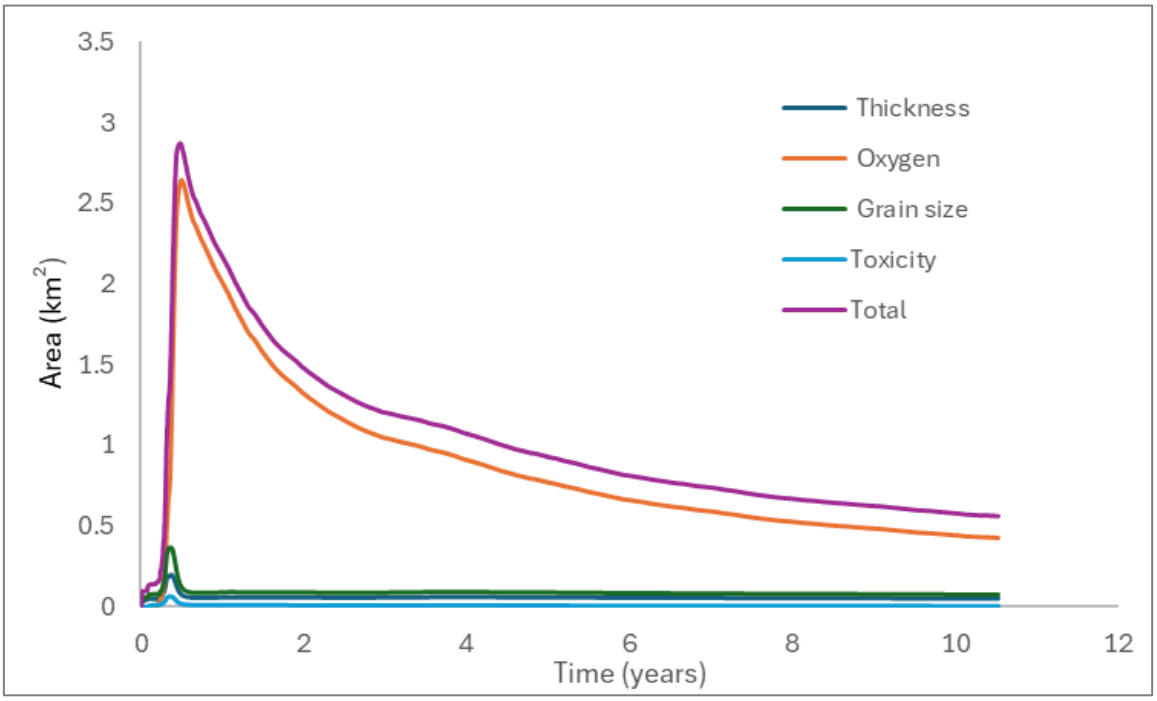


Figure 4-6: Contribution to area where there is risk to more than 5% of sensitive species over whole model period for each sediment stressor

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The evolution of predicted combined risk (at 29 days after the end of drilling, two years, five years and ten years after the end of drilling) is shown in Figure 4-7 and summarised in Table 4-1.

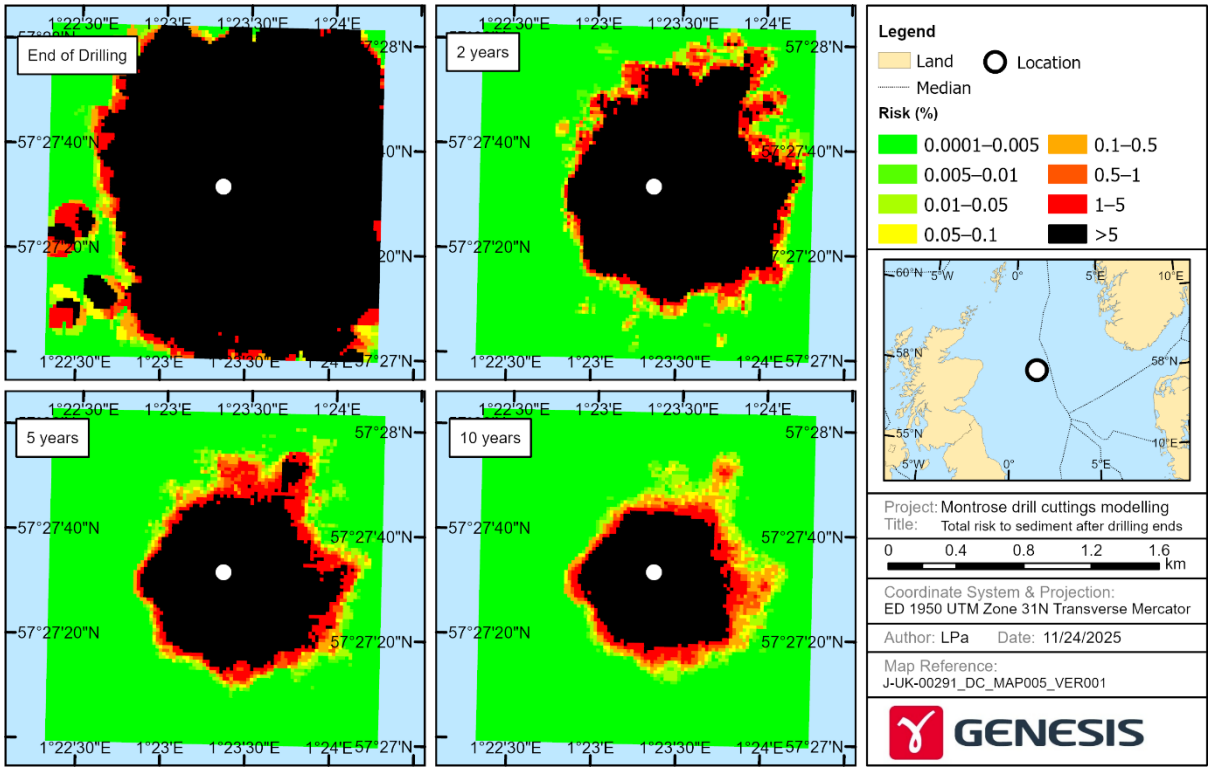


Figure 4-7: Predicted combined risk to the sediment over time

The maximum area where there is a risk to more than 5% sensitive species is 2.64 km^2 5 days after drilling discharges end. The area reduces to 1.30 km^2 after two years, to 0.87 km^2 after 5 years, and to 0.56 km^2 after 10 years.

Table 4-1: Predicted combined risk over time

Time period	Units	Description	Area where combined risk is >5% (km^2)	Percentage change in area (%)
220	days	5 days post drilling (maximum combined risk)	2.64	-
2	years	2 years post drilling	1.30	50.80
5	years	5 years post drilling	0.87	67.14
10	years	10 years post drilling	0.56	78.62

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As noted above, the main risk stressor as a result of the modelled drilling discharges is oxygen depletion. The maximum extent of risk occurs 5 days after drilling ends and is driven by a continued increase in oxygen depletion (the most dominant stressor) after the end of drilling. This is a result of oxygen being consumed as the reservoir oil breaks down.

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 area where the risk to the most sensitive species exceeds 5% appears extensive (14.07 km^3), 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 area where risk exceeds 5% at any instance in time would be much smaller than that shown in Figure 4-8. The area of 5% risk and above mostly occurs in the lower water column with a small amount of risk occurring near the surface where the lower sections are discharged, as shown in the cross section (Figure 4-9).

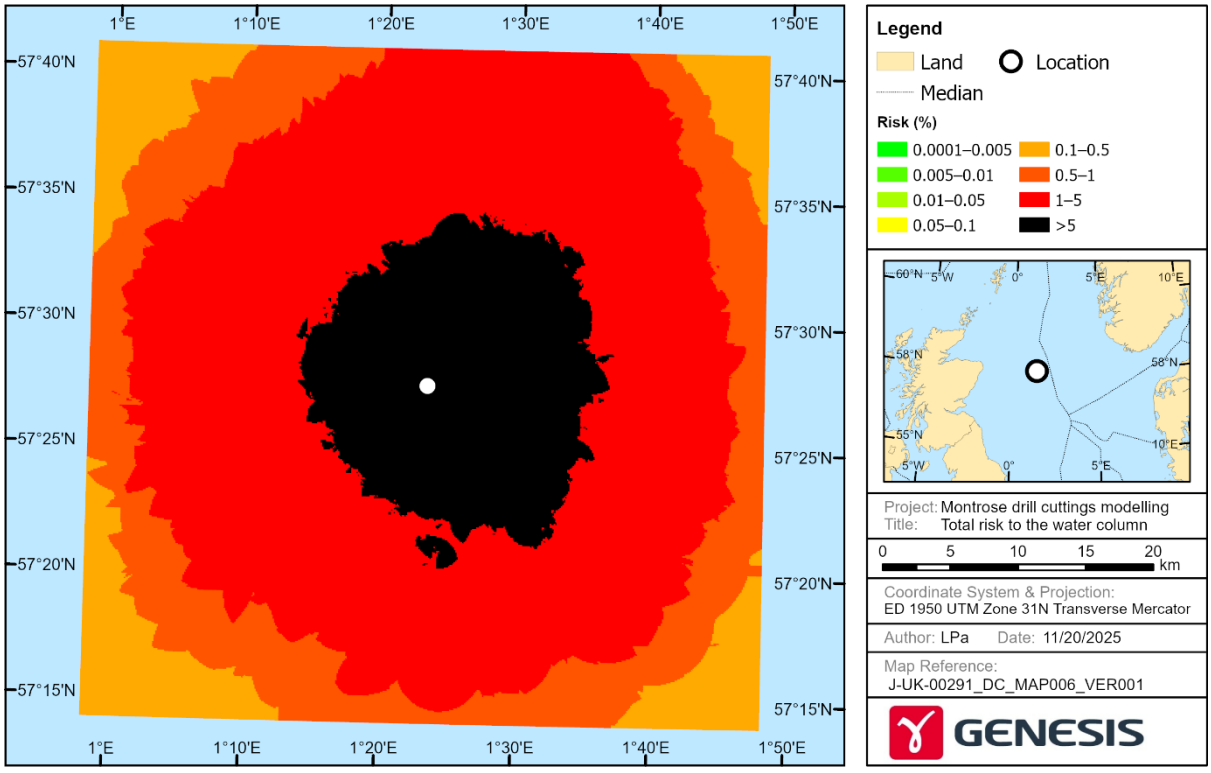


Figure 4-8: Total risk to the water column (swept path)

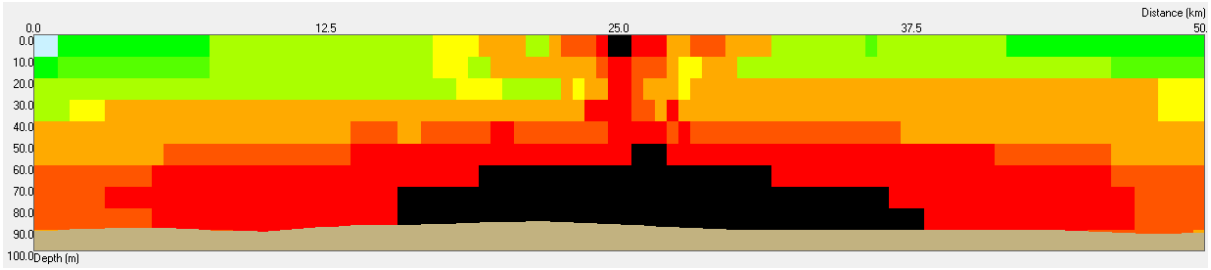


Figure 4-9: Southwest to northeast cross-section of total risk

Figure 4-10 and Figure 4-11 show of the maximum instantaneous risk to the water column at 12 days from the start of drilling. This is the model timestep that highlights the maximum instantaneous volume where there is a risk to more than 5% of sensitive species (7.41 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.

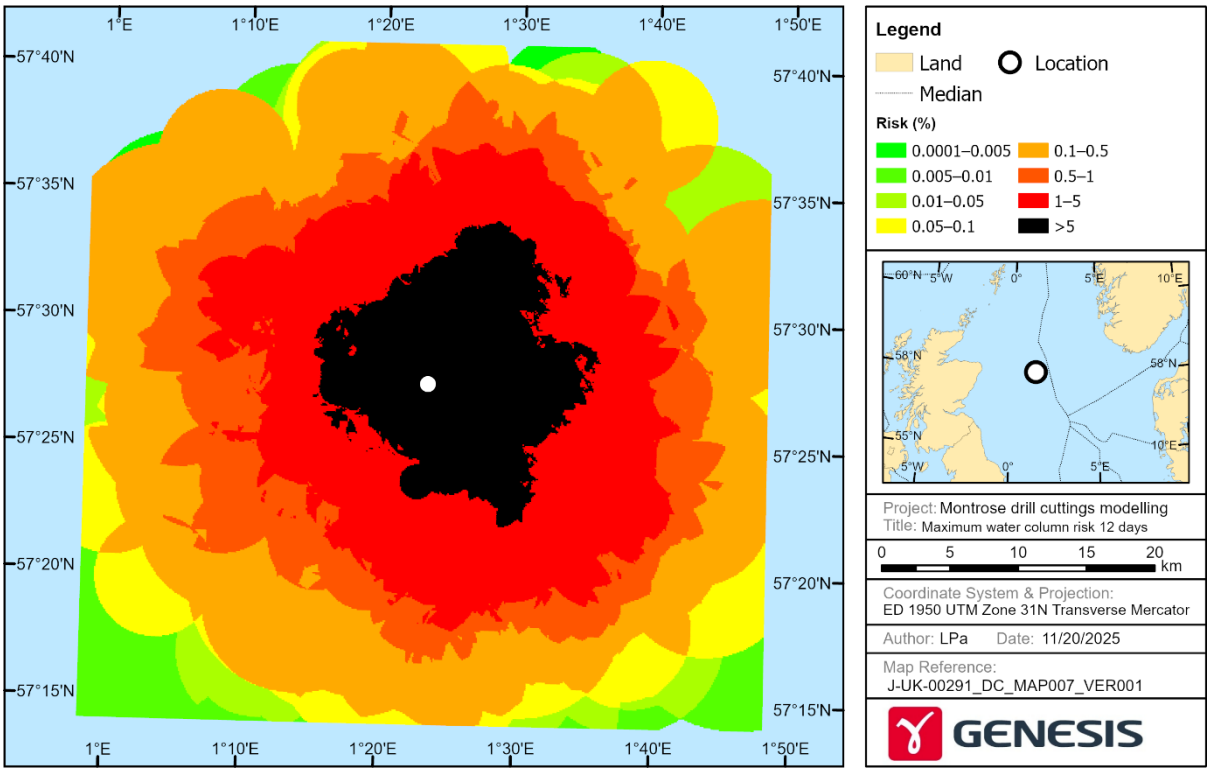


Figure 4-10: Maximum instantaneous risk to the water column after 12 days, 0 hours

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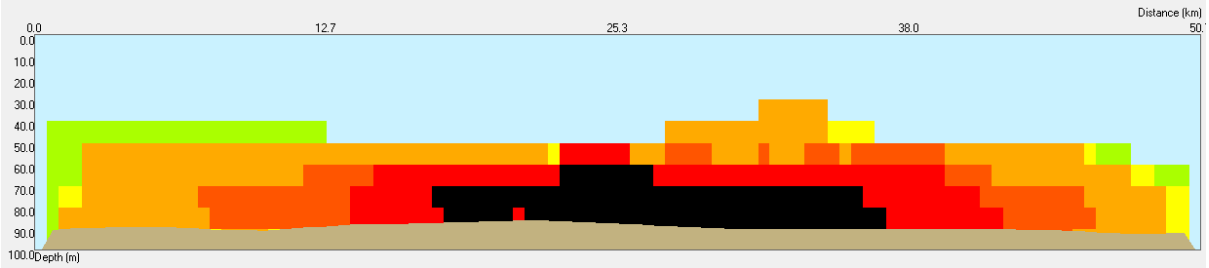
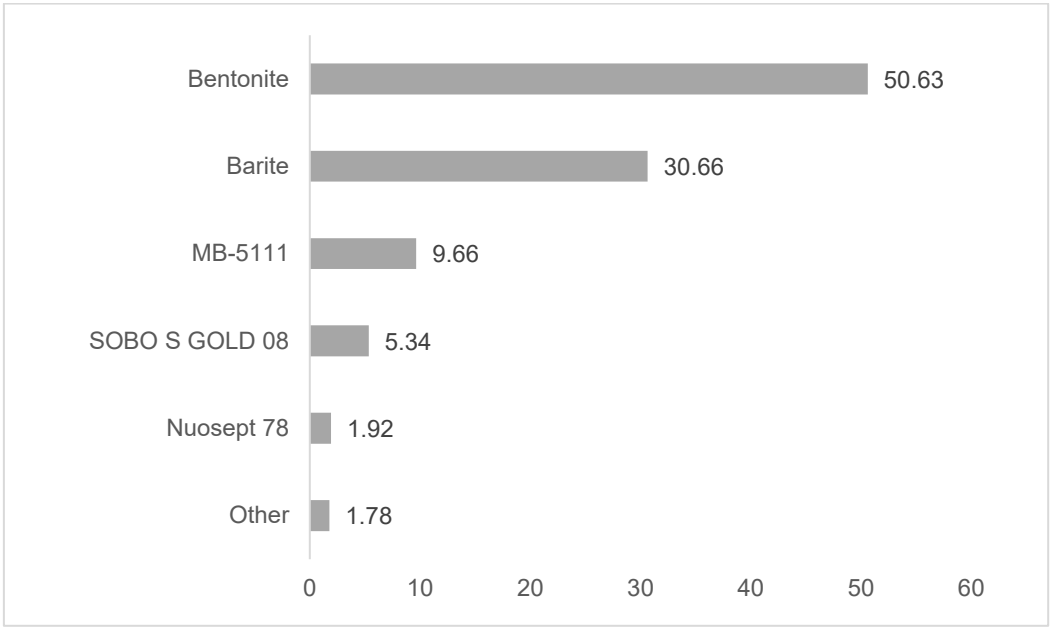


Figure 4-11: Southwest to northeast cross-section of maximum instantaneous risk after 12 days, 0 hours

The primary contributors to the water column risk are from bentonite particles (50.63%), barite particles (30.66%) and MB-5111 (biocide) (9.66%) as shown in Figure 4-12.



Note: Other comprises of , DUO-VIS, FLO-VIS PLUS, Saraline 185V, DEFOAM PLUS NS, cuttings and RotoMill™ 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). The risk is dominated by the drilling of the two top hole sections, After each batch of sections are drilled the volume at risk reduces to zero and disappears completely within 48 hours of the end of drilling. Risk to the water column is not predicted as a result of RotoMill™ discharges associated with the lower three sections.

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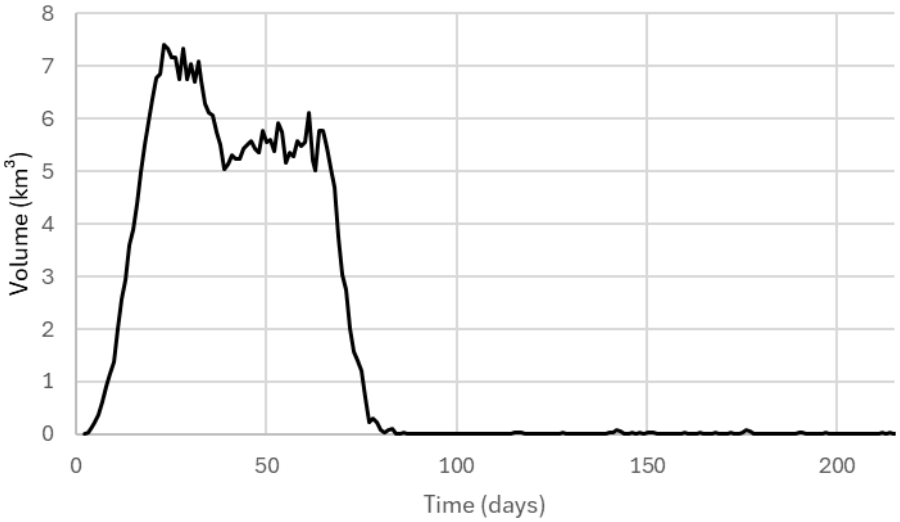


Figure 4-13: Volume of water where there is risk to over 5% of species over time

4.5 Impact to Protected Areas

The discharge location is located within The East of Gannet and Montrose Fields NCMPA, which covers an area of 1,839 km^2 with water depths ranging from 80 to 100 m. It was designated in 2014 for the following protected features:

- 'offshore deep sea muds' habitat;
- low or limited mobility species 'ocean quahog aggregations'; and
- 'offshore subtidal sands and gravels' habitat (representing sediment types suitable for ocean quahog colonisation).

The following paragraphs assess the modelled risk to both the sediment and Water column in relation to the protected area .

4.5.1 Sediment Model

The entirety of the sediment model domain is within the East of Gannet and Montrose Fields NCMPA (see Section 4). The sediment model exists on a seabed habitat characterised as 'Deep Circalittoral Sand' considered suitable for ocean quahog colonisation. Ocean quahog assemblages have a high resilience to smothering up to 30 cm (Tyler-Walters & Sabatini, 2017). The sediment models predict only 0.01 km^2 will be buried beyond this thickness (extending up to a maximum 122 m from the discharge sites. Therefor the risk posed to species designated within the East of Gannet and Montrose Fields NCMPA by the cuttings pile itself is considered minimal.

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4.6 Summary of Outputs

Model outputs are summarized in Table 4-2. The potential impact to the seabed initially covers an area greater than a typical 500 m exclusion zone (>0.785 km^2), however this decreases to <0.785 km^2 within ten years of completion of drilling. The key contributor of the risk to the seabed sediment is oxygen depletion. Ten years after the end of drilling the risk to the seabed is reduced to an area of 0.56 km^2. 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 (mm) – only occurs in single model cell (100 m^2 or 0001 km^2).	373
	Area where thickness >6.5 mm - end of drilling (km^2)	0.17
	Area where thickness >50 mm - end of drilling (km^2)	0.09
	Area where thickness >300 mm - end of drilling (km^2)	0.01
Risk to sediment		
Thickness (%)	>6.5 mm	5.72
Grain size (%)	>52 µm	8.48
Oxygen depletion (%)	>20%	84.95
Toxicity (%)	Toxicity (PNEC exceeded)	0.85
Area where there is a total combined risk (>5%) to the most sensitive species (km^2)	36 days (after end of drilling)	2.64
	2 years (after end of drilling)	1.30
	5 years (after end of drilling)	0.87
	10 years (after end of drilling)	0.56
Risk to water column		
Bentonite (%)	Physical effect of particles	50.63
Barite (%)	Physical effect of particles	30.66
Cuttings (%)	Physical effect of particles	0.01
Toxicity of base oil (SARALINE 185V) (%)	Toxicity (PNEC exceeded)	0.03
Toxicity of reservoir oil (%)	Toxicity (PNEC exceeded)	0
Toxicity of MB-5111 (%)	Toxicity (PNEC exceeded)	9.66
Toxicity of SOBO S GOLD 08 (%)	Toxicity (PNEC exceeded)	7.96
Toxicity of Nuosept 78 (%)	Toxicity (PNEC exceeded)	2.92

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Model output	Criteria	Value
Toxicity of DUO-VIS (%)	Toxicity (PNEC exceeded)	0.68
Toxicity of FLO-VIS PLUS (%)	Toxicity (PNEC exceeded)	0.51
Toxicity of DEFOAM PLUS NS (%)	Toxicity (PNEC exceeded)	0.19
Volume where combined risk to >5% most sensitive species (km^3)	Maximum instantaneous volume	7.41
	Total volume (swept path)	14.07

Note: for comparison 500 m safety zone area is equivalent to 0.785 km^2

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5 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 five proposed wells in Block 22/17. The wells will be drilled using WBM in the top two sections and LTOBM for subsequent sections of the well. The resulting cuttings from the two upper sections are planned to be discharged directly at seabed (before the riser is installed). Cuttings from the three lower LTOBM sections will be lifted up through the riser, treated using a RotoMill™ (if available on the drilling rig) and discharged through the cuttings hose below the rig floor. The assumption has been made that all five proposed wells will have the same design based on the largest volume well with the maximum volume of cuttings to be discharged. The worst-case cuttings discharge scenario was assumed as required by OPRED resulting from:

- Five maintracks;
- Five contingency re-spuds of the two upper sections; and
- Five mechanical sidetracks of the two lower sections.

This is the worst case scenario; a maximum of one contingency re-spud and one mechanical sidetrack would be attempted during the actual drilling programme. The maximum estimated deposited sediment thickness (cuttings pile height) was 373 mm, in the immediate vicinity of the wells, reducing rapidly with distance. In reality the height of the cuttings pile is expected to be smaller as the model includes the discharges from the four contingency re-spuds and four contingency sidetracks.

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 2.64 km^2 29 days after the end of drilling. This area reduces significantly over time, to 0.87 km^2 five years after drilling ends then to 0.56 km^2 ten years after drilling ends; though in reality re-colonisation by benthic organisms would result in a faster seabed recovery.
- The risk to the sediment mainly results from oxygen depletion (84.95%).
- The volume of the water column where there is a risk to over 5% sensitive species reaches up to 7.41 km^3 at any one point in time but is transient in time and space. The risk to the water column disappears within 48 hours of the cessation of drilling of the tophole sections.
- The primary contributors to the water column risk are from bentonite (50.63%), barite (30.66%) and MB-5111 (biocide) (9.66%).

Should RotoMill™ be unavailable, the OBM cuttings will be skipped and shipped to shore.

Modelling does not predict significant risk to the nearby NCMPA from either the sediment model or the water column model. The risks identified from the modelling are used within the ES to assess environmental impacts associated with the drill cuttings (see Sections 8 and 9).

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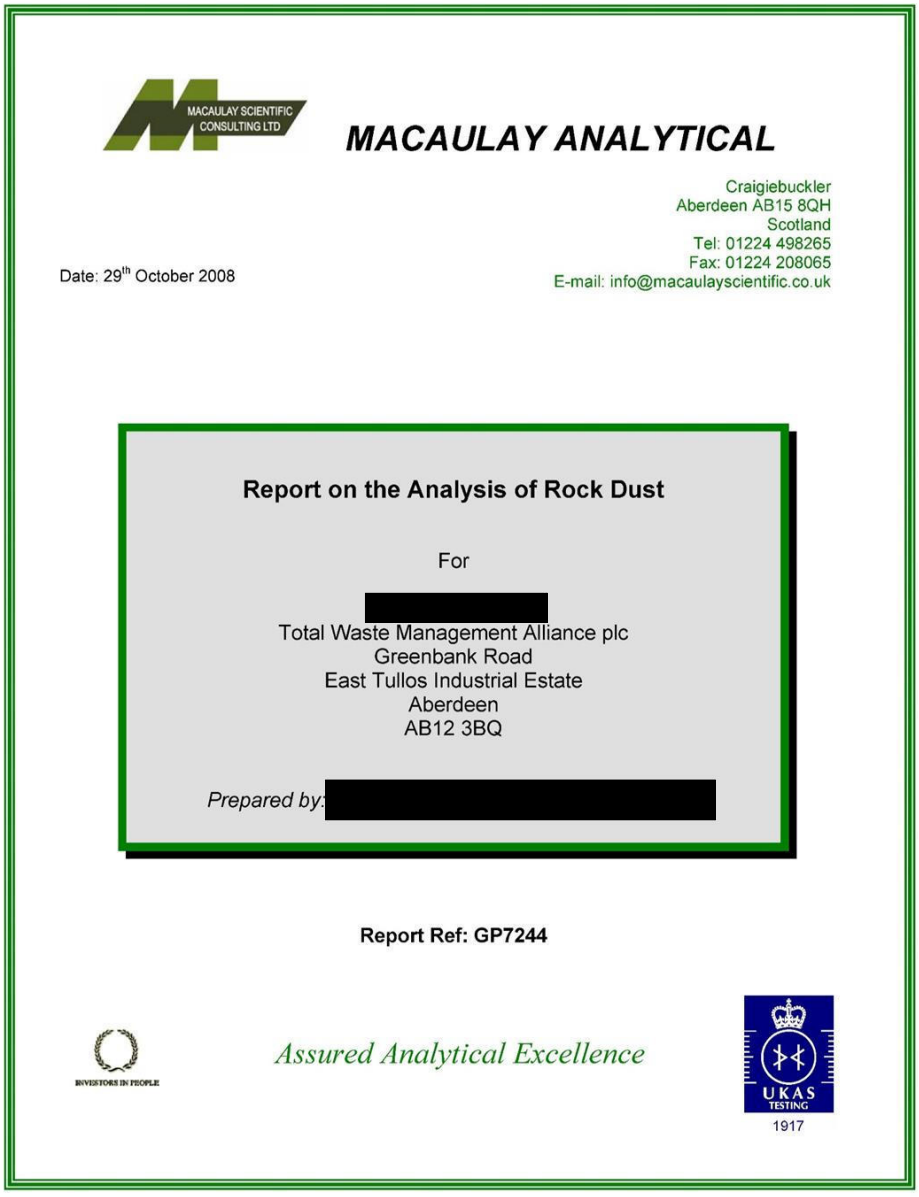
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APPENDIX A PARTICLE SIZE DISTRIBUTION FOR CUTTINGS AFTER THERMAL DESORPTION



MACAULAY SCIENTIFIC CONSULTING LTD

MACAULAY ANALYTICAL

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Date: 29th October 2008

Report on the Analysis of Rock Dust

For

[redacted]
Total Waste Management Alliance plc
Greenbank Road
East Tullos Industrial Estate
Aberdeen
AB12 3BQ

Prepared by: [redacted]

Report Ref: GP7244

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MACAULAY SCIENTIFIC CONSULTING LTD

Result Analysis Report

Laboratory Code
PHD Powder 22/10 952015

Measured:
24 October 2008 08:25:17

Sample Source & type:
Supplier = Total Waste Management

Measured by:
jo0425

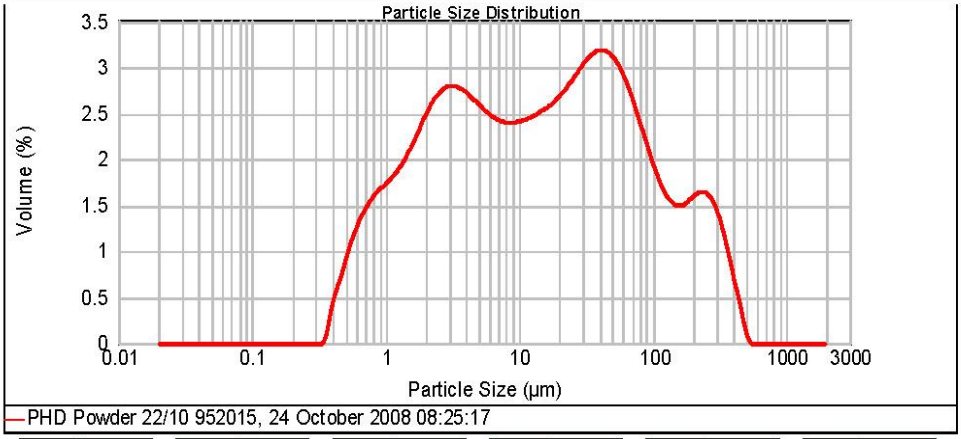
Analysed:
24 October 2008 08:25:18

Sample bulk lot ref:
952015 = Run 1

Result Source:
Edited

Particle Name: Default	**Accessory Name:** Hydro 2000G (A)	**Analysis model:** General purpose	**Sensitivity:** Normal
Particle RI: 1.520	**Absorption:** 0.1	**Size range:** 0.020 to 2000.000 um	**Obscuration:** 11.81 %
Dispersant Name: Water	**Dispersant RI:** 1.330	**Weighted Residual:** 1.612 %	**Result Emulation:** Off
Concentration: 0.0075 %Vol	**Span :** 10.408	**Uniformity:** 3.11	**Result units:** Volume
Specific Surface Area: 1.61 m²/g	**Surface Weighted Mean D[3,2]:** 3.715 um	**Vol. Weighted Mean D[4,3]:** 48.725 um	

d(0.1): 1.219 um **d(0.5): 14.249 um** **d(0.9): 149.525 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.020	0.00	0.142	0.00	1.002	7.70	7.096	38.91	50.238	73.90	355.656	98.62
0.022	0.00	0.159	0.00	1.125	9.04	7.962	40.73	56.368	76.21	399.052	99.32
0.025	0.00	0.178	0.00	1.262	10.43	8.934	42.53	63.246	78.42	447.744	99.78
0.028	0.00	0.200	0.00	1.416	11.90	10.024	44.35	70.963	80.48	502.377	99.99
0.032	0.00	0.224	0.00	1.589	13.47	11.247	46.17	79.621	82.38	563.677	100.00
0.036	0.00	0.252	0.00	1.783	15.15	12.619	48.02	89.337	84.11	632.456	100.00
0.040	0.00	0.283	0.00	2.000	16.96	14.159	49.90	100.237	85.66	709.627	100.00
0.045	0.00	0.317	0.00	2.244	18.89	15.887	51.80	112.468	87.04	796.214	100.00
0.050	0.00	0.356	0.00	2.518	20.90	17.825	53.74	126.191	88.30	893.367	100.00
0.056	0.00	0.399	0.19	2.825	22.98	20.000	55.73	141.589	89.46	1002.374	100.00
0.063	0.00	0.448	0.62	3.170	25.09	22.440	57.78	158.866	90.59	1124.683	100.00
0.071	0.00	0.502	1.22	3.557	27.19	25.179	59.90	178.250	91.73	1261.915	100.00
0.080	0.00	0.564	2.01	3.991	29.27	28.251	62.10	200.000	92.90	1415.892	100.00
0.089	0.00	0.632	2.95	4.477	31.30	31.698	64.38	224.404	94.12	1588.656	100.00
0.100	0.00	0.710	4.02	5.024	33.28	35.566	66.73	251.785	95.36	1782.502	100.00
0.112	0.00	0.796	5.18	5.637	35.20	39.905	69.12	282.508	96.57	2000.000	100.00
0.126	0.00	0.893	6.42	6.325	37.08	44.774	71.52	316.979	97.68		

Operator notes: *2008-07244*

Malvern Instruments Ltd.
Malvern, UK

Mastersizer 2000 Ver. 5.22
Serial Number : ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ

File name: 2008-07244-DM011(Data Used)
Record Number: 4

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Appendix F. Production Profiles

The oil, gas, and produced water production profiles are presented in Table F-1 to Table F-4 for Low, Mid and High case from the Montrose field with and without the proposed Montrose Infill Project.

Values are presented for forecast production without the Montrose Infill wells, the increase associated with the Montrose Infill wells, and the total for Montrose Complex plus the infill wells.

Note that, in all three cases, production from the proposed Montrose Infill Project wells is assumed to commence in 2028. Without the Montrose Infill Project, CoP of the Montrose Complex is planned for 2030. With the addition of the infill wells, CoP will be extended to 2035.

Table F-1: Montrose Field Oil Production Rates in te/d (Low, Mid, and High Cases).

Year	Existing Wells Oil Production Rate (te/d)		Project Low Case Oil Production Rate (te/d)		Project Mid Case Oil Production Rate (te/d)		Project High Case Oil Production Rate (te/d)	
	Baseline Production from Existing Wells	Existing Wells Extended Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production
2026	738	0	0	0	0	0	0	0
2027	694	0	0	0	0	0	0	0
2028	619	0	173	173	209	209	243	243
2029	525	0	1,195	1,195	1,500	1,500	2,061	2,061
2030	453	0	706	706	925	925	1,495	1,495
2031	0	389	518	907	709	1,098	1,196	1,584
2032	0	361	429	789	609	970	1,090	1,450
2033	0	310	349	659	512	821	974	1,284
2034	0	280	286	566	416	697	843	1,123
2035	0	277	260	537	370	647	791	1,068

Table F-2: Montrose Field Oil Production Rates in m^3/d (Low, Mid, and High Cases).

Year	Existing Wells Oil Production Rate ($stdm^3/d$)		Project Low Case Oil Production Rate ($stdm^3/d$)		Project Mid Case Oil Production Rate ($stdm^3/d$)		Project High Case Oil Production Rate ($stdm^3/d$)	
	Baseline Production from Existing Wells	Existing Wells Extended Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production
2026	931	0	0	0	0	0	0	0
2027	876	0	0	0	0	0	0	0
2028	781	0	205	205	247	247	288	288
2029	662	0	1,414	1,414	1,775	1,775	2,439	2,439
2030	572	0	835	835	1,095	1,095	1,769	1,769
2031	0	491	613	1,104	839	1,330	1,415	1,906
2032	0	455	507	963	721	1,177	1,290	1,745
2033	0	391	413	804	605	996	1,152	1,543
2034	0	354	339	692	493	846	997	1,351
2035	0	350	308	658	437	787	936	1,286

Table F-3: Montrose Field Gas Production Rates in m^3/d (Low, Mid, and High Cases).

Year	Existing Wells Gas Production Rate ($stdm^3/d$)		Project Low Case Gas Production Rate ($stdm^3/d$)		Project Mid Case Gas Production Rate ($stdm^3/d$)		Project High Case Gas Production Rate ($stdm^3/d$)	
	Baseline Production from Existing Wells	Existing Wells Extended Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production
2026	497,461	0	0	0	0	0	0	0
2027	644,867	0	0	0	0	0	0	0
2028	968,545	0	22,152	22,152	26,723	26,723	31,191	31,191
2029	547,306	0	151,481	151,481	192,073	192,073	263,433	263,433
2030	381,917	0	89,296	89,296	117,078	117,078	190,560	190,560
2031	0	348,266	65,186	413,452	89,237	437,504	151,814	500,080
2032	0	284,323	53,693	338,016	76,559	360,883	137,737	422,061
2033	0	192,125	43,558	235,683	64,237	256,363	122,891	315,017
2034	0	166,831	35,651	202,482	52,304	219,136	106,068	272,899
2035	0	158,828	32,349	191,177	46,447	205,275	99,296	258,124

Table F-4: Montrose Field Water Production Rates in te/d (profiles presented are the water volumes associated with the Low, Mid, and High Cases Hydrocarbon volumes).

Year	Existing Wells Water Production Rate (te/d)		Project Water Production associated with Low Case Hydrocarbon Rate (te/d)		Project Water Production associated with Mid Case Hydrocarbon Rate (te/d)		Project Water Production associated with High Case Hydrocarbon Rate (te/d)	
	Baseline Production from Existing Wells	Existing Wells Extended Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production	Production from Montrose Infill Wells	Total Project Production
2026	1,403	0	0	0	0	0	0	0
2027	1,557	0	0	0	0	0	0	0
2028	1,520	0	61	61	65	65	41	41
2029	1,720	0	1,139	1,139	1,205	1,205	759	759
2030	1,763	0	1,514	1,514	1,645	1,645	1,130	1,130
2031	0	1,745	1,605	3,350	1,743	3,488	1,277	3,022
2032	0	1,840	1,767	3,607	1,913	3,753	1,429	3,269
2033	0	1,578	1,847	3,426	2,006	3,584	1,516	3,094
2034	0	1,535	1,833	3,368	2,016	3,550	1,546	3,080
2035	0	1,616	1,925	3,541	2,146	3,762	1,667	3,282

Appendix G: Air Quality Dispersion Modelling

REPORT

Air Quality Assessment Report

Prepared for: **NEO NEXT+**

Prepared by: **Genesis Energies**
www.genesisenergies.com

Project Title: **Montrose Infill Project Environmental Statement**
Document: Appendix G: Air Quality Assessment

Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval
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2A	13/11/2025	Internal Review	[redacted]	[redacted]	[redacted]	
A	24/11/2025	Issued for Client Review	[redacted]	[redacted]	[redacted]	
B	11/02/2026	Final	[redacted]	[redacted]	[redacted]	

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ABBREVIATIONS

Abbreviation	Definition
°C	Degrees Celsius
Am^3/s	Actual metres cubed per second
g/s	Grams per second
km	Kilometres
m	Metres
m/s	Metres per second
MW	Megawatt
MWe	Megawatt Electrical
MW$_{th}$	Megawatt Thermal
Te/d	Tonnes per day
teCO$_2$/te	Tonnes of carbon dioxide per tonne
µg/m^3	Micrograms per meter cubed
ADMS	Atmospheric Dispersion Modelling System
AQS	Air Quality Standards
BLP	Bridge Linked Platform
CERC	Cambridge Environmental Research Consultants'
CNS	Central North Sea
CO	Carbon Monoxide
CO$_2$	Carbon Dioxide
EA	Environment Agency
EEMS	Environmental and Emissions Monitoring System
EF	Emission Factor
FPSO	Floating Production, Storage, and Offloading
FSO	Floating Storage and Offloading
GT	Gas Turbine
HP	High Pressure
IED	Industrial Emissions Directive
LP	Low pressure
LSD	Low Sulphur Diesel
NO$_2$	Nitrogen Dioxide
NO$_X$	Oxides of Nitrogen
NWP	Numerical Weather Prediction

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Abbreviation	Definition
OSGB	Ordnance Survey Great Britain
PC	Process Contribution
PEC	Predicted Environmental Concentration
SO_2	Sulphur Dioxide
Te/d	Tonnes per Day
UK	United Kingdom
UKCS	United Kingdom Continental Shelf

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1.0 INTRODUCTION

NEO NEXT+ has commissioned Genesis Energies to undertake an air quality assessment to support the Montrose Infill Project. The air quality modelling assessment has been undertaken for the Montrose Bridge-Linked Platform (BLP) and Alpha platform, including the proposed infill activities. This supersedes previous modelling which was undertaken for Montrose in 2016 (Ref 1).

The Montrose Field is located on the United Kingdom Continental Shelf (UKCS) in Blocks 22/17 and 22/18 of the Central North Sea (CNS) and is c. 190 km from Peterhead and c. 46 km from the UK/Norway median line. The proposed Montrose project is hereafter referred to as the proposed Montrose Infill Project.

Pollutant concentrations of NO_2, SO_2, and CO caused by combustion emissions from the existing facilities during the production phase have been modelled to assess their significance. These pollutants have been assessed as they are target pollutants under the Industrial Emissions Directive (IED).

The Montrose Platform power generation load and fuel consumption during the production phase will increase as a result of the Montrose Infill Project. Therefore, this phase has been modelled to capture the worst case results.

The proprietary Atmospheric Dispersion Modelling System package (ADMS 6) was used to carry out the modelling. The modelling followed UK guidance for air dispersion modelling for environmental permitting.

The purpose of the modelling is to assess the sea level concentrations resulting from the operation of the Montrose Platforms combustion plant against health-based limits set out in the UK Air Quality Strategy. Any assumptions are based on data for similar installations and are considered acceptable for the purposes of this assessment.

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2.0 LEGISLATION AND GUIDANCE

The significance of the pollutant concentrations in the environment is generally compared against published environmental AQS (Ref 2). However, there are no prescribed air quality standards for the offshore environment. Therefore, for comparison purposes and in order to assess the impacts of emissions to air in this assessment, the terrestrial UK AQS will be used. The AQS are based on standards from expert recommendations, representing levels at which no significant health effects would be expected in the population as a whole. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive subgroups or on ecosystems.

Considering the emissions from the proposed Montrose Infill Project combustion equipment, the key pollutants of concern under the AQS are NO_2, SO_2 and CO. The objectives for these pollutants are presented in Table 2-1.

Table 2-1: Relevant UK Air Quality Limit Values.

Pollutant	Air Quality Limit Value (µg/m^3)	Comment
NO_2	200	1-hour mean not to be exceeded more than 18 times/year (99.79th percentile)
	40	Annual Mean
SO_2	350	1-hour mean not to be exceeded more than 24 times/year (99.73rd percentile)
	125	24-hour mean not to be exceeded more than 3 times/year (99.18th percentile)
	266	15-minute mean not to be exceeded more than 35 times/year (99.9th percentile)
CO	10,000	Running 8-hour mean

The standards include a ‘permitted exceedance’ which allows the exceedance of an air quality limit a specific number of times per year. This approach acknowledges that the highest concentrations that occur may be outlying values which are caused by anomalous conditions and may not be truly representative of normal atmospheric concentrations at a location. Such extreme values are unlikely to have a significant effect on sensitive receptors, due to their limited temporal and spatial occurrence, and therefore are not considered to be realistic values with which to legislate air quality.

Model results will be considered in terms of the relevant percentile. For example, where the benchmark allows for 24 exceedances of the hourly mean per year, this equates to the 99.73rd percentile. In this case the maximum value occurring anywhere in the model domain at the 99.73rd percentile is reported.

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Environment Agency Air Quality Risk Assessment guidance (Ref 3) sets out criteria for determining the significance of emissions from industrial sources. Emissions from a source are termed insignificant if the Process Contribution (PC) comprises:

- Less than 1% of the long-term environmental benchmark;
- Less than 10% of the short-term environmental benchmark

However, even if the PC does not meet these criteria, the emission may still be judged as having an acceptable level of environmental risk if the total concentration of the substance (i.e. the Predicted Environmental Concentration (PEC) including the existing background contribution from other sources) falls below the benchmark.

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3.0 METHODOLOGY

3.1 Dispersion Model

Cambridge Environmental Research Consultants' (CERC)' ADMS (version 6) (Ref 4) was used to calculate the potential air quality impact of the proposed Project. ADMS is a computer-based Gaussian plume dispersion model that simulates a wide range of buoyant and passive releases from single or multiple sources.

ADMS 6 models the air quality impact of emissions from industrial installations to the atmosphere. The model calculates long-term and short-term concentrations from pollutant sources. It uses hourly data for the relevant location, allowing realistic outputs to be generated. ADMS 6 can take many factors into account, providing a complex, realistic prediction. ADMS is one of the modelling software packages that are suitable for this type of study and is accepted by UK regulators.

There are a number of assumptions associated with modelling of atmospheric emissions, including the number of years of meteorological data to use, the incorporation of chemical processes that could, for instance, lead to removal of pollutants from the atmosphere, and the influence of cloud cover.

3.2 Modelling Basis

3.2.1 Equipment

The following list of equipment is currently operational within the Montrose BLP and Alpha platforms:

BLP platform

- 2 x Dresser Rand LM2500+ Gas Turbine (GT);
- High Pressure (HP) Flare; and
- Low Pressure (LP) Flare.

Montrose platform

- 2 x Solar Centaur 40 GT;
- HP Flare; and
- LP Flare.

Drilling Activities

- Semi-submersible drill rig

3.2.2 Mode of Operation

The main power for Montrose platforms is typically generated by operating a single Dresser Rand LM2500+ GT at the BLP platform to meet the electrical demand of up to 20MW during normal operations. The second Dresser Rand LM2500+ is typically in standby mode for backup energy supply. Each dual fuel turbine generator has a maximum rated output 28.5 MWe and maximum thermal Input of 75.4 MW_{th}.

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At the Montrose Alpha platform, each Solar Centaur turbine generator has a maximum rated output 2.3 MW_e (Ref 5) and maximum thermal input 12.5 MW_{th}.

The equipment use for drilling activities are indicative based on Genesis project experience as there was not detailed information at the time of the assessment. It is expected that the drilling will be undertaken with a semi-submersible rig or a heavy duty jack up rig. The semi-submersible rig has been used in the modelling as it has a higher fuel consumption. The semi-submersible drill rig is assumed with a 24 Te/d fuel consumption rate.

3.2.3 Modelling Scenarios

Air dispersion modelling was carried out such that conservative cases, with respect to planned "normal" operations, were modelled to determine the worst emissions cases for the main combustion equipment (i.e. power generation and flaring), which might occur during a typical year.

NEO NEXT+ have forecasted the power demand for Montrose and have determined the future loads that the gas turbines must operate on to meet this power demand. To ensure the air quality assessment is conservative with respect to planned operation the BLP platform gas turbine emissions have been modelled at 85% load and the Alpha platform diesel gas turbine at 75% load.

The operating philosophy for Montrose is to run 1x BLP GT at 70% load with an additional BLP GT of the same size offline. For this assessment, emission rates of 1x BLP at 85% load have been compared to the potential situation where 2 x BLP GTs are in operation at 42.5% load each. It can be concluded that the associated emission rate of 1x BLP GT at 85% load (NO_X= 25.2 g/s) is greater than 2x BLP GTs at 42.5% load each (NO_X= 18.7 g/s total). Therefore, 1x BLP GT at 85% load has been used for this assessment as it represents the worst-case scenario.

Three variations of operating conditions were considered for this assessment. Each scenario also includes a representative flaring rate associated with the BLP and Alpha platforms.

- Scenario 1: Normal Operations
  - 1x Dresser Rand LM2500+ GT is operating on fuel gas, 1x Solar Centaur 40 GT using diesel, and a representative flaring rate at the BLP and Alpha platform.
- Scenario 2: Non- Routine Operations
  - In events where the fuel gas supply is unavailable or operational issues are encountered, the 1x Dresser Rand LM2500+ GT is switched to diesel fuel operation and the 1x Solar Centaur 40 GT also uses diesel. These GTs operate on diesel fuel, and a representative flaring rate at the BLP and Alpha Platforms.
- Scenario 3: Normal Operations + Drilling Activities
  - All power generation equipment listed Scenario 1, a representative flaring rate at the BLP and Alpha Platforms, and power generation equipment using diesel associated with drilling activities.

Scenario 2 and Scenario 3 will not necessarily occur over a long-term duration and are considered temporary (i.e. temporary operation of the GTs on diesel). However, in order to capture the worst-case emissions these scenarios are modelled over a full year. This will provide results for both scenarios to show what the worst-case pollutant concentrations could be under the least favourable meteorological conditions across the entire modelling period.

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3.3 Modelling Inputs

The following sections present details on the modelling inputs which were used in the modelling, which are specific to the Montrose site.

3.3.1 Emissions Calculations

The emissions rates are input into ADMS in grams per second (g/s). These rates are derived from annual emissions loads in tonnes per year (Ref 6) calculated using an emission factor for different pollutants. These factors are primarily taken from the Environmental and Emissions Monitoring System (EEMS). These have only been used when they are deemed conservative compared to emissions monitoring data for a given modelling scenario. For the Dresser Rand LM2500+ GTs, more site specific emission rates have been calculated.

It should be noted that, for combustion of diesel in engines, Low Sulphur diesel (LSD) has been used (0.1 wt %), as part of the emission calculations of this assessment.

3.3.2 Modelled Receptors

Figure 3-1 shows the proximity of receptors to the proposed Montrose Platform. The closest receptors to the proposed Montrose Infill Project are listed in Table 3-1. In addition to these receptors, predicted concentrations over a 10 km by 10 km grid centred on the BLP platform were also calculated.

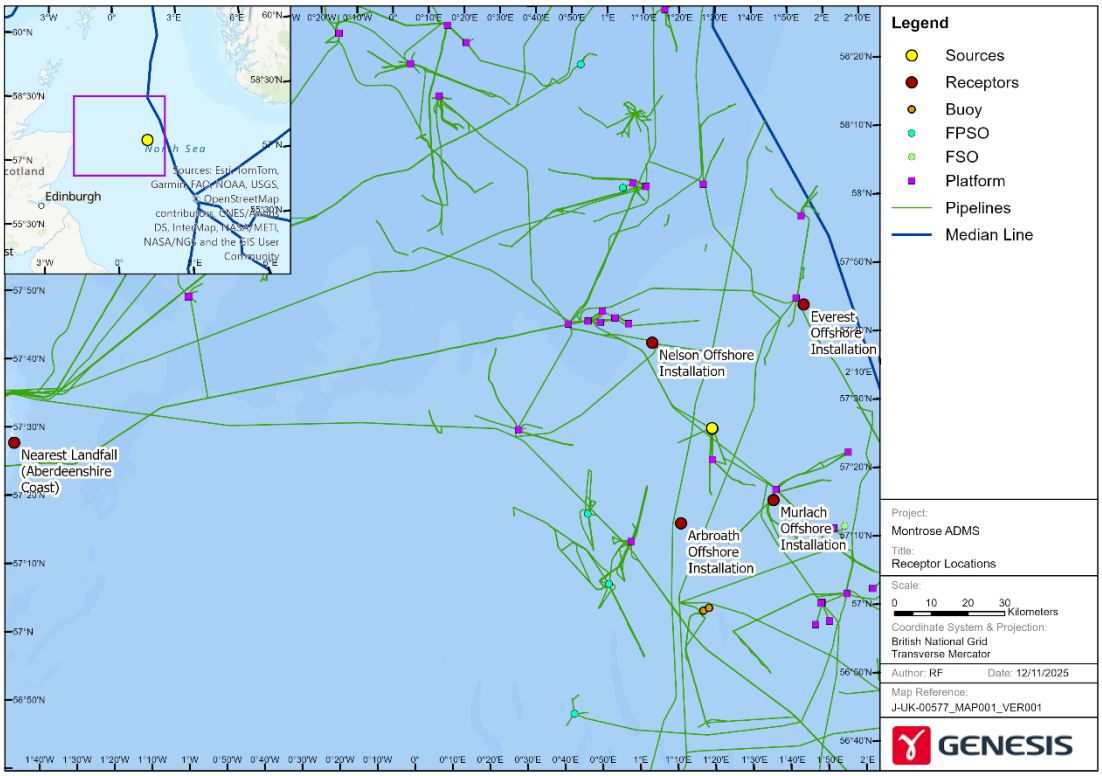


Figure 3-1: Receptor Locations.

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Table 3-1: Receptors of Interest.

Receptor	Coordinates (OSGB 1936 British National Grid)		Height above sea level (m)	Distance to Site (km)
	Eastings (m)	Northings (m)		
Murlach Offshore Installation	620011	825653	30	26
Arbroath Offshore Installation	594857	819304	30	27
Nelson Offshore Installation	587001	868385	30	28
Everest Offshore Installation	628239	878810	30	42
Nearest Landfall (Aberdeenshire Coast)	413465	841244	0	190

3.3.3 Meteorological Data

Three years of meteorology data (2022 to 2024) has been used for this modelling study. The data has been obtained from Numerical Weather Prediction (NWP) model data for the Montrose Platform location. This data source is considered suitable for the purposes of this assessment. The wind roses for this study are presented in Appendix A.

3.3.4 Background Pollutant Concentrations

Ambient levels of pollution are incorporated into model outputs for analysis in context of the AQS. Ambient air quality data is not gathered offshore. Therefore, available information for rural coastal areas north of Aberdeen is assumed to be representative of the offshore conditions for this air quality assessment and is presented in Table 3-2. Current data for NO_2 and CO is available but SO_2 is no longer monitored in this location and therefore archived data is presented in Table 3-2 (Ref 7).

Table 3-2: Ambient Pollutant Concentrations (North Tarbothill, Aberdeen).

AVERAGING TIME	NO_2 (µg/m^3)	SO_2 (µg/m^3)	CO (µg/m^3)
Long-Term	3.8	0.88	72.5
Short-Term	7.2	1.76	145

As per EA guidelines, the long-term ambient concentrations have been doubled to approximate a short-term background concentration in Table 3-2 (Ref 3).

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3.3.5 NO_X to NO_2 Conversion Rates

The AQS objectives for the protection of human health relate to the concentrations of the NO_2 component of NO_X. Once released, NO can be converted to NO_2 by reaction with low level ozone in the atmosphere. The process is also reversible in sunlight and the net rate of conversion of NO to NO_2 in the plume is therefore a function of the rate of dilution of the plume by ambient air, trace gas concentrations in the air and meteorology.

As per EA guidance (Ref 8), 35% of the modelled short-term NO_2 values and 70% of the modelled long-term NO_2 values have been used for the air quality assessment presented in this report.

3.3.6 Surface Roughness

ADMS includes a 'surface roughness' parameter. This is an index of surface height derived from land-use. Each point in the grid is assigned a roughness value related to land-use. The surface roughness has been modelled within ADMS for this assessment using the 'Marine Module'. This module uses the specific meteorological data input to the modelling to calculate the factor for the area being modelled.

3.3.7 ADMS Inputs

Specific model inputs, based on the calculations, as entered into the ADMS model are tabulated in Table 3-3 below.

Physical stack flare parameters used in this assessment are based on the Ontario guidance (Ref 9). Modelling open flares adds a layer of technical complexity to the modelling with certain pseudo-parameters being used within the model to better emulate the conditions of the open flare.

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Table 3-3: Summary of Model Inputs.

INPUT	DRESSER RAND LM2500+		SOLAR CENTAUR	ALPHA FLARE	BLP HP FLARE	BLP LP FLARE	ENGINE (DRILLING ACTIVITIES)
FUEL TYPE	Fuel Gas	Diesel	Diesel	Flare (Fuel Gas)	Flare (Fuel Gas)	Flare (Fuel Gas)	Diesel
Stack Location OSGB (X&Y) coordinates	(603314, 845149)		(603311, 845028)	(603450, 845114)	(603306, 845214)	(603306, 845214)	(603310, 845962)
Stack Height (m)	69.6		42.4	36.0*	110.1*	109.3*	42.4
Exit Diameter (m)	2.01		1.68	0.61*	0.89*	0.67*	1.70
Exit Temperature (°C)	830	571	238	1000*	1000*	1000*	300
Exit Velocity (m/s)	70.1	26.9	7.09	20.0*	20.0*	20.0*	9.24
Volume Flow Rate (Am^3/s)	222.9	85.4	15.6	-	-	-	20.4
NO_X (g/s)	25.228	10.360	3.008	0.133	0.128	0.068	16.500
SO_2 (g/s)	0.055	0.632	0.446	0.001	0.001	0.001	0.556
CO (g/s)	0.000	3.436	0.250	0.745	0.714	0.381	4.361

Note: *Input values are derived from the Ontario Technical Bulletin- Modelling Open Flares (Ref 9).

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4.0 RESULTS

The key results from the assessment of pollutant concentrations are presented in the context of the relevant AQS. These results represent the maximum mean concentrations (annual or percentile based) modelled within the designated calculation grid for the worst case meteorological year.

The AQS were derived for the purposes of onshore air quality management and the protection of human health and the environment. The AQS apply at the site boundary rather than within the boundaries, where occupational health standards apply.

The results presented in this section are the maximum PCs and PEC on the grid for each pollutant and scenario. The full results showing the maximum PC at each receptor for all pollutants and scenarios can be found in Appendix B.

4.1 Scenario 1 – Normal Operations

The maximum NO_2, SO_2 and CO concentrations on the modelled grid for Scenario 1 are presented in Table 4-1. These results indicate that the relevant pollutants AQS are not likely to be breached at sea level during the course of normal operations The concentrations modelled represent a conservative worst case operational mode and do not predict any AQS breaches.

All the short-term PCs were screened out as insignificant (<10% of the relevant AQS) using the criteria set out in Section 2.0. The maximum short-term PC occurs for NO_2 and comprises less than 3% of the relevant AQS.

The long-term PC for NO_2 was identified is 1.1%, which is just above the 1% AQS. However, the approach used in this air quality assessment in terms of emissions is conservative, there is no receptor at this location, and therefore, the change in the long-term PC is considered to be insignificant.

Scenario 1 NO_2, SO_2 and CO contour plots are shown in Figure 4-1 to Figure 4-6. These figures illustrate that the highest concentrations occur between approximately 550 – 1,265 m to the south of the proposed Montrose Infill Project.

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Table 4-1: Scenario 1 – Normal Operations- Maximum Concentrations.

POLLUTANT	AVERAGING PERIOD PERCENTILE	PC (µg/m³)	AQS (µg/m³)	PC (%AQS)	BACKGROUND (µg/m³)	PEC (µg/m³)	PEC (%AQS)
NO_2	Annual mean	0.5	40	1.1	3.8	4.3	10.6
	1-Hour Mean (99.79th)	5.5	200	2.8	7.2	12.7	6.4
SO_2	15-minute Mean (99.9th)	2.1	266	0.8	1.8	3.9	1.5
	1-Hour Mean (99.73th)	1.6	350	0.5	1.8	3.4	1.0
	24-Hour (99.18th)	1.1	125	0.9	1.8	2.9	2.3
CO	Max Daily Running 8 - Hour Mean	5.0	10,000	0.1	145	150	1.5

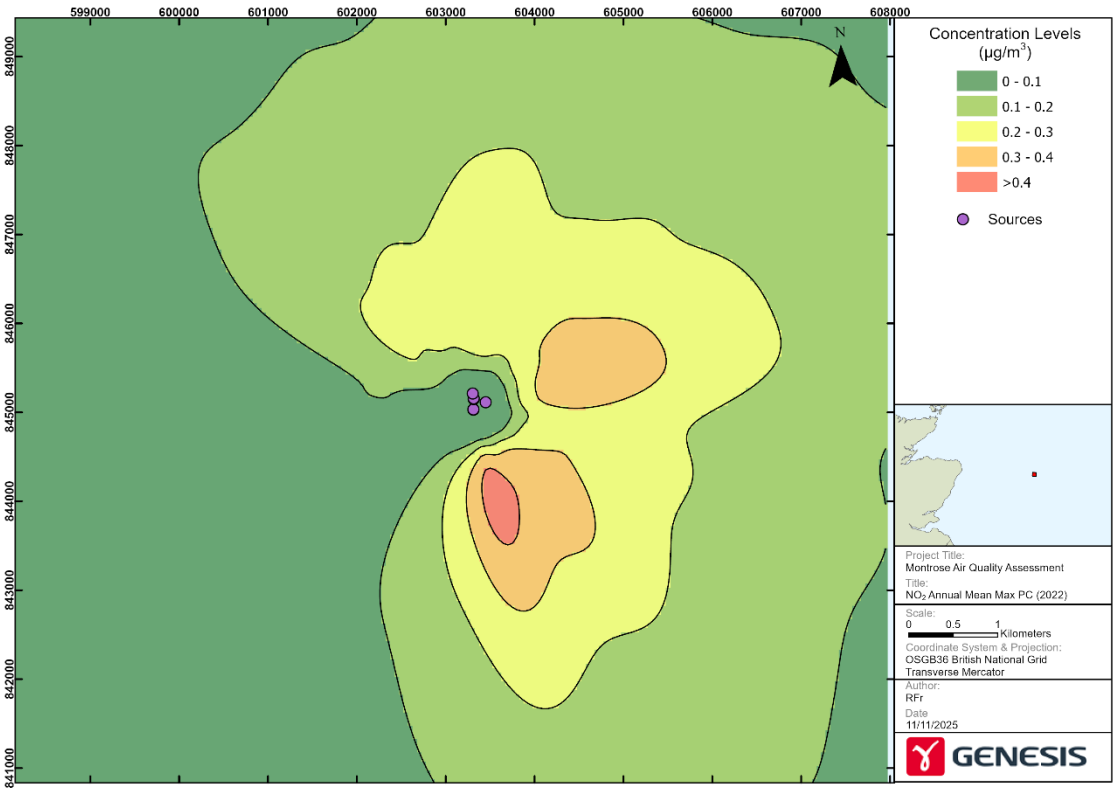


Figure 4-1: Scenario 1: NO_2 Annual Mean Max PC (µg/m³).

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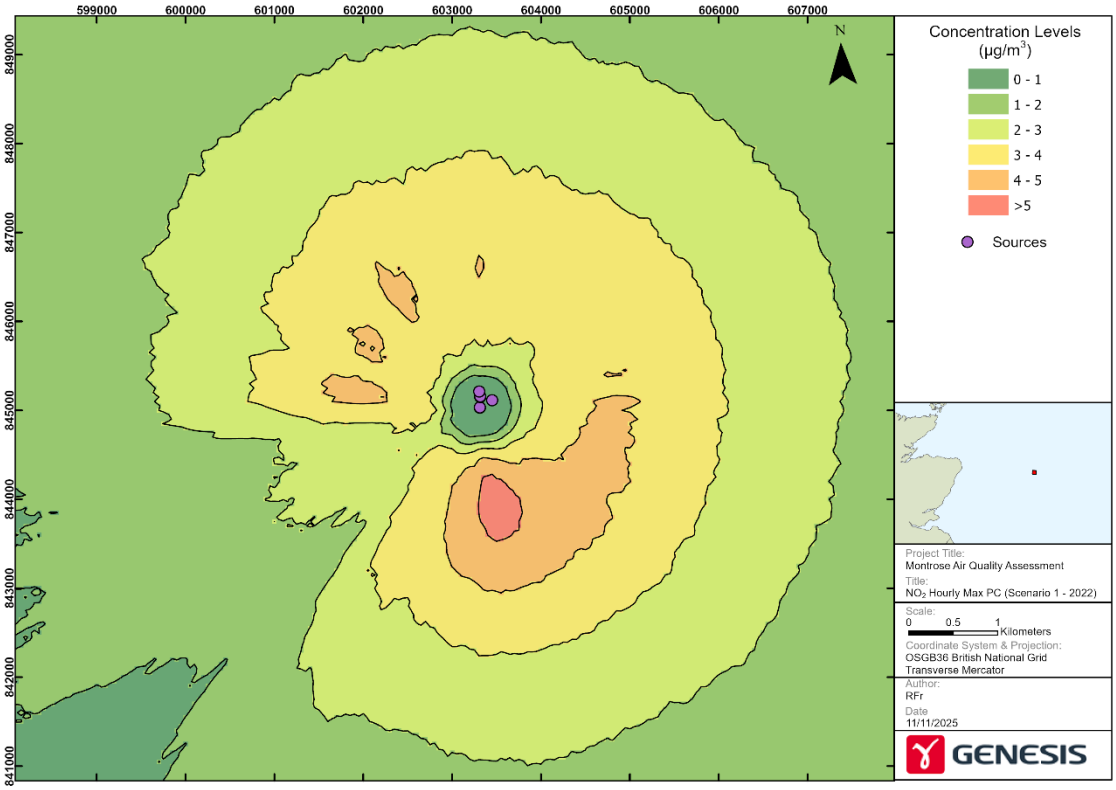


Figure 4-2: Scenario 1: NO_2 1-Hour Mean (99.79th percentile) Max PC (µg/m^3).

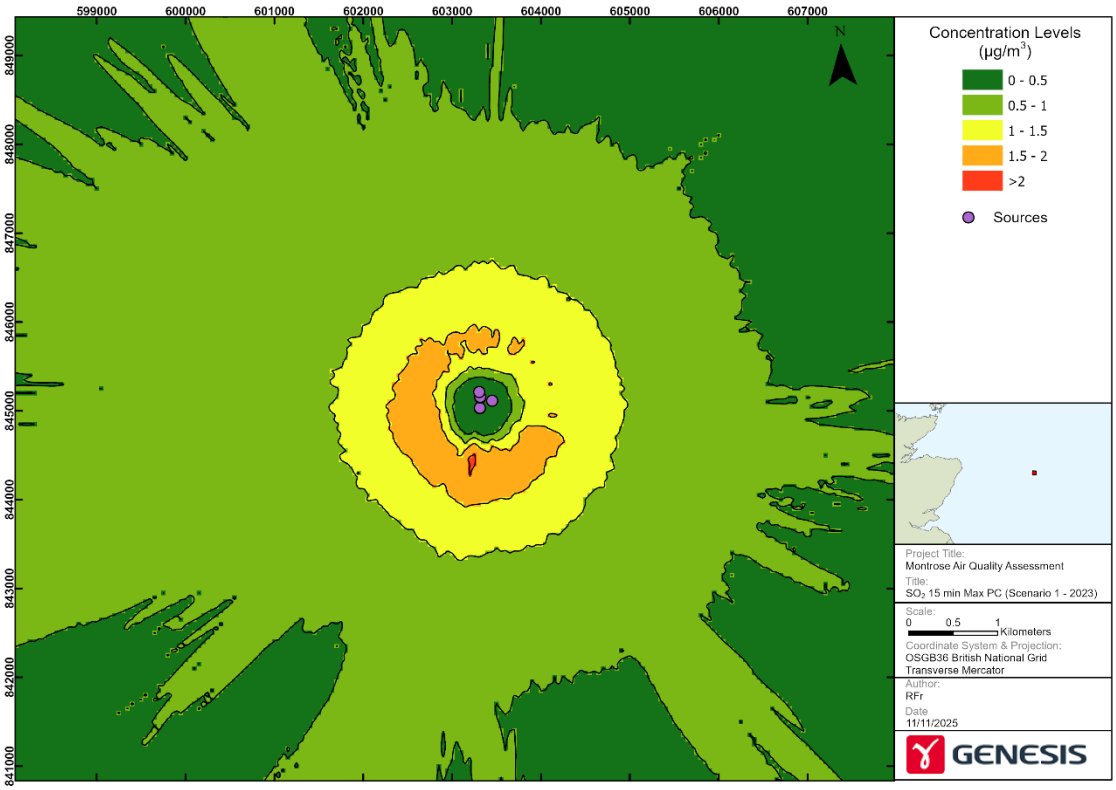


Figure 4-3: Scenario 1: SO_2 15 - Minute Mean (99.9th Percentile) Max PC (µg/m^3).

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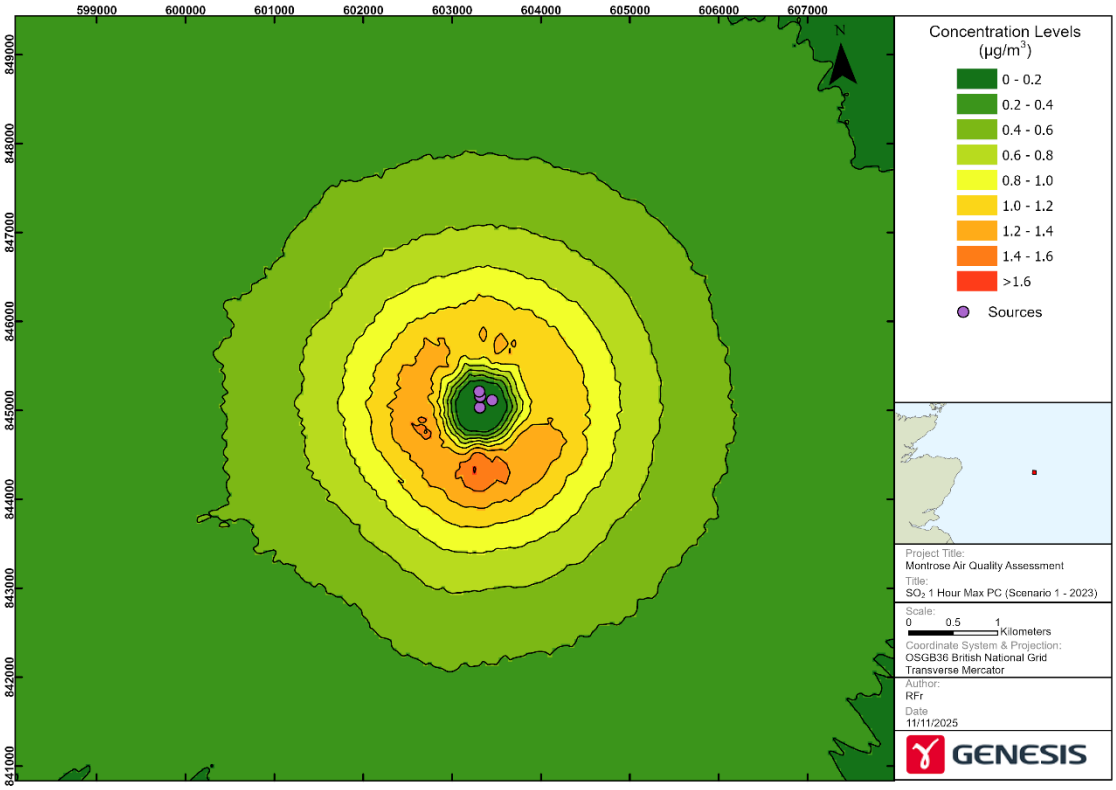


Figure 4-4: Scenario 1: SO_2 1-Hour Mean (99.73th Percentile) Max PC (µg/m^3).

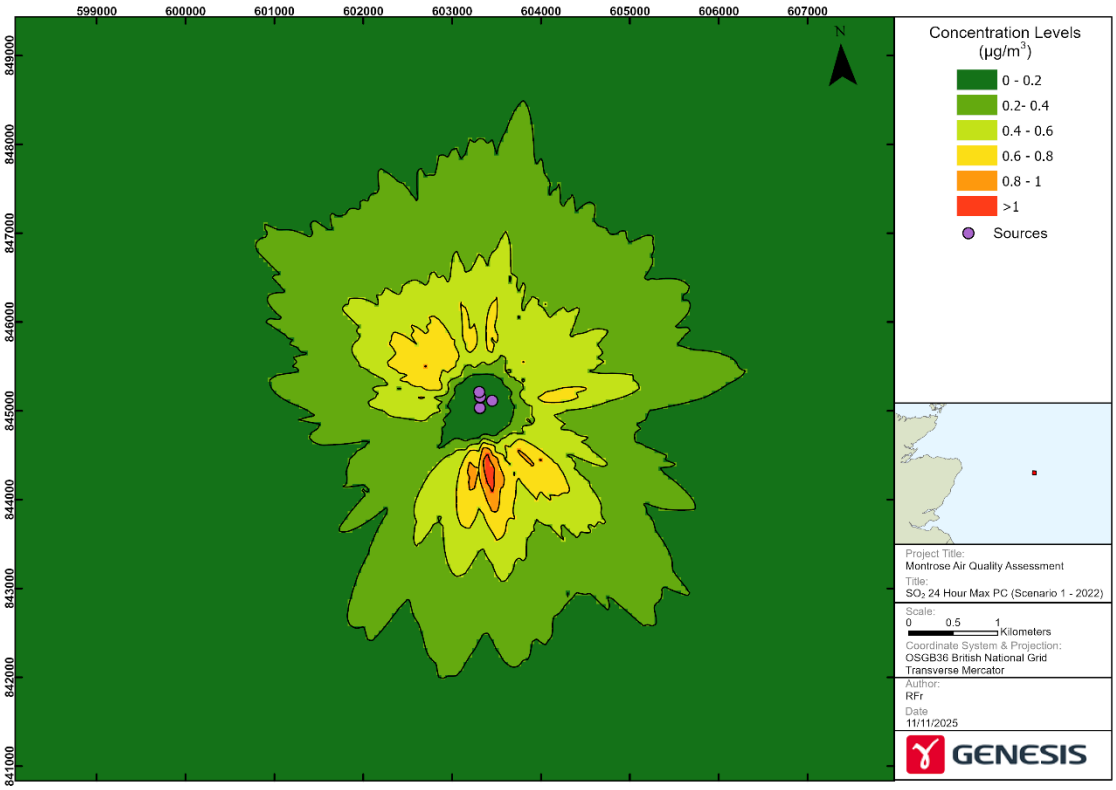


Figure 4-5: Scenario 1: SO_2 24 Hour (99.18th Percentile) Max PC (µg/m^3).

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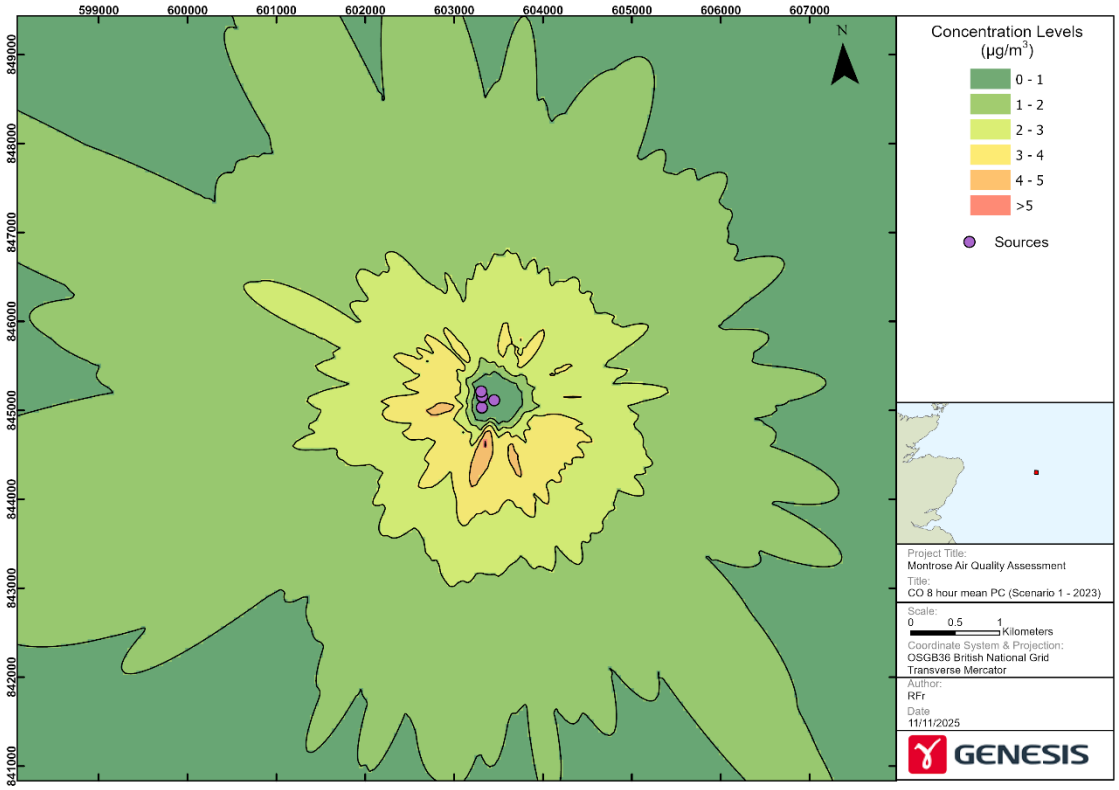


Figure 4-6: Scenario 1: CO Max Daily Running 8 - hour Mean Max PC (µg/m^3).

4.2 Scenario 2 – Non-Routine Operations

The results presented in Table 4-2 indicate that the relevant pollutants AQS are not likely to be breached at sea level during the course of temporary non-routine operations (diesel use). As noted previously, only the short-term concentrations are considered to be relevant for non-routine operations.

All the short-term PCs have been screened out as insignificant using the criteria set out in Section 2.0. The maximum short-term PC occurs for NO_2 and comprises less than 3% of the relevant AQS.

NO_2, SO_2 and CO contour plots for Scenario 2 are shown in Figure 4-7 to Figure 4-11. These figures illustrate that the highest concentrations occur between approximately 700 – 1,000 m to the south of the proposed Montrose Infill Project.

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Table 4-2: Scenario 2 – Non-Routine Operations - Maximum Concentrations.

POLLUTANT	AVERAGING PERIOD (PERCENTILE)	PC (µg/m³)	AQS (µg/m³)	PC (%AQS)	BACKGROUND (µg/m³)	PEC (µg/m³)	PEC (%AQS)
NO_2	1 Hour Mean (99.79th)	5.2	200	2.6	7.2	12.4	6.2
SO_2	15 - minute (99.9th)	2.2	266	0.8	1.8	4.0	1.5
	1 - Hour Mean (99.73th)	1.8	350	0.5	1.8	3.5	1.0
	24 - Hour (99.18th)	1.3	125	1.1	1.8	3.1	2.5
CO	Max Daily Running 8 - hour Mean	5.0	10,000	0.1	145	150	1.5

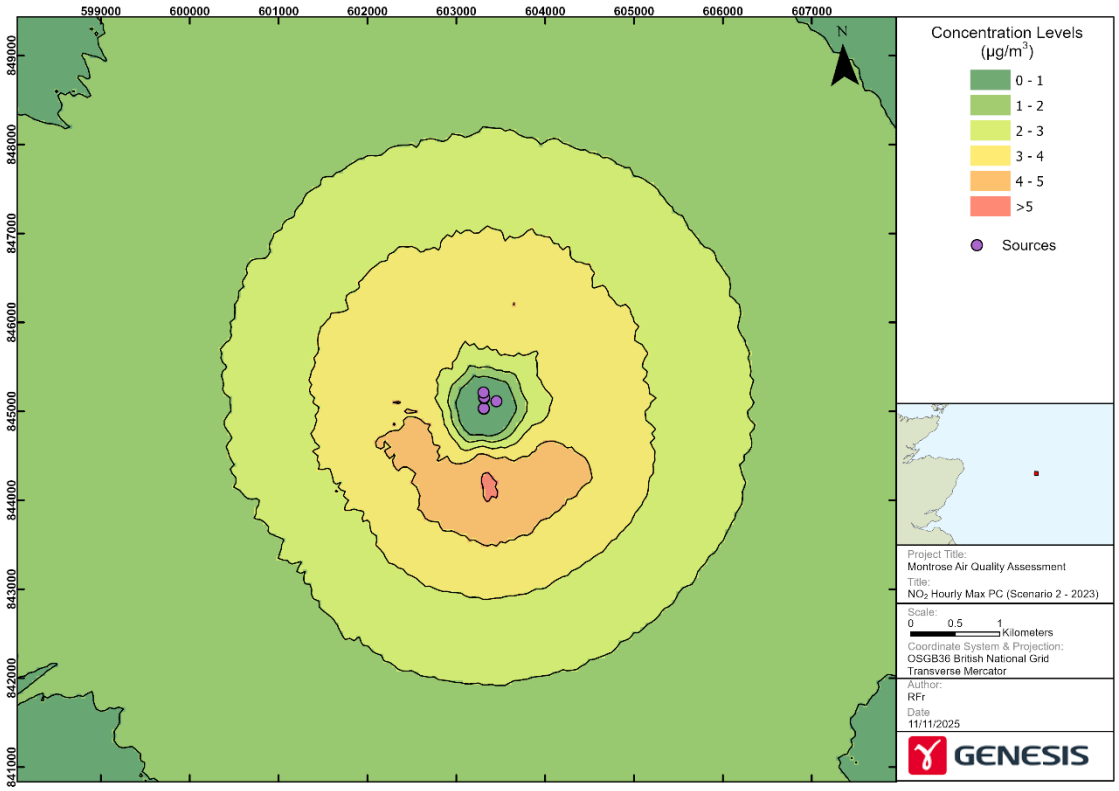


Figure 4-7: Scenario 2: NO_2 1-Hour Mean (99.79th percentile) Max PC (µg/m³).

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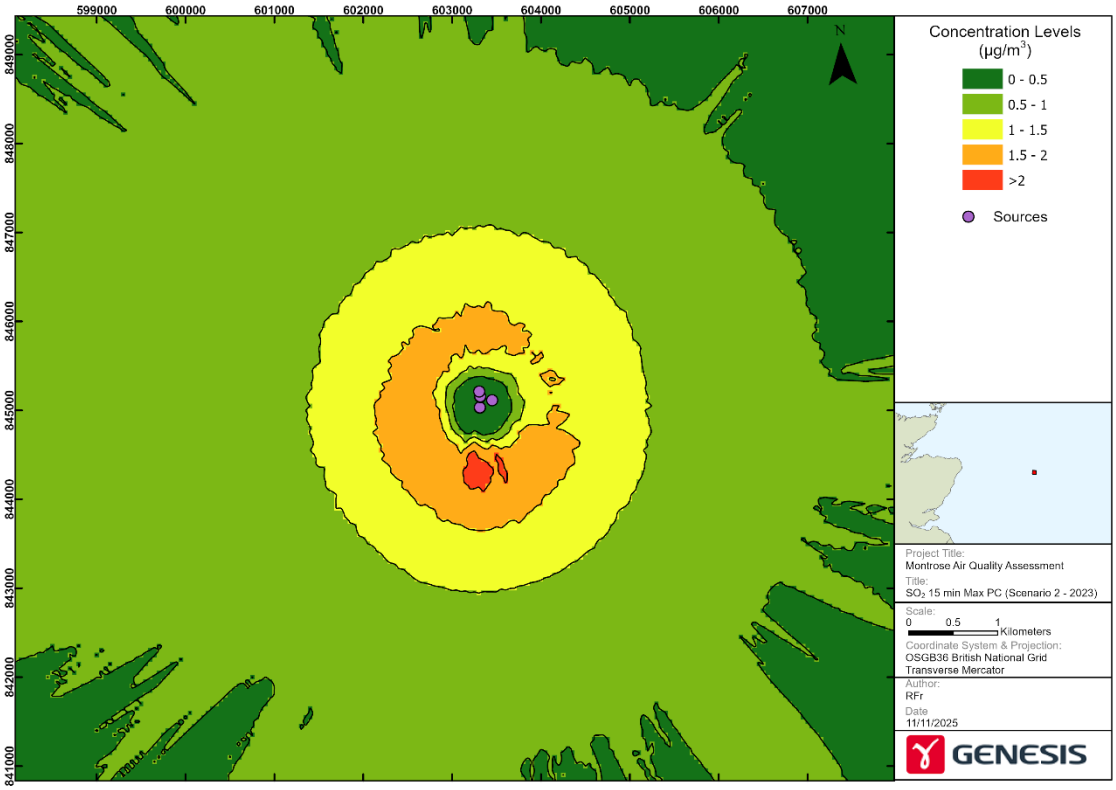


Figure 4-8: Scenario 2: SO_2 15 - Minute Mean (99.9th Percentile) Max PC (µg/m³).

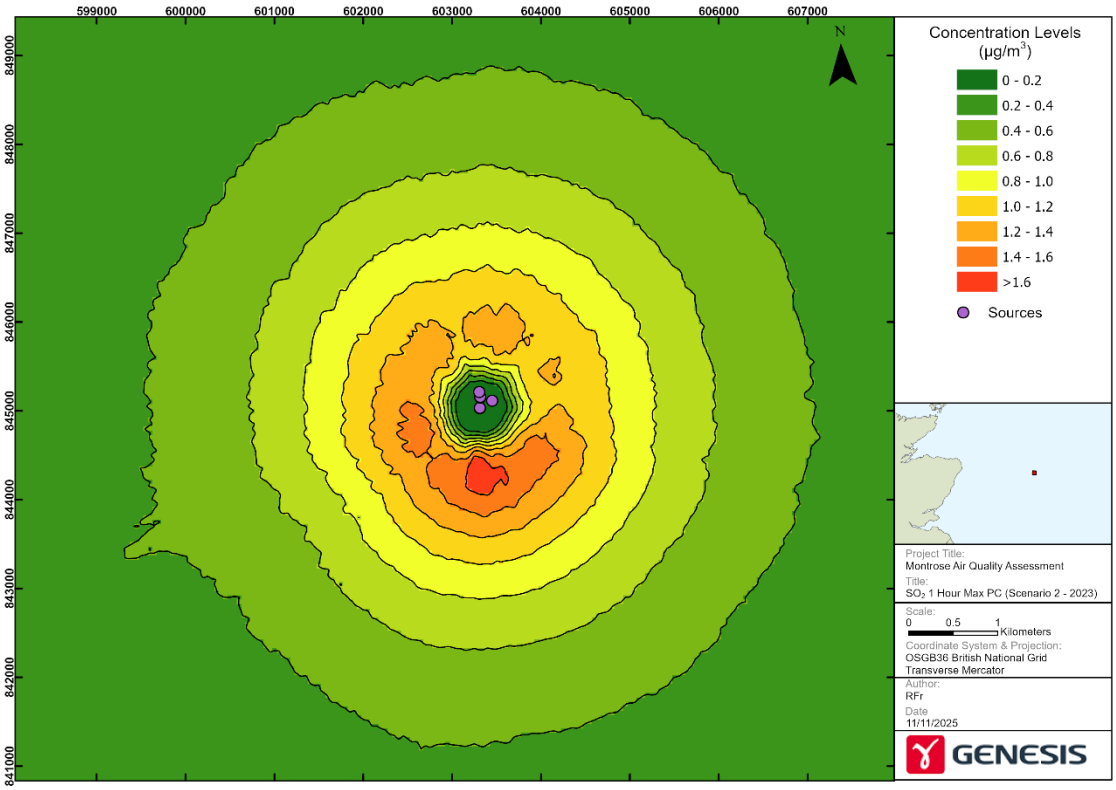


Figure 4-9: Scenario 2: SO_2 1 - Hour Mean (99.73th Percentile) Max PC (µg/m³).

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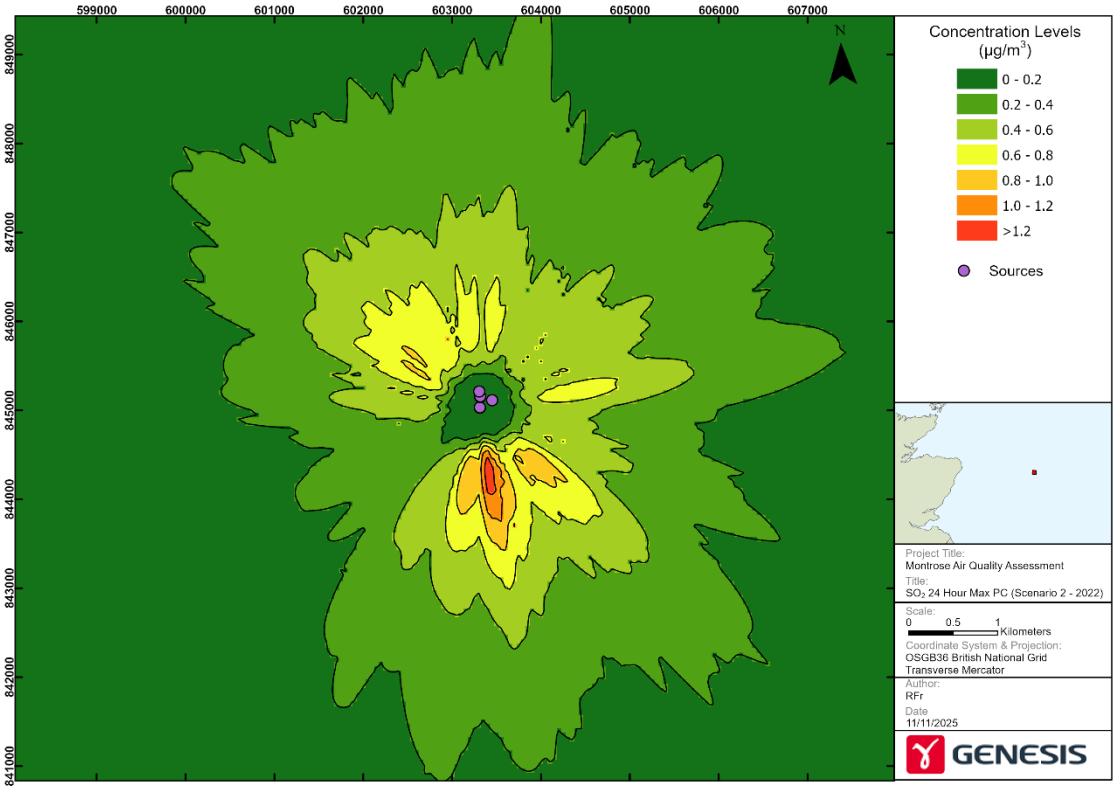


Figure 4-10: Scenario 2: SO_2 24 Hour (99.18th Percentile) Max PC (µg/m³).

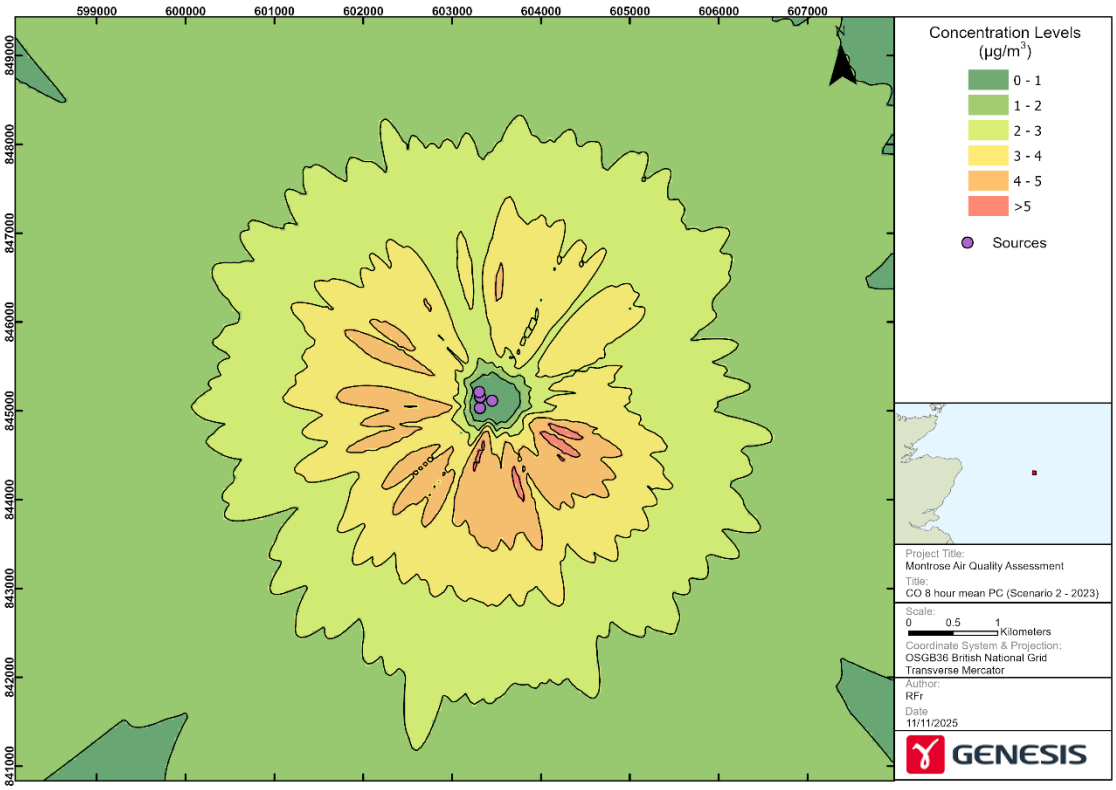


Figure 4-11: Scenario 2: CO Max Daily Running 8 - hour Mean Max PC (µg/m³).

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4.3 Scenario 3 – Normal Operations + Drilling Activities

The key results for Scenario 3 are featured in Table 4-3. The combination of drilling activities and normal operations associated with the proposed Montrose Infill project are expected to be temporary.

The results for Scenario 3 show the highest short-term concentrations for all pollutants out of the three scenarios modelled. These results indicate that the relevant pollutants AQS are not likely to be breached at sea level. The maximum short-term PC occurs for NO_2 and comprises less than 9% of the relevant AQS. All the short-term PCs are below the 10% threshold and are therefore considered to be insignificant.

NO_2, SO_2 and CO contour plots for Scenario 3 are presented in Figure 4-12 to Figure 4-16. These figures illustrate that the highest concentrations occur between approximately 750 – 1,550 m to the south of the proposed Montrose Infill Project.

Table 4-3: Scenario 3 – Normal Operations + Drilling Activities - Maximum Concentrations.

POLLUTANT	AVERAGING PERIOD (PERCENTILE)	PC (µg/m³)	AQS (µg/m³)	PC (%AQS)	BACKGOUND (µg/m³)	PEC (µg/m³)	PEC (%AQS)
NO_2	1 Hour Mean (99.79th)	17.3	200	8.7	7.2	24.5	12.3
SO_2	15 - minute (99.9th)	3.0	266	1.1	1.8	4.8	1.8
	1 - Hour Mean (99.73th)	2.5	350	0.7	1.8	4.2	1.2
	24 - Hour (99.18th)	1.6	125	1.3	1.8	3.4	2.7
CO	Max Daily Running 8 - hour Mean	15.0	10,000	0.2	145	160	1.6

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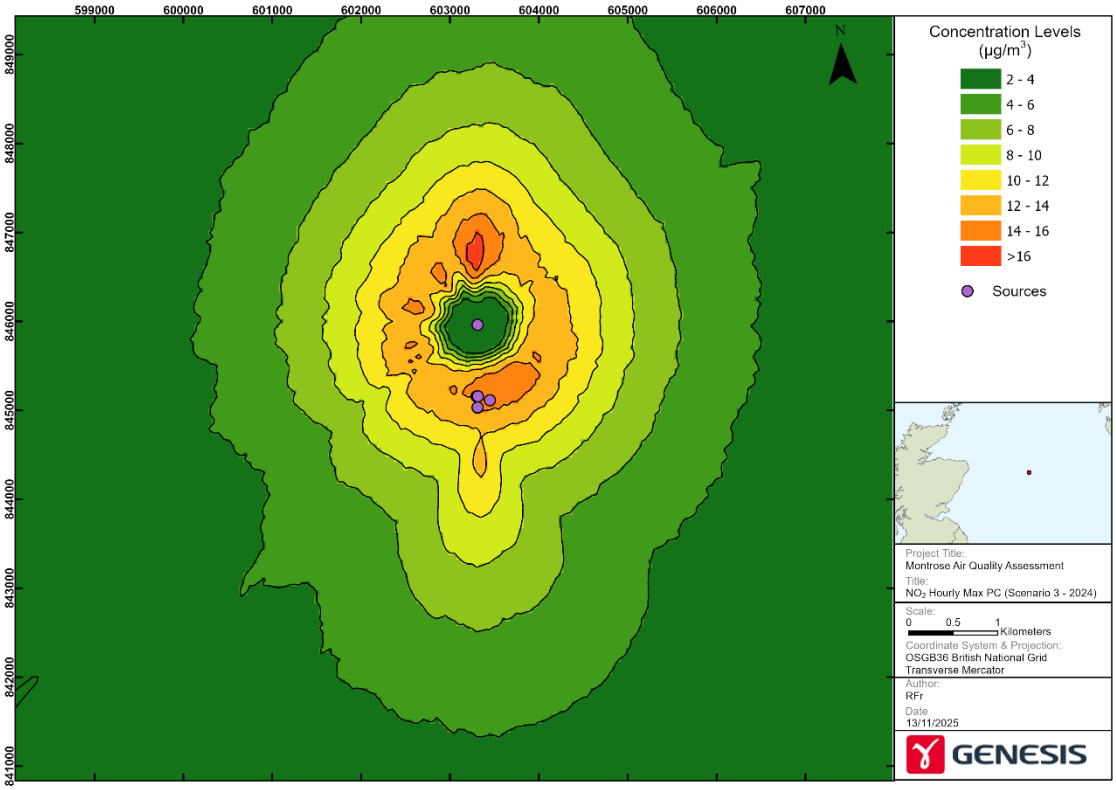


Figure 4-12: Scenario 3: NO_2 1-Hour Mean (99.79th percentile) Max PC (µg/m^3).

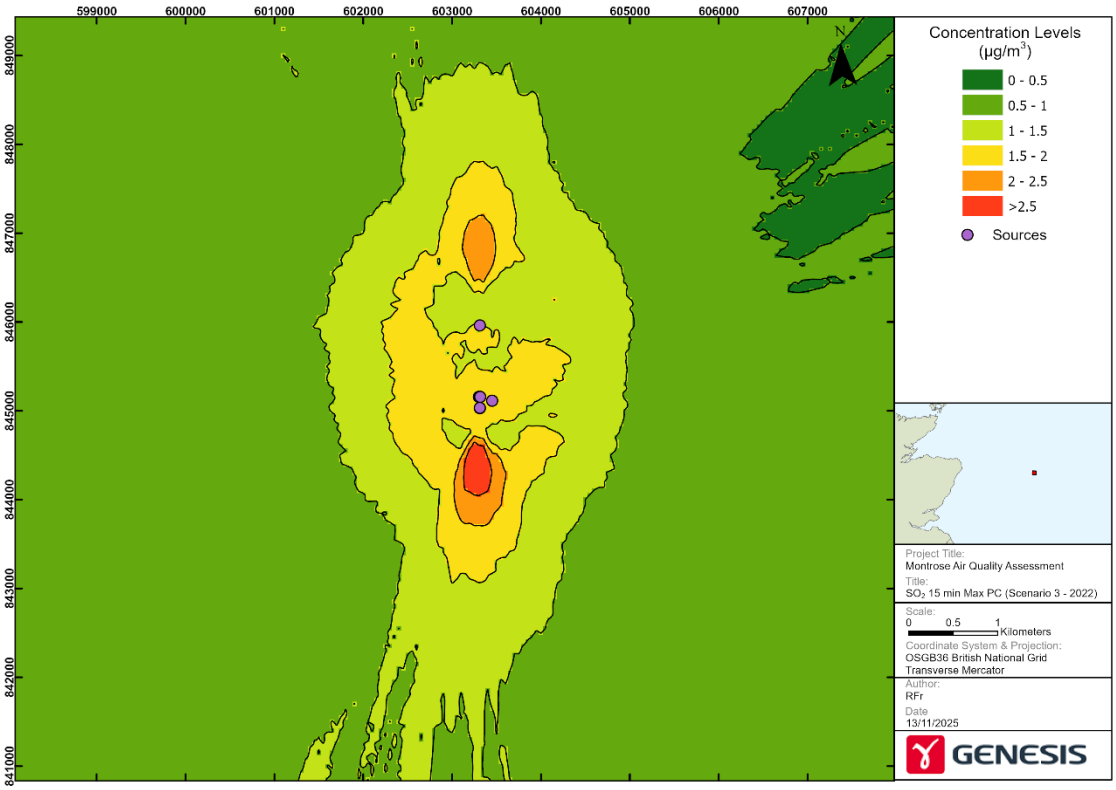


Figure 4-13: Scenario 3: SO_2 15 - Minute Mean (99.9th Percentile) Max PC (µg/m^3).

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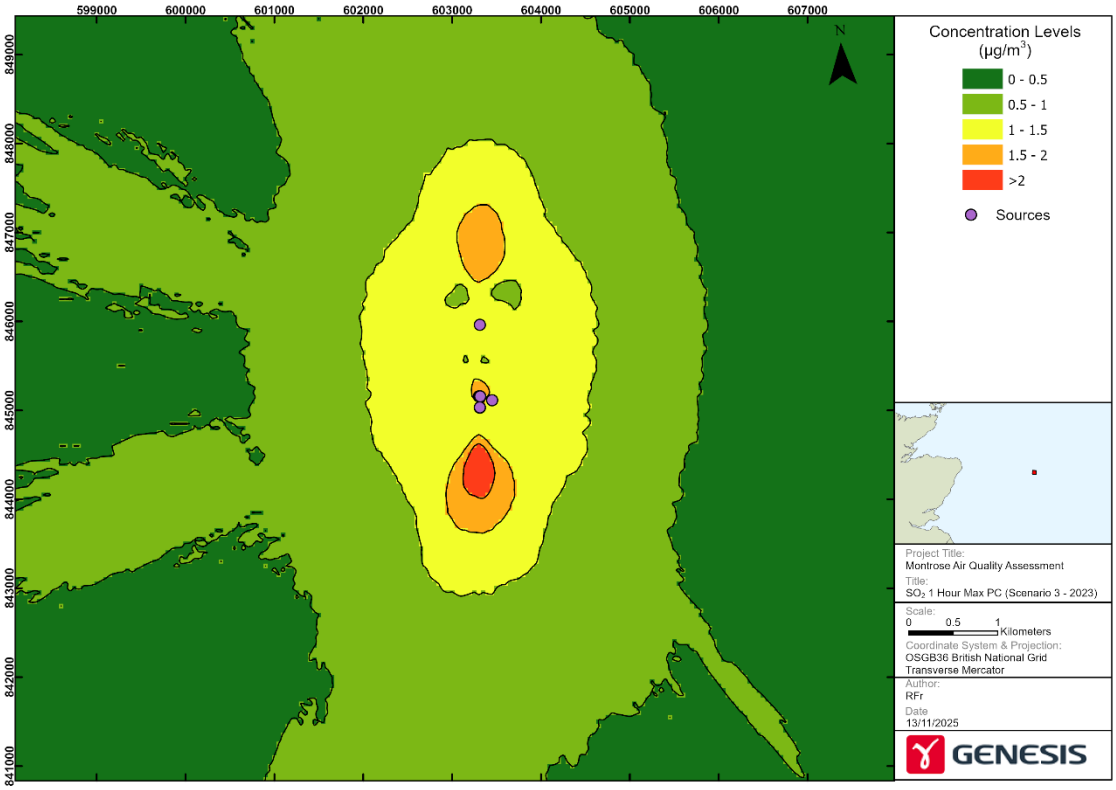


Figure 4-14: Scenario 3: SO_2 1 - Hour Mean (99.73th Percentile) Max PC (µg/m^3).

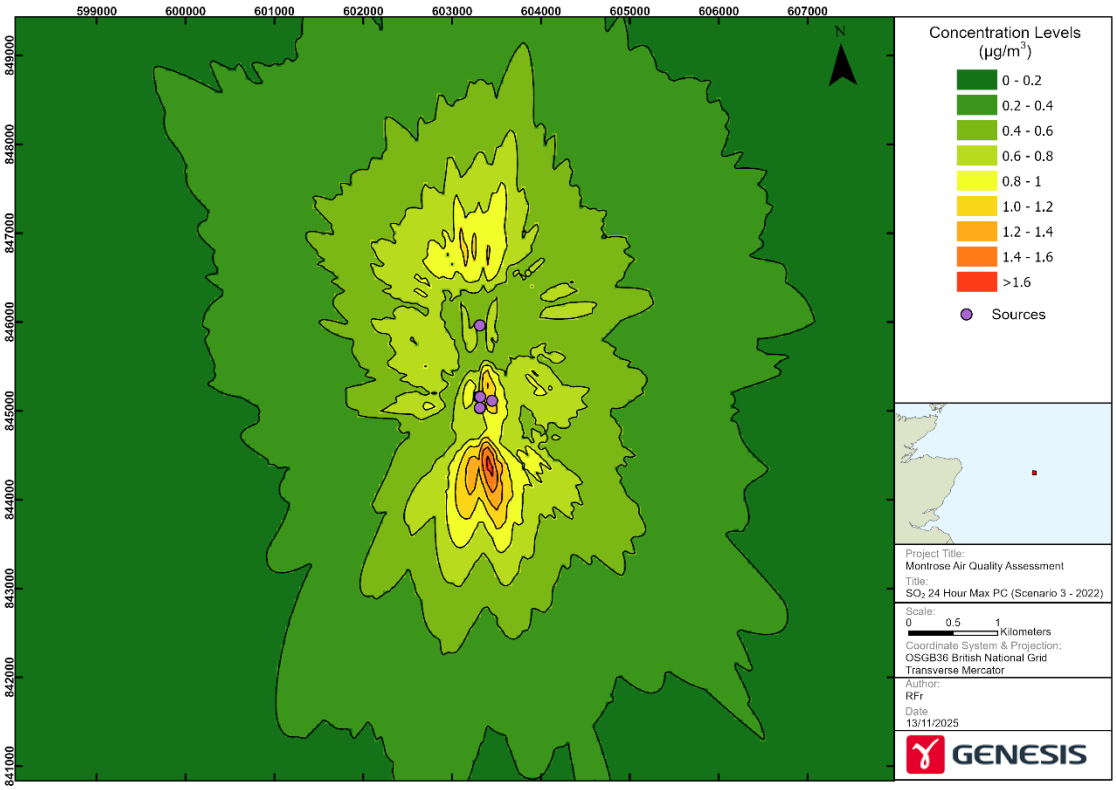


Figure 4-15: Scenario 3: SO_2 24 Hour (99.18th Percentile) Max PC (µg/m^3).

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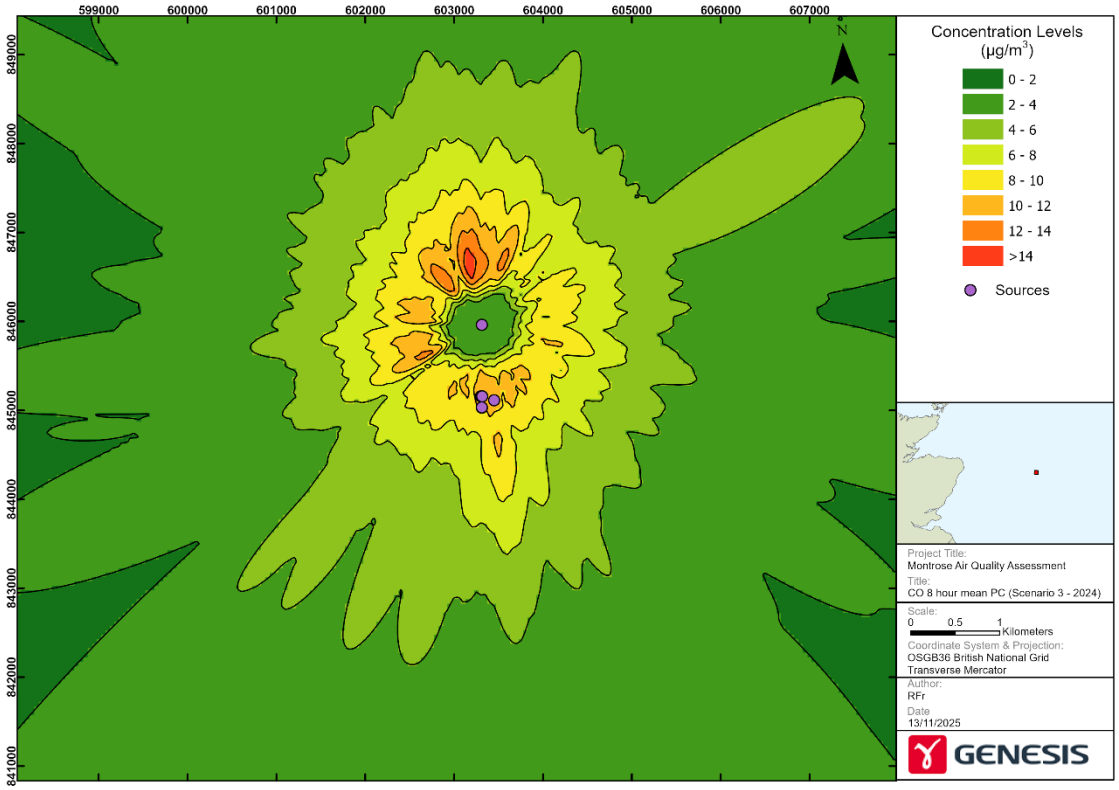


Figure 4-16: Scenario 3: CO Max Daily Running 8 - Hour Mean Max PC (µg/m³).

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5.0 CONCLUSIONS

An air quality modelling assessment was undertaken for the Montrose Infill Project, comprising emissions sources from the Montrose Bridge-Linked Platform (BLP) and Alpha platform, including the proposed infill activities.

Detailed air quality modelling was undertaken for three scenarios to determine the worst emissions cases for the main combustion equipment. The approach used in this assessment represents a conservative approach for the actual emissions associated with normal operational conditions at the Montrose platform.

It is observed for all scenarios, that the NO_2, SO_2, and CO AQS limits were not exceeded within 10 km of the site or at any receptor modelled. The PCs for all pollutants have been identified as insignificant for all scenarios modelled.

In summary, therefore, it can be concluded that the proposed Montrose Infill Project will not have a detrimental impact on local air quality.

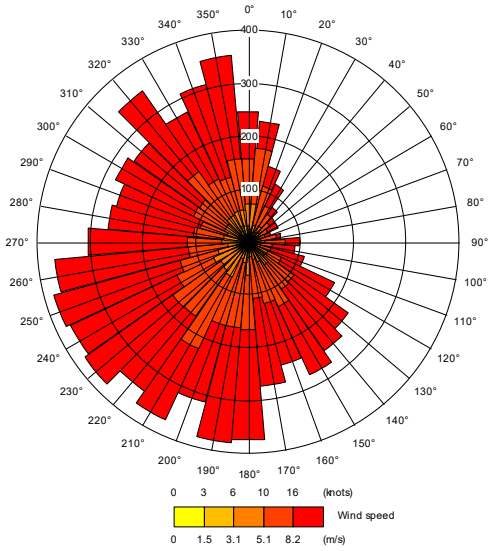
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6.0 REFERENCES

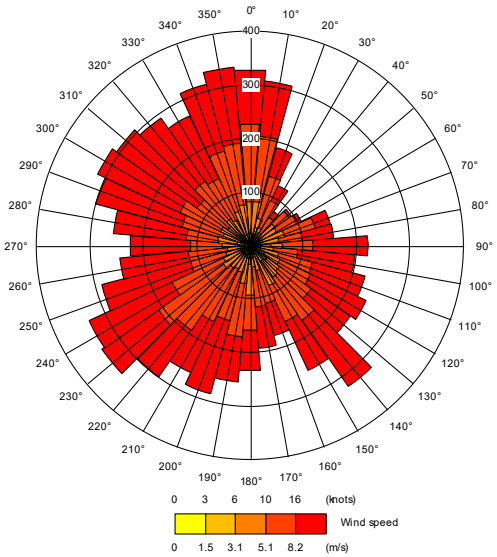
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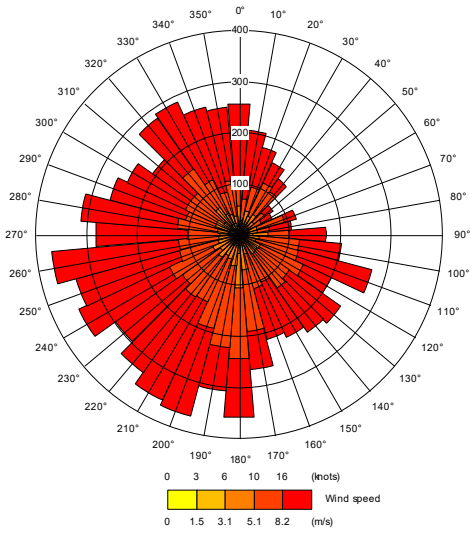
APPENDIX A: WIND ROSE -MONTROSE



2022



2023



2024

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APPENDIX B: FULL RESULTS

This appendix contains the modelling results for each pollutant for all scenarios modelled.

NO_2

Table B-1: Scenario 1: NO_2 Annual Mean Concentrations (µg/m^3).

ID	RECEPTOR	PC			PC (MAX)	PC (%AQS)	BACKGROUND	PEC	PEC (%AQS)
		2022	2023	2024					
Scenario 1	Max on Grid	<0.5	0.4	0.4	<0.5	1.1	3.8	4.3	10.6
	Arbroath	<0.1	<0.1	<0.1	<0.1	<0.1	3.8	3.8	9.5
	Everest	<0.1	<0.1	<0.1	<0.1	<0.1	3.8	3.8	9.5
	Murlach	<0.1	<0.1	<0.1	<0.1	<0.1	3.8	3.8	9.6
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	3.8	3.8	9.5
	Nelson	<0.1	<0.1	<0.1	<0.1	<0.1	3.8	3.8	9.6

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Table B-2: All Scenarios: NO_2 1-Hour Mean concentrations (µg/m^3).

ID	RECEPTOR	PC			PC (MAX)	PC (%AQS)	BACKGROUND	PEC	PEC (%AQS)
		2022	2023	2024					
Scenario 1	Max on Grid	5.5	5.0	5.3	5.5	2.8	7.2	12.7	6.4
	Arbroath	0.6	0.6	0.6	0.6	0.3	7.2	7.8	3.9
	Everest	0.5	0.4	0.4	0.5	0.2	7.2	7.7	3.8
	Murlach	0.7	0.6	0.6	0.7	0.3	7.2	7.9	3.9
	Nearest Landfall	0.1	0.1	0.1	0.1	<0.1	7.2	7.3	3.6
	Nelson	0.6	0.6	0.5	0.6	0.3	7.2	7.8	3.9
Scenario 2	Max on Grid	5.1	5.2	4.9	5.2	2.6	7.2	12.4	6.2
	Arbroath	0.4	0.5	0.4	0.5	0.2	7.2	7.7	3.8
	Everest	0.3	0.3	0.2	0.3	0.1	7.2	7.5	3.7
	Murlach	0.4	0.5	0.5	0.5	0.2	7.2	7.7	3.8
	Nearest Landfall	0.1	0.1	0.1	0.1	<0.1	7.2	7.3	3.6
	Nelson	0.4	0.4	0.4	0.4	0.2	7.2	7.6	3.8
Scenario 3	Max on Grid	17.0	16.7	17.3	17.3	8.7	7.2	24.5	12.3
	Arbroath	1.2	1.2	1.1	1.2	0.6	7.2	8.4	4.2
	Everest	0.9	0.8	0.8	0.9	0.4	7.2	8.1	4.0
	Murlach	1.3	1.4	1.3	1.4	0.7	7.2	8.6	4.3
	Nearest Landfall	0.2	0.2	0.2	0.2	0.1	7.2	7.4	3.7
	Nelson	1.2	1.4	1.1	1.4	0.7	7.2	8.6	4.3

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SO_2

Table B-3: All Scenarios: SO_2 15- Minute Mean Concentrations (µg/m^3).

ID	RECEPTOR	PC			PC (MAX)	PC (%AQS)	BACKGROUND	PEC	PEC (%AQS)
		2022	2023	2024					
Scenario 1	Max on Grid	1.8	2.1	1.8	2.1	0.8	1.8	3.9	1.5
	Arbroath	0.1	0.2	0.1	0.2	0.1	1.8	1.9	0.7
	Everest	0.1	0.1	0.1	0.1	<0.1	1.8	1.8	0.7
	Murlach	0.1	0.1	0.1	0.1	0.1	1.8	1.9	0.7
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	0.7
	Nelson	0.1	0.2	0.1	0.2	0.1	1.8	1.9	0.7
Scenario 2	Max on Grid	2.0	2.2	2.0	2.2	0.8	1.8	4.0	1.5
	Arbroath	0.2	0.2	0.2	0.2	0.1	1.8	2.0	0.8
	Everest	0.1	0.1	0.1	0.1	0.1	1.8	1.9	0.7
	Murlach	0.2	0.2	0.2	0.2	0.1	1.8	2.0	0.8
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	0.7
	Nelson	0.2	0.2	0.2	0.2	0.1	1.8	2.0	0.7
Scenario 3	Max on Grid	2.9	3.0	2.6	3.0	1.1	1.8	4.8	1.8
	Arbroath	0.2	0.3	0.2	0.3	0.1	1.8	2.1	0.8
	Everest	0.2	0.2	0.1	0.2	0.1	1.8	1.9	0.7
	Murlach	0.3	0.3	0.2	0.3	0.1	1.8	2.1	0.8
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	0.7
	Nelson	0.2	0.3	0.3	0.3	0.1	1.8	2.1	0.8

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Table B-4: All Scenarios: SO_2 1-Hour Mean Concentrations (µg/m^3).

ID	RECEPTOR	PC			PC (MAX)	PC (%AQS)	BACKGROUND	PEC	PEC (%AQS)
		2022	2023	2024					
Scenario 1	Max on Grid	1.5	1.6	1.4	1.6	0.5	1.8	3.4	1.0
	Arbroath	0.1	0.1	<0.1	0.1	<0.1	1.8	1.8	0.5
	Everest	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	0.5
	Murlach	0.1	0.1	0.1	0.1	<0.1	1.8	1.8	0.5
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	0.5
	Nelson	<0.1	0.1	0.1	0.1	<0.1	1.8	1.8	0.5
Scenario 2	Max on Grid	1.7	1.8	1.6	1.8	0.5	1.8	3.5	1.0
	Arbroath	0.1	0.1	0.1	0.1	<0.1	1.8	1.9	0.5
	Everest	0.1	0.1	0.1	0.1	<0.1	1.8	1.8	0.5
	Murlach	0.1	0.1	0.1	0.1	<0.1	1.8	1.9	0.5
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	0.5
	Nelson	0.1	0.1	0.1	0.1	<0.1	1.8	1.9	0.5
Scenario 3	Max on Grid	2.3	2.5	2.2	2.5	0.7	1.8	4.2	1.2
	Arbroath	0.1	0.2	0.1	0.2	<0.1	1.8	1.9	0.5
	Everest	0.1	0.1	0.1	0.1	<0.1	1.8	1.8	0.5
	Murlach	0.1	0.1	0.1	0.1	<0.1	1.8	1.9	0.5
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	0.5
	Nelson	0.1	0.1	0.1	0.1	<0.1	1.8	1.9	0.5

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Table B-5: All Scenarios SO_2 Daily Mean Concentrations (µg/m^3).

ID	RECEPTOR	PC			PC (MAX)	PC (%AQS)	BACKGROUND	PEC	PEC (%AQS)
		2022	2023	2024					
Scenario 1	Max on Grid	1.1	0.9	0.9	1.1	0.9	1.8	2.9	2.3
	Arbroath	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Everest	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Murlach	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Nelson	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
Scenario 2	Max on Grid	1.3	1.0	1.0	1.3	1.1	1.8	3.1	2.5
	Arbroath	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Everest	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Murlach	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Nelson	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
Scenario 3	Max on Grid	1.6	1.4	1.2	1.6	1.3	1.8	3.4	2.7
	Arbroath	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Everest	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Murlach	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4
	Nelson	<0.1	<0.1	<0.1	<0.1	<0.1	1.8	1.8	1.4

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CO

Table B-6: All Scenarios: CO Max Daily Running 8 - Hour Mean (µg/m^3)

ID	RECEPTOR	PC			PC (MAX)	PC (%AQS)	BACKGROUND	PEC	PEC (%AQS)
		2022	2023	2024					
Scenario 1	Max on Grid	4.4	5.0	4.5	5.0	0.1	145	150	1.5
	Arbroath	0.2	0.3	0.1	0.3	<0.1	145	145	1.5
	Everest	0.1	0.1	0.1	0.1	<0.1	145	145	1.5
	Murlach	0.3	0.3	0.2	0.3	<0.1	145	145	1.5
	Nearest Landfall	<0.1	<0.1	<0.1	<0.1	<0.1	145	145	1.5
	Nelson	0.2	0.2	0.2	0.2	<0.1	145	145	1.5
Scenario 2	Max on Grid	5.0	5.4	5.3	5.4	0.1	145	150	1.5
	Arbroath	0.4	0.6	0.4	0.6	<0.1	145	146	1.5
	Everest	0.3	0.2	0.2	0.3	<0.1	145	145	1.5
	Murlach	0.4	0.5	0.6	0.6	<0.1	145	146	1.5
	Nearest Landfall	0.1	0.1	0.1	0.1	<0.1	145	145	1.5
	Nelson	0.5	0.4	0.4	0.5	<0.1	145	145	1.5
Scenario 3	Max on Grid	13.1	14.5	15.0	15.0	0.2	145	160	1.6
	Arbroath	0.6	1.1	0.5	1.1	<0.1	145	146	1.5
	Everest	0.4	0.3	0.3	0.4	<0.1	145	145	1.5
	Murlach	0.9	0.9	0.8	0.9	<0.1	145	146	1.5
	Nearest Landfall	0.1	0.1	0.1	0.1	<0.1	145	145	1.5
	Nelson	0.7	0.8	0.7	0.8	<0.1	145	146	1.5

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