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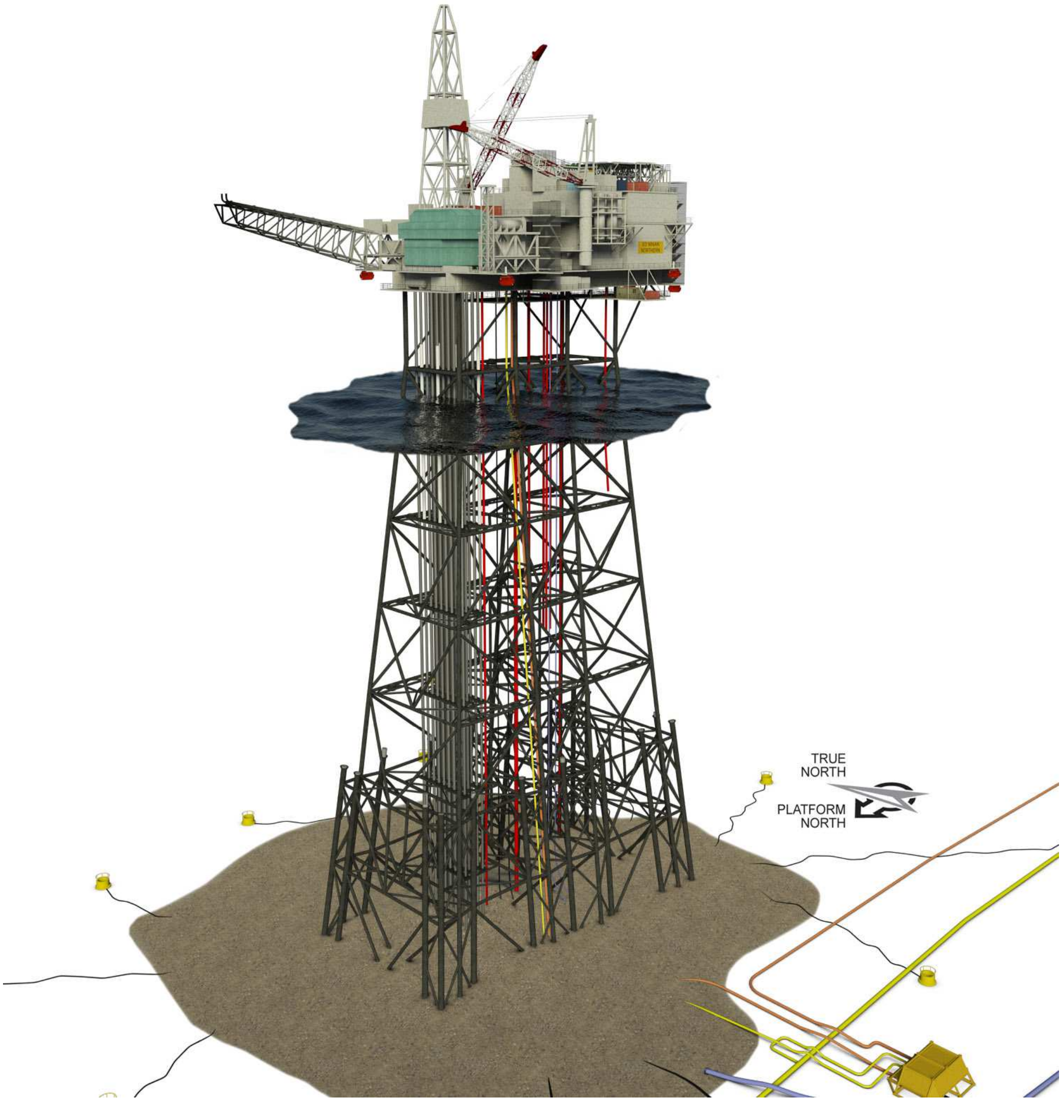

NINIAN NORTHERN PLATFORM LATE LIFE & DECOMMISSIONING PROJECT

Report – Environmental Statement

P0005-BMT-EN-REP-00006

February 2017

Document prepared by

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on behalf of

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ABBREVIATIONS AND ACRONYMS

Abbreviations	
µg/g	Microgram per Gram
µm	Micrometres
ºC	Degrees Celsius
ACOPS	Advisory Committee On Protection Of The Sea
AHV	Anchor Handling Vessel
Al	Aluminium
APE	Alkyphenol Ethoxylates
As	Arsenic
Audiogram	A curve of hearing threshold (SPL) as a function of frequency that describes the hearing sensitivity over tis normal hearing range
AWJ	Abrasive Water Jetting
Ba	Barium
BAC	Background Assessment Concentration
BAT	Best Available Technique
BC	Background Concentration
BEIS	UK Government's Department for Business, Energy and Industrial Strategy (formerly DECC)
BEP	Best Environmental Practice
BERR	Department of Business Enterprise and Regulatory Reform (currently BEIS)
BOD	Biological Oxygen Demand
CA	Comparative Assessment
CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
Cd	Cadmium
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CH_4	Methane
CNRI	Canadian Natural Resources International (U.K.) Limited
CO_2	Carbon Dioxide
CoP	Cessation of Production
CPI	Carbon Preference Index
Cr	Chromium

Abbreviations	
CRI	Cuttings Re-Injection
CSV	Construction Support Vessel
Cu	Copper
dB	Decibel – the logarithmic measure of sound intensity/pressure
dB_{ht} (species)	Sound level in decibels above the hearing threshold of a species
dB re 1 µPa m	Unit of pressure of the source level
DBT	Dibutyltin
DECC	UK Government's Department for Energy and Climate Change (currently BEIS)
Defra	Department of Environment, Food and Rural Affairs
DEMP	Decommissioning Environmental Management Plan
DP	Decommissioning Programme
DTI	Department of Trade and Industry
DWC	Diamond Wire Cutting
EAC	Environmental Assessment Criteria
EC	European Commission
ED	Endocrine Disruptors
EDC	Engineering-Down and Cleaning
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ENVID	Environmental Hazard Identification
EPS	European Protected Species
ERL	Effects Range Low
ES	Environmental Statement
EU	European Union
FAD	Fish Aggregation Device
Fe	Iron
FMD	Flooded Member Detection
GJ	Giga Joules
HAZID	Hazard Identification Study
Hg	Mercury
HLV	Heavy Lift Vessel
HSE	Health and Safety Executive

Abbreviations	
ICES	International Council for the Exploration of the Sea
IoP	Institute of Petroleum
ISS	Integrated Subsea Services Limited
ITOPF	International Tanker Owners Pollution Federation Limited
JNCC	Joint Nature Conservation Committee
kHz	Kilo Hertz
LAT	Lowest Astronomical Tide
Li	Lithium
MARPOL	International Convention for Prevention of Pollution from Ships
MBES	Multi-Beam Echo Sounder
MBT	Monobutylin
MCA	Marine and Coastguard Agency
MCAA	Marine and Coastal Access Act
Mn	Manganese
MoD	Ministry of Defence
MPA	Marine Protected Area
m/s	Meters per Second
MS	Marine Scotland
MSFD	European Marine Strategy Framework Directive
MSV	Maintenance and Support Vessel
NCMPA	Nature Conservation Marine Protected Area
NCP	Ninian Central Platform
Ni	Nickel
NNP	Ninian Northern Platform
NNPWMP	NNP specific Waste Management Plan
NOAA	The National Oceanic and Atmospheric Administration
NORBRIT	Norway-UK Joint Contingency Plan
NORM	Naturally Occurring Radioactive Material
NOx	Nitogen Oxides
NP	Nonyphenol
NPD	Naphthalenes, Phenenthrenes, Dibenzothiophenes
NPL	National Physical Laboratory

Abbreviations	
NPV	Net Present Value
NSP	Ninian Southern Platform
OP	Octylphenol
OPEP	Oil Pollution Emergency Plan
OPITO	Offshore Pertoleum Industry Training Organisation
OPOL	Oil Pollution Operator's Liability
OSCAR	SINTEF Oil Spill Contingency and Response model
OSPAR	Oslo and Paris Conventions for the protection of the marine environment of the North-East Atlantic
OSRL	Oil Spill Response Ltd.
OVI	Offshore Vulnerability Index
P&A	Plug and Abandonment
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyls
PETS	Portal Environmental Tracking System
Ph	Phytane
PLANC	Permits, Licences, Authorisations, Notifications and Consents
PMF	Priority Marine Features
ppt	parts per thousand
Pr	Pristine
PTS	Permanent threshold shift – A permanent elevation of the hearing threshold resulting from physical damage to the sensory hair cells of the ear
rms	Root mean squared
ROV	Remotely Operated Vehicle
SAC	Special Areas of Conservation (c-candidate, d-draft, p-possible)
SAST	Seabirds at Sea Team
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCI	Site of Community Importance
SEA	Strategic Environmental Assessment
SEL	Sound Exposure Level in dB re 1 $\mu Pa^2 s$
SEPA	Scottish Environment Protection Agency

Abbreviations	
SFF	Scottish Fishermen's Federation
SHEMS	Safety, Health and Environmental Management System
SL	Source level - the SPL that would be measured at 1 m from a point-like source radiating an equivalent amount of sound power as an actual source (dB re 1 µPa m)
SLV	Single Lift Vessel
SNH	Scottish Natural Heritage
SO_2	Sulphur Dioxide
SOPEP	Ship Oil Pollution Emergency Plan
SPL	Sound Pressure Level - the decibel ratio of sound pressure to some reference pressure in dB re 1 µPa in underwater acoustics (zero-to-peak)
Sr	Strontium
SSIV	Subsea Isolation Valve
SSS	Side-Scan Sonar
TBa	Total Barium
TBT	Tributylin
THC	Total Hydrocarbones
TOC	Total Organic Carbon
TTS	Temporary threshold shift – Temporal and reversible elevation of the auditory threshold which is the minimum sound level that can be perceived by an animal in the absence of background noise
UCM	Unresolved Complex Mixture
UK BAP	United Kingdom Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKDMAP	United Kingdom Digital Marine Atlas
UKOOA	United Kingdom Offshore Operators Association
UCM	Unresolved Complex Mixture
WEEE	Waste Electrical and Electronic Equipment
WFD	EU Waste Framework Directive
WMS	Waste management Strategy
V	Vanadium
VMS	Vessels Monitoring System
VOC	Volatile Organic Compounds
Zero-to-Peak	Zero-to-Peak is a sound signals maximum rise in pressure from an ambient pressure

Abbreviations	
Zn	Zinc

GLOSSARY

Glossary	
Benthic fauna	Organisms that live on, associated with, or in the seabed sediments.
Benthos	See 'Benthic Fauna'.
Biogeographic area	An area of the Earth as defined by the flora and fauna found there.
Biotope	The region of a habitat associated with a particular ecological community.
Block	A North Sea acreage sub-division measuring approximately 10 km x 20 km forming part of a quadrant, e.g. Block 21/05 is the 5th block of Quadrant 21.
Cephalopod	A class of mollusc characterised by bilateral body symmetry, reduction and internalisation of the shell and modification of the foot into tentacles. Examples include squid, cuttlefish, octopus and nautilus.
Cetacean	Aquatic mammals e.g. whales, dolphins and porpoises.
Circalittoral	The region of the sublittoral zone which extends from the lower limit of the infralittoral to the maximum depth at which photosynthesis is still possible.
Controlled Waste	The term Controlled Waste is defined in Section 75(4) of the Environmental Protection Act 1990 as: "household, industrial and commercial waste or any such waste." Not all radioactive waste is classified as controlled waste and may be regulated under The Radioactive Substances Act 1993 (explained below).
Copepods	Small crustaceans whose adult stage usually includes a single eye in the centre of the head. The free living marine species form a vital part of many marine food webs.
Demersal	The zone that is the part of the sea or ocean (or deep lake) comprising the water column that is near to (and is significantly affected by) the seabed.
Directive Waste	Directive Waste is defined in Article 1(a) of Council Directive 75/442/EEC as: "any substance or object which the producer or the person in possession of it discards or intends or is required to discard". In determining if a substance or object has been discarded, the following question may be asked: "has the substance or object been discarded so that it is no longer part of the normal commercial cycle or chain of utility?"
Diatoms	A group of eukaryotic algae that secrete characteristic cell walls consisting of two separate halves with an overlap between them. Diatoms reproduce by binary fission and often exist as single cells, but some species form colonies of chains.
Dinoflagellates	A diverse group of eukaryotic algae that often have two protruding flagellae used for propelling and directing the cell.
Dispersant	An agent added to a suspension to improve the separation of particles. Dispersants added to spilled oil can help the oil break up into smaller droplets, increasing the exposed surface area and increasing the rate of degradation.
Diurnal	Daily, may describe a daily cycle or 'during the day'
Ecosystem	The physical environment and associated organisms that interact in a given area. There is no defined size for an ecosystem.
Epifauna	Fauna inhabiting the surface of rocks, sediment or other fauna/flora.

Glossary	
Fauna	Animal life.
Flora	Plant life.
Hazardous Waste	Hazardous Waste is a term used in England, Wales and Northern Ireland for materials that have one or more of the hazardous properties described in the Hazardous Waste Directive 91/689/EEC.
Infauna	Fauna that lives within sediments.
Inorganic	Relating to or denoting compound which are not organic, broadly, compounds not containing carbon
Krill	Shrimp-like marine animals found in all oceans of the world.
Mattress	A subsea structure used to protect offshore pipelines
Motile	Organisms able to propel themselves from one place to another.
Niche	An environment that is different from the surrounding area and that requires the organisms exploiting it to be specialised in ways not generally found in the surrounding area.
Non-Hazardous Waste	Material that does not fall within the classification of Special or Hazardous Waste.
Organic	Compounds containing carbon and hydrogen.
Pelagic	Any water in the sea that is not close to the bottom or near to the shore. Marine animals that live in the water column of coastal, ocean and lake waters, but not on the bottom of the sea or the lake.
Photic zone	In this context defined as the upper water column which receives enough light for photosynthesis to occur.
Phytoplankton	Planktonic organisms that obtain energy through photosynthesis.
Radioactive Waste	The Radioactive Substances Act 1993 defines radioactive waste as: “waste which consists wholly or partly of: a) a substance or article which, if it were not waste, would be radioactive material; or b) a substance or article which has been contaminated in the course of the production, keeping or use of radioactive material, or by contact with or proximity to radioactive waste”. Where Radioactive Waste is below threshold levels stated in the Radioactive Substances Act 1993 and has one, or more, properties included in the Hazardous Waste Directive then this material is classified as Hazardous Waste and must be treated as such.
Risk	The combination of the probability of an event and a measure of the consequence.
Salinity	The dissolved salt content in this case of a body of water.
Sedentary	Organisms which are essentially fixed in one location, and unable to move.
Sediment	Any deposit of insoluble material, primarily rock and soil particles, as well as the remains of marine organisms and other sources which accumulate on the seafloor
Special Waste	The term Special Waste is used in Scotland and is defined under the Special

Glossary	
	Waste Regulations 1996 which transposed the requirements of the European Hazardous Waste Directive (91/689/EEC). Special Waste is defined as material that has one, or more, properties that are described in the Hazardous Waste Directive (91/689/EEC) as amended by Council Directive 94/31/EC. Outside of Scotland such material is referred to as Hazardous Waste.
Stratification	Separation of a body of water into two or more distinct layers due to differences in density or temperature.
Semi- submersible	A specialised mobile offshore drilling unit or vessel which is designed to partially submerse itself for increased stability on the water.
Substrate	In this context, any surface which could provide a habitat for an organism to live, i.e. a rock outcropping or area of sand.
Surge	A rise in water level above that expected due to tidal effects alone; the primary causes are wind action and low atmospheric pressure.
Thermocline	An area in the water column where there is a rapid temperature change with increasing depth. This is due to stratification between warmer, well mixed, less dense water in the surface layer and deeper, colder water below.
Tie-Back	Tie-backs connect new oil and gas discoveries to existing production facilities.
Topography	The surface features of the seabed.
Transient	In this context, a transient sound is a high amplitude, short-duration sound
Waste Electrical & Electronic Equipment (WEEE)	The Waste Electrical & Electronic Equipment (WEEE) Regulations 2006 implement the provisions of the WEEE Directive (2002/96/EC and 2003/108/EC). The aim of the WEEE Directive was to reduce the amount of WEEE disposed of in landfills and is achieved by essentially forcing producers of electrical and electronic equipment responsible for financing the collection, treatment and recovery of WEEE and requiring distributors of WEEE to enable consumers to return items and force through recycling activities in the market.
Water column	A theoretical column through a body of water from the surface to the sediments. This concept can be helpful when considering the different processes that occur at different depths.
Zooplankton	Broadly defined as heterotrophic (deriving energy from organic matter) planktonic organisms, although some protozoan zooplankton species can derive energy both from sunlight and by feeding on organic matter.

NON-TECHNICAL SUMMARY

This non-technical summary outlines the findings of the environmental impact assessment (EIA) conducted by CNR International (UK) Limited (CNRI) as part of the planning and consents process for the future decommissioning of the Ninian Northern Platform (NNP).

The purpose of the EIA is to understand and communicate the potential significant environmental impacts associated with the project options to inform the decision-making process. The detailed assessment is presented within the Environmental Statement (ES).

The NNP is located in the UK Continental Shelf (UKCS) in the Ninian field, which extends over Blocks 3/2, 3/3, 3/7 and 3/8 of the northern North Sea, approximately 120 km east of the northern Shetland coastline, and 23 km west of the UK/ Norway median line (Figure i). The Ninian field was discovered in 1974, with oil first produced in 1978. Produced oil from the NNP is exported to Ninian Central Platform, located approximately 6.5 km southeast.

This ES covers the decommissioning of the NNP (jacket and topsides) and associated drill cuttings pile, located underneath NNP. Decommissioning of the remaining assets associated with NNP, such as the pipelines and subsea isolation valve (SSIV), will be undertaken as part of wider Ninian field decommissioning programme. As these pipelines are tied back to NSP and NCP, decommissioning of the pipelines with the Ninian field allows for an efficient field wide decommissioning programme along with the remaining platforms.

Regulatory Context

The decommissioning of offshore oil and gas infrastructure in the UKCS is principally governed by the Petroleum Act 1998, as amended by the Energy Act 2008, which sets out the requirements for a formal Decommissioning Programme and the approval process. Under the Department for Business, Energy and Industrial Strategy (BEIS), formerly the Department for Energy and Climate Change (DECC), Guidance Notes on Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1988 (DECC, 2011), the Decommissioning Programme must be supported by an EIA.

The BEIS Guidance Notes state that an EIA should include an assessment of:

- All potential impacts on the marine environment including exposure of biota to contaminants associated with the decommissioning of the installation; other biological impacts arising from physical effects; conflicts with the conservation of species with the protection of their habitats, or with mariculture; and, interference with other legitimate uses of the sea.
- All potential impacts on other environmental compartments.
- Consumption of natural resources and energy associated with reuse and recycling.
- Interference with other legitimate uses of the sea and consequential effects on the physical environment.
- Potential impacts on amenities, the activities of communities and on future uses of the environment.

In addition, under the Marine and Coastal Access Act 2009 and the Marine (Scotland) Act 2010 a licence application will be required at the time of decommissioning and the supporting EIA/ ES updated to reflect detailed engineering design and specific mitigation measures.

OSPAR Decision 98/3 (the Decision) sets out the United Kingdom's international obligations on the decommissioning of offshore installations. The Decision prohibits the dumping and leaving wholly or partly in place of offshore installations. The topsides of all installations must be returned to shore, and all installations with a jacket weight of less than 10,000 tonnes must be completely removed for re-use, recycling or disposal on land. Any piles securing the jacket to the seabed should be cut below the natural seabed level at a depth that will ensure they remain covered. The depth of cutting is dependent upon the prevailing seabed conditions and currents.

Under the assessment criteria for OSPAR derogation candidates, NNP meets the requirements as a candidate for derogation, as the weight of the jacket exceeds weight of 10,000 tonnes and the structure was installed before 1999.

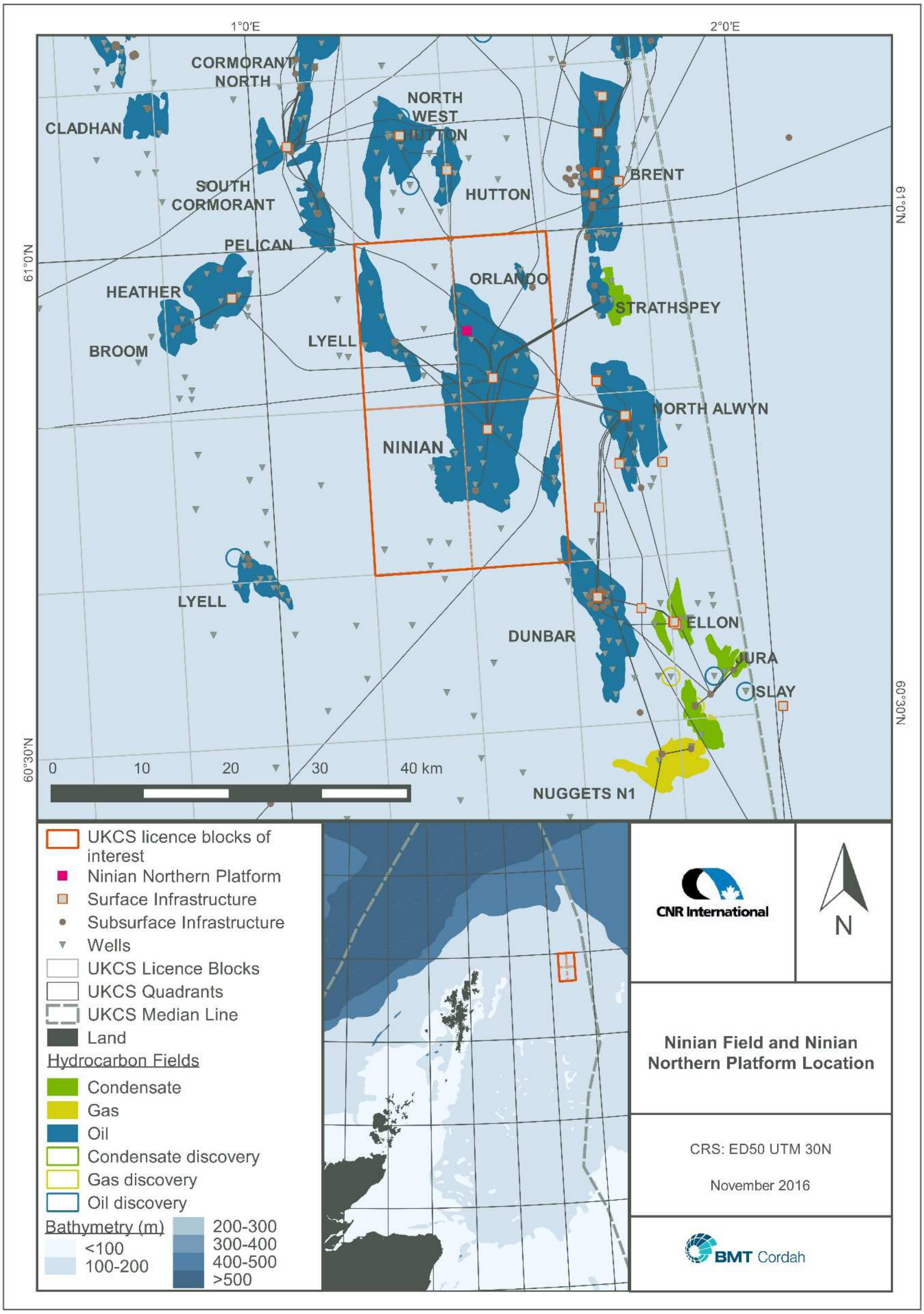


Figure i: Location of the Ninian Field and NNP

Scope of the NNP Decommissioning Programme

The main scope of the programme includes the decommissioning of the NNP topsides and jacket and the drill cuttings pile. The main elements of the NNP decommissioning project are:

- Wells plug and abandonment (P&A) and conductor recovery.
- The engineering-down and cleaning of the NNP topsides facility.
- The removal and subsequent recovery to shore of the NNP topsides and jacket down to the footings, which will be left in situ. The top of the footings is defined as the height of the jacket piles at -88.5 m (defined as the highest point of the piles which connects the installation to the seabed, as described in the BEIS Guidance Notes for Decommissioning 2011).
- The jacket will be removed to between -77.5 m and -88.5 m depending on the selected method for removal. The height of the footings remaining in situ will be between 63.5 m and 52.5 m from seabed. Below this height there are numerous diagonal cross members that would be technically challenging to cut and remove with the jacket.

The platform wells will be plugged and abandoned in accordance with a well abandonment programme and the Oil and Gas UK Guidelines for the Suspension and Abandonment of Wells, when NNP approaches the end of its field life.

Decommissioning Studies

CNRI commissioned a number of studies to support the NNP decommissioning planning process and option evaluation, in order to determine the recommended decommissioning option and optimal engineering solution. The conclusions from these studies have been included within the Environmental Statement. These studies include:

- Inventories of the assets, materials and hazardous materials on the NNP.
- Quantitative risk assessment and high level Hazard Identification Study (HAZID) of Decommissioning and Removal Options.
- A series of engineering studies and reports on the options for decommissioning the topsides, jacket and drill cuttings pile.
- A comparative assessment of the NNP jacket and drill cuttings pile decommissioning options.
- Pre-decommissioning environmental survey.
- Commercial fisheries socioeconomic impact study.
- Environmental assessments of underwater noise and energy and emissions from the decommissioning options, as well as modelling and impact assessment of the options for the management of the NNP drill cuttings pile.

Recommended Decommissioning Options

CNRI conducted a formal comparative assessment of the options for decommissioning the NNP jacket and the drill cuttings pile in order to determine the recommended options, as required under the Petroleum Act 1998.

Table i provides an overview of the recommended decommissioning option for each of the NNP facilities, including those that were subject to the formal comparative assessment.

Two decommissioning methods are being considered for removal of the topsides. The specific method for the decommissioning of this facility will be determined during the contracting phase of the project; therefore, the impacts associated with both decommissioning methods for the recommended option has been assessed in this ES.

Table i: Overview of recommended decommissioning options

Facility	Recommended decommissioning option	Possible decommissioning methods
Wells	P&A and conductor recovery	In accordance with the Oil and Gas UK Guidelines for the Suspension and Abandonment of Wells (2012)
Topsides	Full removal	Reverse installation
		Single lift
Jacket	Partial removal	Multiple lifts
Cuttings pile	Leave in situ	Natural degradation

Environmental Setting and Sensitivities

The NNP is located in a water depth of approximately 141 m, in an area that is typical of the offshore regions of the northern North Sea, where hydrographical, meteorological, geological and biological characteristics are relatively uniform over large areas. Users of the area are mainly associated with oil and gas exploration and development, shipping and fishing.

Table ii provides a summary of the key physical, chemical, biological and socioeconomic components of the environment in the NNP area that may be impacted.

Table ii: Summary of environmental sensitivities in the vicinity of the NNP

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Habitats Directive: Annex I Habitats There are no known Annex I habitats in the NNP area. Although *Lophelia pertusa* has colonised the NNP, it would not have occurred without the presence of the platform and therefore does not qualify as an Annex I habitat (Fugro ERT, 2011).											
Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity
Habitats Directive: Annex II Species Of the Annex II species, only the harbour porpoise has been sighted in the NNP area, with very high abundance in February and July, medium numbers in August and low numbers in December, January and throughout the summer months (April, May, June and September) (UKDMAP, 1998).											
Low sensitivity	Very high sensitivity	Not surveyed/No data available	Low sensitivity	Low sensitivity	Low sensitivity	Very high sensitivity	Moderate sensitivity	Low sensitivity	Not surveyed/No data available	Not surveyed/No data available	Low sensitivity
Benthic Fauna Benthic communities in the NNP area are similar to those found throughout a large surrounding area of the northern North Sea. No rare species are known to occur in this area (Fugro ERT, 2011).											
Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity
Plankton The plankton in the NNP area is typical of the northern North Sea. Peak productivity occurs in spring and summer.											
Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity	Low sensitivity
Finfish The NNP is located in spawning grounds for cod (Jan to Apr), haddock (Feb to May), Norway pout (Jan to Apr), saithe (Jan to Apr) and sandeel (Nov to Feb); and in nursery grounds for herring, ling, mackerel, spurdog, haddock, Norway pout, blue whiting, sandeel, whiting, anglerfish and European hake (throughout the year) (Coull et al., 1998; Ellis et al., 2010).											
High sensitivity	High sensitivity	High sensitivity	High sensitivity	High sensitivity	Moderate sensitivity	Moderate sensitivity	Moderate sensitivity	Moderate sensitivity	Moderate sensitivity	Moderate sensitivity	Moderate sensitivity
Marine Mammals Marine mammals sighted in and around the NNP area include minke whales, long-finned pilot whales, killer whales, white-beaked dolphins and harbour porpoises. Peak sightings predominantly occur in the summer months (Reid et al., 2003; UKDMAP, 1998).											
Low sensitivity	Very high sensitivity	Moderate sensitivity	Low sensitivity	Moderate sensitivity	Low sensitivity	Very high sensitivity	Moderate sensitivity	Low sensitivity	Not surveyed/No data available	Not surveyed/No data available	Low sensitivity
Seabirds Seabird vulnerability to oil pollution in the NNP area is "high" in January, March, July, October and November and "moderate" to "low" for the rest of the year. The overall vulnerability in the NNP area is "low" (JNCC, 1999).											
Moderate sensitivity	Moderate sensitivity	High sensitivity	Moderate sensitivity	Low sensitivity	Low sensitivity	High sensitivity	Low sensitivity	Moderate sensitivity	Moderate sensitivity	High sensitivity	Low sensitivity
Fisheries The fishing effort in 2015 in the NNP area was dominated by pelagic fisheries. Demersal species dominated the landings, with their relative value being "moderate" in 2015 (Scottish Government, 2016).											
Shipping Shipping traffic in the vicinity of NNP is of moderate density (DECC, 2014).											
Oil and Gas – nearby surface infrastructure Within 30 km radius of NNP there are Ninian Central (Block 3/3), Ninian Southern (Block 3/8), Alwyn North NAA and NAB (Block 3/9), Brent A, B, C and D (Block 211/29), NW Hutton A (decommissioned, footings in place; Block 211/27), Cormorant A (Block 211/26) and Heather A (Block 2/5), (UK Oil and Gas Data, 2016).											
Other users of the sea In the vicinity of the NNP there are no renewable energy sites, military training areas, recorded wrecks and telecommunication or power cables (SeaZone, 2013; KIS-ORCA, 2016).											

Key

Very high sensitivity	Low sensitivity	Moderate sensitivity
High sensitivity	Not surveyed/No data available	

Key Environmental Concerns

An EIA Scoping Workshop at the onset of decommissioning planning and a desk-based risk assessment of the preferred options were undertaken to identify the range of high level environmental impacts which could occur as a result of the proposed NNP decommissioning program. The planned and unplanned/ accidental events that might occur were considered. Following the identification of the interactions between the proposed decommissioning activities and the local environment, stakeholder consultation and the assessment of all potentially significant environmental impacts, the following key environmental impacts were identified as requiring further assessment and their significance assessed.

Energy Use and Atmospheric Emissions

Energy use and associated emissions resulting from the proposed NNP decommissioning activities are mainly attributed to the manufacture of new materials to replace recyclable materials decommissioned in situ and sent to landfill in case of partial jacket removal. The cutting and lifting of the topsides in reverse installation will result in the next highest energy usage and emissions.

The emissions from the decommissioning activities will only have a localised effect on air quality and will be lower than during normal NNP operations. Though the proposed decommissioning will contribute to an increase in CO_2, the total CO_2 emissions from the proposed decommissioning operations for NNP represent less than 3% of the total annual CO_2 offshore emissions from the UKCS in 2014. The impact on air quality is unlikely to affect any sensitive receptors within the NNP area as the impact is expected to be limited to the immediate vicinity. For this reason, there is unlikely to be a significant transboundary or cumulative impact on air quality.

Underwater Noise

Man-made underwater noise has the potential to impact on marine mammals. Several activities associated with the proposed decommissioning operations will generate underwater noise.

The main marine mammal species that occur in the NNP area are minke whale, long-finned pilot whale, killer whale, white-beaked dolphin and harbour porpoise, with most sightings occurring in the summer months. Due to the offshore locality of the NNP (120 km from the nearest coastline), it is unlikely that significant numbers of grey or harbour seals will occur in the vicinity of the facilities.

The vessel operations are expected to be the highest source of sound associated with the decommissioning activities, with the potential to result in marine mammal avoidance. However, the proposed decommissioning activities will result in the sound levels proportional to the number of vessels on site at any one time, and potential impact is concluded not to be significant and will only result in minimal disturbance.

Seabed Disturbance

Decommissioning operations at the NNP will result in work being undertaken at or near the seabed. Therefore, there is the potential for localised seabed disturbance. The anchoring of heavy lift vessel during lifting operations of topsides and jacket would create some disturbance of the seabed.

This disturbance would be relatively small and an anchor plan will be put in place to minimise potential adverse effects, followed by seabed survey and removal of potential anchor mounds or scars.

In addition, leaving the drill cuttings pile in situ may lead to some long-term impacts arising from the physical presence of the cuttings pile and from the eventual collapse of the NNP jacket footings. Such an event may result in a relatively localised disturbance of the pile.

Socioeconomic Impacts

Potential socioeconomic impacts can arise as a result of the proposed NNP decommissioning activities are:

- interference to fishing activities;
- damage to, or loss of, gear; and
- onshore impacts.

There will be minor impact to fishing activities in the NNP area as a result of the proposed decommissioning operations. This impact will be managed by minimising the number of vessels travelling to, or standing by, NNP. CNRI will minimise potential damage or loss of demersal fishing gear because of the partial removal of the jacket by notifying the appropriate organisations or authorities of any subsea structures left in place after decommissioning.

Waste

Decommissioning the NNP will generate quantities of controlled waste. The amount of controlled waste generated at any one time during the decommissioning operations will depend on the processes used for dismantling and the subsequent treatment and disposal methods utilised. The objective is to recycle as much of the waste material as possible.

CNRI will develop a NNP specific Waste Management Plan to translate a Waste Management Strategy into individual project plans with defined actions, roles and responsibilities. The scope of the Facilities Waste Management Plan will cover the decommissioning programme for the selected removal options and disposal routes.

Accidental Events

Accidental events, such as the accidental release of hydrocarbons and chemicals, can result in a complex and dynamic pattern of pollution distribution and impact on the marine environment. Although the likelihood of such a spill is remote, there is a potential risk to organisms in the immediate marine and coastal environment, and a socioeconomic impact if a spill were to occur.

The residual risk of environmental impact from accidental oil spills will be reduced by preventive measures incorporated during program design, operational control procedures and training. The worst case scenario from NNP is well blow-out where a maximum volume of 100 m^3 would beach on Scotland and Norway coastlines. However, since all wells will have been abandoned and the topsides and pipelines cleaned of hydrocarbons, the probability of this volume of hydrocarbon being released is so low that it does not contribute to the overall spill risk in the area. Any diesel discharge would be expected to disperse rapidly in the immediate environment. Chemical spills will not add significantly to the overall spill risk in the area owing to a combination of rapid dispersion and dilution of the chemicals and the depth and distance from shore of the NNP infrastructure.

During the proposed operations, there is the potential for the loss of objects dropped overboard which may present a hazard to shipping, fishing activities and may also impact the seabed community within the drop zone. Where practicable CNRI will endeavour to minimise the number of dropped objects and will secure items to prevent loss during the proposed decommissioning operations. The recovery of debris wherever practicable will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea.

Environmental Management

A Register of Commitments has been developed to address each aspect of the NNP decommissioning and to provide a summary of key management and mitigation measures identified during the EIA process. This register will form part of the Decommissioning Environmental Management Plan and will be integrated into the relevant project phases.

Conclusions

Overall, the Environmental Statement has evaluated the environmental risk reduction measures to be taken by CNRI and concludes that CNRI have, or intend to, put in place sufficient safeguards to mitigate environmental risk and to monitor the implementation of these safeguards.

Therefore, it is the conclusion of the Environmental Statement that the recommended options to decommission the NNP can be completed without causing significant impact to the environment.

1. INTRODUCTION

This Environmental Statement (ES) presents the findings of the environmental impact assessment (EIA) undertaken by CNR International (UK) Limited (CNRI) for the proposed activities associated with the decommissioning of the Ninian Northern Platform (NNP) including the associated drill cuttings pile.

1.1. Location of the Ninian Northern Platform

The NNP is one of three fixed platforms in the Ninian field, located in the UK Continental Shelf (UKCS) Blocks 3/2, 3/3, 3/7 and 3/8 of the northern North Sea (Figure 1.1). The NNP is located approximately 120 km east of the Shetland coastline and 23 km west of the UK/ Norwegian median line (Figure 1.1)

1.2. Project Background and Purpose

The Ninian field was discovered in 1974 and has been in operation since 1978. CNRI acquired the Ninian field from Kerr McGee in 2002. CNRI are the operator of the field with an equity share of 87.06%, in partnership with JX Nippon (12.94%). Production from the NNP is now moving towards the end of its economic life.

Figure 1.2 illustrates the layout of the Ninian field infrastructure. The NNP stands in a 141 m water depth and comprises a drilling and production platform, supported by a steel jacket with eight legs (26 piles).

Separation facilities on the platform remove water from produced oil and recover gas, which is subsequently used for fuel. Produced oil is transported via a 24 inch subsea pipeline (PL 71) to Ninian Central Platform (NCP), located approximately 6.5 km south east.

During the life of NNP, drill cuttings have been discharged to sea resulting in a drill cutting pile with an approximate volume of 33,144 m^3 (Fugro ERT, 2011). The majority of these cuttings are located underneath NNP with a maximum height of 11.93 m. The pile covers the bottom bracing members of the NNP jacket.

This ES covers the proposed decommissioning of the NNP (jacket and topsides) and associated drill cuttings pile. Decommissioning of the remaining assets associated with NNP, such as the pipelines and subsea isolation valve (SSIV), will be undertaken as part of a wider Ninian field decommissioning programme. As some of the risers and umbilicals are attached to the jacket structure, these will be separated at the derogation height. Risers and umbilicals above the derogation height will be removed with the topsides and jacket. Those sections of risers and umbilicals below the derogation height will remain in-situ to the derogated footings. Therefore disturbance of the drill cuttings pile will be avoided.

Power and control facilities for the Lyell Multi-Phase Booster Pump are provided from NNP via an umbilical that will be likely re-located to NSP. There are 12 anodes that lie on the seabed at between 115 m and 190 m radius from the platform to protect the submerged steelwork. These will be removed as part of the decommissioning programme (Figure 1.2).

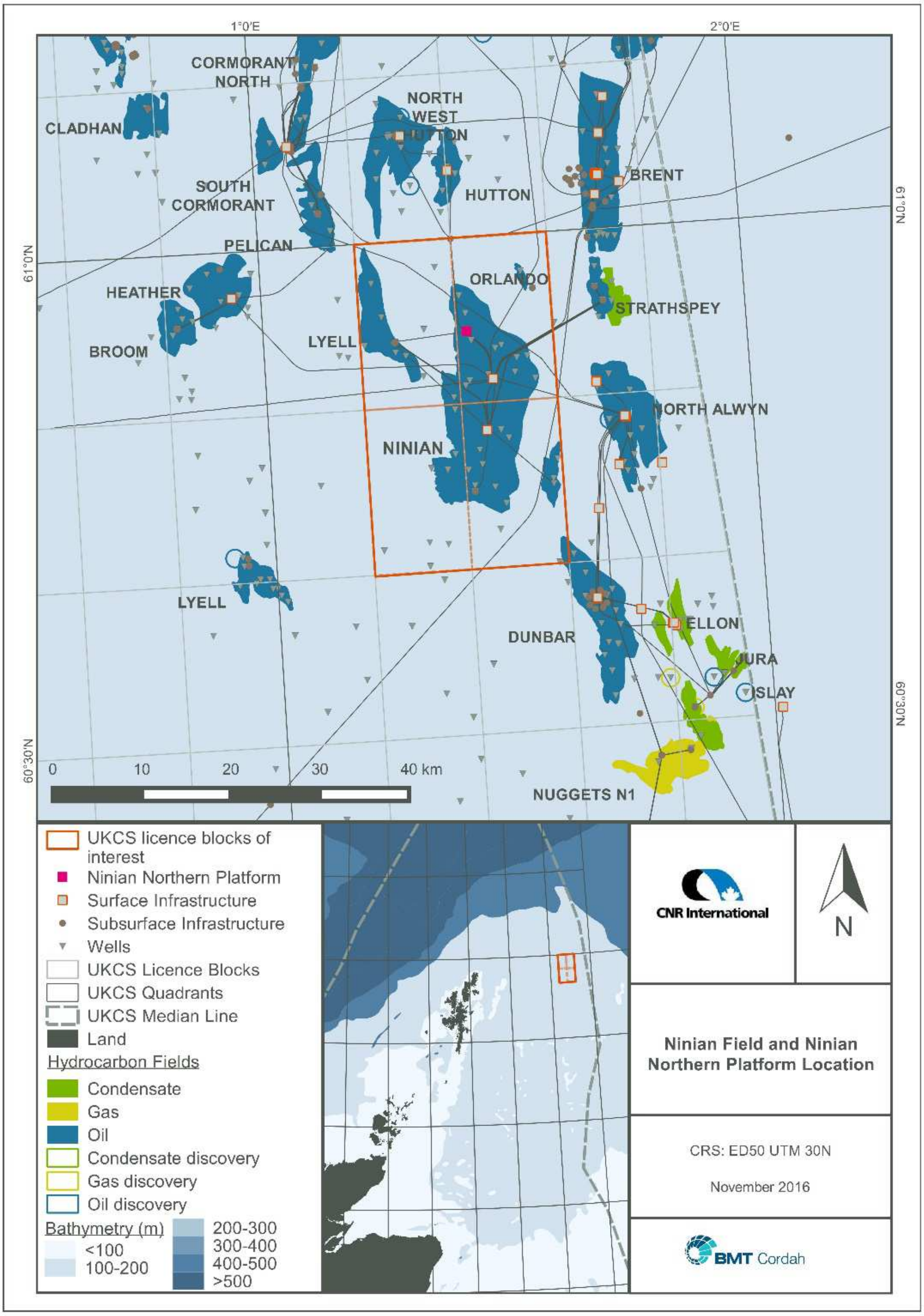


Figure 1.1: Location of the Ninian field and NNP

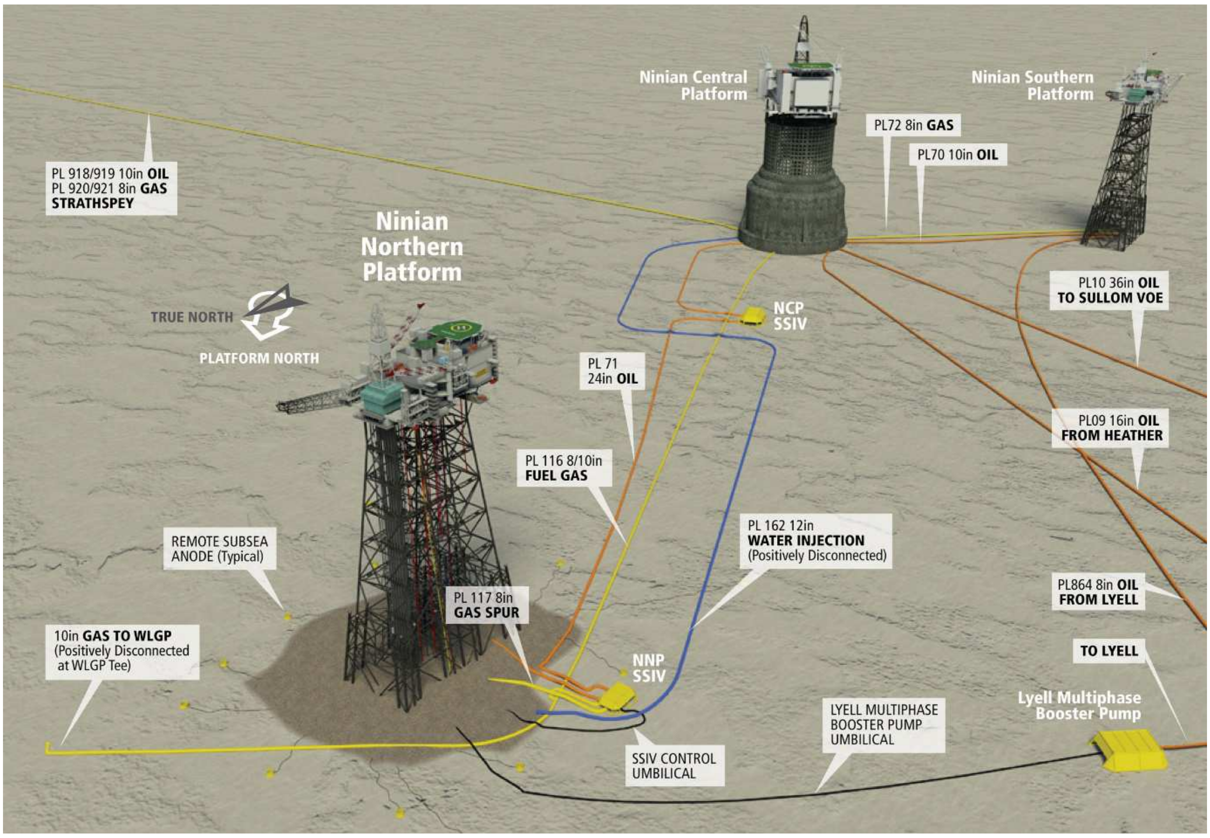


Figure 1.2: Schematic of Ninian Field facilities

1.3. Purpose of the Environmental Impact Assessment

The purpose of the EIA process is to understand and communicate the potential significant environmental impacts associated with the project options.

The EIA process was conducted in accordance with the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) to support the NNP Decommissioning Programme (Section 1.4). The ES presents the findings of the EIA and has been prepared as part of the planning and consents process for the decommissioning of NNP.

1.4. Regulatory Context

The decommissioning of offshore oil and gas infrastructure in the UKCS is principally governed by the Petroleum Act 1998, as amended by the Energy Act 2008. The Petroleum Act sets out the requirements for a formal Decommissioning Programme, which must be approved by the Department of Business, Energy and Industrial Strategy (BEIS) (formerly the Department of Energy and Climate Control [DECC]) before the owners of an offshore installation or pipeline may proceed.

At present there is no statutory requirement to prepare an ES for decommissioning. However, under the Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998, the Decommissioning Programme (DP) must be supported by an EIA.

The Guidance Notes state that an EIA should include an assessment of the following:

- All potential impacts on the marine environment including exposure of biota to contaminants associated with the decommissioning of the installation; other biological impacts arising from physical effects; conflicts with the conservation of species with the protection of their habitats, or with mariculture; and, interference with other legitimate uses of the sea.
- All potential impacts on other environmental compartments, including emissions to the atmosphere, leaching to groundwater, discharges to surface fresh water and effects on the soil.
- Consumption of natural resources and energy associated with reuse and recycling.
- Interference with other legitimate uses of the sea and consequential effects on the physical environment.
- Potential impacts on amenities, the activities of communities and on future uses of the environment.

In addition, BEIS have advised the Oil and Gas Industry that under the Marine and Coastal Access Act 2009 (MCAA) and the Marine (Scotland) Act 2010, an EIA/ ES will be required for all licence applications relating to decommissioning operations.

OSPAR Decision 98/3 (the Decision) sets out the United Kingdom's (UK's) international obligations on the decommissioning of offshore installations. The Decision prohibits the dumping and leaving wholly or partly in place of offshore installations. The topsides of all installations must be returned to shore, and all installations with a jacket weight of less than 10,000 tonnes must be completely removed for re-use, recycling or disposal on land. Any piles securing the jacket to the seabed should be cut below the natural seabed level at a depth that will ensure they remain covered. The depth of cutting is dependent upon the prevailing seabed conditions and currents (DECC, 2011).

However, a derogation from the requirement for full removal can be requested, if the competent authority of the relevant Contracting Party is satisfied that an assessment in accordance with Annex 2 of Decision 98/3 shows that there are significant reasons why an alternative disposal is preferable to reuse or recycling or final disposal on land. The competent authority, in this case BEIS, may issue a permit for:

- All or part of the footings of a steel installation in a category listed in Annex 1, placed in the maritime area before 9 February 1999, to be left in place.
- A concrete installation in a category listed in Annex 1 or constituting a concrete anchor base, to be dumped or left wholly or partly in place.
- Any other disused offshore installation to be dumped or left wholly or partly in place, when exceptional and unforeseen circumstances resulting from structural damage or

deterioration, or from some other cause presenting equivalent difficulties, can be demonstrated.

A summary of the environmental legislation applicable to this project is provided within Appendix A.

1.5. Report Structure

The ES Structure is detailed within Table 1.1.

Table 1.1: Structure of the NNP Environmental Statement

Section		
No	**Title**	**Contents**
0	Non-Technical Summary	A summary of the ES
1	Introduction	An introduction to the project and the scope of the ES. This section also includes the methodological approaches used in the EIA process and a summary of the supporting reports and studies undertake
2	Project Description	A description of the decommissioning options and the recommended decommissioning option determined by a formal Comparative Assessment (CA) process
3	Environmental Description	A description of the environment and sensitive receptors in the vicinity of the project area
4	Stakeholder Views	Details of the consultation process and outcomes
5	Risk Assessment	A detailed description of the risk assessment approach and findings
6	Energy Use and Atmospheric Emissions	A quantification of energy use, identification of emission sources and potential impacts of emissions
7	Underwater Noise	Identification of sound sources and potential impacts of noise
8	Seabed Disturbance	Identification of sources of seabed disturbance and potential impacts
9	Socioeconomic Impacts	Description of the potential socioeconomic impacts of the project
10	Waste	Details the waste likely to be generated and the management processes to be implemented during decommissioning activities
11	Accidental Events	Worst case scenarios and measures to prevent spills arising from accidental events, and proposed contingency measures to ensure an effective response in the event of a spill
12	Environmental Management	A description of CNRI's environmental management procedures and how these will apply to the decommissioning of the Murchison Facilities. The section also includes a Register of Commitments made within the ES
13	Conclusions	Key findings and conclusions
14	References	Sources of information used to inform the assessment
Appendix A: Legislation		A summary of relevant environmental legislation

1.6. Methodology

The EIA systematically identifies significant environmental risks (potential impacts) associated with the project and assesses the requirement for impact/ risk mitigation measures. The objective of the EIA process is to incorporate environmental considerations into project planning and design to ensure that best environmental practice is achieved.

The ES was prepared in accordance with the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended), with this section of the ES describing the methods used to:

- Identify and evaluate the potential environmental (including social) impacts arising from the decommissioning of the NNP and drill cuttings pile.
- Ensure an appropriate level of assessment is applied to the identified impacts, particularly those impacts identified as being significant.
- Identify actions needed, through design or management control, to avoid or mitigate the key anticipated impacts.

1.6.1. EIA Scoping Workshop

To inform the EIA an EIA Scoping Workshop was conducted on completion of the engineering studies and the environmental baseline survey, to ensure all activities potentially associated with the NNP decommissioning options could be fully assessed (BMT Cordah, 2016a).

The key objectives of the workshop were to validate impacts identified through a scoping matrix, identify any additional potential environmental issues likely to arise from the proposed project and to agree the appropriate control and practicable measures required to manage the identified impacts (Section 5).

1.6.2. Environmental Impact Assessment Process

An overview of the EIA process to identify and assess the impacts associated with the NNP decommissioning programme is provided within Table 1.2.

Table 1.2: Key stages of the EIA process for decommissioning

EIA stage	Description
Scoping	Scoping of the EIA allows the study to establish the key issues, data requirements and impacts to be addressed in the EIA and the framework or boundary of the study.
Consideration of alternatives	Demonstrates that other feasible approaches, including alternative uses, endpoints and decommissioning methods have been considered.
Description of project actions	Provides clarification of the purpose of the project and an understanding of its various characteristics – including stages of decommissioning, location and processes.
Description of environmental baseline	Establishes the current state of the environment on the basis of data from literature and field surveys and may involve discussions with the authorities and other stakeholders.
Identification of key impacts and prediction of significance	Seeks to identify the nature and magnitude of identified change in the environment as a result of project activities and assesses the relative significance of the predicted impacts.
Impact mitigation and monitoring	Outlines the measures that will be employed to avoid, reduce, remedy or compensate for any significant impacts. Mitigation measures will be developed into a project environmental management plan. Aspects of the project which may give rise to a significant impact and which cannot be mitigated to an acceptable level of impact may need to be redesigned. This stage will feed back into project decommissioning activities.
Presentation of the ES	Reporting of the EIA process, through the production of an ES, which clearly outlines the processes above. The ES provides a means to communicate the environmental considerations and environmental management plans associated with the project to the public and stakeholders.

1.6.3. Scoping

Scoping is an integral part of the impact assessment process, the aim of which is to identify potential impacts to be assessed in greater detail within the ES. Scoping is a two-stage process comprising:

- An initial identification of potential effects.
- A preliminary evaluation of significance based on available information.

The NNP Environmental Impact Scoping Assessment (BMT Cordah, 2016a) identified the potential environmental receptors and other considerations which may be impacted by the proposed decommissioning operations (Figure 1.3).

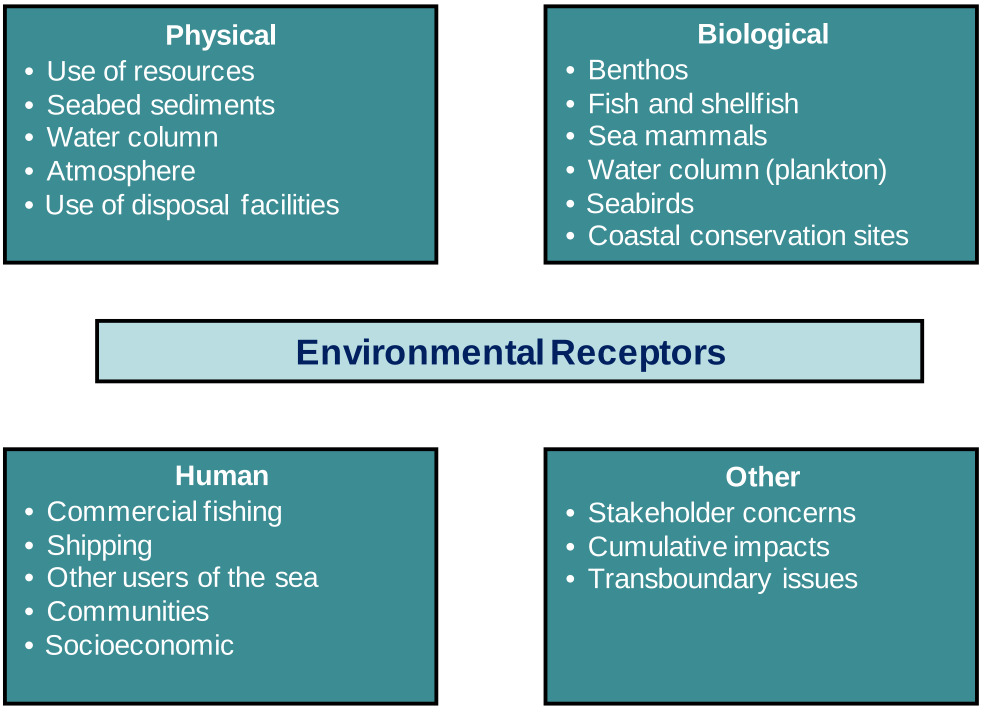


Figure 1.3: Environmental receptors

A summary of the issues identified during the scoping exercise for further assessment during the EIA includes potential effects from (BMT Cordah, 2016a):

- Physical presence of vessels causing interference with other users of the sea.
- Seabed disturbance during decommissioning operations.
- Disturbance of drill cuttings.
- Energy use and atmospheric emissions.
- Underwater noise generated during decommissioning activities.
- Near-shore and onshore dismantling of structures.
- Cleaning of marine growth from NNP jacket.
- Landfill disposal and associated impacts.
- Socioeconomic impact to fishermen.
- Non-routine events – spillage of hydrocarbons and other fluids.

The above issues were further validated and assessed through baseline assessments, modelling studies, studies on marine growth, energy and emissions, noise, and stakeholder engagements.

1.6.4. Transboundary and Cumulative Impacts

The EIA process also includes the identification of any potential cumulative and transboundary impacts that could be caused by the proposed decommissioning programme. Cumulative impacts may occur as a result of a number of activities (e.g. discharges or emissions) combining or overlapping and potentially creating a new impact. Even where impacts do not overlap, it is important to consider the incremental effect of many small areas of impact on a particular environment or its use. Transboundary impacts are those which could have an impact on the environment and resources beyond the boundary of UK waters. The Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991) addresses the need to enhance international co-operation in assessing transboundary environmental impacts. The Espoo Convention was a key step in bringing together all stakeholders to prevent environmental damage before it occurs.

A consideration of the potential cumulative impacts resulting from wider field decommissioning is provided in Section 2.7. The EIA process assessed the transboundary and cumulative impacts of all decommissioning options within assessment Sections 7 to 10 of this ES.

1.7. Comparative Assessment

The NNP jacket weighs approximately 17,678 tonnes including marine growth and as such is a candidate for derogation from the rule of total removal under the Decision. The NNP jacket footings are embedded within the drill cuttings pile, which is almost wholly located within the base of the jacket structure. Therefore, it is necessary to consider the different methods of removing the drill cuttings pile in order to access the jacket footing for removal. Under the Petroleum Act 1998 (and as described in the associated guidance), detailed Comparative Assessments (CAs) were undertaken to identify the best overall decommissioning options for decommissioning the NNP jacket and drill cuttings pile.

Each decommissioning option was assessed against the five main BEIS criteria – safety, environment (informed by the EIA process), technical, societal and economic. All decommissioning options and the subsequent recommended option are described within Section 2. The EIA process assessed the impacts of all decommissioning options with assessment Sections 7 to 10 of the ES considering only the recommended option as identified within the CA process.

1.8. Supporting Studies

CNRI commissioned a number of studies to support the initial decommissioning planning process and option evaluation, in order to determine the recommended decommissioning option and optimal engineering solution (Table 1.3).

Table 1.3: List of Decommissioning Studies

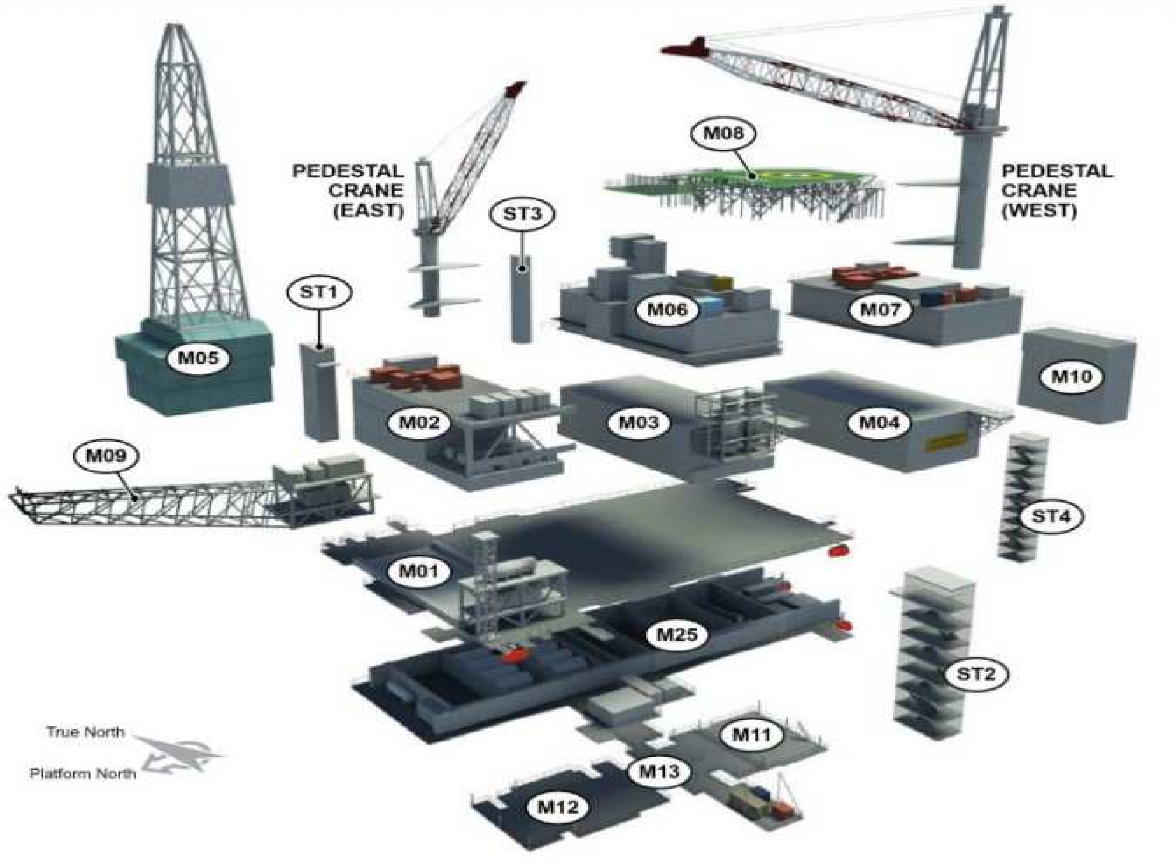
Decommissioning aspect	Study title
Inventory	Asset Inventory Study Report
Engineering	Platform Removal Technology Study
	Platform Shut-down Procedure
	Engineering and Clean Down
	Removal Schedule and Marine Spread Normalisation
	Manhours for onshore demolition
Topsides	Topside Offshore Deconstruction
	Topside Reverse Installation Removal
	Topsides Single Lift Removal
	Topside Weight Review
	Idle Phase Requirements
Jacket	Jacket Removal in Sections
	Jacket Single Lift Removal
	Jacket Weight Report
	Jacket CA
	NNP Jacket Footings Degradation
	Evaluation of Removal Options for Jacket
Management of drill cuttings pile	NNP Drill Cuttings Pile Modelling the Effects of Human Disturbance of the Cuttings Pile Report
	NNP Drill Cuttings Pile Long-Term Cuttings Pile Characteristics Report
	Modelling of Collapse of Jacket Footings into Cuttings Pile
	Environmental Assessment of Options for the Management of the NNP Drill Cuttings Pile
	Drill Cuttings CA
Environmental studies	NNP Pre-Decommissioning Environmental Baseline Survey
	NNP Environmental Description Report
	NNP EIA Scoping Report
	Commercial Fisheries - Socioeconomic Impact Study
	NNP Environmental Impacts Identification workshop
	Energy and Emissions Report for the Decommissioning of NNP
	Underwater Noise Impact Assessment for the NNP Decommissioning
	NNP Marine Growth Report

2. PROJECT OVERVIEW

This section presents a description of the alternative considered, the selected options and the activities associated with the decommissioning of the NNP and drill cuttings pile.

2.1 NNP Facilities and Materials to be Decommissioned

Following Cessation of Production (CoP), CNRI is planning to decommission the NNP (topsides, jacket, and platform wells and conductors) and the drill cuttings pile. CNRI currently consider that the topsides will be removed in the near future, with the potential removal of the jacket occurring up to 2032. Figure 2.1 provides a schematic of the NNP facilities that are to be decommissioned.



MODULE	DESCRIPTION
M01	Wellhead Area
M02	Production and Drilling Equipment
M03	Water Services & Utilities
M04	Diesel Generators and Control Room
M05	Drilling Package
M06	Water Injection
M07	Accommodation

MODULE	DESCRIPTION
M08	Helideck
M09	Flare Boom
M10	Accommodation
M11	Cellar Deck Area 80 - Offices
M12	Cellar Deck Area 80 - Moonpool
M13	Cellar Deck Area 80 - Workshops
M25	Captruss

Source: CNRI (2016a)

Figure 2.1: Schematic diagram of the NNP topsides to be decommissioned

Table 2.1: Overview of NNP facilities to be decommissioned

NNP facility	Components of facilities to be decommissioned
Topsides	Ten main modules. Associated topsides equipment. Three cellar decks and captruss.
Jacket (and footings)	147 m high steel jacket structure. Twenty-six steel piles. Twelve seabed anodes.
Platform wells and conductors	Twenty-four conductors. Fourteen production wells. Ten water injection (WI) wells.
Drill cuttings	Estimated 33,144 m3 of drill cuttings. Estimated footprint area of 23,620 m^2 Cuttings are 11.93 m above the seabed.

2.1.1 Topsides

The NNP topsides comprise ten main modules (M01 to M10) arranged over two levels which provide facilities and equipment for drilling, production, processing, power generation, oil export and accommodation (Figure 2.1). In addition to these ten modules there is a captruss structure (M25) that sits on top of the jacket and transfers the loads from the topsides modules onto the jacket, and three cellar deck modules ((M11 to M13) hung from the underside of the captruss (Figure 2.1).

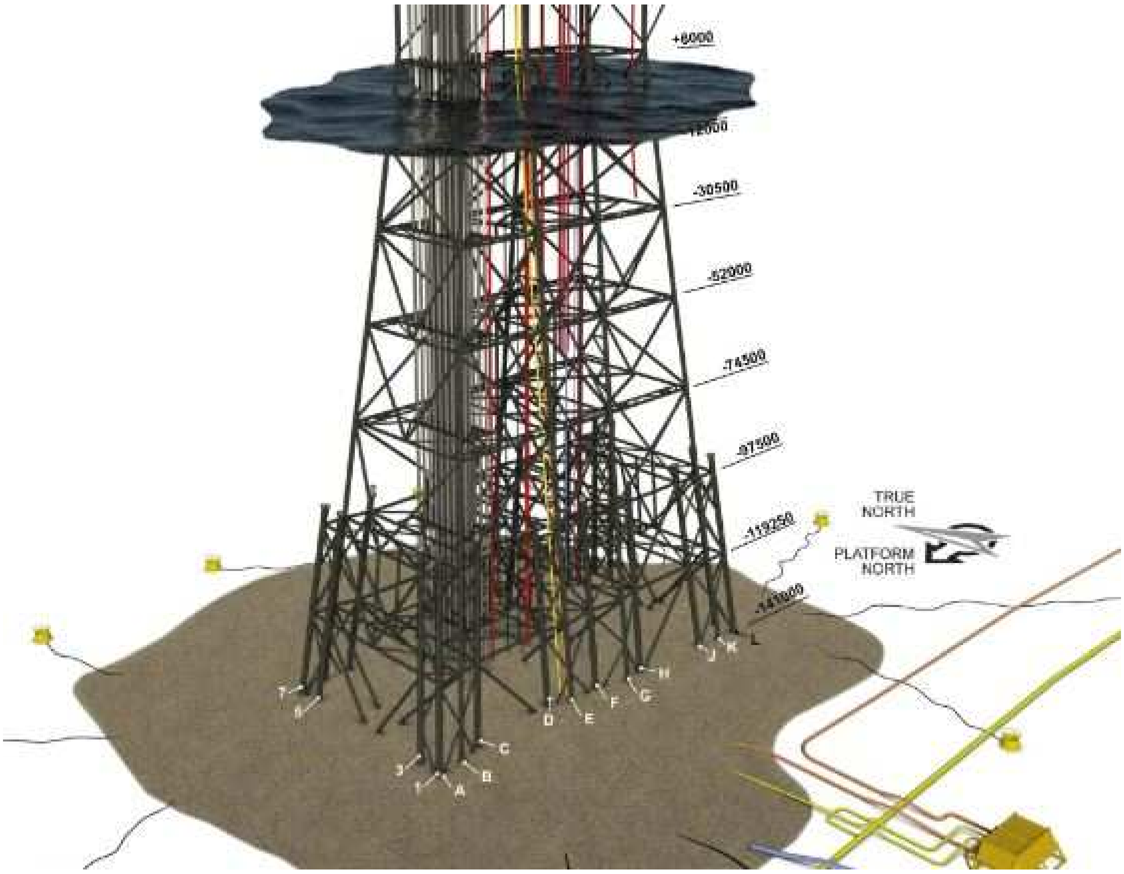
Table 2.2 provided a summary of the quantities of materials associated with the NNP topsides. The total weight of the NNP topsides is estimated at 12,453 tonnes (CNRI, 2016a).

Table 2.2: Inventory of the material associated with the topsides decommissioning

Material	Mass (tonnes)	Material	Mass (tonnes)
Steel	9,658.2	Rubber	56.4
Concrete	106.0	Wood	4.7
Aluminium	1.7	Polychlorinated biphenyls (PCBs)	0.1
Stainless steel	579.3	Residual oils	11.0
Copper	871.9	Other	0.2
Lead	10.9	Paint	80.0
Zinc	2.9	Passive fire protection (PFP)	363.2
Plastics	648.9	Mercury	0.012 kg
Rockwool	57.5	Asbestos*	112 locations
*Weight is not known; Source: CNRI (2016a)		**Total**	**12,453.0**

2.1.2 Jacket

The NNP jacket is a welded, tubular steel, eight legged structure, which measures 147 m high from the seabed to where it connects to the captruss structure (Figure 2.2). The jacket is secured to the seabed by 26 structural piles; the eight leg piles are 1,175 mm in diameter while the 18 skirt piles are 1,524 mm in diameter. Each pile penetrates approximately 50 m into the seabed and has a grouted annulus.



Source: CNRI (2016a)

Figure 2.2: NNP Jacket

The skirt pile sleeves are welded to the jacket via bracings. The footings section of the jacket is below the highest point of the piles. The top of the jacket footings extend to approximately 52.5 m above the seabed which takes account of the pile length protruding above the skirt sleeves (CNRI, 2016a). The maximum height left will depend on the final cutting method selected and will be approximately 63.5 m.

Following installation of the NNP jacket in 1978, a number of modifications were undertaken to strengthen the jacket stability:

- Four jacket legs were filled with concrete between +2 m and +6 m level (extended to +10.5 m in the captruss) in 1979;
- Two jacket legs were filled with concrete between seabed and +2 m level in 1981.
- Fourteen grouted clamps were added between 1983 and 1984.

- 30” steel tubulars/ sleeves connected between -12 m and -30 m at conductor guide slots (six locations). The conductors diameters were reduced to 26” at these 6 locations.

Table 2.3 provides a summary of the quantities of materials associated with the NNP jacket. The total weight of the NNP jacket is estimated at 17,678 tonnes (CNRI, 2016a).

Table 2.3: Inventory of the material associated with the jacket decommissioning

Material	Dry unflooded weight (tonnes)
Jacket (steel)	8,478
Piles (steel)	3,550
Grout	879
Concrete	684
Anodes – Aluminium/ Zinc	1,970
Marine growth*	2,117
Total	**17,678**

*Marine growth weight determined using 2011 ROV survey

2.1.3 Platform Wells and Conductors

NNP has 25 well slots, with 14 production wells, ten WI wells and one spare slot. Table 2.4 provides a summary of the quantities of materials that will be recovered during the NNP plug and abandonment (P&A) campaign.

Table 2.4: Inventory of the material associated with the wells decommissioning

Facility	Material	Mass per well (tonnes)	No. of wells	Total weight in 24 wells (tonnes)
Xmas tree	Steel	5.0	24	120.0
Wellheads	Steel	2.3	24	55.2
9⅝” casing	Steel	17.4	24	417.6
13⅜” casing	Steel	21.9	24	525.6
5½” tubing	Steel	9.1	24	218.4
20” casing	Steel	30.3	1	30.3
26” conductor	Steel	84.5	6	507.0
30” conductor	Steel	99.8	18	1,796.4
Conductor	Cement	9.0	24	216.0

Source: CNRI (2016a)

2.1.4 Drill Cuttings Pile

During the life of NNP, 24 wells were drilled from the platform. Oil-based mud (OBM) was used and discharged with drill cuttings from eight of the 24 wells (CNRI, 2016a). A proportion of these discharged drill cuttings and drilling muds now exist as a mound on the seabed immediately below the NNP jacket and covers the bottom bracing level of the jacket (Figure 2.3).

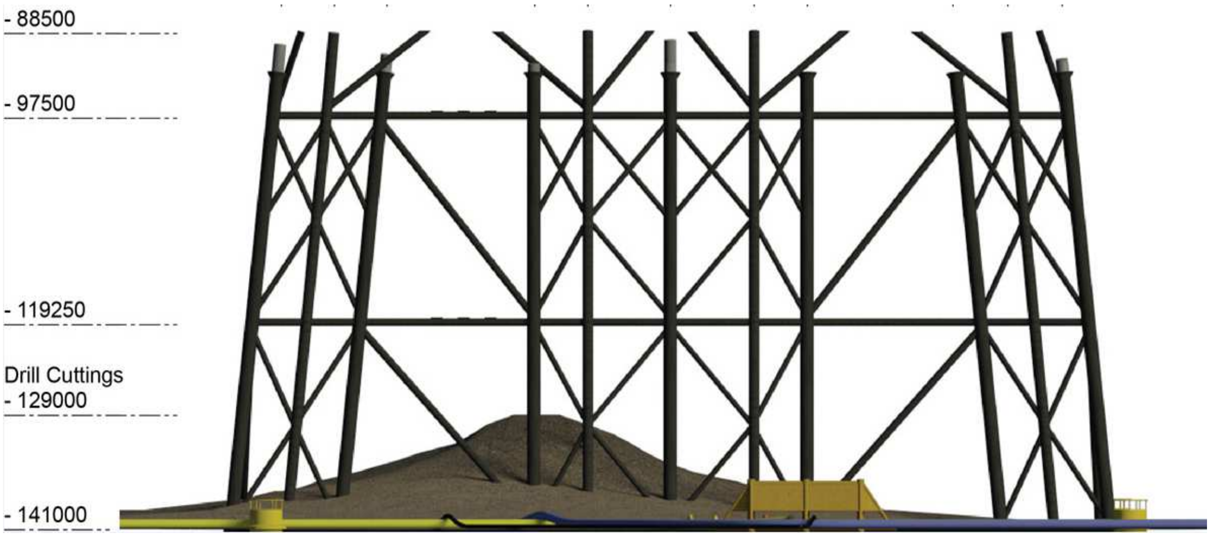
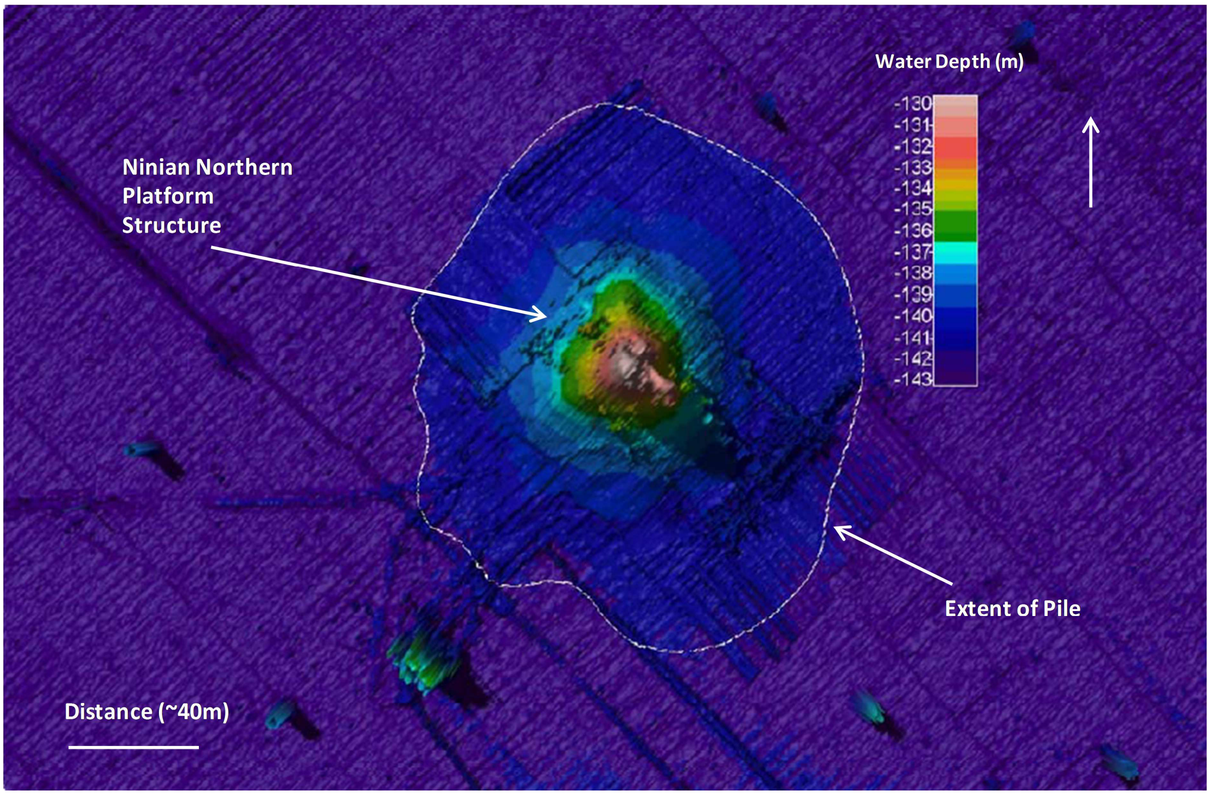


Figure 2.3: Profile view of then NNP jacket footings and drill cuttings pile

Multi-beam Echo Sounder (MBES) mapping of the cuttings mound (Fugro ERT, 2011) was used to calculate that the cuttings pile has an estimated volume of 33,144 m^3 and an estimated footprint area of 23,620 m^2 (Fugro ERT, 2011) (Figure 2.4). The drill cuttings pile has a maximum height of 11.93 m with the majority of cuttings located under the platform, spreading out evenly in all directions. MBES mapping showed that the pile sits almost entirely under the platform and tails off slightly more in the south-easterly direction (Fugro ERT, 2011).



Source: CNRI (2016a)

Figure 2.4: MBES mapping of the NNP Drill Cuttings

2.2 Assessment of Alternative Use of the NNP

During the initial planning stages for the NNP decommissioning, CNRI conducted a study to examine the potential re-use and alternative uses for the NNP facilities (GL Noble Denton, 2011). The study examined the following possible uses:

- Tie-back/ service provisions to other fields;
- Re-use at alternative location;
- Offshore renewable energy generation (wind, wave or tidal);
- Carbon Capture and Storage (CCS);
- Offshore sub-station/ hub; and
- Non-energy sector alternatives
  - Marine research station.
  - Metrology station.
  - Diver training centre.
  - Fish farm.
  - Communication and navigation centre.
  - Artificial reef.

Although a small number of disused offshore facilities have been successfully reused in other parts of the world, it is technically and economically difficult to achieve this in the northern North Sea where structures like the NNP are generally built for the specific requirements of the field they service. Several factors, including the remote location, difficulty of access, extreme weather, high maintenance costs and the design life all influence the technical and economic viability of re-use and alternative use options for the NNP. The re-use and alternative use study concluded that:

- The re-use of the NNP jacket at another site is unfeasible due to the condition, size and age of the platform.
- There are no commercial oil and gas reserves that could be economically accessed to extend the life of the NNP.
- Alternative use of the platform for offshore renewable energy generation would not be commercially viable as the capital outlays combined with annual operational and maintenance costs would far outweigh the revenue from energy generation.
- The remoteness of the NNP and the limited revenue associated with the remaining options would not be expected to support the operating and maintenance costs associated with the platform (GL Noble Denton, 2011).

Decommissioning options for the NNP jacket and drill cuttings pile were subject to a formal CA to determine which decommissioning option should be selected for each facility. Since the topsides are to be removed and transported to shore for disposal they were not included in the CA. The full suite of decommissioning options that CNRI considered for each facility during the CA are presented in Table 2.5.

2.3 Decommissioning Options

Table 2.5: Decommissioning options considered in the CA

NNP facility	Decommissioning option	Method
Jacket	Full removal (multiple lifts)	The jacket top section members would be cut into sections and lifted by Heavy Lift Vessel (HLV). Drill cuttings pile would be removed or relocated to allow access to jacket footing. The piles in the seabed would be cut 3 m below the seabed.
	Partial removal (multiple lifts)	Jacket top sections will be cut into smaller sections down to the top of the footings (between -77.5m and -88.5m) and removed in multiple lifts.
Drill cuttings pile	Option 1 (recover to surface, separation of cuttings offshore, liquids treated and released offshore, solids transported onshore)	Recover drill cuttings to the surface (either to platform or a vessel) using the Remotely Operated Vehicle (ROV) dredge system; separate solids from fluids offshore, discharge the treated oily fluids under permit to the offshore environment and transport the solids for onshore treatment and landfill disposal.
	Option 2 (recover to surface, slurry to shore)	Recover drill cuttings to the surface using the ROV dredge system to a vessel for direct transport to shore for separation and treatment; oily water to be discharged under permit in a coastal environment and the dry cuttings disposed of to landfill.
	Option 3 (recover to surface, offshore re-injection)	Recover drill cuttings to the surface using the ROV dredge system to the platform for slurrification and disposal through a Cuttings Re-Injection (CRI) system to an existing well, which would be converted to a disposal well.
	Option 4 (redistribution of drill cuttings on the seabed)	An ROV dredge system collects the cuttings and an exhaust pipe distributes them from a number of discharge locations 70 m from the current position.
	Option 5 (leave in situ)	No removal.

2.4 Overview of the CA Process

Under the Petroleum Act 1998 and as described in the associated guidance, detailed CAs are required to identify the best overall option for decommissioning the:

- NNP jacket, which falls within the category of structures that may be considered as a candidate for derogation from the general rule of "total removal" (OSPAR, 1998; Petroleum Act 1998); and
- drill cuttings pile which would have to be removed to allow complete removal of NNP jacket footings (OSPAR 2006/5).

CNRI conducted a CA following the BEIS framework for CAs, which outlines five main criteria by which each decommissioning option should be assessed (Table 2.6). Where appropriate, the five main criteria were further defined into sub-criteria (CNRI, 2012a; Table 2.6).

The sub-criteria were selected in light of:

- The "matters to be considered" listed in the OSPAR framework and the Guidance Notes.
- The range of safety, technical, environmental, societal and economic assessments and studies that CNRI decommissioning projects have undertaken or shall undertake.
- CNRI's Environmental Protection and Health and Safety Policies, CNRI vision and mission statements.

The assessment of the performance of each decommissioning option against each of the criteria and sub-criteria was informed by appropriate engineering, environmental, societal, safety and economic studies, which were completed either by suitably experienced and qualified CNRI in-house personnel, or by suitably experienced and capable external organisations.

To enable a comparison of the options to be made, the results were then collated and compared using a normalised/ weighted scoring system, where the results of each of the assessments were expressed in common units and ranked in order of performance from best to worst, based on the percentage weighting assigned by CNRI (BMT Cordah, 2016b).

Table 2.6: Assessment criteria/ sub-criteria and a brief description of method used to assess each option

Main criteria	Sub-criteria	Description of sub-criteria
Safety	Risk to project personnel offshore and onshore	Safety risk to project personnel working offshore and onshore.
	Residual risk to other users of the sea	The combined safety risk to the crews of commercial fishing vessels, the crews of military vessels and the crew and passengers of commercial shipping vessels.
Environment	Impacts of operations	The impacts of offshore and nearshore operations on any aspect of the marine environment. The impacts of onshore operations (e.g. dismantling, transporting, treating, recycling) on any ecological aspect of the terrestrial environment.
	Impacts of end-points	The impacts of offshore and nearshore end-points on any aspect of the marine environment. The impacts of onshore end-points (e.g. landfilling, secondary use) on any ecological aspect of the terrestrial environment.
	Total energy consumption	Total energy consumption (GJ).
	CO_2 emissions	CO_2 emissions (tonnes).
Technical	Technical feasibility	Assessment of the technical feasibility of each option.
	Ease of recovery from excursion	Assessment of the ability to recover from unplanned excursions and complete the planned decommissioning option.
	Use of proven technology and equipment	Assessment of the extent to which the option requires the use of proven technology.
Societal	Commercial impact on fisheries	Impacts of both the operations and the end-points on the present commercial fisheries in and around the field. (Note: Safety risks were considered under “safety” above).
	Socio-economic impacts to amenities	The risks from any near-shore and onshore operations and end-points (dismantling, transporting, treating, recycling, land filling) on any aspect of the amenity or infrastructure of the environment.
	Socio-economic impacts on communities	The risks from any near-shore and onshore operations and end-points (dismantling, transporting, treating, recycling, land filling) on the health, well-being, standard of living, structure or coherence of communities.
Economic	Economic	Total project cost. The estimated total Capital Expenditure (CAPEX) cost plus a Net Present Value (NPV) estimate of the cost of any ongoing liability.

The maximum percentage weighting value for each criterion was assigned to the best performing (and therefore most preferable) option. All subsequent options were assigned a normalised weighting in proportion to the best performing option. The output was a matrix presenting normalised/ weighted scores for the criteria/ sub-criteria for every option.

An overall score was established by totalling the normalised/ weighted scores of the assessments and comparing the totals. The output from the CA was used to select the preferred decommissioning options. A CA report documented the justification for the selection (BMT Cordah, 2016b).

The Guidance Notes (DECC, 2011) make provision for weightings to be assigned to the scoring for the individual assessments to transparently reflect the proportionality/ or balancing of the options from the viewpoint of the operator or its stakeholders. The outcome of the CA process for the selection of the recommended option for decommissioning the jacket and drill cuttings pile is summarised in Section 2.6. The methods and outcomes for decommissioning the NNP wells and topsides are also summarised in Section 2.6.

2.5 Preparatory Work

This section provides a brief description of the preparatory work that would be carried out, regardless of which option was selected for decommissioning.

2.5.1 Post CoP Preparation for NNP Decommissioning

During initial decommissioning activities, the NNP will remain manned for a period of approximately 24 months post CoP. During this period all utilities and life support services will be operational and maintained to support the following operations in the initial decommissioning phases:

- Well P&A (start date may precede CoP).
- Conductor recovery.
- Engineering down and cleaning (EDC).
- Topsides preparation for removal.
- Idle phase.

2.5.2 Well P&A

The decommissioning of the NNP will commence with a phased well P&A campaign, which may be executed using the existing the NNP drilling derrick and facilities and/ or using rig-less abandonment and conductor recovery technology.

All wells will be abandoned in accordance with the Oil and Gas UK Guidelines for the Suspension and Abandonment of Wells (2015). At least two permanent cement plugs will be set within each well, to provide tested barriers between hydrocarbon formations and the environment.

Well abandonment from the NNP will be conducted in four phases:

- **Phase 1: Bull Heading and Circulation**: Circulate or bull head reservoir fluids out of the well bore and pump high density cement into place above the reservoir. If appropriate and completion components installed in the well allow, then the intermediate barrier will also be circulated into place during this phase.
- **Phase 2: Coil Tubing Barrier Placements**: Reservoir isolation will be achieved by placing the required barriers through coil tubing to ensure isolation. If appropriate and the completion components installed in the well allow, then the intermediate barrier will also be circulated into place during this phase.
- **Phase 3**: **Conventional Abandonment:** Reservoir isolation will be achieved by removing the production tubing, setting the required barriers via a work string to ensure isolation of the reservoir.
- **Phase 4: Tubing, Casing, Upper Barrier Placement and Conductor Recovery:** A surface abandonment plug will be set to complete abandonment of the well. Conductors will be cut

below the footings elevation leaving a section of the conductor in-situ. Casings and conductors will be cut by either a mechanical or abrasive cutter and sections will be recovered to the surface for transport to shore. Marine growth will be cleaned from the conductors using a high pressure jet cleaner as they are pulled onto the platform.

2.5.3 Engineering Down, Cleaning and Topsides Preparation

EDC is the preparatory work required on all systems, plant and equipment to ensure that, as far as possible, the platform is free of bulk hydrocarbon fluids, gases and hazardous materials. EDC ensures that during preparations and final removal of the topsides and jacket, no hazards from the production, operating or cleaning elements remain and that the topsides are handed over in a clearly defined and documented condition to facilitate future work.

Engineering-down involves the shutdown of all plant, equipment and systems including mechanical, electrical, instrumentation, piping systems and pipelines which will enable the removal of any safety or environmental hazards prior to decommissioning activities. Prior to CoP, it is possible that EDC activities may commence on some of the systems or subsystems which are currently redundant. Following CoP, the remaining systems will be gradually shut-down following the NNP decommissioning shutdown strategy. The EDC process will run concurrently with the well P&A and conductor recovery phase.

As a result of the proposed offshore cleaning work, the bulk of hydrocarbons, Naturally Occurring Radioactive Material (NORM), process chemicals, sand, scale, sludge and other contaminants will be removed from within process systems. CNRI expect that flushing, draining, venting and purging of the topsides will be sufficient to remove the majority of the mobile hydrocarbons from the systems. These processes are also expected to minimise the safety and environmental hazards on the platform, and achieve a level of cleanliness acceptable to the contractors who will receive the waste onshore. No prescriptive standard exists for the required cleanliness of equipment to be returned onshore for reuse or disposal; this will be determined by CNRI based on industry experience, technical feasibility and their internal objectives and goals (WGPSN, 2012).

The topsides will be prepared for removal by executing a variety of activities including:

- Piece-small removal of loose or special items.
- Separation of pipework, process equipment and utilities.
- Installation of temporary safety and habitation systems (e.g. lighting, fire protection etc.).
- The installation of lifting points.

EDC will be conducted over a 24 month period, with some activities taking place in parallel with well P&A. During the 24 month period additional equipment may be required on the platform to complete the EDC and topsides preparation, including:

- 1 x diesel power generator.
- 1 x diesel driven compressor.
- 1 x diesel pump.
- 1 x temporary crane

2.5.4 Idle Phase

After EDC, it is possible that the NNP will have to be put into idle phase until the arrival of the topsides removal contractor. During this phase the platform will not be manned, but periodic inspections will be conducted to maintain the required temporary plant and navigation aids. This phase may last up to 24 months (CNRI, 2012b).

2.6 Options for Decommissioning the NNP

This section describes the removal methods being evaluated for the dismantling and removal of the NNP and the drill cuttings pile from their present locations and provides a brief outline of the engineering procedures that would be used for each method.

2.6.1 Topsides Decommissioning Options

The NNP topside modules will be completely removed and returned to shore for reuse, recycling and disposal. CNRI considered two different options for the removal of the topsides. These topside options are evaluated within the EIA so that the relative advantages and disadvantages of the different options for full removal can be compared and any potential environmental impacts are identified. The options being considered for topsides removal are:

1. Reverse installation.
2. Single lift

1. Reverse installation

Reverse installation would involve the removal of the topsides module-by-module. Modules would be separated from each other and then removed by a HLV and transported back to shore on the HLV or a barge for subsequent offloading, dismantling, reuse, recycling and/or disposal.

Module separation

Prior to removal, modules would be separated by cutting the interconnecting primary and secondary steelwork, piping, electrical cables (including cable trays and ladder racks), air and exhaust ducting, walkways and stairwells that connect them. The following cutting techniques could be used:

- Plasma cutting for duplex and stainless steel.
- Flame cutting in the absence of hazardous materials.
- Cold cutting techniques such as air powered drill, reciprocating saw, bevel machine, diamond wire or shear cutter.

Preparation for lifting

Access and rigging platforms would be installed to support the slings and to facilitate access to the sling eyes and lifting points. This would enable safe attachment of the slings and shackles.

New lift points would be installed if the original module lift points had been removed following installation; they would be installed in the same location as the original points to maintain the correct load path. Since each module is secured to the module or support frame below it and to adjacent modules, these welds would have to be cut to allow modules to be removed independently. It might be necessary to install structural reinforcements, in areas where structural steel has been removed, to ensure that modules could be removed safely.

There may be alternative options to the method outlined above but that will depend on the method selected by the removal contractor.

Module lifting

An HLV would be used to lift the individual modules and structures from the topsides onto the deck of the HLV or onto cargo barges for transportation to shore. Appropriate sea-fastenings would be designed and installed to the HLV or barges.

Table 2.7 provides an overview of activities and types of vessels that would be required for reverse installation decommissioning of the topsides. The durations and fuel consumptions are detailed in CNRI (2012b).

Table 2.7: Summary of activities and vessels required for topsides reverse installation

Sequence of event
Manufacture of approximately 150 tonnes of temporary steelwork
Mobilisation of vessels (HLV, HLV support vessels, supply vessel, standby vessels)
Preparation of topsides modules
HLV lift of topsides modules
HLV sailing to offloading location in sheltered waters
Mooring of cargo barge to HLV
Transfer of modules from HLV to cargo barge
Transportation and offloading of recovered modules to shore
Demobilisation of vessels
Dismantling of recovered material

Source: CNRI (2016a)

2. Single Lift

Single lift of the topsides utilises a Single Lift Vessel (SLV) capable of lifting the whole topsides in one lift. Following a preparatory campaign, the SLV would arrive at NNP, clamp onto the jacket legs then lift the entire topsides in one lift. The topsides would be separated from the jacket by a series of cuts undertaken prior to the arrival of the SLV. The SLV would transport the topside to a nearshore location for transfer to a barge, which would then transfer the topsides to the onshore demolition yard.

Topside preparation phase

Prior to the arrival of the SLV, the topsides are required to be prepared for the single lift operations. This may involve additional steelwork to strengthen the topsides for the lift and transportation phases. There may be the additional requirement to remove sections of the topsides that are not feasible to strengthen (eg. flare boom, drilling derrick). A number of cuts to the jacket can be performed prior to the arrival of the SLV to separate the topsides from the jacket. Any final cuts will be performed when the SLV arrives at the NNP.

Table 2.8 provides an overview of activities and types of vessels that would be required for decommissioning of the topsides by single lift. The durations and fuel consumptions are detailed in CNRI (2012b).

Table 2.8: Summary of activities and vessels required for single lift of topsides

Sequence of event
Manufacture of approximately 95 tonnes of temporary steelwork
Removal of secondary steelwork underdeck to avoid clashing with SLV lifting clamps
Piece small removal of topsides structure not suitable for sea transportation
Cut jacket legs. Retain sufficient strength
Mobilisation of vessels (SLV, SLV support vessels, supply vessels, standby vessels)
Position SLV around platform
Extend lift beams and engage clamps onto jacket legs
Tension clamps around jacket leg
Lift topsides clear of jacket. Deballast vessel
Sea-fasten topsides to SLV
SLV sailing to offloading location in sheltered waters
Mooring of cargo barge to SLV
Transfer of topside from SLV to cargo barge
Transportation and offloading of recovered modules to shore
Demobilisation of vessels
Dismantling of recovered material

Source: CNRI (2016a)

2.6.2 Jacket Decommissioning Options

The NNP jacket weighs more than 10,000 tonnes, therefore is a candidate for derogation under OSPAR Decision 98/3. Consequently, there are two main options for the decommissioning of the jacket:

- Full removal.
- Partial removal.

Removal options for the full and partial removal of the jacket use the same method, equipment and techniques and only differ in the height of cut, the number of lifts and the maximum weights of the lifted pieces.

Cutting and lifting

The jacket members would be cut into sections using a combination of the cutting techniques. Each jacket section would be held in place on the end of a lifting strop from a crane during cutting operations, and, after separation from the remainder of the jacket, would be lifted by an HLV. Once jacket sections have been separated and lifted to the surface, they would be sea-fastened and transported to an onshore disposal yard, either on dedicated transportation barges or on the HLV.

For both the full and partial removal options, the upper section of the jacket, above the jacket footings, would be removed at between -77.5 m and -88.5 m depth in several sections. CNRI has determined that this is the closest height above the top of the jacket piles where the necessary cutting equipment can safely be deployed and positioned. In the full removal option, the jacket footings would then be cut into sections and removed down to the seabed. The piles in the seabed would be cut at a depth of 3 m below the seabed so that the seabed is left clear of obstructions.

It is likely that the programmes of work for both complete and partial removal would employ all of the following cutting methods:

- **Diamond Wire Cutting (DWC):** A diamond wire cutter uses a loop of steel wire bearing small beads embedded with diamond particles. DWC techniques will be used for jacket members with diameters larger than 1,400 mm and wall thicknesses up to 63 mm. The diamond wire is carried on a framework which is clamped onto the jacket legs to hold the wire in position during cutting.
- **Abrasive Water Jetting (AWJ):** An abrasive jet cutter produces a very high pressure jet of water mixed with grit. The jet is usually mounted on a carriage running over a rail clamped around the leg or brace to be cut. AWJ can be used for jacket legs with no internal stiffening or internal piping. Both external and internal cutting machines are available.
- **Hydraulic shear:** Hydraulic shears are used for cuttings smaller braces up to 1,400 mm diameter.

The above dimensional criteria are based on currently identified equipment, recognising that items of larger capacity may come into future service. Both the internal AWJ and external cutting DWC manipulators will include a feature to perform a castellated and/ or stepped cut. The use of castellation on the external AWJ manipulators is subject to the results of the verification tests. It is not anticipated that explosives would be required to cut jacket members.

Table 2.9 provides an overview of activities and types of vessels required for the full removal of the jacket; durations and fuel consumptions are detailed in CNRI (2012b), while Table 2.10 provides an overview of activities and types of vessel required for partial removal.

Inventory of materials associated with jacket decommissioning

Table 2.11 provides a summary of the quantities of materials that would be recovered and left in situ for the different options being considered for the decommissioning of the NNP jacket.

Table 2.9: Operations and vessel requirements for jacket full removal by cutting and lifting

Sequence of event
Manufacture of approximately 350 tonnes of temporary steelwork
Mobilisation of vessel spread comprising HLV, construction support vessel (CSV) and standby vessels
Preparation of jacket top sections
HLV removal of jacket top sections
Transportation and offloading of jacket top sections to shore
Removal of cuttings pile
Preparation of jacket footings
HLV removal of jacket footings
Transportation and offloading of jacket footings to shore
Demobilisation of vessels
Dismantling of recovered material
Recovered material to recycling site or landfill

Source: CNRI (2016a)

Table 2.10: Operations and vessel requirements for jacket partial removal by cutting and lifting

Sequence of event
Manufacture of approximately 350 tonnes of temporary steelwork
Mobilisation of vessel spread comprising HLV, CSV and standby vessels
Preparation of jacket top sections
HLV removal of jacket top sections
Transportation and offloading of jacket top sections to shore
Demobilisation of vessels
Dismantling of recovered materials
Recovered material to recycling site or landfill

Source: CNRI (2016a)

Table 2.11: Amounts of materials that would be left in place or recovered in different decommissioning options for the NNP jacket

Removal component	Installed weight (tonnes)	Partial removal (at height of footings)		Full removal
		Recovered weight (tonnes)	Mass left in situ (tonnes)	
Jacket	8,487	4,324	4,154	8,478
Piles	3,550	1,222	2,328	3,550
Grout	879	329	550	879
Concrete	684	502	182	684
Anodes	1,970	1,005	965	1,970
Marine growth	0	2,117	[TBC]	2,117
Total	**15,561**	**9,499**	**8,179**	**17,678**

Source: CNRI (2016a), weight of marine growth taken from BMT Cordah, 2016c estimated in 2011.

2.6.3 Decommissioning Options Considered for the Cuttings Pile

During 2011, CNRI conducted a pre-decommissioning environmental survey which included measurements of cuttings pile volume and total hydrocarbon concentrations (Section 2.1.4). In addition, CNRI undertook a Stage 1 OSPAR screening assessment of the NNP cuttings pile. The Stage 1 screening assessment indicated that the pile falls well below the OSPAR thresholds for oil release rate (10 tonnes/ yr) and area persistence (500 km^2 years), and as such would not be subject to a formal Stage 2 assessment.

As a result, OSPAR Recommendation 2006/5 indicates that natural degradation in situ is considered to be the best environmental strategy. The NNP jacket footings are, however, embedded within the drill cuttings pile which is almost wholly located within the base of the jacket structure. If the NNP jacket were to be removed completely, the entire drill cuttings pile would have to be excavated and removed or displaced to allow the jacket footings to be cut and the lower bracings to be released.

Consequently, in addition to the “Leave in situ” option a further four options for the removal or displacement of the NNP drill cuttings pile have been considered. The five decommissioning options for the NNP drill cuttings pile (Table 2.5) include:

- Recover drill cuttings to platform surface, separation of cuttings offshore, liquids treated and released offshore, solids transported for onshore disposal.
- Recover drill cuttings to platform surface, transport slurry to shore, separation and treatment onshore for disposal.
- Recover drill cuttings to platform surface, disposal through a cuttings re-injection (CRI) system to an existing well.
- Dispersion/ of the drill cuttings on the seabed.
- Leave in situ for natural degradation.

2.6.4 Onshore Dismantling and Disposal

Methods available for dismantling

The onshore decommissioning yards where the NNP will be dismantled for recycling and disposal has not been identified, and will be determined during the platform removal contracting process. Whilst the specific dismantling activities and location for the NNP cannot be detailed at this stage of the project, the likely operations that would be conducted during the onshore dismantling of the installation have been identified.

Many of the dismantling operations would be common to both the jacket and the topsides. However, the potential for the presence of very small amounts of residual hazardous substances is unique to the topsides, and the large size of the jacket members makes dismantling this structure technically difficult. All the operations relating to the dismantling, handling, storage, transportation and disposal of materials or structures onshore will be covered by the provisions of existing legislation in the UK, EU or Norway. Prior to transportation to the dismantling yard, the platform would be cleaned during EDC process (Section 2.5) so that only small amounts of loose material and hydrocarbons remained in vessels and pipework.

Operations onshore to dismantle the topsides

Prior commencing the dismantling of the topsides, hazardous waste material not removed during the offshore phase will be removed, using controlled processes. Dismantling of the bulk of the topsides onshore would probably be undertaken using remotely controlled hydraulic shears to minimise the safety risks for onshore personnel. The use of gas cutting may, however, also be appropriate. Other equipment required for the dismantling operations would include: tower cranes, crawler cranes, long-arm and short-arm hydraulic nibblers, bobcats, power plants and possibly burning equipment.

It is possible that small amounts of residual hydrocarbons or environmentally hazardous liquids may be released during these operations. Such releases may include substances that were not found during the pre-dismantling investigations. Appropriate bunding shall be in place around the dismantling pad and an emergency response plan would be prepared to deal with any such contingencies.

Operations to dismantle the jacket and footings

The steel jacket will be dismantled using a combination of hot and cold cutting techniques. Depending on the decommissioning methods selected, some of the sections from the jacket will weigh up to 2,000 tonnes, and their dismantling will present considerable technical and safety challenges.

It may be necessary to remove the marine growth that may still adhere to the steel structures, if these present a safety risk, hygiene risk or environmental odour during the onshore dismantling process.

The dismantled equipment and structural components may be stored on site before removal to recycling centres or to final disposal sites. All hazardous equipment and structures will be stored in a specifically designed and secure compound. This compound shall be appropriately isolated from the environment, especially surface and ground water.

All material arising from the dismantling process will be transported from the dismantling site for ultimate recycling or disposal. Materials may be removed by barge, coaster or lorry to recycling plants, incinerators or landfill sites, as appropriate.

Disposal of material

CNRI will follow the principles of the waste hierarchy (Figure 2.5) in order to minimise waste production resulting from the NNP decommissioning activities.

Reduce and re-use opportunities

An extensive review of operational equipment and components by CNRI, has identified 12 items that could possibly be reused on NCP or Ninian Southern Platform (NSP) (WGPSN 2011). CNRI have also identified 296 items that can be sold for reuse wherever possible, either directly by CNRI, through a platform broker, or through the decommissioning contractor.

Recycling and reprocessing of waste material

Non-hazardous materials, such as scrap metal, concrete, plastic and wood, that are not contaminated with hazardous waste shall be removed and recovered for re-use or recycling. Steel and other scrap metal are estimated to account for the greatest proportion of materials inventory from the topsides, jacket and well abandonment. Recycling is therefore expected to be the most significant endpoint for materials recovered from the NNP.

Where necessary, hazardous waste resulting from the dismantling of the NNP will be pre-treated to reduce its hazardous properties or, in some cases, render it non-hazardous prior to recycling or landfilling. Under the Landfill Directive, pre-treatment will be necessary for most hazardous wastes which are destined to be disposed of to landfill sites. Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site.

Source: CNRI (2016a)

Figure 2.5: Waste Hierarchy

2.6.5 Long-term Monitoring Requirements for Materials Left in the Sea

The NNP owners will remain responsible for any components left in the sea as a result of an approved decommissioning programme, and some form of monitoring would be required. Any future monitoring programme would be undertaken following discussions and agreement with BEIS. The duration, frequency and nature of any such monitoring would depend on the characteristics and state of the material left on the seabed (including the nature and amounts of any contaminants on or in the components), as well as on future political and environmental concerns. It is therefore not yet possible to describe in detail what programmes might be undertaken to monitor structures; nor is it possible to describe the nature, extent and subsequent effects of any remedial activity that might be required.

2.7 Cumulative Impacts of Wider Field Decommissioning

The NNP owners have an inherent and recognised responsibility for understanding and mitigating against potential environmental and socioeconomic impacts. This includes the consideration of the potential for cumulative impacts should NNP be decommissioned in conjunction with the entire Ninian field. Short term impacts, such as noise and atmospheric emissions, are not predicted to have any additional impact if the Ninian field is decommissioned as a whole. Long term impacts, such as the persistence of the NNP drill cuttings pile, are not predicted to have an impact as the NCP is 6 km from NNP and the pile extent is only, approximately, 160 m in diameter (Figure 2.4). Detail pertaining to potential cumulative impacts is provided within the EIA assessment sections of this ES (Sections 6 to 11).

2.8 Recommended Decommissioning Options for the NNP and Drill Cuttings Pile

As described in Section 2.3.1, CNRI conducted a formal CA of the options for decommissioning the NNP jacket and drill cuttings pile, in order to determine the recommended decommissioning option for each facility (BMT Cordah, 2016b).

Table 2.12 provides an overview of the recommended decommissioning option for each of the NNP facilities, including those subject to a formal CA under the Petroleum Act 1998.

For the topsides two decommissioning methods are being considered for the recommended decommissioning option. The specific method for the decommissioning of this facility will be determined during the contracting phase of the project; therefore, the impacts associated with both decommissioning methods for the recommended option will be assessed in this ES.

Table 2.12: Overview of recommended decommissioning options for each facility

NNP facility	Recommended decommissioning option	Possible decommissioning method
Wells	P&A and conductor recovery	In accordance with the Oil and Gas UK Guidelines for the Suspension and Abandonment of Wells (2015)
Topsides	Full removal	Reverse installation, or Single lift
Jacket	Partial removal	Multiple lifts
Cuttings pile	Leave in situ	Natural degradation

3. ENVIRONMENTAL BASELINE

This section provides a description of the environmental setting of the NNP and an assessment of the environmental sensitivities in and around this location. An understanding of the environmental sensitivity will inform the assessment of the risks associated with the proposed decommissioning of the NNP.

3.1. Location of the NNP

The NNP is located in UKCS in the Ninian field, which extends over UKCS Blocks 3/3 and 3/8a (Figure 1.1). The NNP is located in Block 3/3, approximately 120 km east of the northern Shetland coastline, and 23 km from the UK/ Norway median line.

3.2. Environmental Surveys

A pre-decommissioning environmental survey and drill cuttings pile assessment for the NNP was conducted by CNRI in 2011. As there are no records of historical environmental surveys conducted in the Ninian field, data has been extrapolated from surrounding fields to support the 2011 survey with recent information.

Environmental survey data has been collected at the Hutton field in 2001 (pre-decommissioning), 2003, 2011 and 2016 (Fugro EMU, 2016). The Hutton field lies approximately 23km north of NNP in block number 211/27 and 211/28a (Figure 3.1) within a similar region of the North Sea. Spatially, the environment is very similar to that at NNP as the two fields are in close in proximity. Aspects such as currents, meteorology, sea temperature and sediment types are largely within their expected patterns for this region of the North Sea.

Overall, the physical characteristics of the surface sediments collected at the Hutton field in 2016 were comparable to the earlier post-decommissioning surveys and indicated a stable environment with some natural variations in sediment characteristics, similar to that identified by the 2011 survey at NNP. No evidence has been identified to suggest any major changes in the spatial distribution of the residual seabed cuttings deposits since completion of the decommissioning activities in 2003 (Fugro EMU, 2016). Therefore, a similar trend is likely to be present at NNP, given the homogeneous physical and chemical habitats present in the NNP and Hutton sites.

The spatial distribution of hydrocarbons at the Hutton field has been shown to decrease with time indicating that the environment is recovering from the anthropogenic inputs (in the form of drill cuttings contaminated with hydrocarbons), following decommissioning. Discharges from NNP that would have had an impact on the surrounding benthic environment ceased in 2001, other than those permitted under the Offshore Chemicals Regulations and the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations. Therefore, the NNP 2011 survey data can be interpreted as a 'worst case' in terms of the contaminants found in surrounding sediments around NNP.

In addition, pipeline and structural integrity surveys have been conducted in the Ninian field after the 2011 survey (Harkland ISS, 2014). Visual video stills from structural and pipeline surveys of the NNP carried out in 2011 (ISS, 2011), 2013 and 2014 (Harkand, 2013, 2014) and 2016 (DeepOcean, 2016), have demonstrated that the surrounding environment has not been affected by the activities from NNP (CNRI, 2016; Figure 3.1).

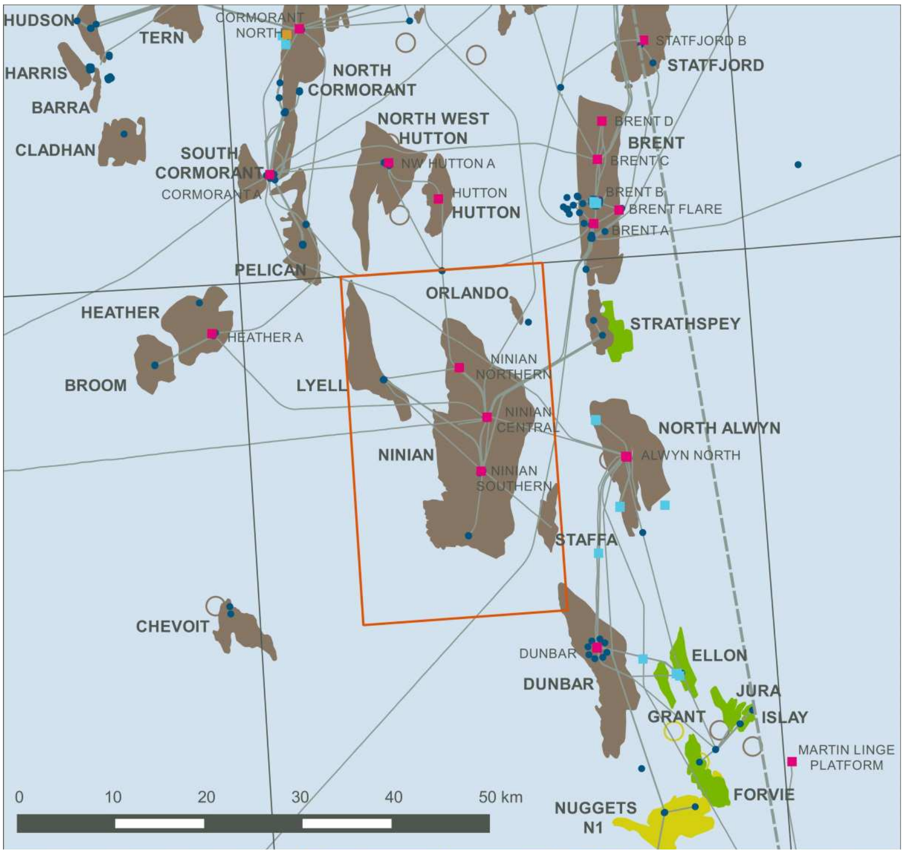


Figure 3.1: Map of Ninian Field and proximity to Hutton

The review of literature and assessment of video images indicates that the bathymetry around NNP remains consistent due to the lack of interference from changes to operations at the platform. For instance, the cuttings pile is consistently colonised with a layer of marine growth that has not altered since 2011 (Figure 3.2). As such, it can be concluded that in the absence of any physical interference to the area surrounding NNP the 2011 seabed survey data still represents an accurate depiction of the state of the environment in 2016.

An assessment has been made within this ES (Section 3.4.9) to demonstrate that there are no Annex 1 habitats in the immediate vicinity of NNP and that the operations at NNP are not capable of affecting any protected feature of any NCMPA areas (Figure 3.11).

The following sections include relevant aspects of other recent surveys and data sources in addition to the pre-decommissioning survey conducted in 2011.

3.2.1. Ninian Pre-Decommissioning Environmental Survey

Integrated Subsea Services Limited (ISS) conducted the pre-decommissioning environmental survey in April and May 2011, with sampling support from Fugro ERT, a division of Fugro GeoConsulting Limited (Fugro ERT, 2011). The main survey objectives were to measure the footprint, dimensions, topography and volume of the drill cuttings piles and characterise the physio-chemical and biological status of the piles and surrounding sediments.

Grab sampling (using a dual van Veen grab) was completed around the platform based on a cruciform plan with the major transects aligned to the main residual current. Twenty-three stations were sampled including a reference station positioned 10,000 m from the platform (Figure 3.3). A remotely operated vehicle (ROV) collected three inner push cores samples from the top 50 cm of the drill cuttings pile. Surface sediment was sampled from the van Veen grabs and from inner push core samples for sediment characterisation, and analysis of chemical contaminants and faunal composition.

3.2.2. Acoustic and ROV Survey

Acoustic and ROV surveys of seabed, drill cuttings pile, pipelines and infrastructure were also conducted (ISS, 2011). *Lophelia pertusa* samples were collected by ROV from the legs of the NNP. A MBES and side scan sonar (SSS) fitted to the ROV were used to produce a debris map of the 500 m area and identify any possible targets such as seabed features (ISS, 2011). Structural surveys of NNP conducted in 2011, 2013 and 2016 indicate that the presence and appearance of the cuttings pile has not altered. Pipeline surveys from 2011 and 2014 show no significant changes to the surrounding seabed. Example images from these surveys are shown in Figure 3.2.

<table>
<tr><th>Time Period</th><th>Base of NNP</th><th>Sediment Surrounding NNP</th></tr>
<tr><td>2011</td><td>


Ninian North -139.5m showing member embedded in cuttings pile, ISS 2011
</td><td>


Image of seabed surrounding anode at NNP, ISS, 2011
</td></tr>
<tr><td>2013/ 2014</td><td>


-141m showing member embedded in cuttings pile, Harkand 2013
</td><td>

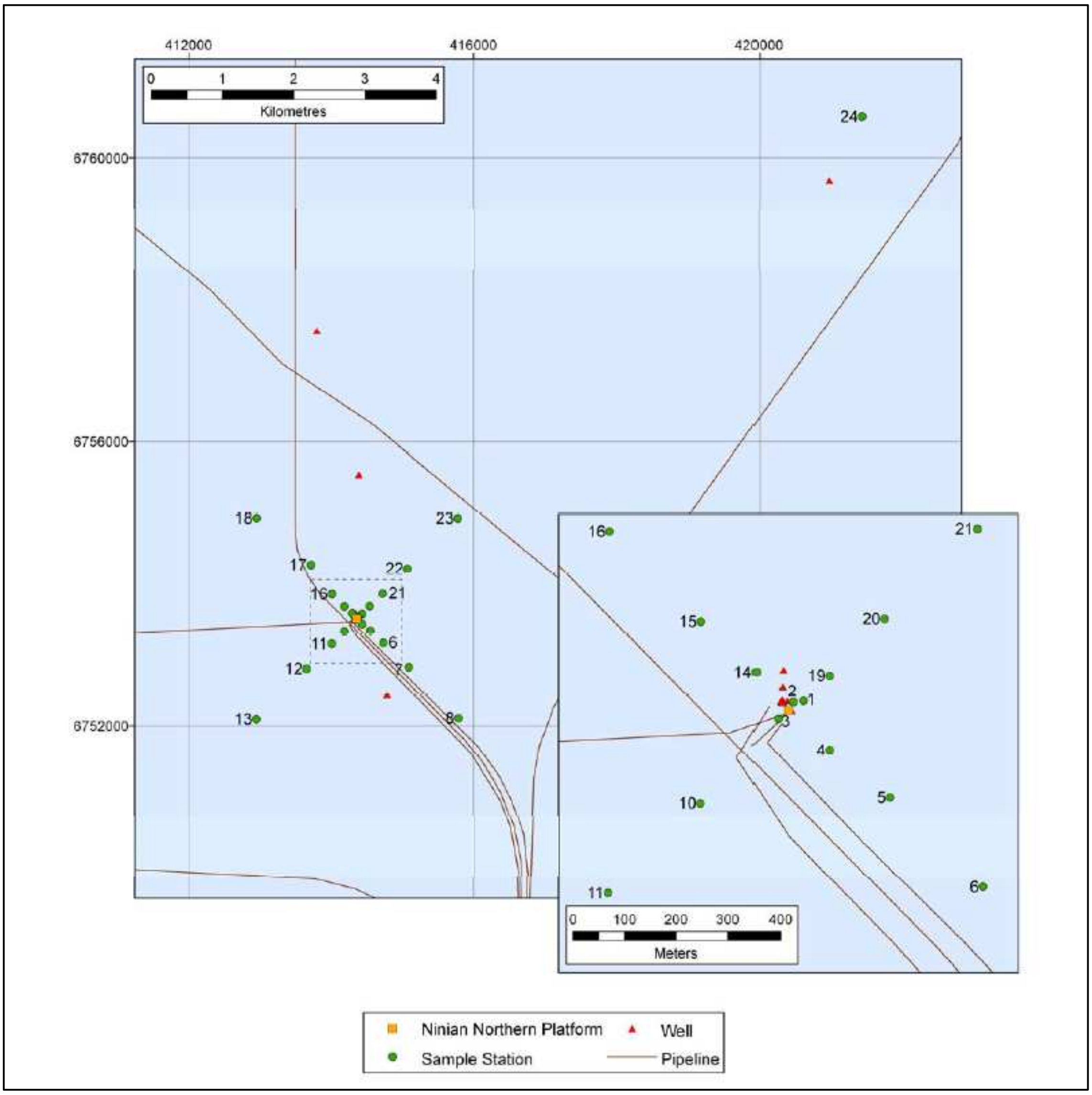

Image of PL115 at NNP, Harkand, 2014
</td></tr>
<tr><td>2016</td><td>


2016 - Member in burial at -141m DeepOcean, 2016
</td><td></td></tr>
</table>

Figure 3.2: ROV images taken from surveys between 2011 and 2016 at NNP

3.2.3. Marine Growth Surveys

Subsea inspection and marine growth surveys of the NNP were carried out in 2003 and 2011 by CNRI. The 2003 survey focussed on a jacket inspection only, while the 2011 survey provided video footage of both jacket members and conductors. An assessment of marine growth with depth was carried out for the NNP jacket in conjunction with a *Lophelia pertusa* conductor assessment in 2013 (BMT Cordah, 2016c). A ROV flooded member detection (FMD) and visual inspection was conducted by CNRI in 2013, however due to time constraints the marine growth survey was not completed (Harkand, 2013). A subsequent marine growth survey was conducted in 2016 (DeepOcean, 2016) which although did not provide an in-depth evaluation of the marine growth; identified that the general zonation pattern of marine growth was consistent between 2011 and 2016 (Section 3.4.4).



Source: Fugro ERT (2011)

Figure 3.3: Sampling stations locations in the NNP pre-decommissioning environmental survey, April/ May 2011

3.3. Physical and Chemical Environment

Characteristics of the bathymetry, currents, meteorology, sea temperature, salinity and seabed sediments in the area of the NNP are described in the following subsections.

3.3.1. Bathymetry

The North Sea basin is relatively shallow, varying from 30 to 200 m, with the deep Norwegian Trench in the northeast margin reaching approximately 700 m depth. Water depth in the UK northern North Sea varies between 50 and 200 m (NSTF, 1993).

The seabed depth across the Ninian Northern field ranges from approximately 140 m at Station 8 (2 km and 135˚ from NNP) to 146 m at Station 24 (10 km and 45˚ from NNP) (Fugro ERT, 2011). Seabed depth at the NNP is 141 m.

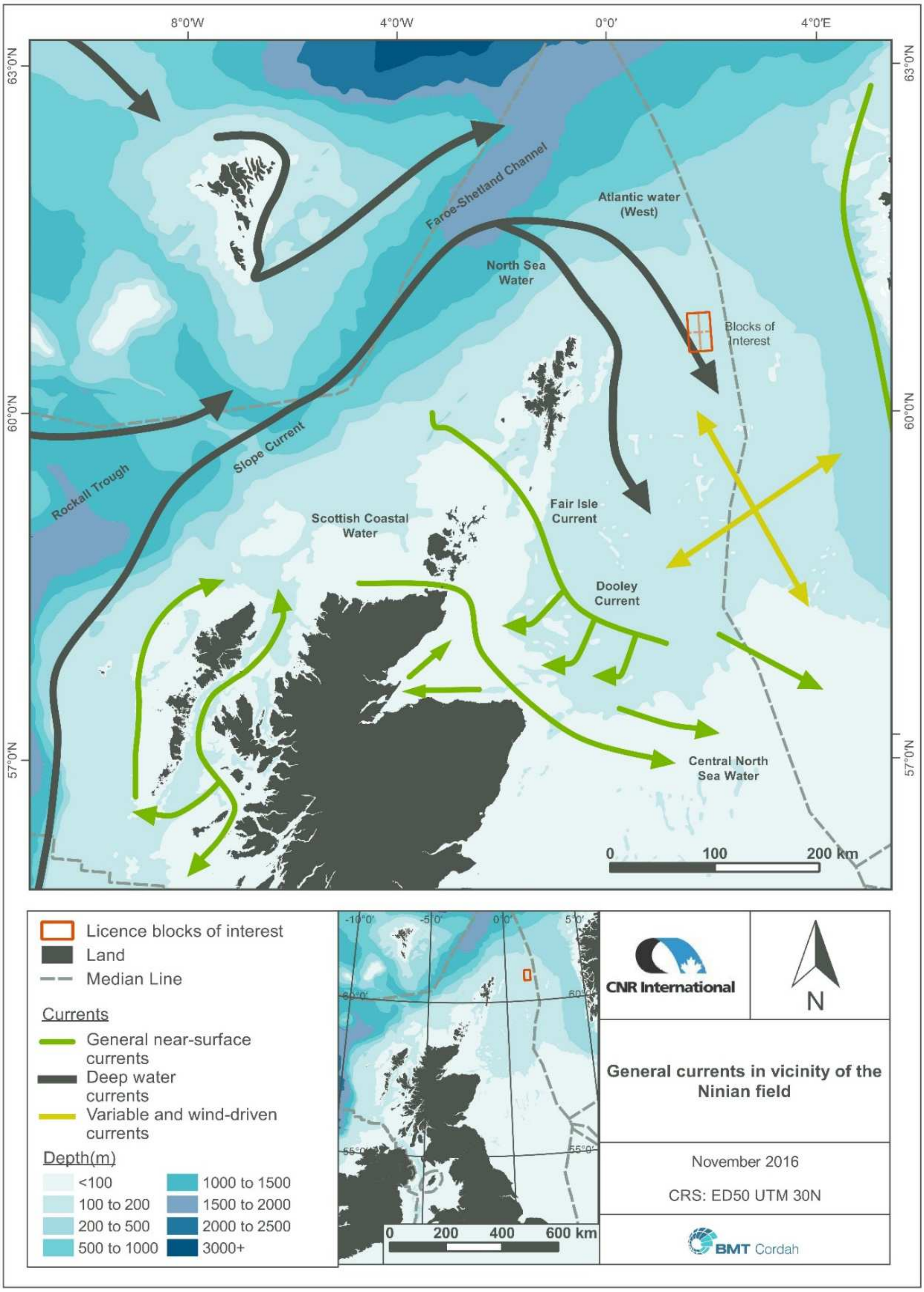
3.3.2. Currents

Several water masses exist in the North Sea with differing temperature, salinity and residual current patterns and/ or stratification. These different factors play a major role in the supply and dispersion of nutrients, plankton and fish larvae. The major water masses in the North Sea can be classified as Atlantic water, Scottish coastal water, northern North Sea water, Norwegian coastal water, Central North Sea water, Southern North Sea water, Jutland coastal water and Channel water (NSTF, 1993). The Ninian field is located in the area influenced most by the northern North Sea water mass (Figure 3.4).

Over most of the North Sea, maximum tidal stream speeds vary from 0.25 to 0.5 m/s and reach in excess of 1.0 m/s around the Orkney and Shetland Islands (UKDMAP, 1998). Tidal currents in the location of the NNP are typical of the northern North Sea, with relatively weak surface current velocities and mean spring tides ranging from 0.26 to 0.39 m/s (UKDMAP, 1998). Throughout the year the residual current speed reaches up to 0.1 m/s (UKDMAP, 1998). The annual mean significant wave height in Block 3/3 is 2.68 m, with a mean spring tide of 1.35 m (NMPI, 2016).

3.3.3. Meteorology

In the vicinity of the Ninian field winds vary seasonally and are characterised by large variations in wind direction and speed, frequent cloud and relatively high precipitation. The annual wind data indicates that winds in the area are multidirectional (Atkins, 2010). Winds from the south, southwest and west are generally predominant from April to June. The wind regime changes from August to February when the predominant wind direction is from the north (Atkins, 2010).



Source: UKDMAP (1998)

Figure 3.4: Water currents circulation in the vicinity of the Ninian field

3.3.4 Sea Temperature and Salinity

In the North Sea, water temperature is relatively uniform throughout the water column during the winter months. Over the summer months, the increase in solar radiation can result in a thermocline, which separates an upper warmer less dense surface layer from the denser cooler water below (Gill, 1982). The strength of the thermocline is determined by the intensity of the input of solar heat and wind and tide generated turbulence. The depth at which the thermocline occurs in the northern North Sea increases from May to September, to a maximum depth of, approximately, 50 m in August and September (NSTF, 1993).

Table 3.1 provides information on sea surface salinity and temperature variation in the Ninian field area. Mean sea surface temperature is around 13.5 °C in the summer and 7 °C in the winter. Mean bottom water temperature is less variable, at around 8 °C in the summer and 7 °C in the winter. The annual mean sea surface temperatures in Block 3/3 range from 7 to 13 °C, while the annual mean near seabed temperatures in Block 3/3 range from 6 to 8 °C (NMPI, 2016).

There is little seasonal variation in the salinity of the water column in the Ninian Field area, which is around 35 parts per thousand (ppt) (UKDMAP, 1998; NMPI, 2016).

Table 3.1: Typical values for temperature and salinity in the area of the NNP

Parameter	Summer	Winter	Annual
Mean Sea Surface Temperature (ºC)	13.5	7	9.6
Mean Bottom Temperature (ºC)	8	7	7.8
Mean Sea Surface Salinity (ppt)	34.75	35.3	35.2
Mean Bottom Salinity (ppt)	35.25	35.2	35.23

Source: UKDMAP (1998), NMPI (2016)

3.3.5. Seabed Sediments

Sediment types

Block 3/3 lies in an area of the northern North Sea where much of the sediment has historically been characterised as fine to coarse sand (Künitzer et al., 1992), with an approximate silt fraction of 5% and an organic fraction of 3% (Basford et al., 1990, Basford et al., 1989). Künitzer et al. (1992) is a general report characterising the sediment of the North Sea area and the characterisation specific to the surroundings of NNP was identified during the 2011 survey and is further detailed below.

Sediment samples collected during the April/ May 2011 NNP pre-decommissioning environmental survey consisted of very poorly to extremely poorly sorted very fine sand, and to a lesser degree fine sands, with mean diameters of 32 to 142 µm. The stations located close to the platform (Stations 2 and 3) were classified as medium to coarse silt, with mean diameters of 31 to 39 µm, suggesting an input of drill cuttings. The silt/ clay proportion in the samples near the platform ranged between 70.9 to 77.9%. The sediment sorting at those stations was poor to moderate (Fugro ERT, 2011). The proportion of fine silt/ clay material ranged from 18.5 to 70.8%, with silt material dominating (approximately 80% of total fines) in the samples further away from the platform.

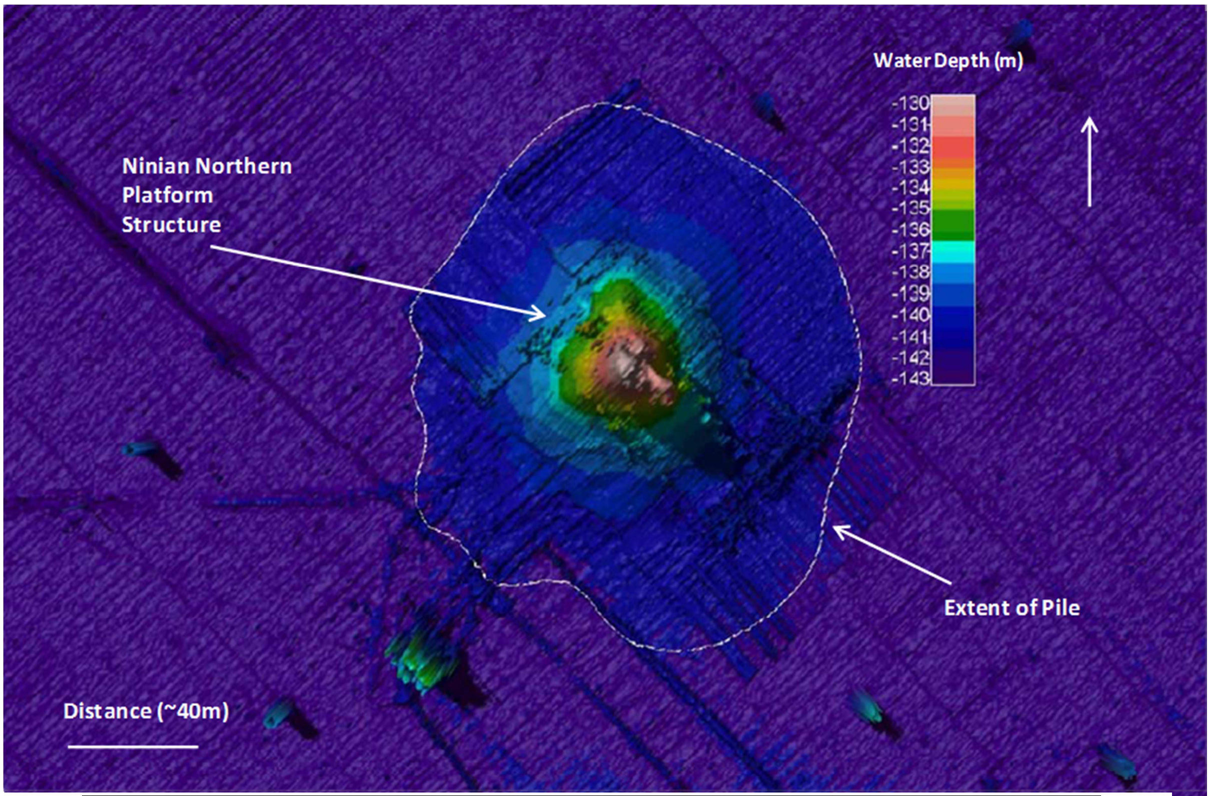
The organic matter content of the sediment ranged from 0.9 to 3.8% at all stations apart from the two innermost stations (2 and 3), where it was 5.5 and 4.9%, respectively. Total carbonate (as calcium carbonate) and organic carbon levels ranged from 20.9 to 26.8% and 0.4 to 1.5% for most of the stations. At stations close to the platform (2 and 3) total carbonate levels were 42.4 and 48.8% and organic carbon levels were 2.7 and 1.2%, respectively. The elevated proportion of fines, higher organic content and differing granulometry at the stations closest to the platform were attributed to drilling activity at the platform (Fugro ERT, 2011).

Seabed features and drill cuttings pile

Based on the findings of the 2011 survey, seabed features are dominated by the NNP drill cuttings pile and associated pipelines that run from the platform. There was no evidence of bedrock or biogenic reefs, pockmarks or unusual or irregular seabed forms (Fugro ERT, 2011). Across the 500 m ROV survey zone the site had a large amount of seabed debris most likely related to previous activity at the NNP (e.g. wire spools, cables, scaffolding) along with numerous boulders. Full details, including detailed images, can be found in the acoustic survey field report (ISS, 2011).

A MBES survey was conducted in 2011 in order to acquire sufficient data to map the drill cuttings pile below the NNP (Figure 3.5). As previously illustrated in Figure 2.3, the majority of drill cuttings were located directly under the platform, spreading out evenly in all directions with a small emphasis to the southeast of the platform (Fugro ERT, 2011; ISS, 2011). The seabed/pile base contour plane (i.e. the level where the drill cuttings pile and seabed merge) was at a depth of 141 m, while the top of the drill cuttings pile was at 129.07 m, giving an overall pile height of 11.93 m (ISS, 2011). The NNP drill cuttings pile volume was calculated as 33,144 m^3, based on the MBES topography mapping of the drill cuttings pile (ISS, 2011).

Three push cores (Stations 1 to 3; Figure 3.3) were sampled from the NNP drill cuttings pile for chemical and physical analysis and the results are compared with the contamination status found in the vicinity to the NNP (Table 3.2).



Feature	Description
———	Estimated boundary of cuttings pile to surrounding seabed based upon depth profile

Source: ISS (2011)

Figure 3.5: Extent of the NNP drill cuttings pile

Assessment of drill cuttings piles with respect to OSPAR 2006/5 Recommendations (2008)

The OSPAR recommendation 2006/5 sets out the management regime for offshore cuttings piles, with the purpose of reducing the impacts of pollution by oil and other substances within the pile to a level that is not significant. The management regime sets out criteria thresholds against which the level of pollution attributable to a historic drill cuttings pile may be measured to determine whether the level of pollution could be considered significant. These thresholds, detailed below, form the basis of the screening assessment detailed in Stage 1 of the management regime to determine if the pile requires further investigation. The thresholds are:

- Rate of oil loss to the water column: 10 tonnes/ year.
- Persistence over the area of seabed contaminated: 500 km^2year.

Where a cuttings pile falls below both of these thresholds and no other discharges have contaminated the cuttings pile, no further action is required. If either of the thresholds is exceeded, the Stage 2 assessment for Best Environmental Practice (BEP) or Best Available Technique (BAT) for the pile must be initiated (OSPAR, 2006).

ERT (2008) carried out a screening assessment of the state of the NNP drill cuttings pile. This was in response to the Department of Business Enterprise and Regulatory Reform's (BERR) implementation of OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles, introducing a two stage approach to the management of drill cuttings piles.

The ERT (2008) study estimated the:

- Volume of the NNP drill cuttings pile.
- Rate of oil loss from the drill cuttings pile.
- Surface area of contamination, defined as the area within which surface oil concentration exceeds 50 mg/kg.
- Persistence of the contamination.

These estimates were based on environmental survey data and regression analysis to establish statistical relationships between drill cuttings pile volumes, contamination areas and leaching rates, and parameters such as number of wells, water depth and volume of discharged drill cuttings for fields for which this data was available. These statistical relationships were then used to infer the drill cuttings pile volume, contamination area and leaching rate for the Ninian Northern field. It was concluded that the results of the NNP drill cuttings pile assessment should be "treated with caution" (ERT, 2008). Results of the analysis for samples taken from the cuttings pile from the recent sampling program are discussed in the following sections.

Seabed chemistry

Chemical analysis of the seabed (concentrations of metals and hydrocarbons) provides an indication of the condition of seabed sediments in the area of the proposed operations. Sediment chemistry is an important factor in ecological investigations, with areas of fine sediments acting as sinks which have the potential to release their contaminant load following disturbance. The principal sources of hydrocarbons in the marine environment are anthropogenic; however, contamination of the marine environment with crude oils is not a recent phenomenon, nor solely attributable to anthropogenic activities (Douglas et al., 1981).

Metals are generally persistent and most are toxic to varying degrees. Many essential metals such as copper, zinc and chromium may bio-accumulate with the potential to cause lethal and sub-lethal toxic effects in benthic organisms even when found in apparently low amounts (Clark, 1997). Metals typical of sediment contaminated with drilling muds or cuttings are barium, chromium, lead and zinc (Neff, 2004). By far the most abundant metal in most drilling muds is barium, found in the form of barite ($BaSO_4$). Generally, contamination by metals form muds and cuttings extends no further than 500 m from production platforms, but elevated concentrations of barium can be found within 500 to 1,000 m (CEFAS, 2001a). Monitoring sediment barium concentrations can provide information on the extent to which drill cuttings have been transported from their point of origin.

Table 3.2 shows the concentrations found in sediment samples taken by grab and core samples in 2011 in the NNP area (Fugro ERT, 2011). The table also provides typical values of contaminants found in surface sediments in the northern North Sea (CEFAS, 2001a), compared with expected background concentrations (BC) in "pristine" areas far from oil and gas installations (UKOOA, 2001; OSPAR, 2005a).

Table 3.3 summarises the results of sediment hydrocarbon analysis undertaken in the NNP area in 2011, with sampling stations at increasing distance from the platform. Table 3.4 summarises the results of polychlorinated biphenyls (PCBs), alkylphenol ethoxylates (APEs) and organotin analysis; and radionuclide levels in surface sediments. Table 3.5 summarises the metal concentration analysis from the same study (Fugro ERT, 2011).

The hydrocarbon analysis of the grab sample sediments from the 2011 survey indicated the samples were generally similar to each other, exhibiting a hydrocarbon distribution typical of low/ mid-level weathered petroleum residues found in northern North Sea sediments (Fugro ERT, 2011).

Table 3.2: Summary of contaminant concentrations typically found in surface sediments from the northern North Sea compared with those found within the NNP survey area

Location	THC (µg/g)	PAH (µg/g)	PCB (µg/kg)	Ni (µg/g)	Cu (µg/g)	Zn (µg/g)	Cd (µg/g)	Hg (µg/g)	Ba (µg/g)
Ninian Northern 2011 survey (min-max) [mean]	8.5-1390 [137]	0.035-0.342 [0.164]	<0.10-0.24 [<0.21]	11.5-32.5 [15.5]	12.1-181 [36.5]	23.1-1238 [201]	0.06-1.72 [0.29]	<0.03-2.05 [0.81]	212-4201 [2267]
Drill cuttings core 1**	24,700	2.45	-	-	-	-	-	3.08	-
Drill cuttings core 2	96,300	347	<0.001	31.1	56.0	979	2.05	2.45	154,000
Drill cuttings core 3	38,400	78.7	<0.001	22.2	39.6	618	1.02	3.01	142,000
Estuaries*	-	0.2-28	6.8-19.1	-	-	-	-	-	-
Coast*	-	-	2	-	-	-	-	-	-
Offshore*	17-120	0.2-2.7	<1	9.5	3.96	20.87	0.43	0.16	-
Oil and Gas Installations*	10-450	0.02-74.7	1,917	17.79	17.45	129.74	0.85	0.36	-
BC in northern North Sea (UKOOA, 2001)	10.82 (20.32)**	0.123 (0.30)	-	10.86 (12.40)	3.57 (5.40)	12.14 (13.00)	-	-	332.38 (637.50)
Maximum expected BC (OSPAR, 2005a)	-	-	-	30	-	90	0.2	0.07	

(BC) - maximum expected background concentration, normalized to 5% aluminium if the environment were pristine, OSPAR (2005a)
* mean BC (µg/g); [bracketed value represents the 95th percentile]
** values for drill cuttings cores (stations 1, 2 & 3) represent a mean
Source: CEFAS (2001a); UKOOA (2001); OSPAR (2005a); Fugro ERT (2011)

Table 3.3: Summary of sediment hydrocarbon analysis from the NNP environmental survey 2011

Distance of sampling station from NNP (m)	Station numbers	THC (µg/g)	UCM (µg/g)	n-alkanes (µg/g)			CPI			Pristane (µg/g)	Phytane (µg/g)	Pr/Ph ratio	2 to 6 ring PAH (ug/g)
				nC12-20	nC21-36	nC12-36	nC12-20	nC21-36	nC12-36				
Drill cuttings core Station 1*	1	24,700	15,200	3,660	110	3,770	0.81	1.34	0.82	56.1	41.7	1.4	2.45
Drill cuttings core Station 2	2	96,300	67,500	10,100	303	10,400	0.75	0.46	0.74	138	93.6	1.5	347
Drill cuttings core Station 3	3	38,400	8,750	26,900	24.3	26,900	1.76	3.24	1.76	5.02	2.72	1.9	78.70
0 (n=3)1**	1, 2 & 3	53,133	30,483	13,553	145.8	13,690	1.11	1.68	1.11	66.37	46.0	1.6	142.72
100 (n=3)	4, 14 &19	829	458	7.6	4.36	11.9	0.8	1.2	0.98	0.5	0.6	0.96	0.28
250 (n=4)	5, 10, 15 & 20	27.0	23.8	0.2	0.7	1.0	1.1	1.1	1.1	0.03	0.02	1.4	0.20
500 (n=4)	6, 11, 16 & 21	12.0	10.5	0.04	0.4	0.4	0.9	1.2	1.1	0.009	0.004	2.2	0.10
1,000 (n=4)	7, 12, 17 & 22	11.7	10.3	0.03	0.4	0.4	1.0	1.2	1.2	0.003	0.003	1.9	0.12
2,000 (n=4)	8, 13, 18 & 23	9.9	8.6	0.02	0.3	0.3	1.0	1.2	1.2	0.005	0.002	2.3	0.09
10,000 (n=1)	24	10.9	9.4	0.02	0.42	0.44	1.01	1.28	1.27	0.006	0.002	2.7	0.12

Concentrations expressed as µg/g dry sediment

Note: 0 m = push core samples of drill cuttings pile; 100 -10,000 m = grab samples of sediment; n=number of stations at each distance;
* values for drill cuttings cores (stations 1, 2 & 3) represent a mean
** for multiple samples from the same distance mean levels are given

Key

THC	Total Hydrocarbon concentration (sum of resolved/unresolved material from nC12 to nC36)
UCM	Unresolved Complex Material (concentration of unresolved material from nC12 to nC36)
CPI	Carbon Preference Index
PAH	Polycyclic Aromatic Hydrocarbons (total 2 to 6 ring PAH and alkylated species)

Source: Fugro ERT (2011)

Table 3.4: Summary (mean levels) of sediment PCB, APEs and organotin analysis and gross alpha/ beta radionuclide levels in surface sediments from the NNP environmental survey 2011

Distance of sampling station from NNP (m)	Station numbers	PCB: Total ICES7 (ng/g)	Total APEs (ng/g)	MBT (ng/g)	DBT (ng/g)	TBT (ng/g)	Total Organotins (ng/g)
0 (n=2)1	2 & 3	0.74	2650	<0.7	4.4	8.3	13.9
100 (n=3)	4, 14 & 19	0.45	654	<0.4	10.2	7.1	17.4
250 (n=4)	5, 10, 15 & 20	0.45	67.2	<0.4	1.1	1.2	2.1
500 (n=4)	6, 11, 16 & 21	<0.1	42.8	<0.4	<0.4	<0.4	<0.4
1,000 (n=4)	7, 12, 17 & 22	<0.1	27.3	<0.4	<0.4	<0.4	<0.4
2,000 (n=4)	8, 13, 18 & 23	<0.1	32	<0.4	<0.4	<0.4	<0.4
10,000 (n=1)	24	<0.1	16.8	<0.4	<0.4	<0.4	<0.4

Note: 0 m = push core samples of drill cuttings pile; 100-10000 m = grab samples of sediment; 1 n=number of stations at each distance;

Key:

PCB	polychlorinated biphenyls
APEs	alkylphenols/phenolethoxylates
MBT	monobutyltin
DBT	dibutyltin
TBT	tributyltin

Source: Fugro ERT (2011)

Total Hydrocarbon Concentration (THC)

Overall distribution of the THC concentrations across the sampling stations in the Ninian Northern survey area is shown below in Figure 3.6. Total hydrocarbon levels in the Ninian Northern area ranged from 8.0 µg/g at Station 17 to 1,390 µg/g at Station 14 (mean 137 µg/g), while those within the drill cuttings pile ranged between 24,700 µg/g to 96,300 µg/g (Fugro ERT, 2011). Within 250 m of the NNP the values exceed the background concentrations for THC in proximity to oil and gas installations (CEFAS, 2001a).

Correlations between the chemical values and distance from the platform, as well as with biological data were undertaken to identify relevance or indicators within the data set. A strong negative correlation (99.9%) exists between THC and distance from the platforms. Conversely, strong positive correlations were noted between THC and the hydrocarbon components (i.e. UCM, n-alkanes, polycyclic aromatic hydrocarbons (PAH) and naphthalenes, phenanthrenes, dibenzothiophenes (NPD)).

Additional strong positive correlations were observed between THC and nonylphenols, TBT, total barium, aluminium, cadmium, lead and 226Ra. A negative correlation (95.0%) was reported between THC and the number of species (Fugro ERT, 2011). In general, this supports the conclusion that contamination from THC (anthropogenic sources) decreases as you move away from the platform and that biological diversity increases. The North Sea Quality Status Report (NSTF, 1993) found that typical THC levels (i.e. 'background') in sediments remote from anthropogenic activities range from 0.2 µg/g to 5 µg/g, although in some areas values may be as high as 15 µg/g (Fugro ERT, 2011).

Table 3.5: Summary (mean levels) of elemental concentrations in surface sediments from the Ninian Northern pre-decommissioning environmental survey 2011

Distance of sampling station from NNP (m)	Metal (ug/g)														
	Al	As	Ba	TBa[2]	Cd	Cr	Cu	Fe	Hg	Li	Mn	Ni	Pb	Sr	V	Zn
0 (n=2)[1]	16,660	11.77	460	148,000	1.53	43	47.8	30,820	1.86	13.54	655	26.65	204	428	44.7	798.5
100 (n=3)	15,073	23.99	1,525	58,000	1.2	86.6	112.1	32,946	0.87	1.91	314.66	26.7	259.96	514	62.03	859.33
250 (n=4)	6,289	5.76	3,976	5,925	0.25	29.52	43.87	10,483	0.86	<0.0005	158.75	14.97	39.15	519	22.65	235.75
500 (n=4)	5,853	3.40	3,021	1,755	0.12	21.07	31.65	9,242	0.34	<0.0005	146.75	14.15	14.67	560.75	17.85	58.8
1,000 (n=4)	5,889	2.87	1,798	1,067	0.08	20.02	15.07	8,095	0.14	0.17	149.25	12.87	10.14	518.5	16.37	31.5
2,000 (n=4)	5,993	2.79	1,629	850	0.08	20.27	14.85	8,184	0.09	<0.0005	149	12.1	10.03	526	17.42	27.77
10,000 (n=1)	5,617	3.33	904	550	0.08	20.2	16.2	8,488	<0.03	<0.0005	140	14.3	8.32	533	14.8	23.1

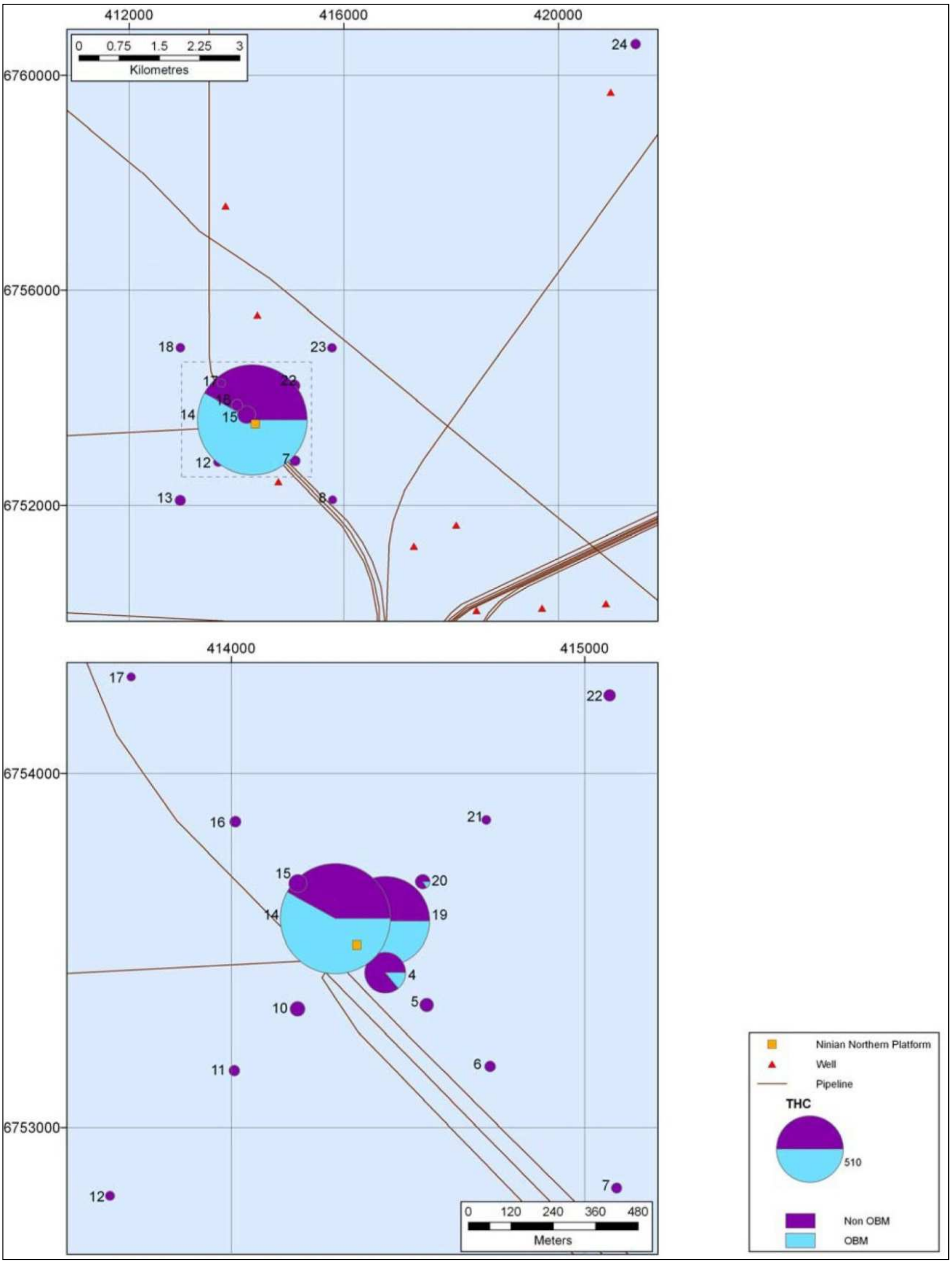
Concentrations expressed as µg/g dry sediment. 0 m = push core samples of drill cuttings pile;
100-10,000 m = grab samples of sediment;
1 n=number of stations at each distance; 2 TBa is result for total barium by alkali fusion technique

Key:

Al	aluminium
As	arsenic
Ba	barium
Cd	cadmium
Cr	chromium
Cu	copper
Fe	iron
Hg	Mercury

Li	lithium
Mn	manganese
Ni	nickel
Pb	lead
Sr	strontium
V	vanadium
Zn	zinc

Source: Fugro ERT (2011)



Source: Fugro ERT (2011)

Figure 3.6: THC distribution in grab samples (with expanded view) across the NNP pre-decommissioning survey area

Information obtained from a later (2016) environmental survey (Fugro EMU, 2016) at the Hutton field provides a consideration of the changes which may have occurred at NNP. As discussed in CNRI (2016b), the environment, including for THC levels, have remained relatively stable when compared to the 2011 survey. The main conclusions from this report state that the presence of drill cutting derived contamination remains within the 500 m of the platform with the magnitude of the seabed impact has decreased over time. Thus, in the absence of any physical disturbance around NNP, the data compiled in 2011 is likely to show a similar trend (CNRI, 2016b).

Unresolved Complex Mixture (UCM)

The UCM is composed of a mixture of hydrocarbons, which remain after substantial weathering and biodegradation of petrogenic inputs (Farrington et al., 1977; Fugro ERT, 2011) and can provide an indication of the origin of contamination. The presence of the UCM in the survey area (Table 3.3) suggests that there was a contribution to the sediments of weathered hydrocarbon material most likely originating from anthropogenic sources (Fugro ERT, 2011).

The results for n-alkanes nC_{12} to nC_{36}, were typically dominated by the odd carbon numbered compounds nC_{29} and nC_{31} suggesting biogenic origin. Total n-alkanes (nC_{12} to nC_{36}) in the grab samples ranged from 0.31 µg/g at Station 17 to 17.1 µg/g at Station 19 (mean 2.27 µg/g), while in the core samples the UCM values were 3,770, 10,400 and 26,900 µg/g at Stations 1 to 3, respectively (Fugro ERT, 2011).

Carbon Preference Index (CPI)

The ratio of odd to even carbon numbered normal alkanes is termed the carbon preference index (CPI), and was calculated over various chain length ranges (Table 3.3). The lower CPI (nC_{12-20}) values calculated (0.79 to 1.66 µg/g; mean 0.97 µg/g) corroborate the presence of the low-level chronic input of non-drilling related petroleum hydrocarbons in the wider background area sediments, as well as the drilling fluid contamination at stations closer to the platform. The higher CPI ($nC_{21–36}$) values observed (0.22 to 1.7 µg/g 5; mean 1.33 µg/g) show the influence of odd-chain length n-alkanes (nC_{27} to nC_{31}) typically associated with inputs from land run-off (leaf waxes etc.) (Fugro ERT, 2011).

Pristane/Phytane Ratio

The isoprenoidal alkanes pristane (Pr) and phytane (Ph) were found in all of the sediment samples analysed (Table 3.3). The ratio of these compounds is used as an indicator of the relative input of petroleum hydrocarbons where a ratio of less than or near one is generally indicative of anthropogenic origin (Cripps, 1989). These compounds are typically found in significant amounts in crude oils, although they may also be bio-synthesised. The Pr/Ph ratios measured in the sampled sediments overall ranged from 0.6 to 2.9 (mean 1.9) with those in the drill cuttings pile ranging between 1.4 and 1.9 (mean 1.6) (Table 3.3; Fugro ERT, 2011) being indicative of biogenic (crude oil) origin of contamination.

Polycyclic Aromatic Hydrocarbons (PAHs)

Monitoring aromatic hydrocarbon type and content is particularly important due to the toxic nature (mutagenic/carcinogenic) of several of PAHs even at low concentrations. Overall aromatic hydrocarbon levels (PAHs) in grab sample sediments collected during the 2011 survey ranged from 0.035 to 0.342 µg/g (mean 0.164 µg/g) (Table 3.3) and 2.45 to 347 µg/g (mean 142,7 µg/g) in the push core samples from the drill cuttings pile. A strong positive correlation (>99%) exists between the 2 to 6 ring PAH and the other hydrocarbon variables measured (THC, UCM, n-alkanes), with a weaker (<99.0%) positive correlation between the 2 to 6 ring PAH, the alkyl-phenols, TBT, sediment characteristics, selected metals and radium-226 (Fugro ERT, 2011).

From sampling stations beyond cuttings pile the mean Ninian Northern grab sediment (2 to 6 ring) PAH concentration levels (Table 3.2) were lower than the cited BC of 0.30 µg/g referenced in the UK Offshore Operators Association (UKOOA) (2001) report and 0.21 µg/g in the OSPAR (2009a) report.

Endocrine Disrupters

Endocrine Disruptors (ED) are exogenous substances or mixtures that alter function(s) of the endocrine system and consequently cause adverse health effects in an intact organism, or its progeny, or (sub) populations. For the purposes of this survey, the EDs studied were polychlorinated biphenyls (PCBs), alkylphenols/alkylphenol ethoxylates (APEs) and the organotins, mono, di, tri-butyltins (MBT, DBT, TBT) (Fugro ERT, 2011; Table 3.4). The results are discussed in more detail in subsequent sections.

<u>Polychlorinated Biphenyls (PCBs)</u>

There are 209 possible PCBs, with varying degrees of toxicity. OSPAR's recommended environmental monitoring has concentrated on a set of seven PCB congeners (ICES/ Dutch 7) which cover the range of toxicological properties of the group (OSPAR, 2009a). Total PCB (ICES/ Dutch 7) levels in grab sample sediments ranged overall from <0.10 to 1.07 ng/g (mean <0.21 ng/g) and 0.70 to 0.78 ng/g (mean 0.74 ng/g) in the push core sediments from the drill cuttings pile. PCBs were not detected beyond samples taken beyond 250 m from the platform. No correlations were found between PCBs and the other environmental/ macrofaunal variables assessed (Fugro ERT, 2011).

<u>Alkylphenols (APEs)</u>

Alkylphenol ethoxylates (APEs) are natural constituents of petroleum and are found in produced water discharges from offshore oil and gas installations. Three alkylphenols (nonylphenol (NP), octylphenol (OP) and 2, 4, 6-tri-tert-butylphenol (2, 4, 6-TTBP)) are listed by OSPAR as chemicals for priority action, as they are toxic to marine organisms because they bioaccumulate and persist in the environment (OSPAR, 2009a). Total APE levels for the sampled sediments from the Ninian Northern area survey ranged overall from 13.7 to 1,085 ng/g (mean 133 ng/g), while total APE levels for the push core sediments ranged overall from 2,027 to 3,274 ng/g. APE Levels dropped significantly at sampling stations greater than 100 m from the platform.

Organotin compounds

Organotins are a group of compounds which includes monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT). Organotins are entirely manmade and, as a result, most organisms have developed little or no resistance/ tolerance to them (OSPAR, 2005b). Total organotin (tri-, di-, monobutyltin) levels for the grab samples ranged overall from <0.4 ng/g at the majority of stations, to 37.3 ng/g at Station 14 (overall mean <3.3 ng/g). Total organotin levels for the push core samples ranged from 2.9 to 8.6 ng/g (mean 5.5 ng/g) (Fugro ERT, 2011). In 2009, OSPAR reported a provisional Environmental Assessment Criteria (EAC) for TBT of 0.01 ng/g and in 2004 a provisional upper EAC limit of 0.15 ng/g was suggested. The mean TBT levels from the Ninian Northern grab samples were 0.17 and 0.6 ng/g with the data normalised to 1% TOC, both of which are higher than the upper OSPAR provisional upper EAC values. Significant negative correlations (99.0%) were found between TBT and distance (Table 3.4) and carbonate content (Fugro ERT, 2011). Organotin levels were below laboratory detection limits beyond the 250 m sampling stations.

Radionuclides

There are a number of potential sources of radionuclides in the marine environment, including Naturally Occurring Radioactive Material (NORM). Radionuclide discharges from the oil and gas industry are mainly NORM (although some artificial radionuclides are used as tracers) and are mainly due to produced water. This water may be discharged to the marine environment and may contain radionuclides from the naturally occurring uranium and thorium series. The radionuclides reported from the offshore oil and gas industry are: 226Ra, 228Ra, 210Pb. The data are converted into total alpha and total beta (excluding tritium) activity in order to be able to compare the magnitude with discharges from other sectors (OSPAR, 2009b).

Gross alpha from the Ninian Northern area survey samples ranged overall from below the detection to 346 Bq/kg, while gross beta values ranged overall from 368 to 503 Bq/kg. These results were typical of those observed in background sediments (e.g. Štrok, et al., 2010). Given the lack of true 'background' data on North Sea radionuclides, aside from the oil and gas operational discharges, the results from the drill cuttings pile have been included in the data set for comparison. The mean Ninian Northern gamma and gross alpha/beta radionuclide activities were 203 and 598 Bq/kg, respectively, with gross gamma being slightly higher than the EC exemption value of 500 Bq/kg, the level below which wastes can be disposed of unconditionally (EC, 2002).

Heavy metals

Metals occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms. Anthropogenic inputs of metals to the marine environment of particular relevance to the offshore oil and gas industry are drilling discharges which can contain substantial amounts of barium sulphate (barite) as a weighting agent (NRC, 1983). Barite also contains measurable concentrations of heavy metals as impurities, including cadmium, chromium, copper, lead, mercury and zinc (NRC, 1983).

Comparison of the overall mean levels for cadmium, lead and mercury (Cd, Pb and Hg) analysed in the Ninian Northern grab sediments (0.29, 0.81, and 54.2 µg/g, respectively) against their relevant assessment criteria (BC, Background Assessment Concentration (BAC), Effects Range Low (ERL)) revealed cadmium was below its assigned ERL (1.2 µg/g). Mean levels of lead and mercury exceeded the ERL (47 and 0.15 µg/g, respectively) primarily due to the high level measured at Stations 14 and 19. All three metals substantially exceeded their respective BC values when normalised to 5% aluminium. These metals all exhibited levels above BAC within the first 250 m of the platform.

Total barium shared significant positive similarities with the contaminants typically associated to drill cuttings, i.e. hydrocarbons and metals. Likewise, a significant negative similarity exists with distance as sample stations move away from the drill cuttings pile (Table 3.5), with the total barium concentrations being greatest at stations closest to the platform along the main residual current (Fugro ERT, 2011). Metal concentrations beyond 1 km from the platform were similar to the levels recorded for Station 24 which was, approximately, 10 km from the NNP.

3.4. Biological Environment

This section summarises the characteristics of plankton, benthos, finfish and shellfish spawning and nursery grounds, marine mammals, seabirds and offshore conservation areas relevant to the NNP.

3.4.1. Plankton

The majority of the plankton occurs in the photic zone, the upper 20 m of the sea which receives enough light for photosynthesis to occur (Johns and Reid, 2001). The composition of the plankton community reflects environmental conditions such as salinity, temperature, water movements in the area and the presence of local benthic communities that have planktonic larval stages. The majority of phytoplanktonic organisms are unicellular, such as diatoms and dinoflagellates, whereas zooplankton comprises a wide variety of multicellular herbivorous and carnivorous organisms.

The phytoplankton community in the northern North Sea is dominated by the dinoflagellate genus *Ceratium* (Johns and Reid, 2001) showing a recent trend of increase in the dinoflagellates, with a gradual decrease in the diatom species (DTI, 2001, Johns and Reid, 2001). Phytoplankton abundance and productivity is dependent on light intensity and nutrient availability, which is affected by water column stratification. Densities of phytoplankton therefore fluctuate throughout the year (Johns and Reid, 2001), demonstrating peak productivity during the spring and summer. Typical zooplankton organisms are the copepods, arrow worms, krill and jellyfish. Zooplankton also includes the larval stages of non-planktonic organisms such as fish, crabs and barnacles (Johns and Reid, 2001).

The total biomass of zooplankton follows a seasonal pattern governed by the availability of phytoplankton, their main food source, and consequently the peak in zooplankton biomass occurs after the phytoplankton peak. Zooplankton is not restricted to the upper layers of the water column, but exhibit a diurnal movement. Generally, they migrate into the upper layers of the water column at night to feed, and then descend again to deeper water during daylight hours (Johns and Reid, 2001).

The zooplankton communities of the northern North Sea are dominated by copepods, predominantly Calanus spp. (Johns and Reid, 2001), mainly *Calanus finmarchicus* and *Calanus helgolandicus*, as well as smaller species such as *Para-Pseudocalanus* spp. and *Acartia* spp. (DTI, 2001). The larger zooplankton (or megaplankton) includes the Euphausiida (krill), Thaliacea (salps and doloids), Siphonophora and Medusae (jellyfish). Blooms of salps and doloids produce large swarms in late summer to October, depleting food sources for other herbivorous plankton with subsequent effects to the higher trophic levels. Siphonophores (colonial hydrozoa) can also reach large densities in the North Sea.

3.4.2. Benthic Fauna

An understanding of the composition of the seabed (benthic) faunal communities can facilitate in the assessment of the impacts of a proposed oil and gas activity, such as the decommissioning of the NNP. Benthic fauna comprises species which live either within the seabed sediment (infauna) or on its surface (epifauna). Such species, which may be either sedentary or motile, and may encompass a variety of feeding habits (e.g. filter-feeding, predatory or deposit-feeding) occupy a variety of different niches. Epifaunal and infaunal species are particularly vulnerable to external influences which alter the physical, chemical or biological characteristics of the sediment. These organisms are largely sedentary and are thus unable to avoid unfavourable conditions.

Benthic fauna is also typically divided into categories, principally according to size. The largest are the megafauna and this group comprises animals, usually living on the seabed, which are large enough to be seen in seabed photographs and caught by trawl (i.e. brittle stars, sea urchins, sea cucumbers, sea spiders, sponges and corals). Macrofauna are defined as those animals larger than 500 µm. Meiofauna comprises the smaller interstitial animals (mainly nematode worms and harpacticoid copepods) with a lower size limit of between 45 and 62 µm (Kennedy and Jacoby, 1999).

Colonisation of sediments by different species is largely dependent on the type of sediment present and its characteristics. Physical and biological factors including seabed depth, water movements, salinity, temperature and available oxygen are important in determining species abundance and distribution. The species composition and relative abundance in a particular location provides a reflection of the immediate environment, both current and historical (Clark et al., 1997), as every benthic species has its own response and degree of adaptability to changes in the physical and chemical environment. Determination of sediment characteristics is of particular importance, therefore, in the interpretation of benthic environmental survey data.

Benthic fauna is susceptible to physical disturbance of the seabed, for example from fishing-trawls, anchoring, pipeline trenching and rock-placement operations, or smothering from discharged drill cuttings (DTI, 2001). The effects of discharged drill cuttings on benthic fauna include physical smothering, the presence of potential toxins (heavy metals and hydrocarbons), and organic enrichment (BMT Cordah, 1998). The responses shown by benthic communities to drill cuttings discharges are the result of a combination of these effects. As drill cuttings accumulate on the seabed directly below a development, benthic organisms that occupy the seabed beneath the drill cuttings pile would be smothered. Beyond this point, the effects of any toxins and organic enrichment become more evident, and the changes in the species composition, diversity and abundance of benthic communities may be attributed to one or all of these influences (BMT Cordah, 1998).

3.4.3. Benthic Habitat Classification

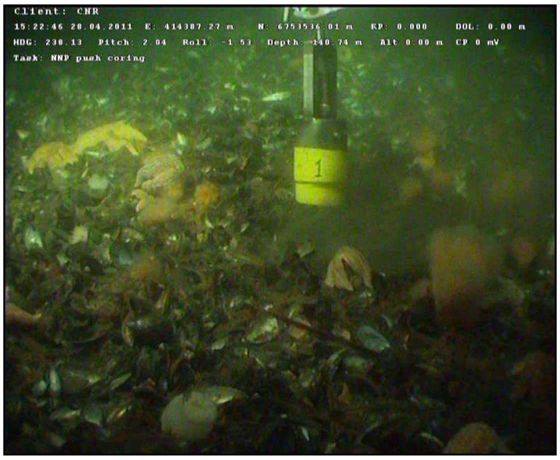
Various attempts have been made to describe the macrobenthic invertebrate communities in the North Sea, with the model of Künitzer et al. (1992) being the most widely accepted. The NNP lies within a widespread seabed area that can be classified into Künitzer et al. (1992) Category IIIb, which is fine sediment below 100 m depth in the northern North Sea. This deep-water infaunal assemblage was found to be characterised by the polychaetes *Prionospio cirrifera*, *Aricidea catherinae* and *Exogone verugera* and the bivalve mollusc *Thyasira* spp.; with high densities (2,863 ± 1,844 individuals per m^2) and species richness (51 ± 13 species) (Künitzer et al., 1992).

Benthic survey results

The 2011 survey and seabed sampling indicate that the sediments of the Ninian Northern survey area comprised of Holocene sediments of fine sands. Generally, macrofauna in the Ninian Northern area were dominated by polychaetes (70.1% of taxa, and 72.4% of individual animals identified, respectively), followed by molluscs (20.9% of taxa and 24.7% of individuals) and echinoderms (4.7% of taxa and 0.7% of individuals).

The analysis showed differences between the benthic communities at outer stations and those positioned close to the platform. Macrofaunal composition at inner stations, up to 100 m away from the platform, was modified in comparison to background stations, which was attributed to physical smothering and organic enrichment of seabed sediments by drill cuttings contaminated by hydrocarbons (Fugro ERT, 2011). Those stations were characterised mainly by lower numbers of taxa, absence or reduced numbers of hydrocarbon intolerant species (polychaetes *Galathowenia oculata*, *Eclysippe vanelli, Amythasides macroglossus*), and increased numbers of indicator species. The inner stations were dominated by increased numbers of cirratulid polychaetes, mainly *Chaetozone setosa* and *Cirratulus cirratus*, which are associated with the disturbance of the seabed, while those species were (with one exception at Station 20) absent from the outer stations. Outer stations (>100 m from the platform) were mainly dominated by the bivalves *Adontorhina similis, Axinulus croulinensis* and *Parvicardium minimum,* and the polychaetes *Paramphinome jeffreysii, Galathowenia oculata, Pholoe assimilis* and *Paradoneis lyra* (Fugro ERT, 2011).

Observations from seabed video footage and stills showed that visible epifauna and mobile megafauna were generally sparse across the survey area but were more abundant on the drill cuttings pile (Stations 1 to 3, Figure 3.6). Taxa encountered included *Paguridae spp*. (hermit crabs); *Ophiura spp*. (brittlestar); species of Asteroidea (starfish); *Echinocardium spp*. (sea urchins); and tubes of sabellid polychaetes. On some boulders and debris within the drill cuttings pile, anemones (*Thenaria* spp.) were also evident. Fish were abundant around the platform but sparse across the rest of the survey area, mostly gadoid species and some flatfish (Pleuronectiformes) (Fugro ERT, 2011).



Station 1

Station 2

Station 3

The whitish branched organism at Station 2 is a piece of *Lophelia pertusa*, marine growth which has been dislodged from the jacket of the NNP
Source: ISS (2011), Fugro ERT (2011)

Figure 3.7: Video stills at core sample stations (1, 2 & 3) on drill cuttings pile during Ninian Northern pre-decommissioning survey 2011

Although differences in the sediment type were observed, the majority of the survey area was recorded as the habitat offshore circalittoral sand with the predominant biotope being SS.SCS.OCS.GlapThyAmy (Connor et al., 2004), *Glycera lapidum*, *Thyasira* spp. and *Amythasides macroglossus* in offshore gravelly sand (EUNIS A5.151; http://eunis.eea.europa.eu/).

Within the drill cuttings pile a biotope of SS.SMU.OMu.CapThy.Odub (EUNIS A5.3741) was observed (Connor et al., 2004). In offshore areas around platforms the changes in the sediment due to drill cuttings deposition and organic enrichment from drill cuttings often leads to the development of communities dominated by pollution tolerant opportunist species such as the polychaetes *Capitella capitata* and

Ophryotrocha spp. These species are generally found in extremely high abundances and accompanied by *Thyasira* spp., *Raricirrus beryli*, *Paramphinome jeffreysii* and *Chaetozone setosa* (Connor et al., 2004).

Although specimens of the cold water, reef building coral *Lophelia pertusa* were evident on parts of structure of the NNP (Figure 3.7), no evidence of subtidal reefs, submarine structures or any other potential Annex I Habitats were found across the rest of the survey area.

The number of taxa, individuals and the diversity recorded at each grab station across the survey area ranged from moderate to high (Table 3.6). Multivariate analysis highlighted variations within the benthic communities relating to the distance from the platform and the bearing of the grab stations. Grab stations closest to the platform contained highly modified benthic communities containing increased numbers of indicator species along with reduced numbers of hydrocarbon intolerant polychaetes. Another transitional community occurred at 250 m, with very low numbers of indicator species and reduced numbers (or absence) of background and common fauna. Polychaetes were the most abundant group in terms of both numbers of taxa and individuals in all grab samples, particularly *Amythasides macroglossus, Eclysippe vanelli, Paradoneis lyra, Aricidea catherinae* and *Paramphinome jeffreysii*, followed by the molluscs *Adontorhina similis, Axinulus croulinensis* and *Mendicula ferruginosa*.

Correlation of the environmental variables against the community structure indicated that drilling discharges and contaminant concentrations, particularly those involving total barium, hydrocarbons and metals were the main environmental variables influencing the benthic communities (Fugro ERT, 2011). The correlation between the EDs, octylphenol, nonyphenol and TBT, and benthic community structure at Ninian Northern suggests that increased concentrations of these chemicals are associated with decreases in the number of identified species (Fugro ERT, 2011).

Overall, the environmental data obtained from the April/ May 2011 pre-decommissioning survey at the NNP site indicated that seabed sediments beyond approximately 500 m could generally be considered ‘as typical for this area of the northern North Sea region’ (Fugro ERT, 2011).

Table 3.6: Macrofaunal community statistics for grab sample stations (0.2 m^2) from the Ninian Northern pre-decommissioning seabed survey 2011

Station Number	Distance and Bearing		Numbers		Diversity indices			Evenness	
	(m)	(°)	Ta	Individuals	Simpsons (D)	Brillouins (Hb)	Shannon-Wiener (Hs)	Pielou (J)	Heip (Eh)
24	10,000	045	117	1160	0.96	5.21	5.44	0.79	0.36
23	2,000	045	87	874	0.96	4.90	5.12	0.79	0.39
22	1,000	045	112	1077	0.96	5.13	5.37	0.79	0.36
21	500	045	93	872	0.95	4.90	5.13	0.78	0.37
20	250	045	79	719	0.94	4.55	4.78	0.76	0.34
19	100	045	61	879	0.86	3.66	3.81	0.64	0.22
10	250	225	96	573	0.96	5.03	5.37	0.82	0.43
11	500	225	87	797	0.95	4.81	5.05	0.78	0.37
12	1,000	225	112	1328	0.94	4.87	5.06	0.74	0.29
13	2,000	225	86	795	0.95	4.79	5.03	0.78	0.37
8	2,000	135	98	907	0.96	5.10	5.34	0.81	0.41
7	1,000	135	99	899	0.95	5.00	5.24	0.79	0.38
6	500	135	106	1057	0.96	5.07	5.29	0.79	0.36
5	250	135	97	702	0.96	5.07	5.36	0.81	0.42
4	100	135	59	838	0.86	3.73	3.88	0.66	0.24
14	100	315	53	861	0.79	3.03	3.16	0.55	0.15
15	250	315	88	644	0.95	4.79	5.07	0.79	0.38
16	500	315	91	929	0.96	5.00	5.23	0.80	0.41
17	1,000	315	87	758	0.94	4.76	5.01	0.78	0.36
18	2,000	315	103	962	0.96	5.03	5.27	0.79	0.37
Minimum			53	573	0.79	3.03	3.16	0.55	0.15
Maximum			117	1328	0.96	5.21	5.44	0.82	0.43

3.4.4. Marine Growth

Over time offshore platforms are likely to become colonised by marine fauna. Steel and concrete platforms provide new attachment sites for marine life and, in effect, become artificial reefs.

Algal spores and invertebrate larvae rapidly colonise submerged areas of the structures, establishing a 'biofouling' assemblage (Wolfson et al., 1979). The location of the platform and prevailing water currents affect the degree to which structures are exposed to these algal spores and invertebrate larvae. Consequently, the composition and thickness of the fouling layer and its rate of development are affected by the site location and therefore may differ between offshore installations (AUMS, 1980). Unless protected by anti-fouling measures, any marine structure is liable to become fouled. Organisms that typically colonise platforms in the North Sea include seaweeds and kelp (algae), hydroids, soft corals, anemones, sponges, tubeworms, hard corals and mussels (AUMS, 1980). The hard coral, *Lophelia pertusa*, colonises the jackets of offshore installations in the northern North Sea (Gass & Roberts, 1996) but has not been observed in other parts of the North Sea.

Marine growth assessments of the NNP jacket and conductors, carried out using ROV video clips taken during ROV surveys in 2003 and 2011, concluded that the jacket and conductors supported an extensive cover of marine growth (BMT Cordah, 2016c). Subsequently and in 2016, a marine growth survey including percentage cover and thickness of the main space-occupying organisms was undertaken as part of a subsea inspection of the NNP (DeepOcean, 2016). Whilst the survey's published results did not provide an in-depth evaluation of the marine growth, the percentage cover and thickness values differed slightly to the 2011 survey. However, the general zonation pattern of marine growth is consistent between surveys. The study estimated an additional 154mm of hard and soft growth for the whole structure (BMT Cordah, 2016c). The general pattern of marine growth from the detailed 2011 survey data are summarised by depth in Table 3.7.

Table 3.7: General pattern of marine growth zonation with depth on the NNP jacket in 2011

Depth range (m)	Pattern of marine growth
0 to ≤12	Continuous cover by mussels. Scattered seaweeds and small anemones also present.
>12 to ≤26	Continuous cover by mussels. Sporadic cover by soft corals anemones and seaweeds.
>26 to ≤60	Anemones, soft corals, hydroids and tubeworms present throughout the depth range. Anemones and soft corals predominated, anemones forming large patches mainly on upper surfaces of members, with soft corals being mainly on lower surfaces. Mussels were mainly found on upper surfaces of members, decreasing in size and abundance with depth. A small patch of *Lophelia* was observed at 55 m depth.
>60 to ≤141	*Lophelia* dominated within this zone with percentage cover increasing with depth. Average thicknesses were largely consistent. Anemones and hydroids were more abundant than soft corals, barnacles and tubeworms, which were also noted.

Source: BMT Cordah (2016c)

From the 2011 survey footage and subsequent analysis, the extent of *Lophelia pertusa* colonisation on the platform's conductors was found to be extensive, particularly at depths greater than 80 m (Table 3.8). The NNP structural members appeared to show less extensive growth of the cold-water coral, yet in certain areas percentage cover and thicknesses were notable. Average thicknesses of the organism on the jacket ranged from 64 to 230 mm (Table 3.9) with percentage cover ranging from 5 to 55% (BMT Cordah, 2016c). Between 2003 and 2011 the growth of *Lophelia* has been considerable. When the jacket was assessed in 2003 only sporadic occurrences of this organism were noted.

Table 3.8: Marine growth assessment of *Lophelia* on the NNP conductors - 2011 survey data

Depth zone (m)	Average *Lophelia* thickness (mm)	Average *Lophelia* percentage coverage (%)
71 to ≤80	0	0
>80 to ≤90	213	23
>90 to ≤100	241	40
>100 to ≤110	296	68
>110 to ≤120	303	74
>120 to ≤130	290	60
>130 to ≤141	178	31

Source: BMT Cordah (2016c)

Table 3.9: Marine growth assessment of *Lophelia* on the NNP jacket – 2011 survey data

Depth zone (m)	Average *Lophelia* thickness (mm)	Average *Lophelia* percentage cover (%)
0 to ≤12	0	0
>12 to ≤26	0	0
>26 to ≤30	0	0
>30 to ≤52	0	0
>52 to ≤74	64	5
>74 to ≤97	230	30
>97 to ≤119	213	38
>119 to ≤141	205	55

Source: BMT Cordah (2016c)

Comparison of marine growth on the NNP jacket from 2003 to 2011

Average Thickness

The hard and compressed soft thicknesses for marine growth on the jacket have increased at all levels since the 2003 assessment. The most notable increases have occurred around the middle (53 to 74 m water depth, relative to Lowest Astronomical Tide) and lower (75 to 141 m) sections of the jacket. These increases are mostly attributable to the presence of *Lophelia* on the structure. An increase in anemone and soft coral thickness can also be seen at these depth zones.

Percentage Cover and Composition of Marine Growth

Lophelia covered 5 to 100% (in places) within the depth range 53 m to the seabed in 2011. Since 2003 anemones and soft corals have increased in percentage cover at all depth ranges. Tubeworm cover has decreased since 2003 at levels ranging from 53 to 119 m water depth. The tubeworms could have been obscured by other overlying marine fouling organisms and therefore not visible in the video clips taken in 2011. At 120 m water depth, cover of the tubeworms was comparable to values seen in 2003.

3.4.5. Finfish and Shellfish

Adult and juvenile stocks of finfish and shellfish are an important food source for seabirds, marine mammals and other fish species. Species can be categorised into pelagic and demersal finfish and shellfish:

- **Pelagic** species occur in shoals swimming in mid-water, typically making extensive seasonal movements or migrations between sea areas. Examples include herring, mackerel, blue whiting and sprat;
- **Demersal** species live on or near the seabed and include cod, haddock, plaice, sandeel, sole, and whiting;
- **Shellfish** species are demersal (bottom-dwelling) molluscs, such as mussels and scallops, and crustaceans, such as shrimps, crabs and *Nephrops* (Norway lobster).

Generally, there is little interaction between fish species and offshore oil and gas developments. Some fish and shellfish species are, however, vulnerable to some offshore oil and gas activities, such as discharges to sea (CEFAS, 2001b). The most vulnerable period for fish species is during the egg and juvenile stages of their life cycles. Fish that lay their eggs on the sediment (e.g. herring and sandeel) or which live in intimate contact with sediments (e.g. sandeel and most shellfish) are susceptible to smothering by discharged solids (Coull et al., 1998). Other ecologically sensitive fish species include cod, most flatfish (including plaice and sole) and whiting because in the North Sea these stocks are considered to be outside 'safe biological limits' (EEA, 2015).

'Safe biological limits' are defined by a minimum safe stock size and a maximum exploitation rate. The stock size is measured in terms of 'spawning stock biomass (SSB)', which represents the total weight of spawning fish each year. The exploitation rate is measured by 'fishing mortality', which represents the rate at which fish are removed from the stock by fishing. If the stock is either below the minimum safe SSB or above the maximum 'safe exploitation rate', the stock is said to be outside safe biological limits (EEA, 2015). A number of factors have contributed to some fish stocks being outside 'safe biological limits' and these include a combination of overfishing, poor recruitment and poor fisheries management, with respect to under estimation of fish stocks and related issues (WWF, 2001).

The industry-commissioned Fisheries Sensitivity Maps in British Waters and Strategic Environmental Assessment (SEA) 2 Technical Report on North Sea Fish and Fisheries (Coull et al., 1998, CEFAS, 2001b), as well as the CEFAS-led spawning and nursery areas of fish of commercial and conservation importance (Ellis et al., 2010); provide data illustrating fish spawning and nursery locations within ICES rectangle 50F1, within which the NNP lies (Figure 3.8 and Figure 3.8). The results of this work have been incorporated in Table 3.10 (spawning) and Table 3.11 (nursery) to gain more understanding about when species are likely to spawn and develop within the Ninian field.

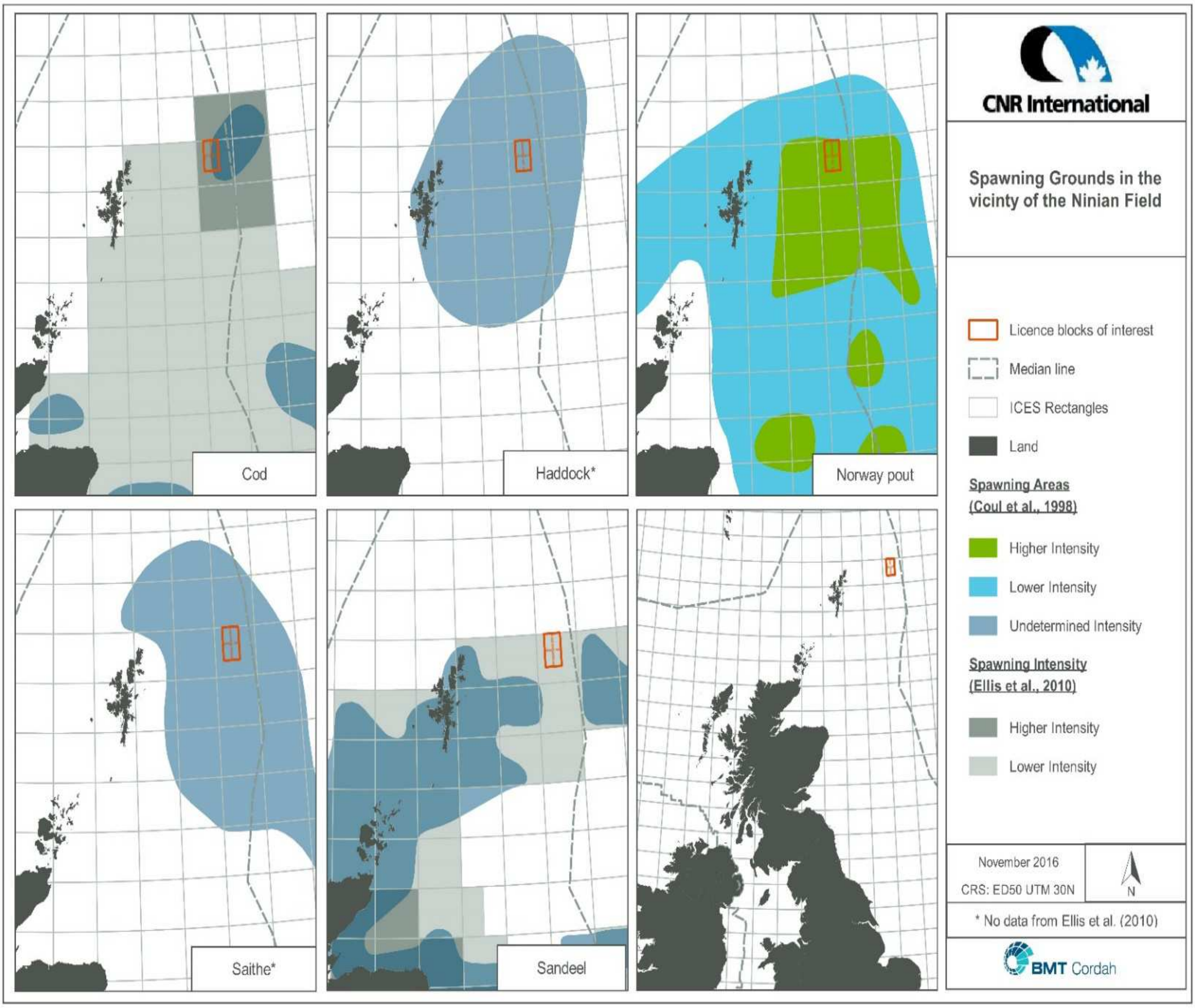


Figure 3.8: Key fish spawning areas around the NNP

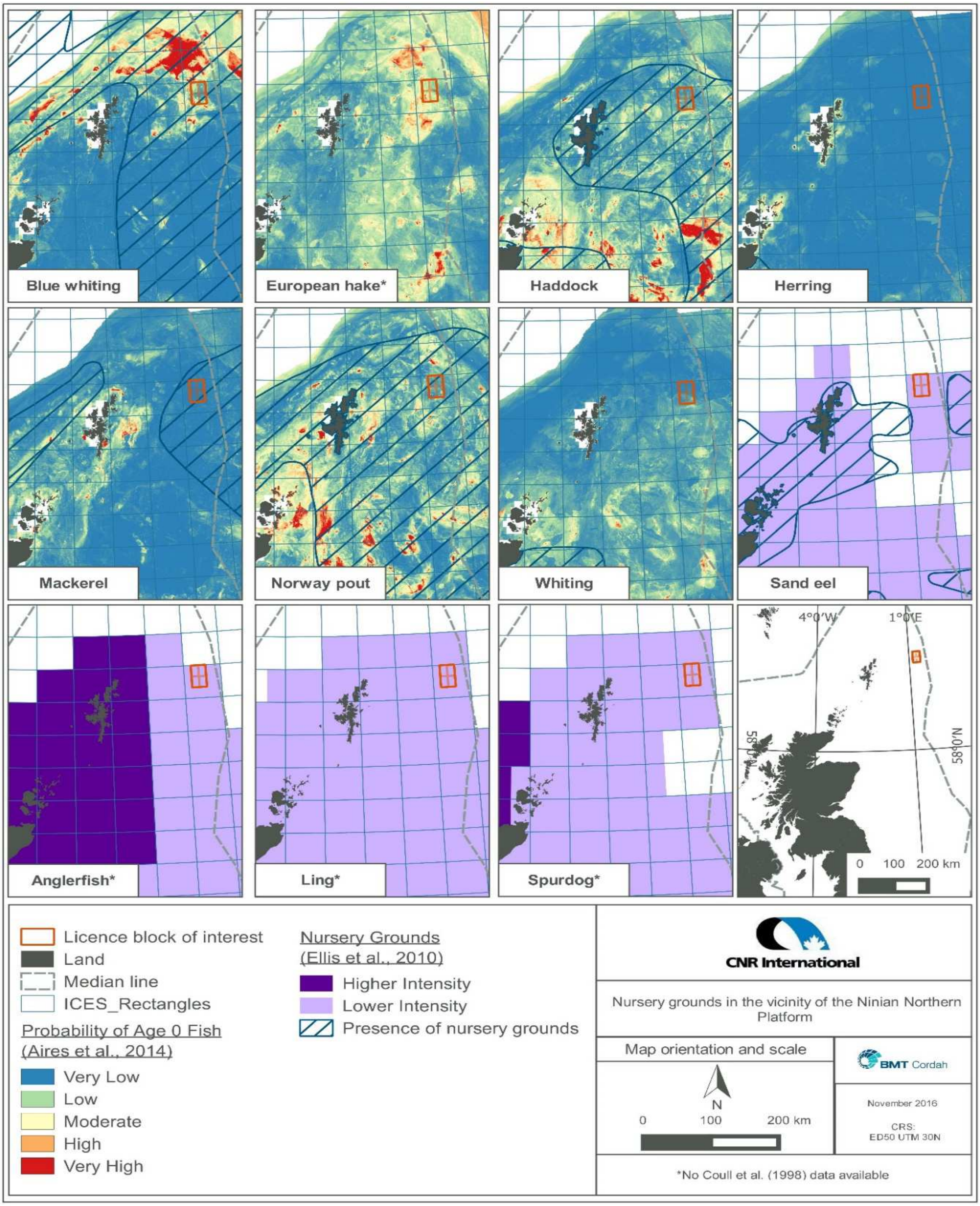
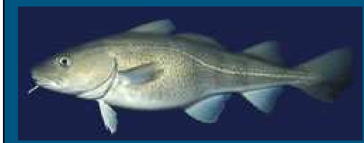
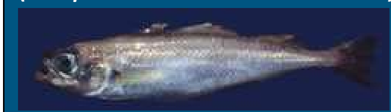
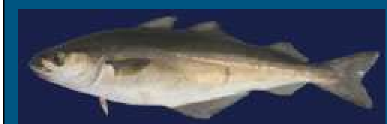


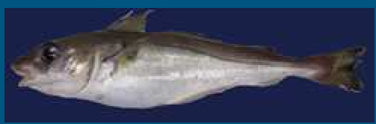
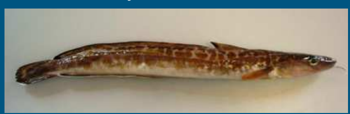
Figure 3.9: Key fish nursery areas around the NNP

Table 3.10: Fish species likely to spawn within the NNP area

Cod **(*Gadus morhua*)** 	• Cod are a predominantly demersal fish however during their first six months their larvae are pelagic1; • Spawning period ranges from January to April[2]; • Cod typically lay their eggs in the top 30 m of the water channel with a peak concentration between 10-20 m[1]; • The larvae may potentially be at risk from discharges into the water from hydrocarbons and other fluids spills and contamination of water through disturbance of drill cuttings pile, resulting in a localized impact to fish stocks[4].
Haddock **(*Melanogrammus aeglefinus*)** 	• Haddock are a predominantly demersal fish however their eggs are pelagic[1]; • Spawning period ranges from February to May[3]; • Adults feed on benthos and small fish[1]; • The larvae may potentially be at risk from discharges into the water from hydrocarbons and other fluids spills and contamination of water through disturbance of drill cuttings pile, resulting in a localized impact to fish stocks[4].
Norway pout **(*Trisopterus esmarkii)*** 	• Norway Pout are benthopelagic to pelagic and their eggs and larvae are pelagic[1]; • Spawning takes place from January to April[3]; • They may potentially be at risk from hydrocarbons and other fluids spills and contamination of water throughout disturbance of drill cuttings pile and result in localized impact to fish stocks[4].
Saithe ***(Pollachius virens)*** 	• Saithe are demersal with pelagic eggs and larvae[1]; • Spawning takes place from January to April[3]; • Saithe may potentially be at risk from hydrocarbons and other fluids spills and contamination of water throughout disturbance of drill cuttings pile and result in localized impact to fish stocks[4].
Sandeel **(*Ammodytes* spp.)** 	• Sandeel are demersal and their eggs and larval stages are pelagic[1]; • Spawning takes place from November to April[2]; • Adults feed on planktonic prey[1]; • Sandeel may potentially be at risk from hydrocarbons and other fluids spills, and particularly from drill cuttings piles as they smother their burrows[4].

Source: (FishBase, 2011)[1], (CEFAS, 2001b)[4], (Ellis et al., 2010)[2], (Coull et al., 1998)[3], images: (ICES FishMap, 1991-2004)

Table 3.11: Fish species whose nursery grounds occur within NNP area

Anglerfish ***(Lophius piscatorius)*** 	• Anglerfish are bathydemersal; however larval stages are pelagic[1]; • Lie half buried on the sea bed and attract their prey with a 'fishing filament'[1]. Therefore, disturbance of drill cuttings piles may potentially disturb and destroy anglerfish habitats[4]; • Anglerfish larvae may also potentially be at risk from discharges such as hydrocarbons and other fluids spills and contamination of water throughout disturbance of drill cuttings pile[4].
Blue whiting **(*Micromesistius poutassou*)** 	• Blue whiting are bathypelagic and larval stages are pelagic[1]; • Blue whiting nurseries may potentially be at risk from discharges such as hydrocarbons and other fluids spills and contamination of water throughout disturbance of drill cuttings pile as they may disrupt the spawning process resulting in localized damage to fish stocks[4].
European hake ***(Merluccius merluccius)*** 	• European hake are demersal but larval stages are pelagic[1]; • Spend most of their time near the sea bed but move off at night, therefore habitats may potentially be disturbed by deposition of drill cuttings piles[4]; • Feed mainly on fish and squid[1]; • European hake nurseries may also potentially be at risk from discharges such as hydrocarbons and other fluids spills and contamination of water through disturbance of drill cuttings piles[4].
Haddock **(*Melanogrammus aeglefinus*)** 	• Haddock occur throughout the northern North Sea and are a predominantly demersal fish[1]; • During the first six months (until they reach a size of about 7 cm) haddock are pelagic[1]; • Adults feed on benthos and small fish[1]; • Nurseries may potentially be at risk from discharges such as hydrocarbons and other fluids spills and contamination of water through disturbance of drill cuttings piles[4].
Ling ***(Molva molva)*** 	• Ling are demersal and their larval stages are pelagic[1]; • Nurseries may potentially be at risk from discharges such as hydrocarbons and other fluids spills and contamination of water through disturbance of drill cuttings piles[4].
Herring ***(Clupea harengus)*** 	• Both larval and adult forms of herring are pelagic, but eggs are benthic[1]; • They undergo metamorphosis after two to seven months depending on spawning time[1]; • Once hatched, the herring larvae become pelagic and are distributed by the prevailing currents[1]; • Herring nurseries may potentially be at risk from discharges such as hydrocarbons and other fluids spills and disturbance of drill cuttings piles[4].

Source: (FishBase, 2011)[1], (CEFAS, 2001b)[4], (Ellis et al., 2010)[2], (Coull et al., 1998)[3], images: (ICES FishMap, 1991-2004)

Spawning and nursery grounds are dynamic features of fish life history and are rarely fixed in one location from year to year. The information provided in Figures 3.8 and Figure 3.9 represents the widest known distribution given current knowledge and should not be seen as rigid, unchanging descriptions of presence or absence (Coull et al., 1998; Ellis et al., 2010). Spawning times represent the generally accepted maximum duration of spawning (Coull et al., 1998).

After spawning, fish hatch quickly from their eggs and many species remain in discrete areas (nursery grounds) in the water column or settle on the seabed as larvae, consuming microscopic organisms and gradually developing the body shape and behaviour patterns of adults. The prevailing water temperature and availability of food can alter the position of these nursery grounds from year to year and they can drift far from initial spawning location. As a result of these factors it is difficult to define precisely the limits of nursery areas. The maps in Figure 3.8 and Figure 3.9 provide an indication of the likely positions of juvenile concentrations around the UK, rather than a definitive description of the limits of all nursery grounds (Coull et al., 1998).

Data from Aires et al. (2014) indicates the probable presence of Age 0 group fish using previously identified nursery grounds by Coull et al. (1998) and environmental habitat variables (Figure 3.9). Age 0 group fish are defined as fish in the first year of their lives and can also be classified as juvenile. Aires et al. (2014) data indicates a moderate probability for blue whiting and European hake, and a low probability for haddock, Norway pout and whiting within ICES rectangle 50F1.

Correlation between the nursery grounds identified by both Coull et al. (1998) and Aires et al. (2014) indicate that the area has higher probability of juvenile fish. The data also indicates high probability of Age 0 group fish within neighbouring ICES Rectangles 51F1 to the North (blue whiting and European hake) and 51F0 to the northwest (blue whiting and European hake) of the NNP area (Figure 3.9; Aires et al., 2014).

The NNP lies within spawning grounds for cod (January to April), Norway pout (January to April), haddock (February to May), saithe (January to April) and sandeel (November to February); and within nursery grounds for haddock, Norway pout, sandeel, whiting, anglerfish, European hake, herring, ling, mackerel, spurdog, and blue whiting (Table 3.10; Table 3.11; Figure 3.8; Figure 3.9).

Cod, whiting, Norway pout, blue whiting, mackerel, herring, ling, saithe, sandeel and anglerfish are mobile species on the Priority Marine Features (PMF) list, which require an appropriate level of protection and conservation measures (SNH, 2014a).

3.4.6. Sharks, Rays and Skates

Chondrichthyans include sharks, rays and chimaeras, which have typically slow growing rates, late age at maturity and low reproductive output. They are generally considered to be vulnerable to human activities (e.g. overfishing). These species require suitable substratum and habitat preferences for the deposition of eggs such as sponges, bryozoans, hydroids and soft corals (Ellis et al., 2010).

Work is underway for developing National Plans of Action for conservation and management of sharks in UK waters (Fowler et al., 2004). UK BAP (Biodiversity Action Plan) has identified several shark species for priority conservation including angel shark, spiny dogfish, undulate ray, sandy ray, tope shark, common skate and basking shark (JNCC, 2014a).

The distribution of the chondrichthyans in the UKCS is not extensively documented. The species that may be encountered in the area are:

- Spurdog (*Squalus acanthias*).
- Lesser spotted dogfish (*Scyliorhisnus canicula*).
- Nurse hound (*Scyliorhisnus stellaris*).
- Starry ray (*Amblyraja radiata*).
- Cuckoo ray (*Leucoraja naevus*).

Nursery areas of these species tend to be typically in shallower coastal areas, with the exception of spurdog and cuckoo ray juveniles which can be found farther offshore (Ellis et al., 2010). Available data suggest nursery grounds for spurdog occur in ICES rectangle 50F1 (Ellis et al., 2010).

3.4.7. Marine Mammals

Marine mammals include whales, dolphins and porpoises (cetaceans) and seals (pinnipeds). This broad group may be vulnerable to the effects of oil and gas activities and can be impacted by noise, contaminants, oil spills and any effects on prey availability (SMRU, 2001). The abundance and availability of prey, including plankton and fish, can be of prime importance in determining the numbers and distribution of marine mammals and can also influence their reproductive success or failure. Changes in the availability of principal prey species may be expected to result in population level changes of marine mammals but it is currently not possible to predict the extent of any such changes (SMRU, 2001).

Cetaceans

Cetaceans can be divided into two main categories: baleen whales (Mysticeti) which feed by sieving water through a series of baleen plates; and toothed whales (Odontoceti) which have teeth for prey capture.

These cetaceans are widely distributed in UK waters and are recorded throughout the year (Reid et al., 2003). Cetacean distribution may be influenced by variable natural factors such as water masses, fronts, eddies, upwellings, currents, water temperature, salinity and length of day. A major factor likely to influence cetacean distribution is the availability of prey, mainly fish, plankton and cephalopods (Stone, 1997).

The main marine mammal species occurring in the NNP area are minke whale (*Balaenoptera acutorostrata*), long-finned pilot whale (*Globicephala melas*), killer whale (*Orcinus orca*), white-beaked dolphin (*Lagenorhynchus albirostris*) and harbour porpoise (*Phocoena phocoena*), with most sightings occurring in the summer months (Reid et al., 2003; UKDMAP, 1998). Marine mammals reported in the vicinity of the NNP are summarised in Table 3.12 (UKDMAP, 1998).

Minke whales occur throughout the central and northern North Sea, particularly during summer months (BEIS, 2016a; SMRU, 2001). They appear to move into the North Sea at the beginning of May and are present throughout the summer until October (Northridge et al., 1995). During the SCANS II survey in July 2005, minke whales were recorded throughout the North Sea, west of Britain and Ireland and on the Celtic Shelf. The highest densities of minke whales occurred in the northern part of the Central North Sea (SCANS II, 2006). The number of minke whales in the SCANS II area is estimated to be approximately 17,500 animals. The abundance of minke whales in the northern and central North Sea is estimated at approximately 3,704 animals (SCANS II, 2006; BEIS, 2016a).

Around the UK, long-finned pilot whales occur mainly along the continental shelf slope, particularly around the 1,000 metre isobath (Hammond et al., 2002). Pilot whale abundance in the central and eastern North Atlantic was estimated at approximately 780,000 in 1989, but there are currently no estimates of pilot whale abundance in UK waters (BEIS, 2016a).

Killer whales have a worldwide distribution and are widely distributed in the deep North Atlantic and in coastal waters of northern Europe, particularly around Iceland, the Faroe Islands and western Norway. In UK waters they are most common off northern and western Scotland and occur in all months of the year. Between Shetland and Norway, the species is regularly recorded from November to March (Reid et al., 2003). No overall population estimates exist for killer whales in the Northeast Atlantic or UK waters (BEIS, 2016a).

White-beaked dolphins are distributed over the continental shelf, and in the North Sea they tend to be more numerous within about 200 nm of the Scottish and north-eastern English coasts (Northridge et al., 1997). White-beaked dolphins are present year-round in the North Sea, with most sightings recorded between June and October (Reid et al., 2003). Initial estimates for the total abundance of white-beaked dolphins in the SCANS II area are approximately 25,000 animals (SCANS II, 2006; BEIS, 2016a). The abundance of white-beaked dolphins in the northern and central North Sea is estimated at approximately 9,443 animals (SCANS II, 2006; BEIS, 2016a).

The harbour porpoise is the most common cetacean in UK waters (BEIS, 2016a). It is present throughout most of the North Sea throughout the year, with higher numbers occurring between May and October. Highest densities in summer are generally found north of 56°N, mostly in a north-south band between 1°E and 3°E (SMRU, 2001). The northern and central areas of the North Sea appear to be important areas for harbour porpoises, especially in summer (BEIS, 2016a; SMRU, 2001). The harbour porpoise is generally described as a coastal species, but there have been numerous sightings in deep, offshore waters (Hammond et al., 2002; MacLeod et al., 2003; Northridge et al., 1995, 1997; Rogan and Berrow, 1996).

Table 3.12: Seasonal cetacean sightings around the NNP

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minke whale							L					
Long-finned pilot whale								M				
Killer whale					M							
White-beaked dolphin		M	M			L	L					
Harbour porpoise	L	VH		L	L	L	VH	M	L			L

Key

	No animals / No data
L	Low densities (0.01 to 0.09 animals/km)
M	Moderate densities (0.10 to 0.19 animals/km)
H	High densities (0.20 to 0.49 animals/km)
VH	Very high densities (≥ 0.50 animals/km)
(green)	Sightings within Quadrant 3
(blue)	Sightings within surrounding Quadrants

Source: UKDMAP (1998)

White-beaked dolphin, harbour porpoise, killer whale, minke whale and long-finned pilot whale are mobile species on the PMF list, which require an appropriate level of protection and conservation measures (SNH, 2014a).

Pinnipeds

Two species of seal are resident in UK waters, the grey seal (*Halichoerus grypus*) and the harbour or common seal (*Phoca vitulina*), both occurring regularly over large parts of the North Sea (SMRU, 2001).

<u>Grey seals</u>

The northeast Atlantic contains approximately half of the world's population of grey seals with, approximately, 38% occurring in the UK. The population size within UK waters is estimated at 111,600 (BEIS, 2016a). Approximately 88% of the UK population of grey seals breed in Scotland, mainly in the Hebrides and Orkney. Major colonies are also present on Shetland and the east coast of Scotland (BEIS, 2016a).

Grey seals spend most of the year at sea and travel long distances between haul out sites and range widely in search of prey (BEIS, 2016a). The majority of the grey seal population will be on land for several weeks from October to December during the pupping and breeding seasons, and again in February and March during the annual moult. Densities of grey seals offshore are likely to be lower during these periods (BEIS, 2016a).

<u>Harbour seals</u>

Harbour (common) seals are one of the most widespread pinnipeds with almost circumpolar distribution in the Northern Hemisphere. Within UK waters they belong to a European sub-species, which mainly occur in UK, Icelandic, Norwegian, Swedish, Danish, German and Dutch waters. With approximately 30% of this population occurring in UK waters (BEIS, 2016a). The harbour seal strongholds within the UK are Shetland, Orkney, the east coast of the Outer Hebrides, most of the Inner Hebrides and the west coast of Scotland, the Moray Firth and the Firth of Tay. Harbour seal counts in the UK are estimated at a minimum of 28,000 animals, the vast majority of which are found in Scotland (BEIS, 2016a). Harbour seals haul out on tidally exposed areas of rock, sandbanks or mud. Pupping occurs on land between June and July, and the moult between August and September (BEIS, 2016a).

Tracking of seals suggests they make feeding trips lasting two to three days, travelling less than 40 km from their haul-out sites and ultimately returning to the same haul-out site from which they departed (Johnston et al., 2002). Grey seals may spend more time further offshore than harbour seals. Both grey and harbour seals are listed in Annex II of the Habitats Directive (Section 3.6).

The Ninian Field is 120 km from the nearest coastline; therefore it is unlikely that grey and harbour seals would be found in the vicinity of the platform (Jones et al., 2013; Figure 3.10).

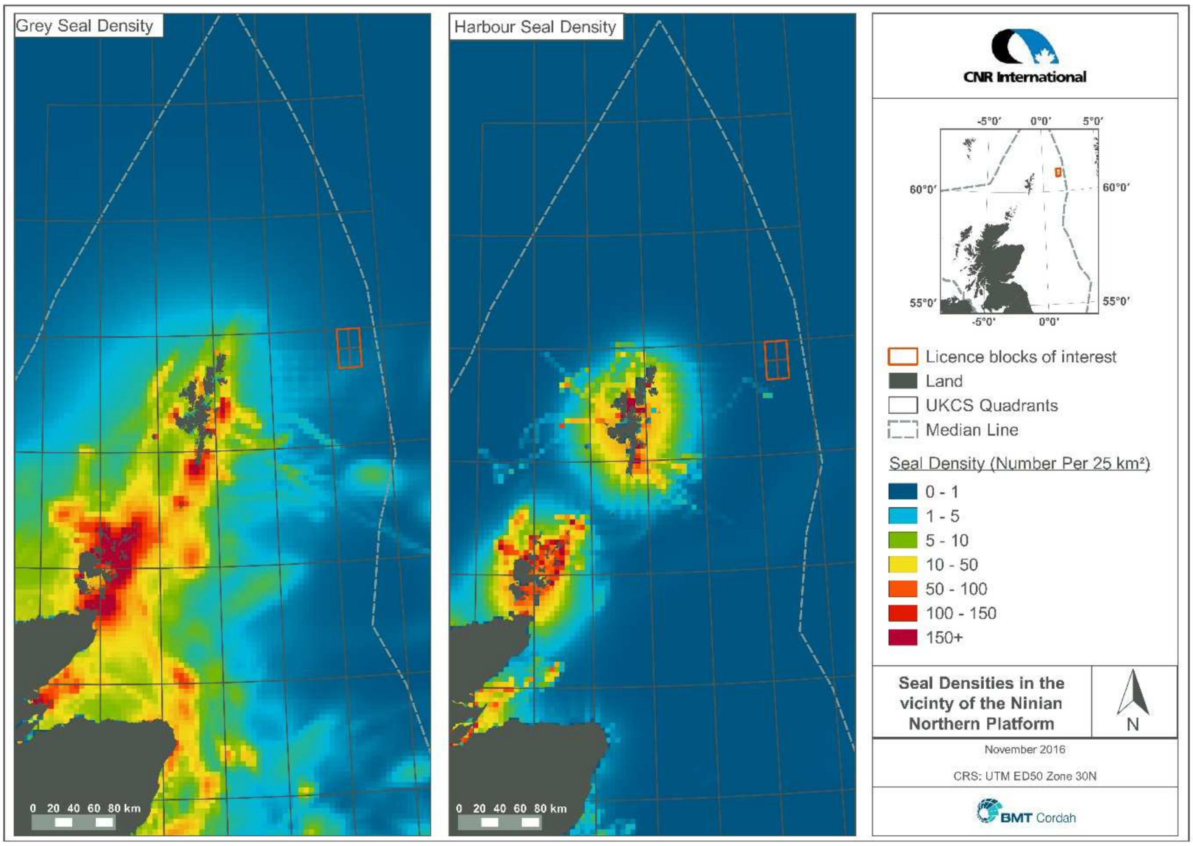


Figure 3.10: Seal densities in the vicinity of the NNP

3.4.8. Seabirds

Important numbers of several species of seabird breed on the North Sea coastal margin, and depend on the offshore North Sea for their food supply and, for much of the year, their habitat. Species commonly found in offshore North Sea waters are Fulmar (*Fulmarus glacialis*), Gannet (*Morus bassanus*), Guillemot (*Uria aalge*), Razorbill (*Alca torda*) and Kittiwake (*Rissa tridactyla*); and Herring (*Larus argentatus*), Great Black-backed (*Larus marinus*) and Lesser Black-backed (*Larus fuscus*) Gulls (DTI, 2001). Other species which are recorded at lower levels include the Pomarine Skua (*Stercorarius pomarinus*), Arctic Skua (*Stercorarius parasiticus*), Black-headed Gull (*Larus ridibundus*), Common Gull (*Larus canus*), Common Tern (*Sterna hirundo*), Arctic Tern (*Sterna paradisaea*), Little Auk (*Alle alle),* and Puffin (*Fratercula arctica*) (DTI, 2001).

Seabird species which breed regularly in the UK and around mainland North Sea coasts include the four species of petrel (Fulmar, Manx Shearwater (*Puffinus puffinus*), Storm Petrel (Hydrobates pelagicus) and Leach's Petrel (*Oceanodroma leucorhoa*)), two species of cormorant (Cormorant (Phalacrocorax carbo) and Shag (*Phalacrocorax aristotelis*)), Gannet, two species of skua (Great Skua (*Catharacta skua*) and Arctic Skua), six species of gull (Herring Gull, Common Gull, Black-headed Gull, Lesser Black-backed Gull, Great Black-backed Gull and Kittiwake), five species of tern (Sandwich Tern (*Sterna sandvicensis*), Roseate Tern (*Sterna dougallii*), Common Tern, Arctic Tern and Little Tern (*Sterna albifrons*)) and four species of auk (Guillemot, Razorbill, Black Guillemot (*Cepphus grylle*) and Puffin) (DTI, 2001; BEIS, 2016b). Each year over 7 million seabirds breed in the UK (BEIS, 2016b).

In general, offshore areas of the North Sea contain peak numbers of seabirds following the breeding season and through winter, with birds tending to forage closer to coastal breeding colonies in spring and early summer (DTI, 2001). High densities of Fulmar are present offshore from May to November; Kittiwake from November to March, and Guillemot from July to October. Gannet are present at low densities all year round.

Birds are vulnerable to oiling from surface oil pollution, which can cause direct toxicity through ingestion, and hypothermia as a result of the birds' inability to waterproof their feathers. During the moulting season, certain species (e.g. Guillemot, Razorbill and Puffin) become flightless and spend a large amount of time on the water surface, making them particularly vulnerable to surface oil pollution (DTI, 2001). However, seabirds are not normally affected by planned offshore oil and gas operations (DTI, 2001). Although locally important numbers of birds have been killed directly by oil spills, such spills have primarily been associated with the transportation of oil, and little or no direct mortality of seabirds has been attributed to exploration, production or decommissioning activities in the North Sea (DTI, 2004).

Seabird vulnerability to surface pollution varies throughout the year with peaks in late summer after breeding when the birds disperse into the North Sea, and during the winter months with the arrival of over-wintering birds. To assess the relative risk for different species, the Joint Nature Conservation Committee (JNCC) Seabirds at Sea Team (SAST) has developed an index to assess the vulnerability of bird species to the threat of oil pollution. This offshore vulnerability index (OVI) is derived by taking account of the following four factors (Williams et al., 1994):

- Amount of time spent on the water.
- Total biogeographic population.
- Reliance on the marine environment.
- Potential rate of recovery.

The seasonal vulnerability of seabirds in the NNP area derived from the JNCC block-specific vulnerability data (JNCC, 1999), is shown in Table 3.13.

The most sensitive times of year for birds in the NNP area (Block 3/3 and surrounding blocks) are January, March, July, September, October and November when vulnerability to oil pollution is "high" in some of the area. Vulnerability ranges from "moderate" to "low" for the remainder of the year. The overall seabird vulnerability to surface pollution in the NNP area is "low" (Table 3.13).

Table 3.13: Seasonal seabird vulnerability to oil pollution around the NNP area

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
211/27	3	3	2	4	4	4	2	4	3	2	3	4	4
211/28	3	3	2	4	4	4	2	4	3	2	2	4	4
211/29	3	3	4	4	4	4	2	4	3	3	2	4	4
3/2	2	3	2	3	4	4	2	4	2	2	3	4	4
3/3	2	3	2	3	4	4	2	4	2	2	2	3	4
3/4	3	3	4	3	4	4	2	4	3	3	2	3	4
3/7	2	3	2	2	4	4	2	4	3	3	3	3	4
3/8	2	3	2	2	4	4	2	4	3	3	2	3	4
3/9	3	3	3	3	4	4	2	4	3	3	2	3	4

Key

1	Very High Seabird Vulnerability
2	High Seabird Vulnerability
3	Moderate Seabird Vulnerability
4	Low Seabird Vulnerability
N/D	No Data

Source: JNCC (1999)

3.4.9. Offshore Conservation Areas

The European Commission (EC) Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the Habitats Directive) and the EC Directive 79/409/EEC on the Conservation of Wild Birds (the Birds Directive), are the main instruments of the European Union (EU) for safeguarding biodiversity.

The Habitats Directive includes a requirement to establish a European network of important high quality conservation sites that will make a significant contribution to conserving the habitat and species identified in Annexes I and II of the Directive. Habitat types and species listed in Annexes I and II are those considered to be in most need of conservation at a European level (Johnston et al., 2002; JNCC, 2016a). The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) implement the EC Habitats Directive (92/43/EEC) in UK Law. These regulations apply to UK waters and to the UK offshore waters.

The UK government, with guidance from JNCC and the Department of Environment, Food and Rural Affairs (Defra), has statutory jurisdiction under the EC Habitats Directive to propose offshore areas or species (based on the habitat types and species identified in Annexes I and II) to be designated as Special Areas of Conservation (SAC). SACs are sites that have been adopted by the European Commission and formally designated by the government of each country in whose territory the site lies. Sites of Community Importance (SCIs) are sites that have been adopted by the European Commission but not yet formally designated by the government of each country. Candidate SACs (cSACs) are sites that have been submitted to the European Commission, but not yet formally adopted (JNCC, 2016a).

In relation to UK offshore waters, three habitats from Annex I and four species from Annex II of the Habitats Directive are currently under consideration for the identification of SACs in UK offshore waters (Table 3.14; Johnston et al., 2002; JNCC, 2016b).

Table 3.14: Annex I habitats and Annex II species occurring in UK offshore waters

Annex I habitats considered for SAC selection in UK offshore waters	Species listed in Annex II known to occur in UK offshore waters
• **Sandbanks which are slightly covered by seawater all the time** • **Reefs (bedrock, biogenic and stony)** - Bedrock reefs – made from continuous outcroppings of bedrock which may be of various topographical shapes; - Stony reefs – these consist of aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces; and - Biogenic reefs – formed by cold water corals (e.g. *Lophelia pertusa*) and *Sabellaria spinulosa*. • **Submarine structures made by leaking gases**	• Grey seal (*Halichoerus grypus*) • Harbour or common seal (*Phoca vitulina*) • Bottlenose dolphin (*Tursiops truncatus*) • Harbour porpoise (*Phocoena phocoena*)

Source: Johnston et al. (2002), JNCC (2016b)

Currently in UK offshore waters there are five SACs, five possible SAC (pSAC), one cSAC and 14 SCIs (JNCC, 2016c). Since December 2015, the Scanner Pockmark and the Braemar Pockmarks have been designated as SACs. The Pobie Bank Reef is the nearest SCI to the NNP (73 km, southwest; Table 3.15 and Figure 3.11).

Table 3.15: Annex I conservation areas in the vicinity of the NNP

Name	Description	Location	Site Location	Area (km^2)	Status	Approx. distance to NNP (km)
Pobie Bank Reef	Reef	Northern North Sea	60º31'23"N 0º17'34"W	1,011	SCI	73
Braemar Pockmarks UK003057	Submarine structures made by leaking gas	Northern North Sea	58°59.4' N, 1°28.8' E	5.18	SAC	212
Scanner Pockmark UK0030354	Shallow depression approx. 600 m by 300 m and 20 m deep	Northern North Sea	58°16.8'N, 0°58.2'W	3.35	SAC	290

Source: JNCC (2016c)

The Offshore Marine Conservation (Natural Habitats, & c.) (as amended) Regulations 2009 transpose the Habitats Directive and Birds Directive in the marine offshore area, from 12 to 200 nm from the UK coast. Under these regulations it is an offence to:

- Deliberately disturb any species, that has a designated SAC or SCI while it is within its SAC/ SCI;
- Capture, injure or kill any wild bird or any wild animal of a European Protected Species (EPS); and/or
- Significantly disturb any EPS, whether it is within a protected site or not, in such a way as to significantly affect (i) the ability of any significant group of animals to survive, breed, rear or nurture their young; or (ii) the local distribution or abundance of that species.

EPS include all species of cetaceans (whales, dolphins and porpoises), all species of marine turtles, the sturgeon (*Acipenser sturio*) and the otter (*Lutra lutra*) (JNCC, 2011).

Annex I habitats

There are no known Annex I habitats in the immediate vicinity (within a 50 km radius) of NNP (Table 3.15, Fugro ERT, 2011). From survey data there is no evidence to suggest that any 'sandbanks which are slightly covered by seawater all the time', 'submerged or partially submerged sea caves' or bedrock or stony reefs are present. Although the biogenic reef-forming cold-water coral *Lophelia pertusa* has colonised the steel jacket of the NNP (Section 3.2.3), it would not have occurred without the presence of the platform and therefore would not be considered as constituting an Annex I habitat. Additionally, Block 3/3 is outside of any identified areas of pockmarks.

Annex II species

Of the Annex II species listed in Table 3.14, the harbour porpoise is the only species sighted within the NNP area. It has been observed in very high numbers in February and July, in medium numbers in August and in low numbers in January, April, May, June, September and December (UKDMAP, 1998; see Section 3.4.7). Five pSACs have been proposed for the management of harbour porpoise populations in the southern North Sea (JNCC, 2016d). The Scottish Government is currently considering areas for designation as pSACs in the northern North Sea.

The Inner Hebrides and the Minches, located within the West Scotland harbour porpoise Management Unit, has been submitted as a cSAC to the European Commission for the presence of high densities of harbour porpoise. The area included within the site covers important summer habitat, where the density of animals has been shown to be consistently above average. Although there are more data from summer months, harbour porpoise are present throughout the year (SNH, 2016). Harbour porpoise are mobile species within the PMF list, which requires an appropriate level of protection and conservation measures (SNH, 2014a).

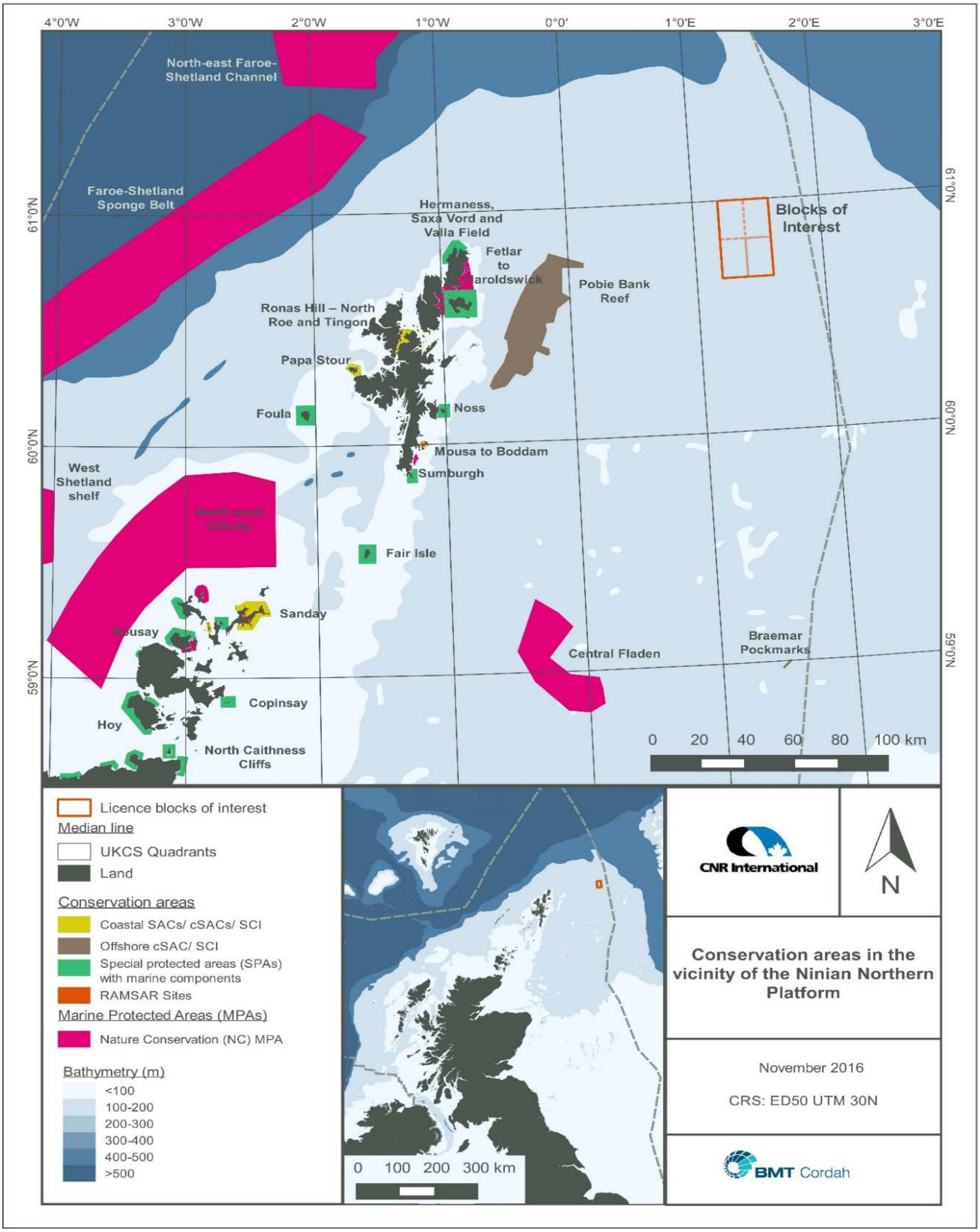


Figure 3.11: Conservation areas in the vicinity of the NNP

Scotland's National Marine Plan

The Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 established a new legislative and management framework for the marine environment, allowing the competing demands on the sea to be managed in a sustainable way across all of Scotland's seas (Scottish Government, 2015). Under the Marine (Scotland) Act 2010 Scottish Ministers must prepare and adopt a National Marine Plan covering Scottish inshore waters. In addition, the Marine and Coastal Access Act 2009 require Scottish Ministers to seek to ensure that a marine plan is in place in the offshore region when a Marine Policy Statement is in effect (Scottish Government, 2015).

The Scottish and United Kingdom Governments have agreed to publish a marine plan for Scotland's inshore waters and a marine plan covering Scottish offshore waters in one document collectively referred to as the 'National Marine Plan' (Scottish Government, 2015). The 'National Marine Plan' has been prepared in accordance with, and gives consideration to the EU Directive 2014/89/EU which came into force in July 2014. The Directive introduces a framework for maritime spatial planning and aims to promote the sustainable development of marine areas and the sustainable use of marine resources. In accordance with article 5(3) of the Directive, a wide range of sectoral uses and activities have been considered within the National Marine Plan.

The General Policies of the National Marine Plan introduce General Policy 9 (Natural Heritage), which concerns the development and use of the marine environment. The policy states that development and use of the marine environment must not result in significant impact on the national status of PMF. Supporting the National Marine Plan, the Strategy for Marine Nature Conservation in Scotland's seas sets out aims and objectives to achieve sustainable development and use, including the protection and, where appropriate, enhancement of the health of the Scottish marine area. Scottish Natural Heritage (SNH), the JNCC and Marine Scotland have been working together to develop a priority list of marine habitats and species in Scotland's sea known as PMFs. The list contains 81 habitats and species considered to be of conservation importance in Scotland's seas (SNH, 2014b), that will help to focus future conservation action and marine planning, direct research and education and promote a consistent approach to marine nature conservation advice (Marine Scotland, 2011).

As the NNP is located 120 km east of the northern Shetland coastline, the proposed operations are located within the marine area covered by the Scottish National Marine Plan. Habitats and species on the PMF list, in the vicinity of the NNP, are discussed throughout this chapter.

Marine and Coastal Act 2009

Scottish Marine Protected Areas (MPAs) are a new national designation under the Marine (Scotland) Act for inshore waters and the Marine and Coastal Access Act 2009 for offshore waters, where Scottish Ministers have executive devolution of authority for the designation of MPAs for the conservation of important marine biodiversity and geodiversity out to 200 nautical miles (nm) (Scottish Government, 2015; JNCC, 2014b). There will be three types of MPAs across Scottish territorial waters: Nature Conservation MPAs (NCMPA); Historic MPAs; and Research/ Demonstration MPAs (JNCC, 2014b).

The new MPA powers allows Scotland to contribute to the UK's European and International marine conservation commitments, such as those laid out under the Marine Strategy Framework Directive, the

OSPAR Convention and the Convention on Biological Diversity with the government required by European law to introduce a network of MPAs (JNCC, 2014b).

The network will contribute to an agreement with international partners to create an ecologically coherent network of well-managed MPAs in the northeast Atlantic (Scottish Government, 2016a). The NNP does not lie in any of the NCMPA areas (Figure 3.11) and therefore it has been concluded that the proposed activities are not capable of affecting (other than insignificantly) any protected feature of an NCMPA.

3.5. Socioeconomic Environment

This section focuses on the broader socio-economic considerations of the existing baseline in relation to the NNP decommissioning activities. Attention is given to the potential impact on the fishing (UK and non-UK fishing in the area) and shipping industries as well as any potential impact on other users of the sea, such as military activity and activity within the renewable energy sector. The existence of submarine cables, historic wrecks and other oil & gas installations are also considered.

3.5.1. UK Commercial Fishing Industry

An assessment of the fishing industry in the NNP area has been derived from International Council for the Exploration of the Seas (ICES) fisheries statistics, provided by Marine Scotland Science Division. Offshore oil and gas operations, including decommissioning activities, have the potential to interfere with fishing activities, for example as a result of the exclusion of fishing vessels from around an area of operation (CEFAS, 2001b). It is therefore important to have an understanding of the fishing activities and intensity in the NNP area in order to evaluate the potential impacts associated with the proposed decommissioning on the fishing industry.

For management purposes, ICES collates fisheries information for individual rectangles measuring 30 by 30 n miles. Data was obtained for ICES rectangle 50F1, which contains the NNP. Statistical data from the ICES rectangles provide information on the UK fishing effort and live weight of whitefish, pelagic and shellfish caught by all UK vessels between 2013 and 2015 and by foreign fishing vessels landed in UK (Scottish Government, 2016b).

Data on the economic value of the fishing industry in this area have been produced based on UK catches and landings (Scottish Government, 2016b). The overall value of different fisheries by area (financial yield per ICES rectangle) is an indication of the differential worth of areas and is used as a method of expressing commercial sensitivity (Coull et al., 1998).

The type of fishing gear and techniques employed by fishermen depends on a variety of factors, such as:

- Species fished, e.g. whitefish, pelagic or shellfish.
- Depth of water and seabed topography.
- Seabed characteristics.

Species found in the water column (pelagic species) are fished using techniques that do not interact with the seabed, whereas demersal and shellfish species are generally fished on or near the seabed. Both finfish, such as cod, whiting, haddock and flatfish, and shellfish species, such as *Nephrops* which are found on or near the bottom, are caught by demersal gear. Demersal trawling methods interact with the seabed, and may interact with the existing infrastructure on the seabed and historical seabed anomalies created by oil and gas activities, including disturbance from subsea structures left in situ such as footings, pipelines, rock-placement or concrete mattresses left or buried in the sediment.

Fishing effort

Fishing effort in number of days for different gear types in ICES rectangle 50F1 over the period 2013 to 2015 is shown in Table 3.16. The total number of days' effort in 50F1 was highest in 2013 with 278 days and lowest in 2015 with 191 days. The fishing effort was dominated by the trawls, seine nets and surrounding nets (Table 3.16).

Table 3.16: UK fishing effort (days fished) according to gear type in ICES Rectangles 50F1 from 2013 to 2015

Gear type	Effort (days)		
	2013	2014	2015
Trawls	278	205	191
Seine nets	-	disclosive data	disclosive data
Surrounding nets	disclosive data	-	disclosive data
Total	278	205	191

Source: Scottish Government (2016b)

Catch composition

Between 2013 and 2015 the annual total live weight of fish landed from ICES rectangle 50F1 ranged from 1,851 tonnes in 2013 to 3,799 tonnes in 2015 (Scottish Government, 2016b; Table 3.17).

Demersal fish species dominated the catch (around 66%) in 2013, with pelagic species accounting for 34% of the catch. In 2014 and 2015, pelagic fish species dominated the catch with 51% to 74% of the total and demersal species accounted for 26% to 49%. Shellfish species made up only a small proportion of the catch (between 0 to 0.1%) (Scottish Government, 2016b).

Catch composition by weight of UK landings from UK and foreign vessels in ICES rectangle 50F1 for 2013 to 2015 was dominated by mackerel and saithe. Mackerel made up 24% to 57% of the catch in 50F1. Other species landed included cod, monkfish, haddock, ling, European hake, whiting, megrim and catfish (Scottish Government, 2016b).

Table 3.17: Total landings (tonnes) of demersal, pelagic and shellfish species caught in ICES Rectangle 50F1 by UK and Foreign Vessels between 2013 and 2015

Species type	Live weight (tonnes)		
	2013	2014	2015
Demersal	1,217	1,068	1,001
Pelagic	632	1,131	2,795
Shellfish	2	1	2
Total	1,851	2,200	3,799

Source: Scottish Government (2016b)

Quantity and value

During 2015, 3,799 tonnes of fish were landed from ICES rectangle 50F1 amassing a value of £3,126,143 (Scottish Government, 2016b). Data indicates that the majority of these fish were landed in October (2,934 tonnes amassing a value of £1,944,495). The highest value catch was demersal species (Table 3.18).

Table 3.18: 'Relative Value' of Commercial Fisheries in ICES Rectangle 50F1 for 2015

Species type	Fisheries relative value (£)	Relative quantity landed (tonnes)
Demersal	Moderate (500,000 to <2,000,000)	High (1,000 to <2,000)
Pelagic	Low (≤2,000,000)	Moderate (2,000 to <10,000)
Shellfish	Low (≤500,000)	Low (<500)

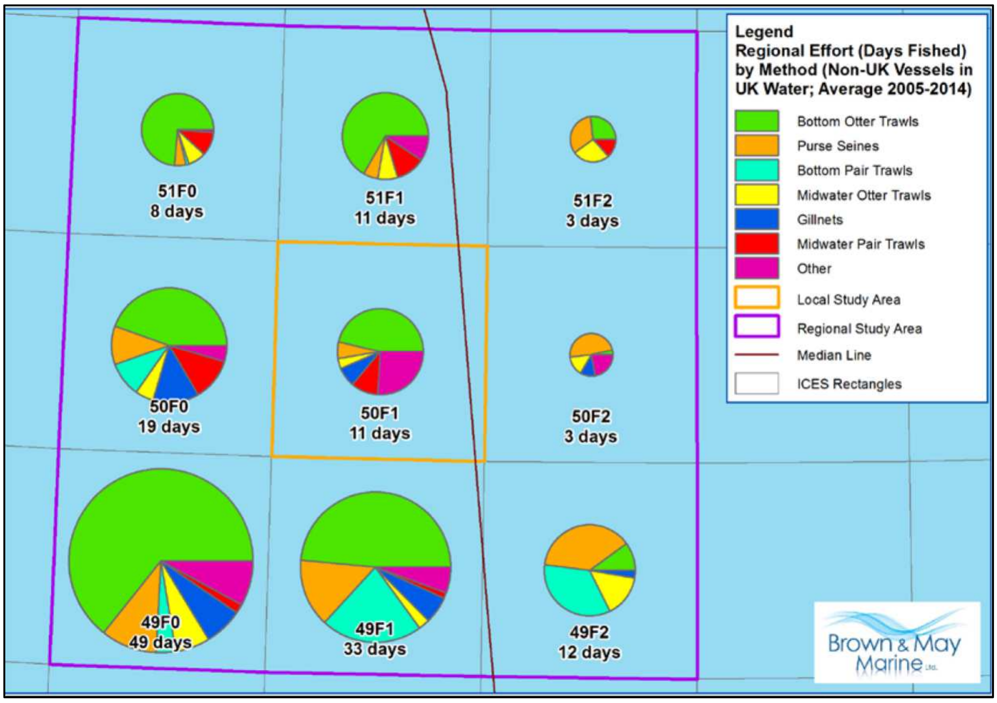
Source: Scottish Government (2016b)

3.5.2. Non-UK Commercial Fishing Activity

It has been noted during the consultation with stakeholders that the UK fisheries statistics will not represent the true levels of foreign vessel activity, as values are only recorded if the foreign vessel lands into a UK port. CNRI commissioned SFF Services Ltd. to undertake a socioeconomic study which assesses the contribution of non-UK fishing vessels relative to the UK fishing activity in relation to the NNP decommissioning activities. This study was part of an impact assessment of the potential interactions between NNP decommissioning vessels and inventory to the existing fishing industry (SFF Services, 2016).

Effort

The effort of the non-UK fleet active in the regional study area is given with respect to Scottish, English and Northern Irish vessels which compose the majority of the UK fleet. Effort by all countries is commensurate with landings values. The highest effort recorded by non-UK vessels is by Norway, France and Northern Ireland registered vessels in the regional study area, although considerably lower effort is recorded compared to UK registered vessels. All other non-UK vessels record lower effort (SFF Services, 2016). The average effort of non-UK vessels in ICES 50F1, for the period from 2005 to 2014, was 11 days, and was dominated by the use of bottom otter trawls (Figure 3.12; SFF Services, 2016).



Source: SFF Services (2016)

Figure 3.12: Effort by gear type for non-UK vessels in the NNP area, ICES rectangle 50F1

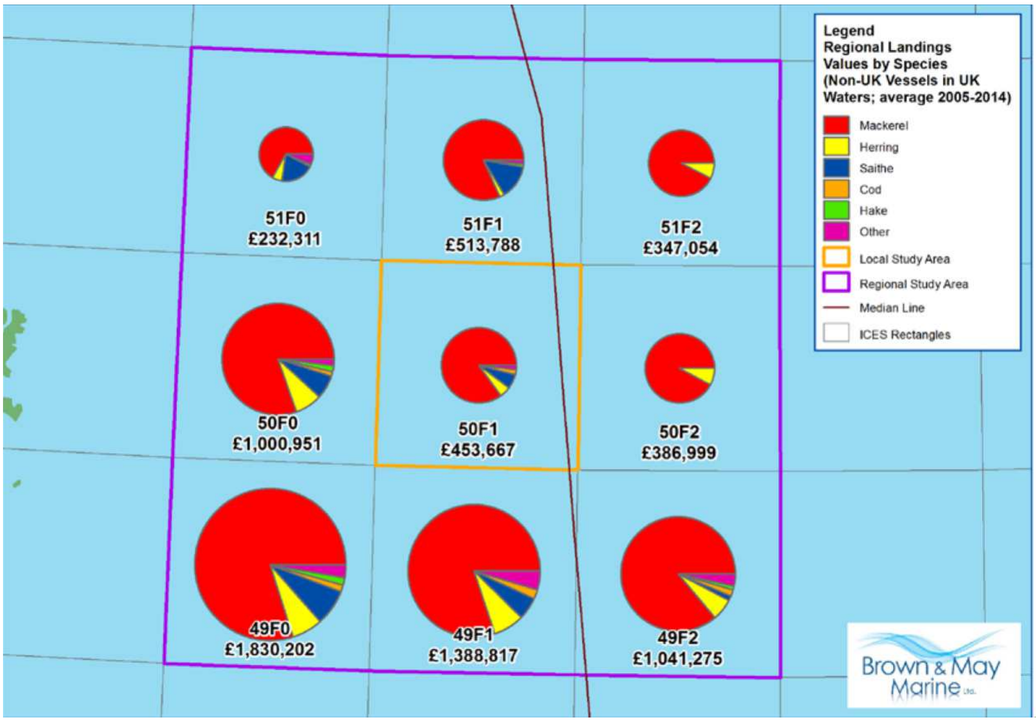
Catch composition

Targeted by single and pair mid-water otter trawlers and purse seiners, mackerel, contributes the most to landings values in the regional study area. The non-UK pelagic fleet also targets herring, but landings values for herring are recorded at much lower levels (Figure 3.12; SFF Services, 2016).

Value

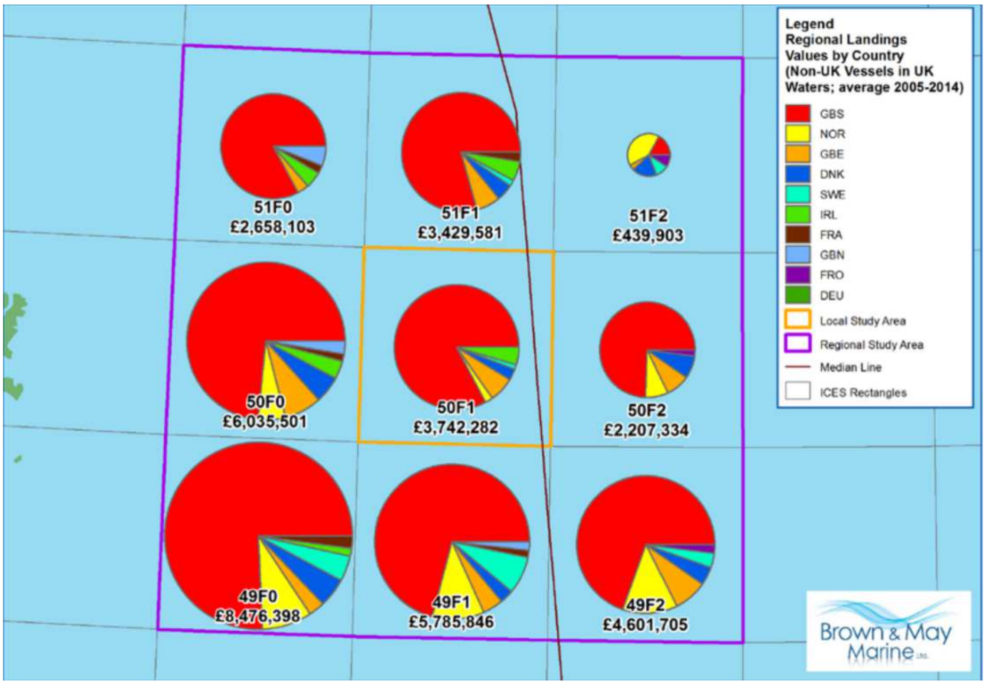
An average annual landing overview of the fisheries activity by country is presented in Figure 3.13 (SFF Services, 2016). Approximately 20% of the total fishing boats in the 50F1 area for the period 2005 to 2014 were non-UK registered and were dominated by vessels from the Republic of Ireland, Denmark and Norway (SFF Services, 2016). Other foreign vessels in proximity to the NNP area were from Sweden, the Faeroe Islands and France (Figure 3.14; SFF Services, 2016). The average overall value for the ICES 50F1 for the period 2005 to 2014 was £3,742,282 (SFF Services, 2016; Figure 3.13).

During the decommissioning project, there will be a potential for navigational conflicts arising between fishing vessels and decommissioning vessels transiting to and from the site. This could include vessels with towed gear being required to alter their towing direction, or fouling of fixed gear markers. This interference by decommissioning vessels has the potential to impact more fishing vessels than just those operating in the immediate vicinity of the NNP and its associated pipelines, depending upon the location of decommissioning port(s).



Source: SFF Services (2016)

Figure 3.13: Annual landing value by species from non-UK vessels in the NNP area, ICES rectangle 50F1



Source: SFF Services (2016)

Figure 3.14: Average annual fishing landing of UK and non-UK vessels in the NNP area, ICES rectangle 50F1

3.5.3. Vessels Monitoring System (VMS) Data

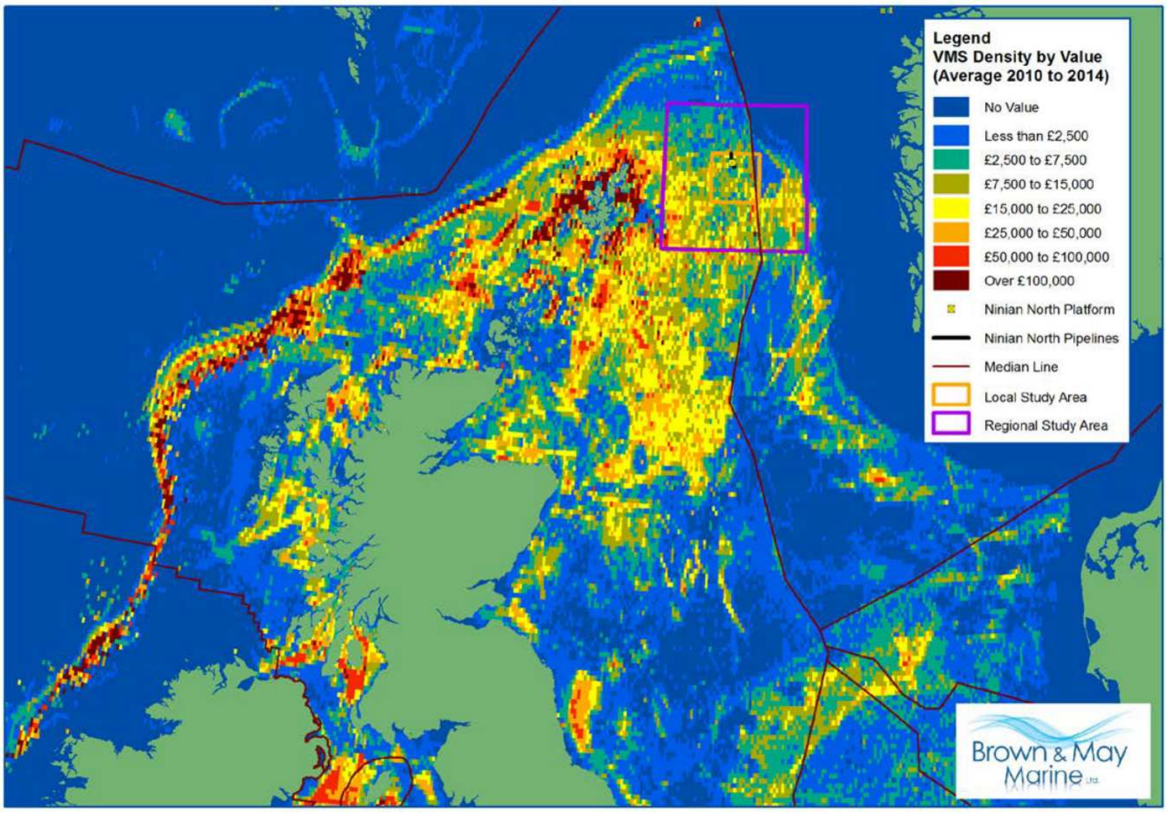
VMS (satellite tracking) data complement ICES fisheries statistics data presented above. The Marine Management Organisation (MMO) has provided satellite tracking data for the years (2010 to 2014) for all UK fishing vessels over 15 m in length (SFF Services, 2016). The dataset is not broken down by method due to concerns over data protection, but has been cross-referenced with the landings data. To avoid misallocation of landings, data were assigned to overlapping ICES rectangles. To differentiate between vessels steaming and fishing, only vessels with speeds between 0 and 6 knots were assumed to be fishing.

UK VMS

Figure 3.14 illustrates satellite (VMS) density of all UK vessels over 15 m in length by landing values (average 2010 to 2014). Areas with the highest recorded values are generally concentrated offshore along the west and north east coasts and in inshore areas along the west of Scotland. This pattern of distribution directly reflects the location of grounds where the pelagic fleet targets mackerel.

The wider Ninian Northern study area (“regional study area” Figure 3.15) is located in an area which records moderate landings values that are relatively homogenously distributed throughout the southern half of the study area (average values within £7,500 to £25,000 range). Landings in the northern area are much lower (£7,500 or less) (SFF Services, 2016).

Most of the fishing grounds within the local NNP study area (Figure 3.15) records values of between £7,500 to £25,000, although there are a small number of discrete areas that record higher values in the east and west (maximum of £100,000). Areas in close vicinity of the NNP record low values, maximum of £7,500 (SFF Services, 2016).



Source: SFF Services (2016)

Figure 3.15: Satellite (VMS) density of all UK over 15 m vessels by landings values (average 2010-2014)

Non-UK VMS

Areas of high density VMS transmissions for Norwegian vessels are concentrated offshore, some distance to the north of the NNP, and at a narrow band which corresponds to mackerel movements and the areas where the species are targeted by the pelagic fleet (SFF Services, 2016).

Densities have not been provided for Norwegian vessels fishing in Norwegian waters to the east of the study area. Areas recording average VMS transmission densities of between 10 and 40 are recorded in the north of the regional study area, with the areas in the south recording average densities of between 2 to 20 (SFF Services, 2016). Low to moderate activity levels are recorded within the local study area where VMS transmission densities range from between 2 and 20 vessels. The NNP is located in area with lower transmissions recorded, ranging from between five to 10 transmissions.

Areas of high density of Danish vessels are concentrated offshore along the north and northeast coasts. Areas of moderate density are variably located in offshore areas of the east coast. The regional study area is located in an area with moderate densities to the west and southwest (SFF Services, 2016).

Dutch VMS density is generally recorded in the west and south west of the regional study area, with limited activity recorded only in the west of the local study area. Activity in the vicinity of the NNP and is negligible, recording average values of less than £2,500 (SFF Services, 2016).

3.5.4. Oil and Gas Industry

Oil and gas development in this region of the North Sea is relatively intensive. There are several oil developments close to the NNP. Those within 30 km radius include: Ninian Central (UKCS Block 3/3); Ninian Southern (UKCS Block 3/8); Alwyn North NAA and NAB (UKCS Block 3/9); Brent A, B, C and D (UKCS Block 211/29); NW Hutton A (decommissioned, footings in place; UKCS Block 211/27); Cormorant A (UKCS Block 211/26); and Heather A (UKCS Block 2/5) (Table 3.19). The location of these platforms in relation to the NNP is illustrated in Figure 1.1.

Pipelines in the vicinity of the NNP include: Alwyn Export 12" oil pipeline; Heather to Ninian 16" oil line; Ninian to Grutwick 36" MOL; Magnus to Ninian 24" MOL; Strathspey to Ninian Central – one 10.75" and three 8.625" pipelines; Ninian Central to Brent 16" gas line; Brent A to St. Fergus (FLAGS) 36" gas line; Alwyn to Ninian 12" oil line; and Cormorant A to Brent A (Western Leg) (UK Oil and Gas Data, 2016).

Table 3.19: Oil and gas developments within close proximity of the NNP

Platform	Distance from the NNP	Bearing (˚)
Ninian Central	5.9 km	160
Ninian Southern	11.1 km	170
Alwyn North NAA	20.2 km	120
Alwyn North NAB	20 km	120
Brent A	21 km	50
Brent B	23 km	45
Brent C	27 km	40
Brent D	30.4 km	35
NW Hutton A (only footings in place, decommissioned)	23.4 km	345
Cormorant A	29 km	320
Heather A	26.4 km	285

Source: UK Oil and Gas Data (2016)

3.5.5. Shipping

CNRI commissioned Anatec to identify the shipping routes passing the NNP. Details of all shipping routes passing close to the platform have been identified using Anatec's ShipRoutes database (Anatec, 2016; Table 3.20; Figure 3.16). The NNP is located in an area of moderate shipping activity within the Ninian Field (DECC, 2014). There are 22 shipping routes that pass within 10 n miles of NNP, with a total of 941 ships travelling through these shipping routes, which equates to an average of 3 vessels per day (Anatec, 2016). This is 69% of the total number of ships that pass through the Ninian Field (1,333). Shipping lanes are used by shuttle tankers, supply and standby vessels serving the offshore oil installations in the area.

Table 3.20: Ship Routes Passing within 10n miles of NNP

	Description	CPA (nm)	Bearing (˚)	Ships Per Year	% of Total of shipping within the Ninian Field
1	Froysjoen-Lerwick*	1.2	332	10	1%
2	Clyde-N Norway/Russia a	1.5	145	10	1%
3	Aberdeen-Murchison a*	2.4	294	55	4%
4	Bruce-Magnus b*	3.6	087	40	3%
5	Bruce-Magnus a*	3.8	267	60	5%
6	Aberdeen-Murchison b*	4.3	095	37	3%
7	Canada-Sognefjorden*	4.8	008	30	5%
8	Aberdeen-Dunlin*	4.8	294	26	2%
9	Statfjord Term.-Milford Haven *	4.8	310	25	2%
10	Harding-North Cormorant b*	5.0	268	16	1%
11	Sognefjorden-Canada	5.5	004	23	2%
12	Brent-Aberdeen *	5.5	114	190	14%
13	Gullfaks Term.-Moray Firth *	6.6	127	12	1%
14	N Norway/Russia-Bristol *	6.6	145	5	0%
15	Aberdeen-Thistle *	6.6	294	170	13%
16	Statfjord Term.-Mersey	6.6	313	10	1%
17	Sognefjorden-Iceland	6.7	008	12	1%
18	Belfast-N Norway/Russia *	6.8	141	30	2%
19	Moray Firth-N Norway/Russia E*	7.7	308	30	2%
20	Aberdeen-Magnus b*	8.0	284	88	7%
21	Storfjorden-Lerwick	8.4	316	20	2%
22	Alwyn-Lerwick*	9.5	152	24	25%
TOTAL				**941**	**69%**

Source: Anatec (2016)

*Where two or more routes have an identical Closest Point of Approach (CPA) and bearing they have been grouped together. In this case, the description lists the sub-route with the most ships per year.

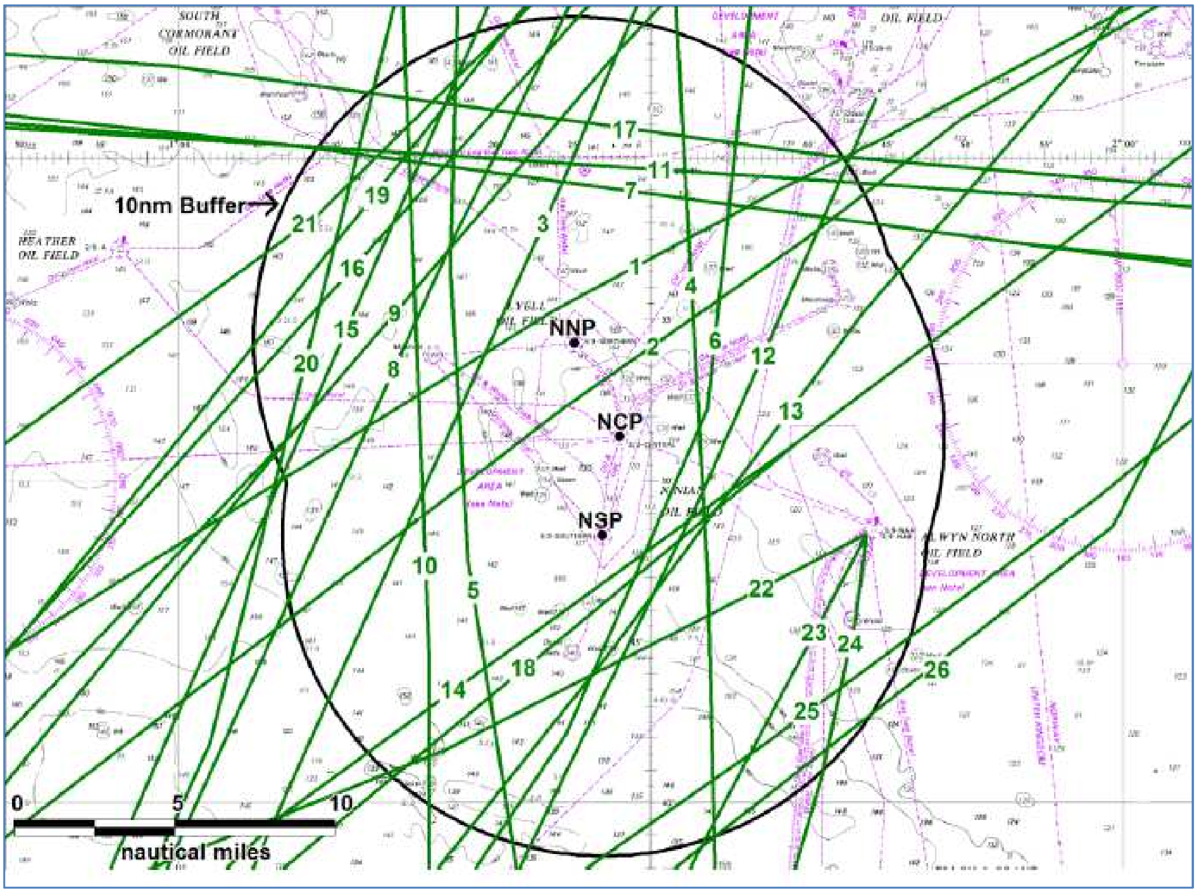


Figure 3.16: Shipping Route Positions within 10 n miles of the Ninian Field
Source: Anatec (2016)

Routes 1 and 2 pass within 2nm of NNP. Details of these routes are as follows:

- Route No. 1 is used by an estimated 10 vessels per year between Froysjoen and Lerwick. This route passes NNP to the NW at a mean distance of 1.2nm.
- Route No. 2 is used by an estimated 10 vessels per year between the Clyde and N Norway/Russia. This route passes the NNP location to the SE at a mean distance of 1.5nm.

A plot of all tracks by vessel type during the year survey period is presented in Figure 3.17. This is dominated by 'other' vessels, which are mainly oil & gas support vessels passing the Ninian Field when heading between port and other North Sea Fields. The rest of the shipping in the area is comprised of tanker and cargo vessels (Figure 3.18). The dominant vessel type in the Ninian Field is offshore supply vessels with sizes of 1,500 to 5,000 dead weight tonnage (DWT) (Figure 3.19) (Anatec, 2016).

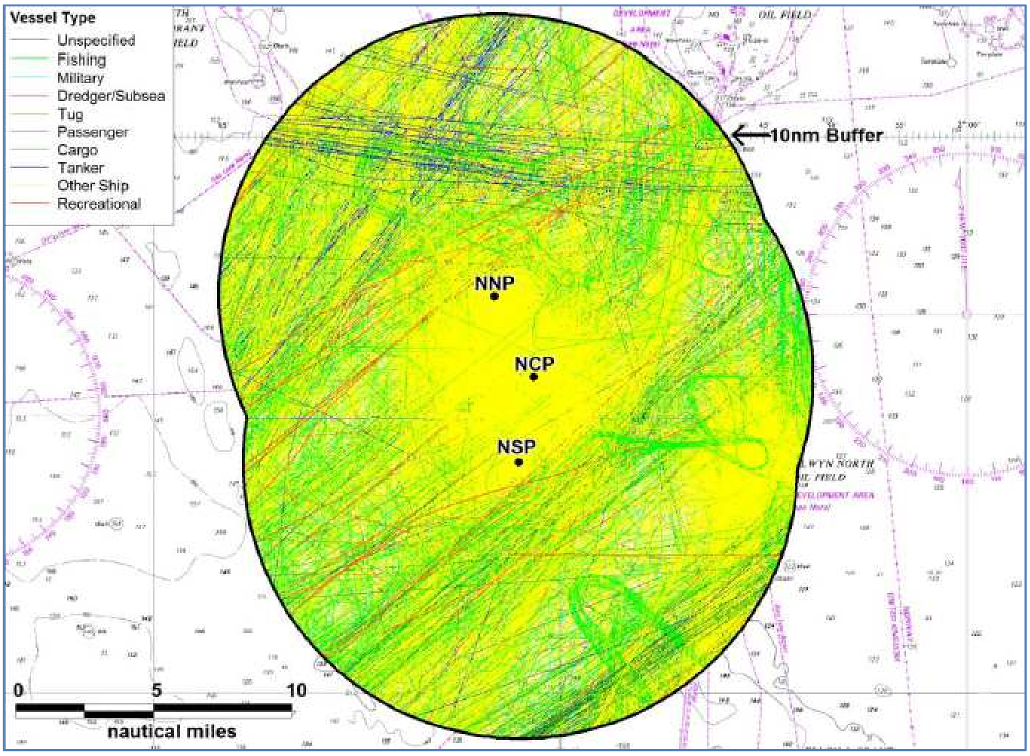


Figure 3.17: All Tracks recorded within 10nm of the Ninian Field Platforms
Source: Anatec (2016)

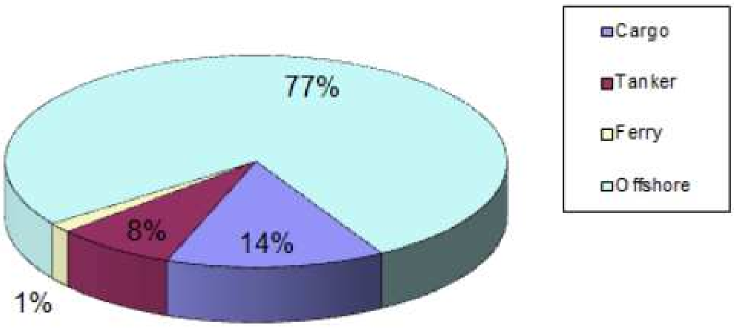


Figure 3.18: Vessel Type Distribution within 10nm of the Ninian Platforms
Source: Anatec (2016)

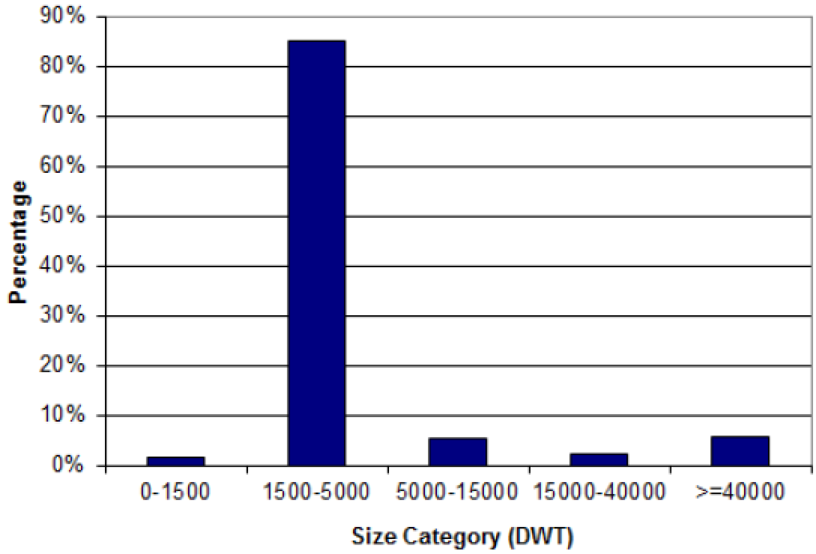


Figure 3.19: Vessel Size Distribution within 10nm of the Ninian Platforms
Source: Anatec (2016)

3.5.6. Defence

Military operations in Scottish waters include the triennial exercises run jointly by the Royal Navy and the Royal Air Force. These exercises include operations to the north and east of Scotland. Several areas of the inner and outer Moray Firth, including an extensive area to the east of Orkney, are used by the Air Force for activities which include radar training, high and low-angle gunnery and air to sea or ground firing. Areas in and around the Firth of Forth are predominantly used by the Navy for submarine exercises, mine countermeasures and minesweeping, and explosive trials (DTI, 2001).

There are no recorded historic military disposal sites, nor license conditions, applied to Block 3/3 by the BEIS on behalf of the Ministry of Defence (MoD) within, or close, to the NNP.

3.5.7. Submarine Cables and Pipelines

Currently there are no subsea communication cables laid within Block 3/3 (KIS-ORCA, 2016). The closest submarine cable is the CANTAT-3 telecommunication cable which is located approximately 21 km north-east of the NNP (KIS-ORCA, 2016).

3.5.8. Marine Archaeology and Wrecks

In the UK, submerged prehistoric sites and shipwrecks are not protected unless specific action has been taken to protect them. There are, however, two different acts under which wrecks that may be of archaeological interest may be designated, namely the Protection of Wrecks Act 1973 and the Protection of Military remains Act 1986. Designation of wrecks and submerged prehistoric sites is also possible under a third act, the Ancient Monuments and Archaeological Areas Act 1979, which applies to Scotland, England and Wales (DECC, 2009). There are no recorded wrecks in the vicinity of the NNP (SeaZone, 2013).

3.5.9. Renewable Energy Activity

Much of the marine and coastal areas around the UK are being investigated and/or developed as renewable energy resources. Wave, tidal and wind renewable energy studies and projects are underway in several areas.

Wave and Tidal

The UK has a particularly good marine current resource with at least 40 possible locations having currents of a suitable speed for energy generation. Many of these are within the waters of Shetland and Orkney. The closest tidal and wave energy zone to the NNP is located more than 100 km to the west, therefore no interaction with the renewable energy sector is expected to occur as a result of the proposed decommissioning program.

Wind

The closest wind renewable energy zone to the NNP is in the Moray Firth. This includes the Beatrice, MacColl, Stevenson and Telford wind farms which are located to the north and east of the Moray Firth renewable zone and are more than 300 km to the southwest of the Ninian field (Crown Estate, 2016).

Gas and Carbon Capture and Storage Activities

As a result of declining natural gas resources in the North Sea, pressure is mounting for more investment in UK gas storage facilities to ensure integrity of supply. There is only one offshore gas storage facility currently in operation in the UK and it is located in the southern North Sea: the Rough 47/8 Alpha facility. Other licences have been granted such as ENI's Deborah field located in Block 48/29 in the southern North Sea, 36 km northeast of the Bacton terminal. Currently there are no gas storage facilities in Scottish waters (Baxter et al., 2011). The use of existing storage facilities and associated infrastructure is unlikely to have a significant environmental impact, although the release of hypersaline water in the production of salt caverns may have some localised effects (Scottish Government, 2015).

Carbon capture and storage (CCS) is a new technology being developed to manage the emissions of CO_2 and reduce the contribution of fossil fuel emissions to global warming. The closest CCS project to the NNP is the Shell Goldeneye project located in the central North Sea. This development is currently in the 'agreement for lease' stage. There are no known CCS plans situated closer to NNP.

Dredging and Aggregate Extraction

Aggregates are mixtures of sand, gravel, crushed rock or other bulk minerals used in construction, principally as a component of concrete. Most UK dredging sites are located in the southern North Sea with the main region of aggregate extraction in the North Sea being the Humber Region (DTI, 2001). There are currently no marine aggregate application options or licensing sites in Scottish waters. The only licensed site is at Middle Bank in the Firth of Forth, which has not been dredged since its last (and only) use in 2005 (Baxter et al., 2011, Crown Estate 2016).

3.6. Summary of Seasonal Environmental Sensitivities

Table 3.21 provides a summary of the seasonal sensitivities for the NNP area.

Table 3.21: Seasonal environmental sensitivities in the vicinity of NNP

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Habitats Directive: Annex I Habitats There are no known Annex I habitats in the NNP area. Although *Lophelia pertusa* has colonised the NNP, it would not have occurred without the presence of the platform and therefore does not qualify as an Annex I habitat (Fugro ERT, 2011).											
Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Habitats Directive: Annex II Species Of the Annex II species, only the harbour porpoise has been sighted in the NNP area, with very high abundance in February and July, medium numbers in August and low numbers in December, January and throughout the summer months (April, May, June and September) (UKDMAP, 1998).											
Low	Very high	Not surveyed/No data available	Low	Low	Low	Very high	Moderate	Low	Not surveyed/No data available	Not surveyed/No data available	Low
Benthic Fauna Benthic communities in the NNP area are similar to those found throughout a large surrounding area of the northern North Sea. No rare species are known to occur in this area (Fugro ERT, 2011).											
Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Plankton The plankton in the NNP area is typical of the northern North Sea. Peak productivity occurs in spring and summer.											
Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Finfish The NNP is located in spawning grounds for cod (Jan to Apr), haddock (Feb to May), Norway pout (Jan to Apr), saithe (Jan to Apr) and sandeel (Nov to Feb); and in nursery grounds for herring, ling, mackerel, spurdog, haddock, Norway pout, blue whiting, sandeel, whiting, anglerfish and European hake (throughout the year) (Coull et al., 1998; Ellis et al., 2010).											
High	High	High	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Marine Mammals Marine mammals sighted in and around the NNP area include minke whales, long-finned pilot whales, killer whales, white-beaked dolphins and harbour porpoises. Peak sightings predominantly occur in the summer months (Reid et al., 2003; UKDMAP, 1998).											
Low	Very high	Moderate	Low	Moderate	Low	Very high	Moderate	Low	Not surveyed/No data available	Not surveyed/No data available	Low
Seabirds Seabird vulnerability to oil pollution in the NNP area is "high" in January, March, July, October and November and "moderate" to "low" for the rest of the year. The overall vulnerability in the NNP area is "low" (JNCC, 1999).											
Moderate	Moderate	High	Moderate	Low	Low	High	Low	Moderate	Moderate	High	Low
Fisheries The fishing effort in 2015 in the NNP area was dominated by pelagic fisheries. Demersal species dominated the landings, with their relative value being "moderate" in 2015 (Scottish Government, 2016).											
Shipping Shipping traffic in the vicinity of NNP is of moderate density (DECC, 2014).											
Oil and Gas – nearby surface infrastructure Within 30 km radius of NNP there are Ninian Central (Block 3/3), Ninian Southern (Block 3/8), Alwyn North NAA and NAB (Block 3/9), Brent A, B, C and D (Block 211/29), NW Hutton A (decommissioned, footings in place; Block 211/27), Cormorant A (Block 211/26) and Heather A (Block 2/5), (UK Oil and Gas Data, 2016).											
Other users of the sea In the vicinity of the NNP there are no renewable energy sites, military training areas, recorded wrecks and telecommunication or power cables (SeaZone, 2013; KIS-ORCA, 2016).											

Key

Dark navy	Very high sensitivity
Blue	High sensitivity
Cyan	Low sensitivity
White	Not surveyed/No data available
Green	Moderate sensitivity

4. STAKEHOLDER VIEWS

Consultation with stakeholders is an important part of the EIA process. It enables the issues and concerns of stakeholders to be recorded, addressed and communicated within the ES and, where applicable, acted upon during the planning stage. This section details CNRI's ongoing engagement programme which elicited views on a range of environmental issues from across the spectrum of stakeholders.

During the EIA scoping exercise, CNRI contacted BEIS and other statutory stakeholders to raise awareness of the NNP Decommissioning Programme and to invite comment on the EIA scoping report (BMT Cordah, 2016a). The initial scoping exercise was undertaken prior to the CA workshops.

Issues raised by stakeholders were used to inform the CA process and to identify a recommended option. The results of the CA and the recommended options were subsequently shared with the stakeholders through the issue of the draft CA report (BMT Cordah, 2016b) and during a one-day workshop (7th December 2016) to explore the results.

The stakeholder engagement workshop was held on a non-attributable basis to encourage open engagement and additional meetings were held to discuss the decommissioning options for NNP.

Table 4.1 summarises all environmental issues raised by stakeholders during the consultations, CNRI's response and the location of response in the ES.

Table 4.1: Environmental issues raised by stakeholders during the NNP consultations process

Issue raised by stakeholder	Influence on the NNP EIA
Acknowledgement given that the various alternatives that may still occur for the decommissioning of NNP the scoping report presents a good account of all the possible environmental impacts, whilst trying to focus the EIA on the key issues. Support provided to CNRIs approach of ensuring that the full and complete assessment of key issues is presented in the ES for the decommissioning programme.	CNRI acknowledges these comments.
Acknowledgement given that at this stage it is not yet clear how the drill cuttings pile will be managed and/or avoided during decommissioning. Comment afforded that it is essential that the NNP decommissioning programme is clear about how the drill cuttings pile will be managed/ avoided and a full assessment of the environmental impacts and any mitigation measures for the proposed operations presented in the ES.	The decision on how the NNP drill cuttings pile will be decommissioned was assessed during the CA workshop. A full assessment of environmental impacts associated with the decommissioning of the drill cuttings pile and the proposed mitigation is presented in **Section 8**.
Acknowledgement that there are no European designated MPAs in the vicinity of NNP, however, consideration should also be given in the ES to nationally designated NCMPAs.	**Section 3** includes a description of the European and nationally designated MPAs in the northern North Sea and in the vicinity of NNP. The nearest NCMPA to NNP is the Fetlar to Haroldswick NCMPA, located approximately 110 km southwest of the platform.
Comment afforded that with regard to potential noise impacts, vessel noise and various cutting techniques are outlined as potential noise sources, with no mention of potential explosives use, which is sometimes used in well abandonment. Given the potential noise impacts associated with the use of explosives, it was suggested that CNRI may wish to assess their possible use at an early stage in the environmental assessment process.	The proposed methods for jacket removal is fully described in **Section 2**. The current project scope will cover all cutting options. Where explosives are considered a suitable method, these will be assessed fully within the ES, including the assessment of noise impacts (**Section 7**).

Issue raised by stakeholder	Influence on the NNP EIA
Acknowledgement given that the spawning, nursery and commercial fishing activities data used in the scoping document is up-to-date. Comment afforded that fishing intensity data at a higher resolution than the ICES rectangle level is available from the link below and should be included in future CNRI documents (where appropriate): http://www.gov.scot/Topics/marine/science/MSInteractive/Themes/fish-fisheries/vms09-13	CNRI have noted the comments and have included up-to-date VMS data within **Section 3**.
When presenting information on drill cuttings, it has been requested that the cuttings distribution is expressed as a percentage volume of the total drill cuttings volume with distance away from the footings. Comment afforded that this provides a more realistic understanding of the cuttings distribution/ footprint on the seabed e.g. 50% of the total drill cuttings volume is located within a 20 m radius of the NNP footings; 75% of the total drill cuttings volume is located within a 50 m radius of the NNP footings; 90% of the total drill cuttings volume is located within a 100 m radius of the NNP footings; and 100% of the drill cuttings volume is located within a 500 m radius of the NNP footings. This provides a much clearer understanding of: • Where the majority of the drill cuttings volume is located together with its associated footprint. • The depth of drill cuttings for the majority of the cuttings pile footprint. • Estimated contaminant recovery rates for impacted seabed surface sediments. • Potential anchor locations for vessels working on the project.	CNRI can confirm that MBES mapping was conducted on the NNP cuttings pile during the 2011 environmental baseline survey and from this it was estimated that at the centre of the pile deposition thickness was almost 12 m in height. The drill cuttings pile is almost entirely situated under the platform with the pile itself being approximately 160 m in diameter. For reference the length of the jacket is approximately 97 m. Therefore, 100% of the pile is located within 100 m from the centre of the platform. A profile view of the cuttings pile, where the bulk of the pile can be seen to be located within the footings. A description of the cuttings pile and the profile view of the cuttings pile are included in **Section 2**.
Comment afforded that the collection of drill cuttings samples should be based on sediment cores as well as surface sediment grabs ensuring a better understanding of the historical distribution of contaminants and the biogeochemical recovery of surface sediments over time.	CNRI can confirm sampling of the pile was undertaken by sediment cores with surface grab samples taken of the sediment contamination on the outer edge of the pile. The results from the baseline survey are described in **Section 3**.

Issue raised by stakeholder	Influence on the NNP EIA
Comment afforded that since the decommissioned works will be phased, and queried how CNRI intend to take into consideration the cumulative consequences of each decommissioning stage? Has consideration been given by CNRI to the influence this approach would have on decommissioning options for future stages?	CNRI can confirm the pipelines will be cleaned and made safe with the intention of decommissioning at a later date under a separate decommissioning plan. The cumulative consequences of decommissioning NNP in phases (i.e. the potential legacy issues and their influence on later stages of the project) is addressed following the CA and is presented in **Sections 6 to 11.**
Comment afforded that not all receptors that could be impacted have been considered in relation to each listed activity. All potential impact receptor pathways should be considered at this stage to allow transparent and risk-based scoping into the future EIA. Recommendation provided that CNRI ensure that all receptors that could be impacted are listed for each activity. For example, the physical presence of vessels could result in marine mammal displacement and the anchoring on the seabed could result in cumulative effects to benthic habitats. In addition, further clarification sought on how CNRI determined if an impact was significant or not and, therefore on what basis impacts are scoped in/ out of further assessment. Recommendation provided that CNRI identify every receptor for which there is a possible impact receptor pathway, and then provide suitable justification as to why some impacts will not require further assessment.	CNRI have reviewed and ensured consideration of all significant receptors within the EIA. Any issue identified as having an impact with a moderate significance and above (identified through the desktop assessment and scoping workshop) was deemed to be a key issue to be described in further detail in the ES (**Sections 6 to 11**).
Interested to hear more about any proposed monitoring plans for the structures, that would assist our understanding of their interaction with the marine environment.	CNRI's intention with respect to long-term monitoring is provided in **Section 2**.
Requirement for detail regarding waste management, including CNRI commitments.	Waste management details and commitments are provided in **Section 11**.
Consideration regarding the cumulative impacts of multiple projects and associated long-term impacts sought.	Comment is provided in **Section 2**, in addition to comments related to identified impacts within the assessment provided in **Sections 6 to 11**.

Issue raised by stakeholder	Influence on the NNP EIA
Comment afforded that the scoping report states that there are no known Annex I habitats in the vicinity of NNP. However, the report also states that *L. pertusa* was the most prolific form of marine growth from 75 to 141 m and that mussels were the largest contributing organism to marine growth at shallower depths. Acknowledgement provided that CNRI aims to discuss marine growth fully in the ES, with the provision of some useful high-level comments on marine growth to be taken into consideration: • Annex I of the Habitats Directive makes it clear the habitats listed for protection should be natural, so we consider that any marine growth on the infrastructure does not need to be considered by itself under the Habitats Directive. • It is important that CNRI assesses whether the decommissioning operations impact any other natural *L. pertusa* that may be occurring around the infrastructure. • Within OSPAR documents on *L. pertusa* reefs, there is no such clarification as to whether the features have to be naturally occurring instances to be considered as Threatened & Declining habitat. Therefore we would suggest that CNRI assesses impacts against the Threatened & Declining habitats.	**Section 3** details that survey video footage indicates that there are *L. pertusa* colonies present on NNP, however the presence of *L. pertusa* has not been detected in the environment surrounding the platform. These colonies are artificial aggregations due to the presence of the platform and as such are not deemed to be natural occurring reefs. These aggregations are found on the footings; as a result, these will be preserved with the decommissioning of the footings in situ.
Comment afforded that the scoping report was unclear in instances where suitable mitigation had been identified and how the mitigation lowered the level of environmental impact, and if CNRI considers impacts which have been mitigated requiring further investigation in the EIA Process. Clarification sought as to how the given mitigation relates to the suggested scale of impact and recommend that further clarification is given in the scoping report on the role mitigation plays in determining the scale of impact. Comment afforded that "Effects associated with cutting pile management" has been listed twice alongside "effects of drill cutting disturbance" in the key environmental concerns which will be taken forward for further consideration. Clarification sought into why this environmental concern has been listed three times and recommend that CNRI amend the scoping report accordingly.	The mitigation proposed has not been used to determine the level of impact, i.e. the impact that has been assigned during the desktop and workshop sessions is without mitigation measures in place. The reason for putting in the 'mitigation proposed' in **Section 6** is to identify these for impacts ascertained to be of significant risk. The effects associated with cuttings pile management are different to the effects of drill cuttings disturbance although this could be clearer in the Conclusion. CNRI can confirm there is a duplication of effects of drill cuttings disturbance, which is an error. Drill cuttings management is discussed in **Section 8.**

Issue raised by stakeholder	Influence on the NNP EIA
Acknowledgement afforded that it is anticipated that well P&A is expected to use the existing drilling derrick and facilities. Recommendations provided that alternative methods of conducting the well P&A campaign and their potential environmental impacts are considered in the ES, or if CNRI consider it more appropriate in the CA. Consideration of alternatives is an important step in the EIA process and providing evidence that CNRI has considered alternatives will provide stakeholders with assurances that the best available techniques have been selected.	CNRI do not consider it appropriate to assess the alternatives to well P&A methods in the CA, as the CA is for the decommissioning of the drill cuttings and jacket only. The environmental impacts associated with well P&A will be described within **Section 8.**
Comment afforded that the full and partial removal of the jacket uses the same method and that the cutting and lifting option has been outlined in the scoping report. Recommendation provided that any technically viable options for complete or partial removal of the jacket are considered within the ES. For example if CNRI want to consider the use of explosives to assist in the decommissioning the NNP then this should be considered in the environmental assessment process and be incorporated into any noise modelling.	The proposed methods for jacket removal are described fully in **Section 2** of the ES. CNRI do not plan to use explosives to cut jacket members.
Recommendation provided that a realistic worst case scenario is used to assess each of the proposed decommissioning options in the ES	The decommissioning options are discussed in **Section 2**.
It is unclear from the scoping report if any of the proposed decommissioning options could require the laying of rock for protection purposes. Recommendation provided that the potential requirement for rock dump is considered for all decommissioning options and that the maximum possible quantities required are evaluated.	CNRI can confirm rock-placement will not be required for the proposed decommissioning operations as this decommissioning programme will only consider the jacket, topsides and drill cuttings pile. It is proposed that the surrounding subsea infrastructure is accounted for under a separate decommissioning programme. Pipelines will be cleaned and made safe.
The historic drill cuttings pile located under the NNP is an important environmental consideration. Comment afforded that based on modelling, CNRI conclude that further management of the cuttings pile is not required. Recommendation provided that the ES includes information that was used to inform the modelling is discussed, along with the model's assumptions and limitations.	**Sections 3 and 8** include information on the model and further information regarding samples taken from the cuttings pile.

Issue raised by stakeholder	Influence on the NNP EIA
Comment afforded that a pre-decommissioning environmental baseline survey was conducted in 2012. Recommendation provided that the full results of this survey and any other relevant surveys are presented and discussed in the ES and the results are used to help justify any relevant impact assessment conclusions. Request provided that they are sent a copy of the environmental baseline survey.	The relevant components of the baseline survey are presented in **Section 3**. A copy of the baseline survey was provided to JNCC.
Recommendation provided that a complete cumulative assessment is included in the ES. This should consider the cumulative impacts of the proposed decommissioning options on key receptors such as birds, marine mammals and benthic habitats. Oil and gas operations and other industries operating in the marine environment should be considered.	A cumulative assessment has been included in each individual impact section (**Section 6 to 11**) of the ES, rather than a separate cumulative assessment section.
Comment afforded that other subsea assets will remain in situ until wider field decommissioning occurs. Clarification sought as to when CNRI expect the wider field to undergo decommissioning and suggest that any potential cumulative impacts associated with the decommissioning of the NNP, and the wider field are fully considered in the ES.	All subsea infrastructure will be cleaned and made safe. It is proposed that the surrounding subsea infrastructure is accounted for under a separate decommissioning programme. At this stage, it is proposed that this will be upon wider Ninian field decommissioning since the pipelines are tied into each other. Wider Ninian field decommissioning is currently planned for 2032.
It was not clear from the environmental scoping report as to the proposed timings of the operations. Recommendation provided that any understood timescales for the proposed operations are clarified in the ES, alongside the longevity of any impacts discussed.	**Section 2** provides a consideration of the relative time periods required within the decommissioning process.

Issue raised by stakeholder	Influence on the NNP EIA
Comment afforded that the extent of seabed that will potentially be disturbed will be estimated once the final decommissioning options for the NNP have been agreed. Consideration provided that this information is an important consideration when conducting an EIA, so that the relative scale of the different decommissioning options can be considered. Recommendation provided that estimates of the area of seabed expected to be disturbed and the potential impacts that will have on the benthic communities and expected recovery times are given some consideration before the CA is completed.	Estimates of the area of seabed expected to be disturbed are discussed as part of the ES (**Section 8**). The CA considered the removal of the jacket and the drill cuttings pile and accounted for any disturbance from these activities, as a qualitative assessment.
Comment afforded that full removal of the platform jacket would require displacement of a large proportion of the drill cuttings pile. Recommendation provided that CNRI consider partial removal of the cuttings pile within the CA. Awareness raised that the full and partial removal options for the steel jacket both involve removing the upper sections. Recommendation provided that leaving the entire steel jacket in place is also considered within the CA.	The options considered within the CA were partial and full removal of the jacket along with options for managing the drill cuttings pile that include leave in situ, excavation, treatment and disposal either onshore or offshore, and excavation and re-distribution offshore.
Comment afforded on the extent from the NNP the contamination from the drill cuttings pile extends, mentioning that if the fishermen were allowed to enter close to the structure, they could potentially contaminate their catch. Further information sought with regards to the thickness and dispersity of the drill cuttings pile. During the CA process, note was afforded that the fishermen prefer the total removal of the jacket structure, but understand the issues surrounding decommissioning.	Detailed information was provided to this stakeholder. A stakeholder representative was invited to take part in the CA workshop. Characteristics of the cutting pile are provided in **Section 2 and 3** of the ES.
An informal response was received stressing the adverse effects on the environment of the drill cutting pile and the importance for the consideration of its full removal.	CNRI acknowledge these concerns.

5. RISK ASSESSMENT

The activities associated with the decommissioning of the NNP and drill cuttings pile have potential to cause environmental impacts in several ways. This section describes the process used to identify and assess the relative significance of the potential environmental impacts associated with these activities.

5.1. Risk Assessment Process

The purpose of the risk assessment process is to identify potentially significant impacts, so that they fully assessed and mitigated as necessary. Potential impacts are evaluated in terms of the magnitude of the environmental impact or risk of the activity and the sensitivity of the receiving environment or environmental receptor, taking into account the location (where applicable) and the time of year the activity is taking place.

An EIA scoping workshop was held to identify the range of high level environmental impacts which might occur as a result of the proposed decommissioning of the NNP and drill cuttings pile and which would need further consideration. The workshop considered the planned and unplanned/ accidental events that might occur during the lifetime of the proposed decommissioning operations (BMT Cordah, 2016a).

The purpose of the EIA Scoping Workshop was to scope the potential environmental risks associated with the decommissioning of the NNP and drill cuttings pile, by examining all the proposed activities and their potential interaction with environmental receptors. The workshop had the following objectives to:

- Ensure that the project team was aware of the main environmental sensitivities within the sphere of influence of the decommissioning of the NNP and drill cuttings pile.
- Ensure that participants had a common, shared understanding of the proposed activities.
- Emphasise the regulatory requirements of the EIA and ES process.
- Highlight the activities, both planned and unplanned or accidental, which would require further detailed examination within the ES and to screen out those which would require less detailed assessment.
- Ascertain and discuss any project-specific mitigation measures that might be needed for the decommissioning of the NNP and drill cuttings pile, in addition to the industry-standard measures that would be automatically applied to a project of this nature.
- Highlight any important data gaps.
- Identify the actions needed to complete the EIA process and ES.

5.2. Assessing the Risk

The assessment criteria used during the risk assessment process to consider the possible sources of potential impact and to judge the significance of each on aspects of the receiving environment is presented in this section.

The first step in the risk assessment is to identify (i) the different activities or sources of potential environmental impact or risk associated with each phase of the proposed decommissioning of the NNP and drill cuttings pile, and (ii) the receiving environmental media that could be affected.

The impacts that might arise during the NNP decommissioning project were identified by:

- Examining the proposed options for decommissioning the topsides, jacket and subsea infrastructure and identifying the specific activities within each of these high level decommissioning phases which may give rise to an environmental impact. The high level activities were identified as:
    - the use of vessels and offshore transportation, during all types of offshore operations;
    - P&A of wells;
    - conductor recovery, topsides EDC and preparation;
    - decommissioning of topsides;
    - decommissioning of the jacket;
    - decommissioning of the drill cuttings pile; and
    - the handling, dismantling, treatment and disposal of materials at inshore and onshore sites.
- Assessing the characteristics and sensitivities of the offshore environment in which the NNP is located (Section 3). These receptors fall within four broad categories: physical environment, biological environment, human aspects and other considerations.

5.2.1. Risk Assessment Method

Potential risks associated with the proposed decommissioning operations were assessed using an environmental risk assessment matrix which combined two measures, the severity of an impact and the likelihood that it would occur (Tables 5.1 to 5.4). The likelihood that an impact would occur was assessed using the definitions specified in the CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314) (Table 5.1).

Table 5.1: Definition of likelihood of occurrence (SHE-PRO-314)

Likelihood	Definition
1. Very Unlikely	• A freak combination of factors would be required for an incident to result. • An incident has occurred within the UKCS in the past. • No direct or associated impact on emissions will result from process/equipment failure or malfunction.
2. Unlikely	• A rare combination of factors would be required for an incident to result. • An incident has occurred on a CNRI platform in the past. • Unlikely that failure or malfunction of process/ equipment will have impact on emissions.
3. Possible	• Could happen if a number of additional factors are present, but otherwise unlikely to occur. • An incident has occurred within the named platform's lifetime. • Possible that failure or malfunction of process/equipment will impact on emissions.
4. Likely	• Not certain, but incident could occur with only one normally-occurring additional factor. • An incident has occurred within the past year on the named platform. • Likely that failure or malfunction of process/equipment will impact on emissions.
5. Very Likely	• Almost inevitable that an incident will occur under the circumstances. • An incident has happened several times on the platform within the last year or the impact on the environment is part of a continuous operation. Certain that failure or malfunction of process/equipment will impact on emissions.

The consequence of an impact occurring as a result of emergency or non-routine events was assessed using the definitions specified in the CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314), and the consequence of an impact occurring as a result of planned events was assessed using the definitions specified in the UKOOA Offshore Environmental Statement Guidelines (1999a) (Table 5.2). The definition for consequence outlined in the CNRI Management of Aspects and Impacts Procedure is specific to a process loss, therefore the UKOOA guidelines were used to support this definition for the assessment of impacts unrelated to process loss.

The likelihood and consequence factors were combined using the risk assessment matrix (Table 5.3) to determine the level of risk each aspect of the project could pose to environmental receptors, physical, chemical, biological, human and other considerations.

The overall significance for each aspect was determined by taking the highest severity of impact (Table 5.2) associated with the event against any one of the environmental receptors and combined with the likelihood of the event from Table 5.1. The definition of environmental risk is presented in Table 5.4.

Table 5.2: Definition of consequence of occurrence (SHE-PRO-314)

Severity	Definition (CNRI, SHE-PRO-314)	Definition (UKOOA Offshore Environmental Statement Guidelines (1999a)
0. None	-	• No interaction and hence no change expected.
Beneficial	-	• Likely to cause some enhancement to the ecosystem or activity within the existing structure. • May help local population.
1. Negligible	• No loss to the external environment. • No regulatory exposure.	• Change which is unlikely to be noticed or measurable against background activities. • Negligible effects in terms of health or standard of living.
2. Slight	• Potential loss to the external environment from a system or process does not exceed 1 tonne.	• Change which is within the scope of existing variability, but can be monitored and/or noticed. • May affect behaviour, but not a nuisance to users or public.
3. Moderate	• Potential loss to the external environment from a system or process is between 1 and 25 tonnes. • There is a breach of consent and/or legislative conditions which is unlikely to result in prosecution from Regulators.	• Change in the ecosystem or activity in a localised area for a short time (< 2 years), with good recovery potential. Similar scale of effect to existing variability, but may have cumulative implications. • Potential effect on health, but unlikely. • May cause nuisance to some users.
4. High	• Potential loss to the external environment from a system or process is between 25 and 100 tonnes. • There is a breach of consent and/or legislative conditions with potential for prosecution from Regulators.	• Change in the ecosystem or activity over a wide area leading to medium-term (>2 years) damage, but with a likelihood of recovery within 10 years. • Possible effect on human health. • Financial loss to users or public.
5. Very high	• Potential loss to the external environment from a system or process of greater than 100 tonnes. • There is a breach of consent and/or legislative conditions with a strong likelihood of prosecution from Regulators.	• Change in the ecosystem leading to long-term (>10 years) damage and poor potential for recovery to a normal state. • Likely to affect human health. • Long-term loss or change to users or public finance.

Table 5.3: Risk Potential Matrix Summary*

Likelihood of occurrence	Severity				
	Negligible	Slight	Moderate	High	Very high
Very unlikely	1	2	3	4	5
Unlikely	2	4	6	8	10
Possible	3	6	9	12	15
Likely	4	8	12	16	20
Very likely	5	10	15	20	25

* Value from Likelihood x Severity is used to assign a level of significance

Table 5.4: Definition of Environmental Risk

Score	Level of Significance	Environmental Risk Definition
1-6	Low significance	Risk acceptable: review annually and continue with current management controls.
8-12	Moderate significance	Risk should be reduced: Identify opportunities for improvement through objectives and targets.
15-25	Significant	Risk unacceptable: Immediate action required to reduce risk to an acceptable level.

5.2.2. Risk Assessment Results

The results of the risk assessment and EIA scoping workshop are summarised within Tables 5.5 to 5.10. The output was a list of potential effects (post mitigation) and activities which would need to be considered further in the ES.

Table 5.5: Risk Assessment: sources of potential environmental impacts and receiving environment associated with the use of vessels during all decommissioning activities

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Planned events																				
Physical presence of vessels outside NNP 500 m zone												✓	✓				✓			
Vessel movement and station keeping								✓	✓								✓	✓	✓	
Anchoring on seabed		✓	✓			✓		✓												
Anchoring on contaminated sediments within 500 m of NNP but not on the drill cuttings pile		✓	✓			✓	✓	✓												
Vessel discharges e.g. sewage		✓				✓	✓	✓				✓								
Vessel discharges e.g. ballast water inshore		✓				✓	✓	✓												
Power generation for vessel operation	✓			✓														✓	✓	
Vessel movement inshore															✓		✓			
Emergency and non-routine events																				
Vessel collision with another vessel leading to vessel sinking.		✓	✓			✓	✓	✓				✓	✓	✓					✓	
Major oil spill as a result of vessel collision with another vessel (>100 tonne fuel oil)		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
Accidental fuel spills during decommissioning operations e.g. fuel bunkering			✓	✓			✓	✓		✓		✓							✓	

Table 5.6: Risk Assessment: sources of potential environmental impacts and receiving environment associated with post COP activities

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Planned events																				
Well P&A tubing recovery		✓	✓			✓		✓									✓		✓	
Well P&A cutting conductor								✓	✓								✓	✓	✓	
Well P&A conductor recovery to surface.								✓									✓			
EDC			✓				✓	✓											✓	
Topside preparation for removal using hot cutting, welding etc.			✓	✓			✓	✓												
Power generation for running topsides during well P&A activities through continued operation of the main power and temporary generators	✓			✓														✓	✓	
Emergency and non-routine events																				
Loss of minor/ small items e.g. scaffold within 500 m of NNP		✓				✓		✓												
Conductor dropped during recovery within 500 m of NNP		✓				✓		✓				✓								

Table 5.7: Risk Assessment: sources of potential environmental impacts and receiving environment associated with topside decommissioning

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Planned events (reverse installation and single lift)																				
Power generation for the manufacture of temporary steelwork	✓			✓														✓	✓	
Power generation for vessel operations	✓			✓														✓	✓	
Power generation for module separation and cutting (plasma, flame or cold cutting)	✓			✓														✓	✓	
Power generation for HLV at site, during transportation to shore and transfer of modules to cargo barge	✓			✓														✓	✓	
Module separation and cutting (plasma, flame or cold cutting)			✓	✓			✓	✓												
Vessel discharges e.g. sewage			✓				✓	✓												
Mooring of cargo barge to support HLV		✓	✓			✓		✓												
Power generation for dismantling structures inshore	✓			✓														✓	✓	
Power generation for onshore transportation of recovered material to recycling site or landfill facility	✓			✓														✓		

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Dismantling structures/ recovered material onshore				✓											✓					
Emergency and non-routine events (reverse installation and single lift)																				
Module loss during lifting and transportation.		✓	✓			✓		✓											✓	
Loss of minor items during module separation e.g. scaffold within 500 m of the NNP		✓				✓		✓												

Table 5.8: Risk Assessment: sources of potential environmental impacts and receiving environment associated with jacket decommissioning

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Planned events																				
Power generation for manufacture of temporary steelwork	✓			✓														✓	✓	
Vessel discharges e.g. sewage			✓				✓	✓												
Power generation for vessel operations	✓			✓														✓	✓	
Power generation for dismantling structures inshore	✓			✓														✓	✓	
Dismantling structures/ recovered material onshore				✓											✓					
Power generation for onshore transportation of recovered material to recycling site or landfill facility	✓			✓														✓		
Offshore removal of marine growth from whole jacket using high pressure jet cleaner		✓	✓			✓		✓											✓	
Power generation underwater cutting of jacket legs and members (techniques include DWC, AWJ, hydraulic shear)	✓			✓														✓	✓	
Underwater cutting (techniques include DWC, AWJ, hydraulic shear)								✓	✓									✓	✓	

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Power generation for underwater cutting (techniques include DWC, AWJ, hydraulic shear)	✓			✓														✓	✓	
Physical presence of jacket footings left in situ (reef effect)						✓		✓				✓								
Physical presence of jacket footings left in situ (commercial consequences of snagging fishing gear on the jacket footings)												✓					✓			
Physical presence of jacket footings left in situ (loss of access for commercial fisheries)												✓								
Physical presence of jacket footings left in situ (release of contaminants from degrading metal footing and anodes which may contain components toxic to marine life)		✓	✓			✓	✓	✓												
Long-term degradation of footings leading to falling jacket members and structures		✓	✓			✓	✓	✓												
Power generation for new manufacture to replace recyclable material left on the seabed	✓			✓																
Emergency and non-routine events																				
Large dropped objects, e.g. jacket, jacket sections		✓				✓		✓				✓								

Table 5.9: Risk Assessment: sources of potential environmental impacts and receiving environment associated with drill cuttings pile management

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Planned events																				
Leave in situ and do nothing (leaching of contaminants including hydrocarbon and metals into the water column from an undisturbed cuttings pile)		✓	✓			✓	✓	✓										✓	✓	
Leave in situ and do nothing (long-term pile presence and contaminant persistence leading to continued impact on sediment quality and benthic communities from an undisturbed cuttings pile)		✓				✓		✓				✓					✓	✓		

Table 5.10: Risk Assessment: sources of potential environmental impacts and receiving environment associated with deconstruction, manufacture and recycling of materials on or near-shore

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Planned events																				
Dismantling structures at an inshore location prior to transfer to an onshore dismantling yard		✓	✓	✓		✓	✓								✓		✓			
Power generation for dismantling structures inshore	✓			✓														✓	✓	
Dismantling structures/ recovered material at an onshore dismantling yard				✓											✓					
Presence of marine growth on jacket structure at inshore site		✓	✓			✓		✓						✓						
Onshore cleaning marine growth from jacket, conductors, using high pressure jet cleaner				✓											✓					
Onshore disposal of marine growth				✓	✓										✓					
Power generation for onshore transportation of recovered material to recycling site or landfill facility	✓			✓														✓		
Power generation for recycling/ reprocessing	✓			✓														✓	✓	
Landfill disposal of non-recyclable materials					✓															

	Physical					Biological						Human					Other			
	Use of resources	Seabed sediments	Water column	Atmosphere	Use of disposal facilities	Benthos	Plankton	Fish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Shipping	Other users of the sea	Communities	Socioeconomic	Stakeholder concerns	Cumulative impacts	Transboundary issues	Overall significance
Treatment and disposal of hazardous waste (including exempt NORM waste)	✓				✓												✓			
Treatment and disposal of non-exempt NORM	✓			✓													✓			
Emergency and non-routine events																				
Unidentified non-exempt NORM mobilised onshore					✓												✓			

5.3. Summary of Risk Assessment Results

A summary of the risk assessment results and predicted level of significance is presented within Table 5.11.

Table 5.11: Summary of the results from the environmental risk assessment for activities associated with the decommissioning of the NNP

Decommissioning activities	Risk					
	Low		Moderate		Significant	
	Planned	Emergency/ Non-routine	Planned	Emergency/ Non-routine	Planned	Emergency/ Non-routine
Use of vessels	5	2	3	1	0	0
Post CoP activities: P&A of wells, conductor recovery, topsides EDC and preparation	6	2	0	0	0	0
Topside decommissioning	10	2	0	0	0	0
Jacket decommissioning	15	1	1	0	0	0
Drill cuttings pile management	1	0	1	0	0	0
Deconstruction, manufacture and recycling of materials on or near-shore	10	1	1	0	0	0

Those decommissioning activities which have the potential to result in a moderate significant impact are assessed in greater detail within Sections 6 to 11. These include those activities which result in:

- Energy use and production of atmospheric emissions (Section 6).
- Generation of underwater noise (Section 7).
- Seabed disturbance during decommissioning operations (Section 8).
- Drill cutting pile disturbance, including the management of the pile (Section 8).
- The physical presence of vessels causing potential interference with other sea users (Section 9).
- A Socioeconomic impact to fishermen from the derogated footings and pipelines (Section 9).
- Cleaning of marine growth from the Ninian jacket (Section 11).
- Landfill disposal and associated impacts (Section 11).
- Non-routine events – accidental spillage of hydrocarbons and other fluids (Section 10).

The assessment of the impact (Sections 6 to 11) associated with each of the activities identified for detailed assessment is undertaken through the criteria in Tables 5.1 and 5.2 with the significance of the impact determined by Tables 5.3 and 5.4.

6. ENERGY USE AND ATMOSPHERIC EMISSIONS

CNRI commissioned a study to assess energy use and the atmospheric emissions likely to arise for all the decommissioning options identified for the NNP and drill cuttings pile to inform the CA (CNRI 2016c, BMT Cordah 2016b). This section summarises the findings of the energy and emissions report for the selected decommissioning options (Section 2.7). Mitigation measures to minimise emissions and optimise energy use are described.

6.1. Regulatory Context

Atmospheric emissions generated from the decommissioning of the NNP and drill cuttings pile will be managed in accordance with current legislation and standards as detailed within Appendix A.

6.2. Assessment Methodology

There is a potential for certain NNP decommissioning activities to require energy usage and produce atmospheric emissions, resulting in environmental impacts (Section 5). In order to assess these impacts, a consideration of the potentially significant impacts and the associated magnitude and risk has been made. In conjunction with an understanding of the sensitive receptors, it has been possible to assess the significance of these environmental impacts.

The energy and emissions assessment was based on the Institute of Petroleum (IoP) "Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures" (IoP, 2000). The main steps of the assessment included:

- Identification of all structures to be decommissioned.
- Establishment of a materials inventory for each structure to be decommissioned.
- Identification of all operations associated with decommissioning each structure, where operations are defined as all the offshore and onshore activities of dismantling and transporting the structure and recycling or treating any recovered materials. These operations require power sources using different fuels for varying periods.
- Identification of all endpoints associated with decommissioning each structure, where endpoints are defined as the final states of the materials at the cessation of the decommissioning operations, including the presence of material in landfill sites or on the seabed. If the end point results in an otherwise-recyclable material being removed from the chain of utility, e.g. steel left in situ on the seabed or disposed of in landfill, this is accounted for by a theoretical cost for re-manufacture of the material, with consequent energy use and emissions attributed to the decommissioning process.
- For each operation and endpoint, the identification of associated activities that will be a source of energy use and gaseous emissions.
- Selection of conversion factors relating each activity to energy use and gaseous emissions.
- Calculate the energy use and gaseous emissions based on these factors.

The assessment predominantly used the energy use and emission factors provided within IoP (2000) guidelines. In accordance with these guidelines, alternative factors may be used where specific equipment is considered to have a significantly different fuel use from that presented in the IoP database. Appendix B details the factors used for each aspect of the energy and emissions calculations: manufacture of new materials, recycling of materials, general fuel consumption, vessel fuel use and deconstruction of materials.

6.3. Sources of Potential Impacts

This section reports the findings of the energy and emissions assessment (CNRI, 2016c) which considered, where appropriate, the following sources which had a potential to result in an environmental impact. These were considered for each stage of the NNP decommissioning process:

- Power generation on topsides CoP.
- Vessels for transportation and offshore operations.
- Helicopters for transportation of personnel.
- Onshore dismantling and/ or processing of materials.
- Onshore transportation to processing, recycling and landfill sites.
- Manufacture or sourcing of new items (e.g. temporary steel work) required for decommissioning operations.
- Recycling.
- New manufacture to replace recyclable materials decommissioned at sea or disposed of in landfill.

6.3.1. Materials and Operations Inventories

Inventories of materials and operations are provided within the Energy and Emissions Report for the Decommissioning of the NNP (CNRI, 2016c).

6.3.2. Vessel Use

The vessels expected to be associated with the decommissioning of the NNP and the drill cuttings pile are summarised in Table 6.1.

Table 6.1: Summary of vessel use for the NNP decommissioning options

NNP facility	Decommissioning option	Decommissioning method	Vessel use
CoP	Not applicable	Not applicable	Supply vessel, standby vessel
Topsides	Full removal	Reverse installation	HLV, standby vessel, support vessel, supply vessel.
		Single lift	HLV, standby vessel, supply vessel, tug (AHV)
Jacket	Partial Removal	Multiple lifts	HLV, standby vessel, CSV, trawler, ROV support, MSV
Drill cuttings pile	Leave in situ	No action required	None

Source: CNRI (2016c) and BMT Cordah (2016b)

6.3.3. Topsides Activities Post CoP

Table 6.2 provides the estimated energy use during activities carried out from the NNP after CoP and before decommissioning of the topsides, including running the topsides, EDC and recovery of the conductors and platform wellheads.

The greatest energy use is attributed to vessel and helicopter use and power generation, amounting to approximately 98% of the total energy use (Table 6.2). As a result, emissions are also significantly higher for vessel and helicopter usage, contributing to approximately 97% of the total CO_2 value (Table 6.2).

Table 6.2: Energy use and atmospheric emissions for topside activities post cessation of production

Decommissioning element	Energy use (GJ)	Emissions (tonnes/ tonne)			
		CO_2	NO_x	SO_2	CH_4
Manufacture of new materials required for decommissioning	0	0.000	0.000	0.000	0.000
Vessel and helicopter use and power generation	1,778,392	129,402.8	1,790.3	161.8	5.4
Onshore transportation	87	6.3	0.1	0.0	ND
Onshore deconstruction	4,469	ND	ND	ND	ND
Recycling	33,035	3,523.7	5.9	13.9	ND
New manufacture to replace recyclable materials left in situ or landfill	0	0.0	0.0	0.0	0.0
Total	**1,815,983**	**132,932.8**	**1,796.2**	**175.7**	**5.4**

"ND" indicates that no data is available to enable a conversion to be made between a particular operation and the resulting gaseous emissions.
Source: CNRI (2016a, 2016c & 2012d)

6.3.4. Topsides Decommissioning

The estimated energy use and produced emissions for the two options under consideration for the decommissioning of the NNP topsides are presented in Table 6.3.

Reverse installation is predicted to use, approximately, 326,000 GJ of energy. Approximately 59% of this is attributed to vessel and helicopter power generation (Table 6.3). Emissions values are highest for CO_2 with a total of 24,801 tonnes/ tonne produced, with vessel and helicopter power generation being the highest contributing decommissioning element to these emissions at approximately 14,393 tonnes/ tonne, constituting approximately 58% to the emissions total (Table 6.3).

Single lift is predicted to use approximately 238,181 GJ of energy. Approximately 47% of this is attributed to recycling (Table 6.3). Emissions values are highest for CO_2 with a total of approximately 18,252 tonnes/ tonne produced, with recycling being the highest contributing decommissioning element to these emissions at 10,104 tonnes/ tonne, constituting approximately 58% to the emissions total (Table 6.3).

Table 6.3: Energy use and atmospheric emissions for decommissioning of the NNP topsides

Decommissioning element	Energy use (GJ)	Emissions (tonnes/ tonne)			
		CO_2	NO_x	SO_2	CH_4
Reverse installation					
Manufacture of new material required for decommissioning	3,750	283.4	0.5	0.8	ND
Vessel and helicopter and power generation	193,859	14,393.3	267.2	18.0	0.8
Onshore transportation	283	20.4	0.3	0	ND
Onshore deconstruction	14,321	ND	ND	ND	ND
Recycling	114,153	10,104.6	16.4	143.8	ND
New manufacture to replace recyclable materials left in situ or taken to landfill	0	0	0	0	0
Total	**326,366**	**24,801.7**	**284.4**	**162.6**	**0.8**
Single lift					
Manufacture of new material required for decommissioning	2,375	179.5	0.3	0.5	ND
Vessel and helicopter and power generation	107,049	7,947.9	147.5	9.9	0.4
Onshore transportation	283	20.4	0.3	0	ND
Onshore deconstruction	14,321	ND	ND	ND	ND
Recycling	114,153	10,104.6	16.4	143.6	ND
New manufacture to replace recyclable materials left in situ or taken to landfill	0	0	0	0	0
Total	**238,181**	**18,252.4**	**164.5**	**154.0**	**0.4**

"ND" indicates that no data is available to enable a conversion to be made between a particular operation and the resulting gaseous emissions.
Source: CNRI (2016c), CNRI (2012d)

6.3.5. Jacket Decommissioning

The estimated energy use and produced emissions for the decommissioning of the NNP jacket is provided in Table 6.4.

Decommissioning the NNP jacket by partial removal with multiple lifts is estimated to use a total of 530,148 GJ of energy. The greatest energy use can be attributed to the new manufacture to replace recyclable materials left in situ or taken to landfill in this option, contributing to 333,801 GJ of energy, approximately 63% of total energy use for this option. The manufacture of new materials also contributes the greatest CO_2 emissions at approximately 51% of total CO_2 emissions for this option (Table 6.4).

Table 6.4: Energy use and atmospheric emissions for decommissioning of NNP jacket by partial removal (multiple lifts)

Decommissioning element	Energy use (GJ)	Emissions (tonnes/ tonne)			
		CO_2	NO_x	SO_2	CH_4
Manufacture of new material required for decommissioning	8,750	661.2	1.2	1.2	1.9
Vessel and helicopter and power generation	121,398	9,013.3	167.3	11.3	371.3
Onshore transportation	187	13.5	0.2	0	ND
Onshore deconstruction	9,462	ND	ND	ND	ND
Recycling	56,550	5,420.7	6.9	16.4	ND
New manufacture to replace recyclable materials left in situ or taken to landfill	333,801	15,995.4	31.2	55.5	ND
Total	**530,148**	**31,064.1**	**206.8**	**84.4**	**373.2**

"ND" indicates that no data is available to enable a conversion to be made between a particular operation and the resulting gaseous emissions.
Source: CNRI (2016c)

6.3.6. Drill Cuttings Pile

The estimated energy use and emissions during decommissioning of the NNP drill cuttings pile is presented in Table 6.5.

Table 6.5: Energy use and atmospheric emissions for decommissioning of the drill cuttings pile (leave in situ)

Decommissioning element	Energy use (GJ)	Emissions (tonnes/ tonne)			
		CO_2	NO_x	SO_2	CH_4
Manufacture of new material required for decommissioning	0	0	0	0	ND
Vessel and helicopter and power generation	0	0	0	0	0
Onshore transportation	0	0	0	0	0
Onshore deconstruction	0	ND	ND	ND	ND
Recycling	0	0	0	0	0
New manufacture to replace recyclable materials left in situ or taken to landfill	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**

"ND" indicates that no data is available to enable a conversion to be made between a particular operation and the resulting gaseous emissions.
Source: CNRI (2016c)

The leave in situ option for drill cuttings decommissioning is predicted to use 0 GJ of energy and produce 0 tonnes/ tonne of CO_2, NO_x, SO_2 and CH_4. The leave in situ option requires no, or very minimal activity, and therefore can be associated to have negligible zero energy and emissions values. This was also reflected in the CA produced for CNRI, in which the leave in situ option was concluded to be the drill cuttings decommissioning option least likely to cause impact or incur risks to the decommissioning operation (BMT Cordah, 2016b). This option has been selected by CNRI for the decommissioning of the NNP drill cuttings because it achieved the lowest levels of risk, environmental impact, energy use and emissions (BMT Cordah, 2016b).

6.4. Impacts on Sensitive Receptors

In order to determine the significance level of impacts resulting from energy use and atmospheric emissions, the magnitude of which has been quantified in Section 6.3, there is a requirement to understand the sensitive receptors. Gaseous emissions from the proposed decommissioning activities include CO_2, CH_4, NO_x, SO_x and Volatile Organic Compounds (VOCs). These have the potential to impact sensitive receptors in the area.

The direct effect of the emission of CO_2, CH_4 and VOCs is the implication for climate change and the contribution to regional air quality deterioration through low-level ozone production (CH_4 has 21 times the global climate change potential of the main greenhouse gas CO_2) (IPCC, 2007). The indirect effects of low level ozone include deleterious health effects, as well as damage to vegetation, crops and ecosystems.

The direct effect of NO_x, SO_x and VOC emissions is the formation of photochemical pollution in the presence of sunlight. Low level ozone is the main chemical pollutant formed, with by-products that include nitric and sulphuric acid and nitrate particulates. The effects of acid formation include contribution to acid rain formation and dry deposition of particulates.

The main environmental effect resulting from the emission of SO_2 is the potential to contribute to the occurrence of acid rain; however, the fate of SO_2 is difficult to predict due to its dependence on weather.

The exposed offshore conditions will promote the rapid dispersion and dilution of these emissions. Outside the immediate vicinity of the decommissioning activities, all released gases would only be present in low concentrations. There are no offshore conservation areas in the immediate vicinity of the NNP. The closest offshore conservation area, is Pobie Bank Reef SCI, which is located approximately 73 km southwest of the NNP. The NNP is located approximately 120 km east of Shetland. No impact is expected for designated coastal or onshore conservation sites from the offshore atmospheric emissions. Potential impacts from onshore emissions are likely to be relatively minor and within local and regional air quality criteria.

Harbour porpoise is the only Annex II species which has been recorded in the area of the NNP. This species has been observed in very high numbers in February and July, in medium numbers in August and low numbers in the months of January, April, May, June, September and December (UKDMAP, 1998). In the open conditions that prevail offshore, the atmospheric emissions generated during the decommissioning activities would be quickly dispersed. The atmospheric emissions from the proposed activities are therefore considered unlikely to have any effect on marine mammals.

In summary, the atmospheric emissions from the NNP decommissioning activities are unlikely to have any effect on sensitive receptors.

6.5. Transboundary and Cumulative Impacts

The NNP is located approximately 23 km west of the UK/ Norwegian median line and released gases may be present in very low concentrations across this boundary. However, under the exposed offshore conditions, the quantity of additional air emissions produced is unlikely to create any measurable transboundary impacts.

The potential cumulative effects associated with atmospheric emissions produced by the decommissioning activities includes a contribution to climate change by emission of greenhouse gases, acidification (acid rain) and local air pollution.

The total CO_2 emissions from the proposed decommissioning operations for NNP using a reverse installation option for topsides decommissioning (188,838.6 tonnes CO_2) represent approximately 1.5% of the total annual CO_2 offshore emissions from the UKCS in 2014 (12,585,726 tonnes CO_2; OGUK, 2015).

The total CO_2 emissions from the proposed decommissioning operations for NNP using a single lift option for topsides decommissioning (182,289.3 tonnes CO_2) represent approximately 1.4% of the total annual CO_2 offshore emissions from the UKCS in 2014 (12,585,726 tonnes CO_2; OGUK, 2015).

6.6. Mitigation Measures

Mitigation measures to minimise atmospheric emissions and energy consumption are detailed within Table 6.6.

Table 6.6: Mitigation Measures

Mitigation
Vessels will be audited as part of selection and pre-mobilisation.
All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency.
Vessels will use ultra-low sulphur fuel in line with MARPOL requirements.
Work programmes will be planned to optimise vessel time in the field.
Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems.
All mitigation measures will be incorporated into contractual documents of subcontractors.

6.7. Conclusions

The high-level risk assessment undertaken for the NNP decommissioning activities concluded that energy use and atmospheric emissions may result in impacts of a moderate significance (Section 5). Detailed quantification provided within the supporting energy and emissions study (CNRI, 2016c) has enabled further assessment of identified potential impacts in accordance with CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314) (Tables 5.1 to 5.4). This in turn has enabled a consideration of the likely significance of these impacts upon relevant sensitive receptors. Of note here is that the energy use and atmospheric emission levels during the decommissioning phase will be considerably lower than those during the production period.

The following conclusions from the energy use and atmospheric emissions impact assessment are identified as:

- Emissions from the decommissioning activities will have a limited impact upon air quality. As such, minimal impacts upon sensitive receptors are anticipated given the localised effects and anticipated rapid dispersion of the emissions. For this reason, there is also unlikely to be a significant transboundary or cumulative impact on air quality.

- Emissions from the decommissioning activities will contribute to greenhouse gas emissions and have a non-significant cumulative and transboundary impact. Emissions will be kept to a practicable minimum. Total CO_2 emissions generated from the proposed decommissioning operations will be lower than CO_2 emissions generated by normal operations at NNP.

In summary, due to the intermittent and localised activities and with the identified mitigation measures in place, the overall significance of the impact of energy use and atmospheric emissions is considered to be **low**. This is based upon the likelihood of the occurrence of effects being 'unlikely' (Table 5.1) and consequence of effects being 'slight' (Table 5.2) as emissions are considered to be within the scope of existing variability.

7. UNDERWATER NOISE

Sound is important for many marine organisms with marine mammals, fish and certain species of invertebrates having developed a range of complex mechanisms for both the emission and detection of sound (Richardson et al., 1995). Cetaceans (whales, dolphins and porpoises) use sound for navigation, communication and prey detection. Thus anthropogenic underwater noise has the potential to impact on marine mammals (Southall et al. (2007); Richardson et al. (1995)). Underwater noise may cause animals to become displaced from activities potentially interrupting feeding, mating, socialising, resting or migration. This may impact body condition and reproductive success of individuals or populations (Southall et al. (2007); Richardson et al. (1995)). Feeding may also be affected indirectly if noise disturbs prey species (Southall et al. (2007); Richardson et al. (1995)). Noise levels in the marine environment decline with increased distance from the source (dispersion in three dimensions) and through absorption by the water (Richardson et al., 1995).

The likely underwater noise from the proposed decommissioning operations was assessed in a directed study. The various type of vessels, drilling (for P&A), helicopters, underwater tools (e.g. cutting and drilling tools) and survey equipment (e.g. side-scan sonar) were identified as the primary noise sources. These sources will emit low frequency noise both in the air and in the water column. The introduction of the additional anthropogenic sound in the environment has the potential to affect the behaviour of and, in extreme cases, even injure local wildlife.

This section will consider the noise and potential impact generated during the NNP decommissioning activities. Information to compile this section has been taken from the NNP Decommissioning Underwater Noise Impact Assessment Report (BMT Cordah, 2016d).

7.1 Regulatory Content

Under regulations 41(1)(a) and (b) of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended) and 39(1) (a) and (b) in the Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (amended 2009 and 2010), it is an offence to:

- Deliberately capture, injure or kill any wild animal of a European Protected Species (EPS).
- Deliberately disturb wild animals of any such species.

Disturbance of animals is defined under the Regulations and includes, in particular, any disturbance that is likely to:

- Impair their ability to (i) survive, breed, rear or nurture their young; or (ii) in the case of animals of a hibernating or migratory species, to hibernate or migrate.
- To significantly affect the local distribution or abundance of the species to which they belong.

In a marine setting, EPS include all the species of cetaceans (whales, dolphins and porpoises) (JNCC, 2010). As underwater noise has potential to cause injury and disturbance to cetaceans, an assessment of underwater noise generated by the activities associated with a development is required in line with guidance provided by JNCC (JNCC, 2010).

7.2 Assessment Methodology

There is a potential for certain NNP decommissioning activities to produce underwater noise resulting in environmental impacts (Section 5). In order to assess this a consideration of the potentially significant impacts and the associated magnitude and risk has been made. In conjunction with an understanding of the sensitive receptors, it has been possible to assess the significance of these environmental impacts.

Therefore, the approach undertaken within this assessment includes the identification of potential noise sources, an evaluation of their levels and frequencies, an introduction to relevant underwater noise propagation pathways and the appropriate assessment model, followed by an impact assessment. The assessment results are then compared against relevant values from the literature, addressing both behavioural impacts to and injury of the target species. Any identified potential issues are also evaluated with respect to transboundary and cumulative impacts.

Sound can be categorised as continuous noise where there are no sudden rises or falls in pressure or impulsive noise. The European Marine Strategy Framework Directive (MSFD) (2008/56/EC) suggested measures to assess underwater sound and the findings were further analysed for DECC (Genesis, 2011) to help inform on compliance with this MSFD Directive. The noise descriptor as specified in the MSFD is for low and mid frequency impulsive underwater sounds within the frequency range of 10 Hz to 10 kHz.

7.3 Sources of Potential Impacts

Sources of underwater noise during the proposed decommissioning operations are likely to include:

- Use of vessels for transportation and to carry out decommissioning operations.
- Helicopters for transportation of personnel.
- Use of underwater tools for cutting and drilling including water jetting.
- Side-scan sonar or multi-beam echo sounder to carry out surveys in the immediate vicinity of the NNP.
- Well P&A using the current drilling derrick.

CNRI does not anticipates using explosives to cut the jacket members or any of the associated subsea equipment.

The typical level and frequency of sound generated by each source was obtained from published studies (reviewed by Genesis, 2011; Table 7.1). In order to model the worst case scenario, it has been assumed that all sources will operate at all times during each activity. In reality, this may not happen and the source level may therefore be lower than predicted within this assessment.

Table 7.1: Summary of model input parameters

Parameter	Value
Activities	• EDC of topsides facilities post CoP. • P&A of wells and recovery of the conductors. • Removal and recovery to shore of the topsides and jacket.
Location	• UKCS Block 3/3 • 160 km from nearest coastline (northeast of Shetland)
Scheduled timing	• Activities occur throughout the year
Water depth	• Approximately 141 m
Mixed layer depth	• Approximately 50 m (average)
Seabed substrate	• Fine sand (with elevated silt content close to NNP)
Absorption coefficient in seawater (α in dB/km)	• Varies with frequency, temperature, salinity and pH – sourced from NPL on-line calculator using S = 35, T = 8°C and pH = 8[1]
Near-field anomaly (k_L in dB)	• Varies with frequency, substrate (sand or mud) and sea state[2]
Attenuation factor (a_t in dB)	• Varies with frequency, substrate (sand or mud) and sea state[2]
Frequency range	• Vessels: 0.005 to 16 kHz; highest noise levels from 0.125 to 1.25 kHz[3]
Source level	• Varies with frequency: • Vessel: maximum ~180 dB re 1 µPa m (zero-to-peak) at 0.08 kHz[3] • Ambient: maximum ~110 dB re 1 µPa m (rms) at 0.0004 kHz[4]
Marine mammal species potentially present	• Minke whale • Long-finned pilot whale • Killer whale • White-beaked dolphin • Harbour porpoise

Key: dB re1 µPa m – unit of Sound Pressure Level extrapolated to 1 m range from source

[1]http://resource.npl.co.uk/acoustics/techguides/seaabsorption/ [2]Urick (1983); [3]Hallett (2004); [4]DEWI (2004)

In the case of the NNP, sound propagation from the source (Ls) was determined using the Marsh-Schulkin model (Schulkin & Mercer, 1985). This model is valid for acoustic transmission in shallow water (up to 100 fathoms or about 185 m) and represents sound propagation loss (transmission loss) in terms of sea state (wave height), substrate type (bottom loss), water depth, frequency and the depth of the mixed layer. A description of the noise quantification, the Marsh-Schulkin model and the parameters used in the model is given in BMT Cordah (2016d).

7.3.1. Vessels

It is likely that most forms of oil and gas decommissioning activities are typically dominated by vessel noise which is continuous and is not captured within the MSDF descriptor for loud, low and mid-frequency impulsive sounds. Broadband source levels for these activities rarely exceed about 190 dB re 1 µPa m and are typically much lower (Hannay and MacGillivray (2005); Genesis (2011)). Whilst continuous noise can mask biologically relevant signals such as echolocation clicks, the sound levels are below the threshold levels for Temporary Threshold Shift (TTS) in cetaceans according to the Southall et al. (2007) criteria (Genesis, 2011).

The level and frequency of sound produced by vessels is related to vessel size and speed, with larger vessels typically producing lower frequency sounds (Richardson et al., 1995). Noise levels depend on the operating status of the vessel and can therefore vary considerably with time. In general, vessels produce noise over the range 100 Hz to 10 kHz, with strongest energy over the range 200 Hz to 2 kHz.

The subsea noise levels generated by surface vessels used during the decommissioning phase are unlikely to result in physiological damage to marine mammals. Depending on ambient noise levels, sensitive marine mammals may be locally disturbed by noise from a vessel in its immediate vicinity, however, the impact is not expected to be significant.

Various combinations of vessels will be on site during the decommissioning operations (Table 7.1). Source levels resulting from a study giving the average of ten merchant ships (lengths 89 to 320 m, average 194 m) during entry or exit to port were used as a basis for this assessment (Hallett (2004); note that the standard deviation was given as 5 to 10 dB). This data is more conservative than many of the published examples for specific construction and support vessels.

For continuous sound such as shipping noise, it is typical to use a measure of the total sound intensity of a signal (rms). However, the larger zero-to-peak values have been used in the modelling to illustrate the worst case scenario.

7.3.2. Helicopters

Helicopter activities related to the decommissioning operations will occur throughout the year for transportation of personnel.

Helicopter noise originates from both the disturbance of the sea surface by the downwash from the rotor blades and the transmission of engine and blade noise directly into the sea. The downwash noise is very similar to wind noise in its frequency characteristics and is greatest in the 2 to 20 kHz region. Additional strong tonals in the 10 to 100 kHz range are associated with rotors and turbine operation, respectively (Harland et al., 2005).

When sound travels from air to water, the energy is largely reflected from the water surface and only a small fraction of the sound produced by the helicopter is actually transmitted into the sea. Although helicopter sound is fairly broad band (0 to 20 kHz), the lower frequency sound, up to 200 Hz, is much more pronounced (Berrow et al., 2002). The dominant tones in the noise spectra from helicopters are generally below 500 Hz (Richardson et al., 1995). The angle at which sound from the aircraft intersects the water's surface is also important. At angles greater than 13° from the vertical, much of the incident sound is reflected and does not penetrate into the water (Richardson et al., 1995).

Consequently, the potential impacts resulting from helicopters' noise will mainly occur at the sea surface. These will also be over short-term durations due to the movement of the helicopters and duration of activities. As no major disturbance on marine species is expected during helicopter activities, it will not be considered further.

7.3.3. Underwater Tool Use Including Cutting and Drilling

The main underwater tool use during the decommissioning operations will be for cutting and drilling. For example, cutting tools will be required to sever the jacket braces. Underwater drilling may be required to create de-watering holes and lift points in various structures.

Several different underwater cutting methods have the potential to be used as part of the decommissioning operations (Section 2), including:

- Abrasive water jetting – using a high pressure jet of water and a sand and grit mix directed onto the item to be cut.
- Diamond wire cutting – using a continuous loop of diamond wire mounted onto a pulley system, which enables a continuous, clean cut to be carried out.
- Hydraulic shear – used for cuttings smaller braces up to 1,400 mm diameter.

There is currently little published data on the sound generated by underwater cutting or other tools. Peak source levels of 148 to 180 dB re 1 µPa are reported for a range of diver operated tools including drills, saws, grinders, water jetters, rock breakers, wrenches and cutters with most energy in the frequency range 200 to 1,000 Hz (Anthony et al., 2009). Consequently, tool use is generally within the hearing range of most cetaceans. As the episodes of tool use are typically intermittent and of short duration, it will not be considered further within this assessment.

7.3.4. Side-Scan Sonar/ Multi-Beam Echo Sounder

During the decommissioning operations, vessels operating side-scan sonar and/ or multi-beam echo sounder will be used to conduct surveys of the seabed and subsea infrastructure. The sound generated by side-scan sonar and/ or multi-beam echo sounder is at frequencies that are outside the main hearing range of all cetacean species likely to occur in the area. Hence, JNCC considers side scan sonar to be of negligible risk of causing injury or disturbance to marine mammals (JNCC, 2010) and is therefore not discussed further in this assessment. In addition, appropriate notifications will be submitted to BEIS for approval prior to working with this equipment.

7.3.5. Well P&A

The decommissioning operations will commence with a phased well P&A campaign, which may be executed using the existing the NNP drilling derrick and facilities and/ or using rig-less abandonment and conductor recovery technology. Underwater sound levels from all types of drilling platforms are increased during drilling periods in comparison to non-drilling periods. Drill ships are considered to produce the highest sound levels compared to semi-submersibles and fixed platforms (Genesis, 2011). The predominant frequencies are broadband with a frequency range of about 100 Hz to 400 Hz. Source levels can be as high as 195 dB (rms) re 1 µPa m for a drill ship, but are more typically lower for semi-submersibles and platforms at up to about 162 dB (rms) re 1 µPa m.

7.3.6. Ambient Noise

Ambient or background noise in the ocean results from sounds generated by physical factors such as wind and waves; by marine mammal vocalisations; and by other shipping.

7.4. Impacts on Sensitive Receptors

In order to determine the significance level of impacts resulting from the production of underwater noise, there is a requirement to understand the sensitive receptors. Underwater noise can affect the behaviour of or may cause injury to several different marine taxa, in particular fish and marine mammals such as pinnipeds and cetaceans.

7.4.1. Fish

The NNP lies within spawning grounds for cod, Norway pout, haddock, saithe and sandeel; and within nursery grounds for haddock, Norway pout, sandeel, whiting, anglerfish, European hake, herring, ling, mackerel, spurdog, and blue whiting (Section 3; Ellis et al., 2010; Coull et al., 1998).

Many species of fish use sound for location of prey, avoidance of predators and for social interactions. The inner ear of fish, including elasmobranchs (sharks, skates and rays), is very similar to that of terrestrial vertebrates, and hearing is understood to be present among virtually all fish (NRC, 2003). The majority of fish species detect sounds from below 50 Hz up to 500 to 1,500 Hz. A small number of species can detect sounds to over 3 kHz, while a very few species can detect sounds to well over 100 kHz. Fishes with the narrower bandwidth of hearing are often referred to as “hearing generalists” or hearing “non-specialists” whilst fishes with the broader range are often called “hearing specialists”. The difference between hearing generalists and specialists is that the latter usually have specialised anatomical structures that enhance hearing sensitivity and bandwidth (Popper and Hastings, 2009).

Hearing generalists include salmonids, cichlids, tunas and numerous other species. Hearing specialists include all the Otophysi and Clupeiformes, and some representatives in a wide range of other fish groups such as few holocentrids, sciaenids, etc. The fish known to have the widest hearing frequency bandwidth are limited to the members of the Clupeiform genus Alosa (Popper and Hastings, 2009). The fish species found in the area of the infrastructure to be decommissioned are mainly “Generalists” except some species such as herring which is considered as “Specialists”.

Fish exhibit avoidance reactions to vessels and it is likely that radiated underwater noise is the cue. For example, noise 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).

A comprehensive review by Popper and Hastings (2009) on the effects of anthropogenic sound on fishes concluded that there are substantial gaps in the knowledge that need to be filled before meaningful noise exposure criteria can be developed. De Robertis and Handegard (2013) mentioned that further research is needed, to identify the stimuli fish perceive from approaching vessels and to what extent fish perceiving these stimuli will react, before further recommendations to reduce vessel-avoidance reactions can be made.

7.4.2. Pinnipeds

The Ninian field is 120 km from the nearest coastline, therefore it is unlikely that grey and harbour seals would be found in the vicinity of the NNP (Section 3; Jones et al., 2013). The offshore noise resulting from the decommissioning activities are not expected to disturb any pinnipeds.

7.4.3. Cetaceans

Harbour porpoise, white-beaked dolphin, killer whale, long-finned pilot whale and minke whale have been recorded as present in the area (Section 3 Table 3.12; Reid et al., 2003, UKDMAP (1998) and DECC, 2016).

Characterisation of hearing sensitivities

Current data (via direct behavioural and electrophysiological measurements) and predictions (based on inner ear morphology, modelling, behaviour, vocalisations, or taxonomy) indicate that not all marine mammal species have equal hearing capabilities, in terms of absolute hearing sensitivity and the frequency band of hearing (NOAA, 2015). and, consequently, vulnerability to impact from underwater noise differs between species. Southall et al. (2007) classified the "hearing types" of different marine mammal species (Table 7.2). In addition, audiograms were obtained for harbour porpoise and killer whale (Nedwell et al., 2004) and white-beaked dolphin (Nachtigall et al., 2008). A generalised Mysticetes (baleen whale) audiogram was obtained and assumed to represent the hearing ability of long-finned pilot whales and minke whales (Tech Environmental, 2006).

Table 7.2: Functional cetacean hearing groups

Cetacean functional hearing group	Estimated auditory bandwidth	Species sighted in the NNP area
Low-frequency	7 Hz – 25 kHz	• Minke whale • Long-finned pilot whale
Mid-frequency	150 Hz – 160 kHz	• White-beaked dolphin • Killer whale
High-frequency	200 Hz – 180 kHz	• Harbour porpoise

Sources: Southall et al. (2007); UKDMAP (1998); NOAA (2015)

Threshold for injury and disturbance to marine mammals

The noise level perceived by an animal (the "received noise level") depends on the level and frequency of the sound when it reaches the animal and the hearing sensitivity of the animal. In the immediate vicinity of a high sound level source, noise can have a severe effect causing a Permanent Threshold Shift (PTS) in hearing; leading to hearing loss and ultimately, with increasing exposure, to physical injuries which are occasionally fatal. However, at greater distance from a source the noise decreases and the potential effects are diminished (Nedwell & Edwards (2004)); possibly causing the onset of only a temporary shift in hearing thresholds (TTS-onset). Hearing sensitivity, in terms of the range of frequencies and sound levels that can be perceived, varies with species and the minimum level of sound that a species is able to detect (the "hearing threshold") varies with frequency (Nedwell et al. (2007); Southall et al. (2007)).

Southall et al. (2007) undertook a review of the impacts of underwater noise on marine mammals and used this to define criteria for predicting the onset of injury and behavioural response in marine mammals with different hearing characteristics (Table 7.2) when subjected to different types of noise (Table 7.3). The estimated bandwidths have been revised recently by the National Oceanic and Atmospheric Administration (NOAA, 2015). This distinction between noise types is required as single and multiple noise exposures at different levels and durations differ in potential to cause injury to marine mammals.

Table 7.3: Noise types and activities associated with the NNP area

Noise type	Definition	Installation activities
Single pulse	Brief, broadband, atonal, transient, single discrete noise events; characterised by rapid rise to peak pressure.	No single pulse sources planned e.g. explosives.
Multiple pulse	Multiple pulse events within 24 hrs.	Side scan sonar/ Multi-beam echo sounder
Non-pulse	Intermittent or continuous, single or multiple discrete acoustic events within 24 hours; tonal or atonal and without rapid rise to peak pressure	Vessels, helicopters, water jetting, general underwater tool use, underwater cutting, drilling for P&A

Source: Southall et al. (2007)

Zone of injury or disturbance

The proposed precautionary thresholds for zero-to-peak sound pressure levels and sound exposure levels that are likely to lead to injury (PTS) and disturbance to marine mammals for different noise types are described within Table 7.4 (Southall et al., 2007). Southall et al. (2007) proposed precautionary criteria for the level of single-pulse sound that would lead to a behavioural response in marine mammals. However, none of the activities associated with the proposed decommissioning programme will generate noise classified as single-pulse.

Table 7.4: Precautionary thresholds for injury or disturbance to cetaceans

Cetacean functional hearing group	Sound measure[1]	Injury threshold for different sound types			Disturbance threshold for single pulse sounds[2]		
		Single pulse	Multiple pulse	Non-pulse	Single pulse	Multiple pulse	Non-pulse
Low-frequency	SPL	230	230	230	224	-	-
	SEL	198	198	215	183	-	-
Mid-frequency	SPL	230	230	230	224	-	-
	SEL	198	198	215	183	-	-
High-frequency	SPL	230	230	230	224	-	-
	SEL	198	198	215	183	-	-

[1] SPL – zero-to-peak Sound Pressure Level in dB re 1 µPa; SEL – Sound Exposure Level in dB re 1 µPa2s.
[2] Southall et al. (2007) did not define thresholds for disturbance from multiple pulse and non-pulse sounds.

Southall et al. (2007) recommend assessing whether a noise from a specific source could cause disturbance to a particular species by comparing the circumstances of the situation with empirical studies reporting similar circumstances. JNCC (2010), in their guidance on how to assess and manage the risk of causing "injury" or "disturbance" to a marine EPS as a result of activities at sea, suggest that disturbance to a marine mammal is likely to occur from sustained or chronic behavioural response with a severity scoring of five or above according to the scale of Southall et al. (2007).

These sound thresholds are compared with the predicted sound levels generated by the decommissioning operations to estimate a distance from the activities within which disturbance may occur.

The Nedwel et al. (2007) dBht (species) alternative approach

Nedwell et al. (2007) suggest that all species with well-developed hearing are likely to proactively avoid sound when the level exceeds 50 to 90 dB above their hearing threshold and receive damage to hearing organs at 130 dB above their hearing threshold. Species-specific audiograms are used to filter received noise levels according to the hearing ability of a species, giving sound levels in dBht (species). The distance from the centre of operations to the points at which 130 dBht (species) and 90 dBht (species) are exceeded represent an estimate of the limits within which injury (PTS) and likely avoidance, respectively, might be expected.

7.5. Noise Modelling Impact Assessment

The potential worst case sound levels generated over a range of frequencies and subsequently propagated into the surrounding environment have been modelled for the selected decommissioning options together with an assessment of the likely impact on marine mammals in the NNP area. This assessment considers the worst-case noise impacts only, which will occur in the project's offshore rather than nearshore locations. At this stage it is not known where the dismantling yard will be located.

The Marsh-Schulkin model is used to predict the distance from the construction activities beyond which the sound level would be too low for injury under the Southall criteria (Table 7.4) and using the alternative dBht (species) method.

7.5.1. Southall Criteria

The predicted cumulative source sound level for five vessels (worst-case noise scenario) during the decommissioning operations is 196 dB re 1 µPa m, as given by the Marsh-Schulkin model. This does not exceed the thresholds for injury to cetaceans (Southall et al., 2007; Table 7.4)).

7.5.2. Alternative dBht (species) Approach

The results of the alternative dBht method indicate that the threshold for a likely avoidance reaction (90 dBht (species)), may be exceeded for killer whales, harbour porpoises; and long-finned pilot whales and minke whales within a maximum radius of approximately 88 m, 60 m and 10 m of the site, respectively for activities involving a maximum of five vessels at once (Table 7.5).

Table 7.5: Predicted frequencies causing greatest effect and radii within which likely avoidance may occur for each species for the noise generated by the decommissioning operations

Selected decommissioning options	Max. no of vessels	Species	Hearing threshold in range (dB)	Source level (dB_{ht} *(species)*)*	Frequency causing greatest effect (kHz)	Maximum radii of likely avoidance zone (m)
Partial removal of jacket using HLV (Method A)**	4	Harbour porpoise	52	120	10	48
		Killer whale	52	123	8	71
		Minke whale Long-finned pilot whale	90	101	0.1	7
Single lift of topside	5	Harbour porpoise	52	122	10	60
		Killer whale	52	125	8	88
Partial removal of jacket using HLV (Method B)**		Minke whale Long-finned pilot whale	90	103	0.1	10

*derived from the underwater noise modelling tool
**two options exist for partial removal by cut and lift, referred to as Methods A and B. These differ in the specific vessel spreads that they would utilise with at most four or five vessels being on site together. Method A would take 16 days (+ 18 days preparation) and Method B would take approximately 5 days (+ 57 days preparation) to complete.

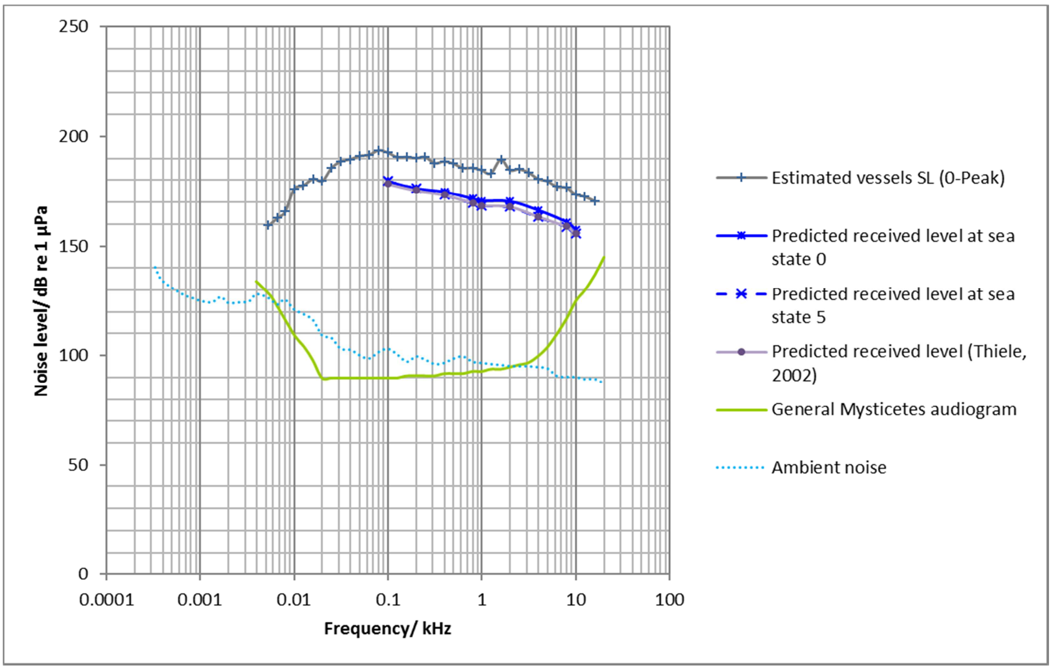
Comparison of marine mammal hearing with decommissioning sound and ambient noise

The modelled frequency profiles are presented together with the relevant marine mammal audiograms for the maximum likely behavioural avoidance zones (Figures 7.1 to 7.3) and the ambient noise levels (DEWI, 2004). Sound level decreases with increasing distance from the source and the rate of attenuation is greater at higher frequencies than at lower frequencies. Source level (SL), which is a sound level measured at a standard reference distance (1 metre) away from the source (NOAA, 2013; Richardson et al., 1995). The SL is expressed in dB re 1 µPa m.

Ambient noise and audiogram values (Figures 7.1 to 7.3) are presented in dB re 1 µPa (rms), whereas vessels and the modelled received sound values are given in dB re 1 µPa m (zero-to-peak). These units are not directly comparable, however, zero-to-peak measurements are greater than rms values and so the conclusions made about auditory zonal radii should be considered as conservative estimates.

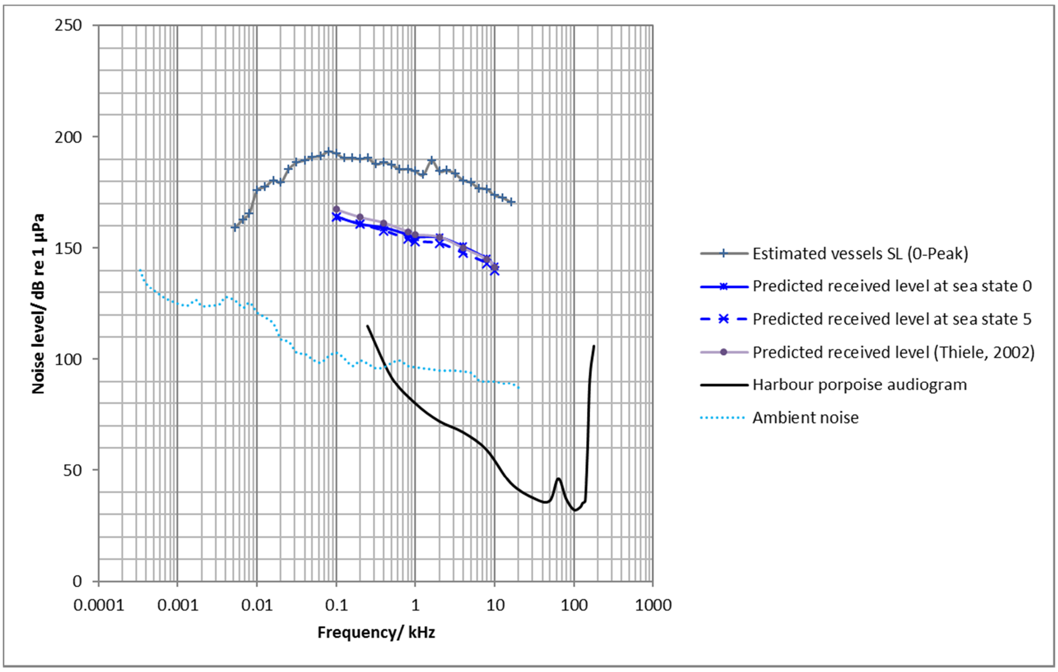
Values for the attenuation factor and the near-field anomaly parameters used in the Marsh-Schulkin model were only available for frequencies of 0.1 to 10 kHz (Urick (1983), p178, Table 6.2). The estimated radii of disturbance for this study all lie within the near-field, calculation of which does not include the attenuation factor.

The minimum cumulative noise source frequencies of this study are not included in the Urick table (0.005 to 0.1 kHz). However; these frequencies are similar to or less than the frequencies with the potential to cause the greatest effect to the marine mammals in this study (Table 7.5); and so it was not deemed necessary to extrapolate the values of the near-field anomaly backwards.



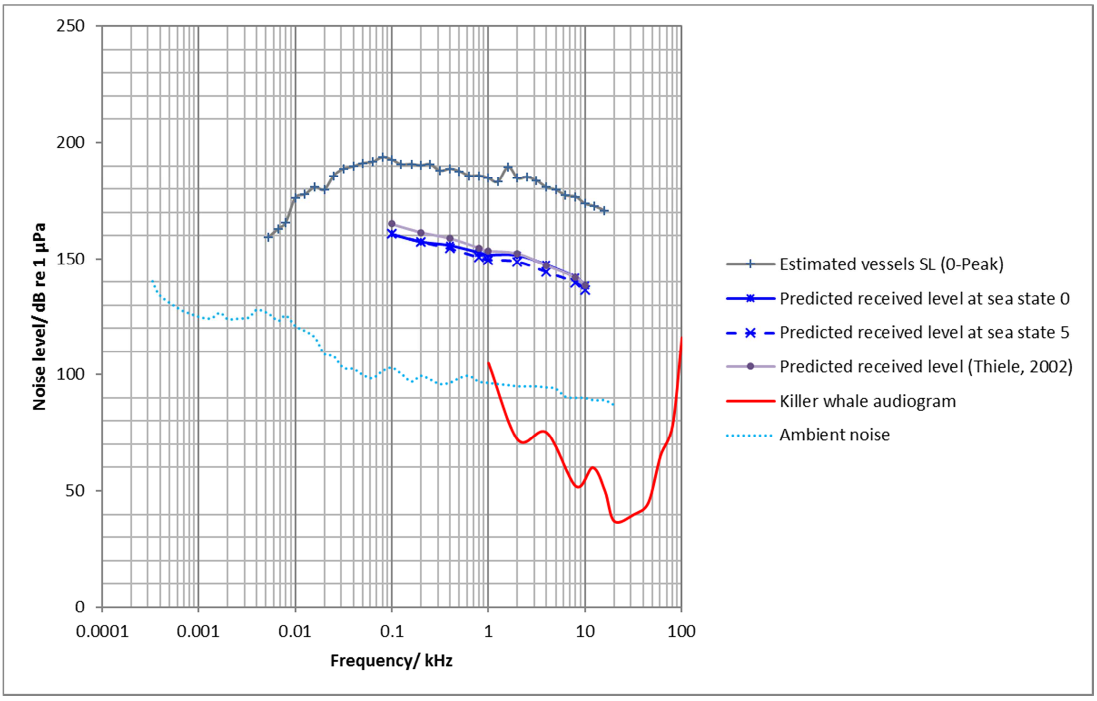
Source: generalised Mysticetes audiogram (Tech Environmental, 2006) and ambient noise levels (DEWI, 2004)

Figure 7.1: Frequency profile of received sound level of decommissioning operations at a radius of 10 m from source (estimated maximum extent of minke whale and long-finned pilot whale likely behavioural avoidance zone)



Source: harbour porpoise audiogram (Nedwell et al., 2004) and ambient noise levels (DEWI, 2004)

Figure 7.2: Frequency profile of received sound level of decommissioning operations at a radius of 60 m from source (estimated maximum extent of harbour porpoise likely behavioural avoidance zone)



Source: killer whale audiogram (Nedwell et al., 2004) and ambient noise levels (DEWI, 2004)

Figure 7.3: Frequency profile of received sound level of decommissioning operations at a radius of 88 m from source (estimated maximum extent of killer whale likely behavioural avoidance zone)

Potential disturbance to marine mammals

Areas of the SCANS II survey (SCANS II, 2006) and densities derived from UKDMAP (1998) have been used to estimate the number of animals of each species potentially experiencing behavioural disturbance from the decommissioning operations (Table 7.6). UKDMAP (1998) densities (Section 3) have been used for the calculations and represent a worst-case scenario in terms of densities. The modelling indicates that it is unlikely that any marine mammals will be affected by any of the decommissioning methods.

Table 7.6: Estimated number of animals potentially experiencing behavioural disturbance for any of the decommissioning methods

Species	Highest density in area (animals/km^2)	Estimated number of animals that may experience likely behavioural disturbance[1]
Minke whale	0.09	< 1
Long-finned pilot whale	0.19	< 1
White-beaked dolphin	0.19	< 1
Harbour porpoise	0.5	< 1
Killer whale	0.19	< 1

[1] Calculation method based on Southall et al. (2007) as recommended by JNCC (2010), abundance given to the nearest whole animal.
Source: SCANS II (2006) for area; UKDMAP (1998) for densities

It should be noted that the methods applied provide an overestimation of the number of animals disturbed and in this assessment would indicate that it is unlikely any marine mammals will be impacted. There is no clear relationship between received sound pressure level (SPL) and likely behavioural response and so this analysis conservatively uses the lowest reported SPL causing likely behavioural response. Additionally, in practice marine mammals are likely to be sparsely located, whether as individuals or groups of individuals, and move over large areas. There may be no individuals within the estimated zone of disturbance at the time of the decommissioning operations.

7.6. Transboundary and Cumulative Impacts

NNP is located, approximately, 23 km from the UK/ Norwegian median line. At this distance, noise levels associated with the decommissioning activities would attenuate to a level lower than that likely to cause injury or disturbance to any cetacean species and hence there is unlikely to be any transboundary impacts.

Oil and gas development in this region of the North Sea is relatively intensive. There are several oil developments within a 30 km radius of NNP (Section 3).

Therefore, there is a potential for cumulative noise impact due to the NNP decommissioning vessel operations. However, the number of vessels anticipated to be present in the area due to these development is small.

Given the localised nature of the proposed decommissioning works, no cumulative impacts are anticipated with other oil and gas installations or fields.

7.7. Mitigation Measures

In accordance with JNCC guidelines (JNCC, 2010) mitigation measures will be implemented during the proposed decommissioning operations as appropriate (Table 7.7). Noise generated from vessel activities are generally not considered by JNCC (2010) to pose a high risk of injury. The noise impact assessment undertaken supports this view, showing that there is unlikely to be any significant impact on any marine species. It is therefore considered unlikely that further mitigation measures will be required beyond those listed in Table 7.7.

Table 7.7: Mitigation measures

Potential source of impact	Planned mitigation measures
Underwater noise from decommissioning activities	• Machinery and equipment will be in good working order and well-maintained. • Helicopter maintenance will be undertaken by contractors in line with manufacturers and regulatory requirements. • The number of vessels travelling to or standing by NNP will be kept to the minimum.

7.8. Conclusions

The high-level risk assessment undertaken within Section 5 concluded that underwater noise generated during NNP decommissioning activities may result in impacts of a moderate significance. Detailed quantification has been provided within the supporting underwater noise impact assessment report (BMT Cordah, 2016d). This has enabled further assessment of identified potential impacts in accordance with CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314) (Tables 5.1 to 5.4). This in turn has enabled a consideration of the likely significance of these impacts upon relevant sensitive receptors.

Records indicate previous sightings of five cetacean species within the study area over the period when decommissioning activities are scheduled to take place. These species are all subject to regulatory protection from injury and disturbance.

The predicted cumulative source sound level during the NNP decommissioning operations is 196 dB re 1 μPa m. This does not exceed the thresholds for injury to cetaceans (Southall et al., 2007).

Depending on ambient noise levels, sensitive marine mammals and fish may be locally disturbed by noise from a vessel in its immediate vicinity. During decommissioning, marine mammals may be disturbed up to a distance of about 100 m from the centre of operations. Pinnipeds are not expected to be found in the area so will not be impacted by noise from decommissioning activities.

Although there is a degree of uncertainty associated with the noise levels generated by each vessel and activity, it follows that the sound levels for each decommissioning method are proportional to the number of vessels on site at any one time. Overall, any potential impact to marine mammals is not considered significant for any of the decommissioning methods and consequently will only result in minimal disturbance to these receptors.

The underwater noise modelling presented within this document considered, as a worst-case scenario, a single cumulative source location. This may therefore lead to an overestimation of the results. Project activities are such that the four to five individual sources of vessel noise may occur at slightly different locations and at slightly different times, thus potentially resulting in a lower effect on marine species.

Of note is that JNCC (2010) do not consider noise from vessel activity to pose a risk of injury to marine mammals (JNCC, 2010). The noise impact assessment undertaken within this study supports this view, showing that there is unlikely to be any significant impact. In addition, no concerns about transboundary and cumulative impacts were raised in this assessment.

In summary, due to the localised and intermittent nature of the activities and with the identified mitigation measures in place, the overall significance of the impact of underwater noise from the project is considered to be **low**. This is based upon the likelihood of occurrence of effects being ‘unlikely’ (Table 5.1) and consequence of effects being ‘slight’ (Table 5.2) as disturbance to receptors is expected to be minimal.

8. SEABED DISTURBANCE

The potential short and long-term environmental impacts associated with seabed disturbance during the NNP decommissioning activities are discussed in this section. The measures taken or planned by CNRI to minimise these impacts are detailed in Section 8.5.

8.1. Regulatory Context

Seabed disturbance resulting from the proposed NNP decommissioning activities will be managed in accordance with current legislation and standards as detailed within Appendix A.

8.2. Assessment Methodology

There is a potential for certain NNP decommissioning activities to disturb the seabed, resulting in environmental impacts (Section 5). In order to assess these impacts, a consideration of the potentially significant impacts and the associated magnitude and risk has been made. In conjunction with an understanding of the sensitive receptors, it has been possible to assess the significance of these environmental impacts.

This assessment is supported by the following studies commissioned by CNRI to assess the impacts associated with seabed disturbance, including drill cuttings disturbance, resulting from potential decommissioning activities:

- Technical Note on Ninian Northern Platform: Jacket Footings Degradation (CNRI, 2013).
- Technical Note on Ninian Northern Drill Cuttings Long-Term Characteristics (Genesis, 2013a).
- Technical Note on Ninian Northern Cuttings Pile – Modelling Disturbance from the Collapse of Structural Piles (Genesis, 2013b).
- Technical Note on Ninian Northern Drill Cuttings: Modelling Effects of Human Disturbance of the Pile (Genesis, 2013c).
- Environmental Assessment of Options for the Management of the Ninian Northern Drill Cuttings Pile (BMT Cordah, 2016e).

8.2.1. Drill Cuttings Modelling and Assumptions

CNRI commissioned Genesis to re-evaluate the conclusions reached regarding the rate of oil loss and footprint of the pile based on the 2011 field survey measurements. The DREAM (Dose-related Risk and Effect Assessment Model)/ParTrack model developed by SINTEF, within the Marine Environmental Modelling Workbench Version 6.2, was used to model the fate of the cuttings discharged to give deposition thickness and oil concentrations on the seabed and to calculate environmental risk to the seabed (Genesis, 2013a, b, c).

The underlying model has a well-documented basis in the way the particle mechanics, the physical, chemical and biodegradation and bioturbation processes and the significant sediment stressors are handled and evaluated. Field data was used to generate the majority of the features of the model, including existing research (such as the UKOOA Joint Industry Project on drill cuttings, Phases 1-3) and new research (as part of the ERMS Joint Industry Project). During model development, validation experiments were also conducted that tested aspects of the model. Input data for the model have been taken from known information or recognised industry sources and contain several conservative assumptions that would overestimate the outputs. Increasing the resolution of the modelling grid may well alter slightly and refine the boundaries shown in the outputs, but the results do not show any granularity that would indicate that grid size is affecting the outputs of leaching rate and footprint (Genesis, 2013a, b, c).

The principal questions being addressed here are whether the Ninian Northern cuttings pile falls below the OSPAR criteria for footprint and leaching rate. The model outputs for both parameters are well below the OSPAR thresholds. Several different configurations of inputs, metocean data and modelling assumptions were made before converging on the most representative set presented in the reports and overall conclusions did not vary (Genesis, 2013a, b, c).

8.3. Sources of Potential Impacts

The scope of this decommissioning programme is limited to the removal of the NNP and drill cuttings pile. These activities will require work below, at, or near the seabed which may result in short-term disturbance to background seabed sediments and, in some cases, to contaminated drill cuttings. The activities which have the potential to result in environmental impacts are:

- Anchoring activities during jacket removal operations (short term impact).
- The eventual collapse of the NNP jacket footings (long term impact).
- The physical presence of the drill cuttings pile (long term impact).

Short term impacts can be defined as those which have transient impacts lasting a few days to a few years. Long term impacts are those which will continue to have an impact for decades to centuries following decommissioning.

8.3.1. Anchoring Activities

CNRI anticipate that a HLV that requires anchors to maintain its position may be required during the lifting activities. The vessel contract has yet to be awarded. However, to calculate a worst-case anchoring scenario, calculations have been based on:

- HLV operation with a maximum 12-point mooring system.
- Two vessel operations (jacket and topside lifts), each involving a maximum of one anchored vessel.
- Anchor dimensions of 7.32 x 6.20 m, (based on a 32.5-tonne (32,500 kg) 'flipper delta' anchor).
- A chain length of 2,400 m, a maximum seabed contact length of 1,500 m and an average chain width of 0.076 m.

Anchoring the HLV during the topsides and jacket lifting operations will impact a total seabed area of, approximately, 0.0038 km^2 (Table 8.1).

Table 8.1: Structures and materials with the potential to impact on the seabed

Structure	Dimensions	Total seabed impact (km^2)	Approximate distance (km) to nearest SAC/ SCI
Anchor	(7.32 m x 6.20 m) x 12 anchors x 2 operations	0.0011	73 km southwest to Pobie Bank Reef SCI
Chain	(1,500 m x 0.076 m) x 12 anchors x 2 operations	0.0027	
Anchoring total		**0.0038**	

Note: Anchoring assumptions based on:

- Dimensions based on a 32.5-tonne (32,500 kg) 'flipper delta' anchor.
- Total chain length 2,400 m and a maximum contact length of 1,500 m, with an average chain width of 76 mm (0.076 m).
- 12-point anchoring HLV vessel. For the purposes of measuring to nearest SAC/ SCI the location has been assumed to be the same as the NNP location.
- Two anchoring events involving a maximum of one anchored vessel each, one for the topsides and one for the jacket lifts.

8.3.2. Eventual Collapse of Jacket Footings

The jacket structure will be cut above the jacket footings at between -77.5 m and -88.5 m below LAT (Section 2) resulting in between 63.5 m and 52.5 m of jacket footings extending above the drill cuttings pile which is approximately 11.9 m in height. Therefore, disturbance of the pile during cutting operations is not anticipated.

Eight jacket legs comprise various different components, which all vary in thickness of steel and consequently will corrode at different rates. A study commissioned to determine the likely corrosion of the NNP jacket footings estimated that at a corrosion rate of 0.1 mm steel/ year and global failure of the members could occur at 80% wall thickness loss (CNRI, 2012d; Genesis, 2013b). Due to the presence of grout in the annulus of the jacket piles, it is assumed that the initial members to fail due to corrosion will be the horizontal and bracing members (to corrode 100%). This is likely to be followed by skirt piles (after approximately 325 years), through leg piles without concrete fill (after 375 years) and through leg piles with concrete fill (after 400 years) (CNRI, 2012d).

Due to the slope gradient of all the pile members, it is expected that the jacket piles will collapse onto the drill cuttings pile, with the assumption that the heaviest concrete filled members of the footings will collapse last. Each pile is between 1.12 m and 1.52 m in diameter and between 48.0 m and 52.8 m in height. This represents a maximum total surface area of 1,813 m^2 which could impact the drill cuttings pile following collapse of all jacket piles.

8.3.3. Physical Presence of the Cuttings Pile

The NNP drill cuttings pile has an estimated volume of 33,144 m^3 and the footprint area of 23,620 m^2 (ISS, 2011). The pile has a maximum height of 11.93 m (ISS, 2011).

OBM was used and discharged with drill cuttings from eight of the 24 wells (CNRI, 2016a). Analysis of the chemical properties of the NNP drill cuttings pile sediments indicates that concentrations of THC, PAH, PCBs, APEs, TBT and heavy metals were elevated in the drill cuttings pile in comparison to mean concentrations from sediments in the wider Ninian Northern area (Section 3).

The potential environmental impacts associated with the different options for the management of the drill cuttings pile have been assessed by CNRI for NNP (BMT Cordah, 2016e) and modelling of the long-term fate of the NNP cuttings pile left in situ has been performed as per the OSPAR Recommendation 2006/5 (Genesis, 2013b). OSPAR Recommendation 2006/5 sets out a management regime for the decommissioning of historic OBM cuttings piles. This is based on criteria thresholds against which the level of pollution attributable to a historic drill cuttings pile may be measured, to determine whether the level of pollution could be considered significant. The NNP drill cuttings pile is below the OSPAR thresholds for both "total rate of oil release into the water column" and "persistence over the area of seabed contaminated" (Genesis, 2013a; Fugro ERT, 2011).

8.4. Impacts on Sensitive Receptors

In order to determine the significance level of impacts resulting from seabed disturbance, the magnitude of which has been quantified within Section 8, there is a requirement to understand the sensitivity of receptors. A discussion of these receptors is presented in the following text. The potential impacts to the water quality or seabed arising from the decommissioning activities are summaries in Table 8.2.

Table 8.2: Summary of potential sources of seabed disturbance and the resulting environmental impacts from each decommissioning activity or its outcome

Decommissioning activity/ outcome	Environmental Impact				
	Water column		Seabed sediments		
	Release of contaminants	Suspended matter	Release of contaminants	Burial and smothering	Oxygen depletion
Anchoring activities	Short-term	Short-term	Short-term	Short-term	-
Eventual collapse of jacket and footings	Short-term	Short-term	Short-term	Short-term	-
Cuttings pile left in situ	Long-term	-	Long-term	-	Long-term

The types of impact arising from the NNP decommissioning activities and outcomes listed in Table 8.2 can be summarised as:

- Disturbance of contaminated drill cuttings and sediments.
- Disturbance of non-contaminated sediments.
- Long-term presence of the drill cuttings pile.

These impacts are assessed in the following sections to determine the potential scale of the impacts to fauna and to local water and sediment quality.

8.4.1. Disturbance of Contaminated Drill Cuttings and Sediments

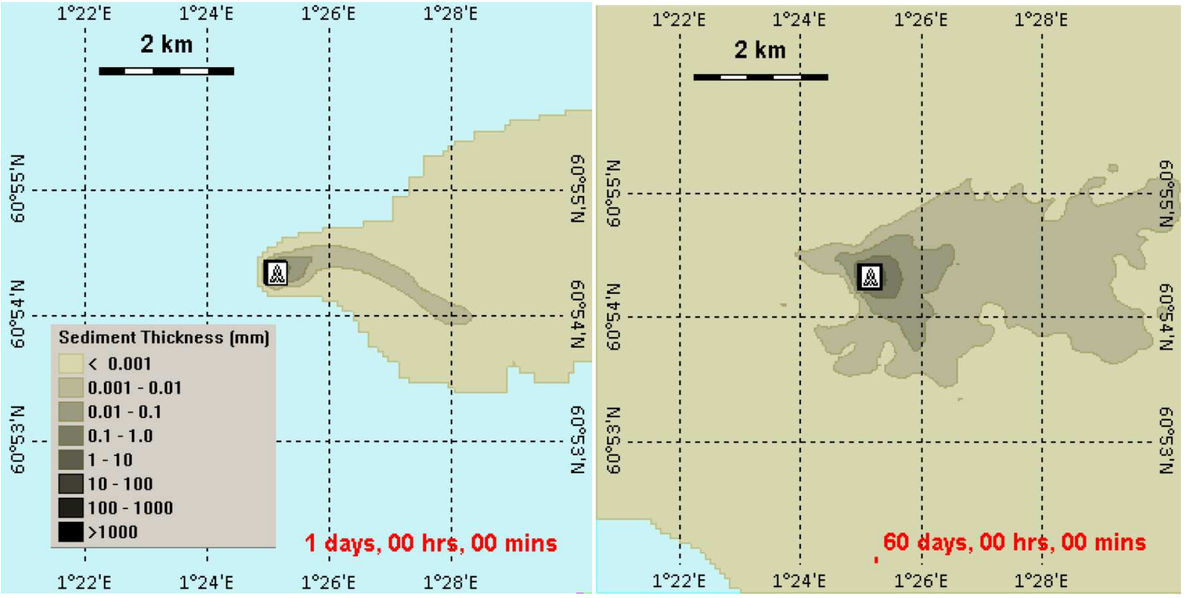
The eventual collapse of the NNP jacket footings (Section 8.3.2) could cause disturbance to drill cuttings pile sediments and result in a release of contaminants from the pile into the adjacent water column and over adjacent sediments. The drill cuttings pile location is well established and every care will be taken to avoid the drill cutting pile during anchoring activities, therefore it is unlikely that a disturbance of the cutting pile during anchoring activities will occur.

The potential impact associated with the disturbance of the drill cuttings from collapsing jacket members, as a result of the long-term degradation of the footings, would be dependent on the size of the failed sections. All collapsing piles are likely to disturb the drill cuttings pile.

Given the very low hydrodynamic forcing at the depth of the NNP drill cuttings pile it is likely that the majority of the disturbed cuttings would resettle over the already contaminated sediments of the existing drill cuttings pile. If disturbed cuttings settle onto the adjacent seabed, this would result in the smothering of organisms which have recolonised the pile sediments and the release of contaminants into the water column and over surrounding sediments (BMT Cordah, 2016e).

Under a worst case scenario where all the structural piles collapse into the cuttings pile, falling sequentially over a period of 60 days, the majority of re-suspended sediments are predicted to deposit within 500 m of the cuttings pile, with finer components travelling considerably further (Genesis, 2013b). Maximum thickness of deposition of sediments is predicted to be approximately 0.6 mm for the collapse of a single pile and up to 8 mm for the collapse of all the piles. The maximum thickness is predicted to occur within 50 m of the discharge point and decreasing rapidly with distance. At a distance of 1 km, the maximum depositional thickness is predicted to be a maximum of 0.01 mm along the dominant, southeast, current axis (Genesis, 2013b).

Figure 8.1 illustrates the modelled deposition thickness for (a) a single pile collapsing and (b) all the piles falling sequentially. The concentration of contaminants from the disturbed cutting pile is difficult to predict in the future. It is expected that in the upper areas of the cuttings pile, degradation of the organic compounds and sequestration of metals and inorganic compounds will have occurred. Chemical contaminants still present are likely to be in low concentration and as modelling indicates thinly distributed. The impact of these chemicals on the marine environment is discussed below and in Section 8.4.3.



a) Single pile collapsing (b) All piles falling sequentially

Source: Genesis (2013b)

Figure 8.1: Modelled deposition thickness of cuttings re-suspended resulting from the collapse of (a) one pile and (b) all the piles

Seabed sediments

Seabed sediments in the wider Ninian Northern area comprise poorly or extremely poorly sorted very fine sand with a low proportion of fine sands. The stations located close to the platform were classified as medium to coarse silt with 70.9 to 77.9% of silt/ clay in samples (Section 5). The collapse of the jacket footings may result in an increase in the percentage of fines material in the receiving sediments, resulting from disturbed cuttings and sediments relocating and settling over the receiving sediments. However, the immediate receiving area already has elevated percentage of fines from the original drilling operations (BMT Cordah, 2016e).

Hydrocarbon concentrations within the wider Ninian Northern area are generally within expected background levels for the northern North Sea, but hydrocarbon concentrations within 250 m of the NNP are elevated above background concentrations (Genesis, 2013b). The collapse of a single pile would not be expected to result in any areas of hydrocarbon concentration in sediment above 50 mg/kg. The collapse of multiple piles is expected to result in sediment hydrocarbon concentration up to 700 mg/kg, with an area exceeding 50 mg/kg extending to 230 m from the pile immediately after collapse. However, the seabed is expected to recover rapidly with peak concentrations declining to 330 mg/kg after one year and to 45 mg/kg after 10 years (Genesis, 2013b).

The area of environmental risk from the existing drill cuttings pile is predicted to decrease gradually over time. The environmental risk equated to 0.25 km^2 of seabed with a risk > 5% in 2013, and is predicted to decrease to 0.18 km^2 by 2020 (Genesis 2013b). If the area of environmental risk continues to shrink at this rate, it is very unlikely that any areas of seabed with a risk level of > 5% will exist once the piles collapse (325 to 400 years following derogation).

Benthic fauna

The macrofaunal community of the Ninian Northern area is typical of the wider northern North Sea, but within 500 m of the NNP and on the drill cuttings pile, the macrofaunal community shows some indication of being moderately modified (BMT Cordah, 2016e). Suspension of cuttings material as a result of jacket piles collapse is likely to physically disturb benthic fauna living on or in the sediment in the area around the disturbance location, smothering benthic fauna in the immediate discharge area. Studies have shown that recolonisation of cuttings pile sediments may commence one to two years after the cessation of cuttings discharges (UKOOA, 1999b).

Resettlement of contaminated sediment onto the seabed could be toxic to benthic organisms. As a result, recolonisation is generally characterised by the appearance of opportunistic species such as *Capitella capitata* which are tolerant to hydrocarbons and physical disturbance. The fauna at NNP consisted mainly of epifaunal taxa suggesting that NNP drill cuttings pile had very little infaunal colonisation (Section 3).

Studies of the effects of cuttings piles in the Norwegian Sector of the North Sea have indicated that heavily contaminated sediment prevented macrofaunal recolonisation during the first five years. It was reported that the layer of contaminated cuttings formed a barrier to burrowing organisms and consequently recovery may be extremely slow (Bakke et al. 1989 cited in UKOOA, 1999b). Recolonisation of the contaminated sediments increases with the biodegradation of contaminants within the surface layer of the disturbed sediments and, therefore, the gradual reduction in the overall contaminated area, especially in the area of thinly deposited material (CNRI, 2016d).

The maximum sedimentation thickness is predicted to be 8 mm, within 50 m of the disturbance. This is a relatively small area where the suspended sediment has been deposited in a thicker layer and would persist after 10 years only in the immediate vicinity of cuttings pile (within 20 m). Faunal samples collected from the existing NNP cuttings pile indicate very limited recolonisation of the contaminated sediments, samples exhibit low species diversity and abundance, and pollution-tolerant species were present only at one station (CNRI, 2016d).

Disturbance of drill cuttings as a result of the jacket piles collapse is not predicted to have a long term impact to benthic organisms. The initial impact area would not significantly exceed the area of the current pile accumulation and would be well within the existing background effects footprint of 50 mg/kg, while the collapse of all piles would result in footprint higher than 50 mg/kg which would be contained within the predicted footprint of the existing pile. Within one and a half to four years post collapse of one and all piles, respectively, the majority of impacted seabed is predicted recover. The collapse of one and all piles would result in an impact to 0.08 km^2 and 0.29 km^2, respectively (Genesis, 2013b).

Water quality

The re-suspension of drill cuttings will result in the release of contaminants and an increase in turbidity, resulting in the localised reduction in water quality. The phytoplankton and zooplankton communities in the Ninian Northern area are typical of the northern North Sea, with a phytoplankton community dominated by the dinoflagellate genus *Ceratium* and a zooplankton community dominated by Calanus species (Section 5).

Impacts to the water column as a result of the jacket piles collapse would be very short lived, with the environmental risk to the water column from each of the 26 structural piles within the footings reducing below 5% within 24 hours. The majority of material is predicted to remain within 30 vertical metres of the seabed. Although a small proportion of material will extend over 40 m into the water column, it would not exceed 5% environmental risk and consequently is not considered to be a significant environmental impact. The maximum extent of water column impact is predicted to be significant for 24 hours with a maximum of 0.04 km^3 volume of water column and limited to 7 km from the drill cuttings pile. The risk is transient and rapidly drops to zero after the collapse of each pile (Genesis, 2013b).

Fish and shellfish

The collapse of the jacket piles is considered to be of low risk to the water column as the associated impacts are predicted to be very localised (<0.29 km^2 of seabed and <0.004 km^3 water volume) and of very short duration (decreasing to below 5% within 24 hours) (Genesis, 2013b). Therefore, it is possible that a small number of demersal and pelagic fish might be temporarily disturbed by the jacket piles collapse. However, fish are highly mobile organisms and are likely to avoid areas of re-suspended sediments and turbulence during the gradual collapse of the NNP jacket piles.

The collapse of the jacket piles could occur at any point in time during the year, and could therefore coincide with spawning periods for cod, haddock, Norway pout, saithe and sandeel (Section 3; Coull et al., 1998 and Ellis et al., 2010). Sandeels are the only species which spawn onto the seabed; all the other species spawn pelagic eggs and larvae. It is unlikely that pelagic eggs and larvae would be affected by the re-suspended material from the drill cuttings pile as modelling studies predict the re-suspended material will remain within tens of metres of the seabed (CNRI, 2016d).

The NNP is located within an area of high spawning intensity for Norway pout (Section 3), however, the size of the potentially affected area is very small (<0.29 km^2) in comparison to the spawning area used by Norway pout in the northern North Sea (>10 Quadrants, each 250 km^2) (BMT Cordah, 2016e). The NNP is located within an area of low spawning intensity for sandeel, the size of the potentially affected area is relatively small (<0.29 km^2) in comparison to the spawning areas used by sandeel in the northern North Sea (>18 Quadrants, each 250 km^2) (Ellis et al., 2012).

The NNP is also located in an area where herring, ling, mackerel, spur dog, haddock, Norway pout, sandeel, whiting, anglerfish, European hake and blue whiting are known to have larval nursery grounds (Section 3; Coull et al., 1998 and Ellis et al., 2010). Sandeel and anglerfish spend their entire life-cycle in the seabed and, since the adults live in the seabed and have a relatively sedentary lifestyle, they are vulnerable to smothering and disruption of seabed sediments (BMT Cordah, 2016e).

In addition to impacts associated with spawning and nursery areas, other potential direct impacts of the hydrocarbons in the drill cuttings on fish include tainting of fish for human consumption, diseases in adult fish such as abnormal tissue growths and other lesions, and physiological impacts such as repression of the immune system in adult fish (CEFAS, 1999). Of the species recorded within the Ninian Northern area, haddock, cod, whiting, saithe, European hake, anglerfish and ling all have a degree of demersal existence as adults and generally feed on benthic organisms (BMT Cordah, 2016e).

Historical studies have recorded taint, mostly in demersal species of fish, caught close to oil and gas platforms (within 1,000 m) (CEFAS, 1999). Taint contamination of benthic species could be due to the ingestion of contaminated sediment (Cordah, 1998). Hydrocarbons, especially PAHs such as those found in OBM drill cuttings, have been associated with teratogenicity, mutagenicity and carcinogenicity in fish (CEFAS, 1999) through chronic effects on tissues.

The incidence of such impacts on adult fish has not been extensively studied in relation to contamination from drill cuttings piles, partly because fish are highly mobile (BMT Cordah, 2016e). Many of these impacts have a long development time and are likely to have multiple causes. Exposure to drill cuttings contamination is likely to be a contributory factor rather than the sole cause in the incidence of disease, but its relative contribution is difficult to establish (BMT Cordah, 2016e).

The release of contaminants from the sediments may affect the early life stages of some fish species, but will be localised and not likely to have an impact on that species' population or its long-term survival.

8.4.2. Disturbance of Non-Contaminated Sediments

Anchoring activities could cause disturbance to seabed sediments that are outside the drill cuttings pile footprint and where levels of contaminants approximate those of background North Sea sediments (Section 8.3.1).

Sediments that are re-suspended during placement anchors will drift with seabed currents before settling out over adjacent areas of seabed. The lateral spread of the re-suspended sediments is expected to be limited due to the weak subsea currents in the NNP area and at worst-case, this could have a minor impact on the local community. In extreme cases, re-suspended sediments might smother surrounding benthic communities, but otherwise this impact area will be limited to the immediate vicinity of the disturbance. Such impact can be comparable to the natural burial of fauna from sediment movement due to subsea currents.

Standard anchors extend approximately 2.4km from the platform which was well within the 2011 environmental baseline survey area that extended up to 10km from the platform. The survey identified no evidence of seabed features or habitats (for example Special Areas of Conservation) that could be impacted upon by anchoring (Fugro ERT, 2011).

Following completion of the lifting activities, due to weak currents in the area (Section 3) the natural physical processes of sediment transportation and biological settlement may not be sufficient to restore the seabed habitat to its original condition. To minimise the adverse effects of anchor operations, careful planning of the anchoring activities has to be undertaken, followed by post decommissioning assessment of anchor sites and mitigation measures as required.

8.4.3. Long-term Presence of the Drill Cuttings Pile

Whilst the NNP drill cuttings pile falls below the OSPAR Recommendation 2005/6 thresholds, if the pile were left in situ to degrade naturally it is likely that the relatively low rate of leaching of contaminants into the water column and the long-term pile presence and contaminant persistence would result in a continued, albeit relatively low, impact on water and sediment quality and local benthic communities.

Leaching of contaminants

The OSPAR Recommendation 2006/5 states:

"The rate of oil loss should be assessed on the basis of the quantity of oil lost from the cuttings pile to the water column over time. The unit used should be tonnes per year (tonnes/yr) (with an acceptance threshold of less than 10 tonnes of oil lost per year)."

The long-term environmental risk to the seabed from the drill cuttings pile is predicted to be a result of oxygen depletion, PAH and alkylphenol ethoxylates (APEs) concentrations (Genesis, 2013a). APEs are listed by OSPAR as chemicals for priority action due to being toxic to marine organisms, bioaccumulative and persistent in the environment. Nonylphenol, octylphenol and their derivates (ethoxylates) are suspected endocrine disruptors which induce sex change in male fish. Therefore, it is likely that APEs will contribute towards the overall environmental risk to benthic and demersal feeding organisms such as fish. APEs were not assessed within the drill cuttings pile modelling. However, results from the pre-decommissioning environmental survey (Section 3) indicated that elevated levels of APEs were present in the drill cuttings pile accumulation but dropped significantly beyond 100 m from the platform.

Leaching of oil into the water column is also likely to result in the release of contaminants (such as PAH and APEs) into the water column. Hence, the core area of the pile, if left in situ, has the potential to cause toxic effects to benthic and demersal organisms through continued leaching of hydrocarbons (BMT Cordah, 2016e). Environmental risk to the water column from the higher leaching rate of 1.4 tonnes per year is predicted to be below the 5% risk value such that it is not considered to pose a significant risk to pelagic organisms (Genesis, 2013a). The total oil loss from the pile is currently predicted to be, approximately, 0.1 tonnes per year, which includes the loss of oil due to biodegradation, the loss of oil to water column is below the OSPAR 2006/5 threshold of 10 tonnes per year. As this value is based on a decreasing trend it provides an over-estimate of the instantaneous rate of oil loss from the pile.

Long-term pile presence and contaminant persistence

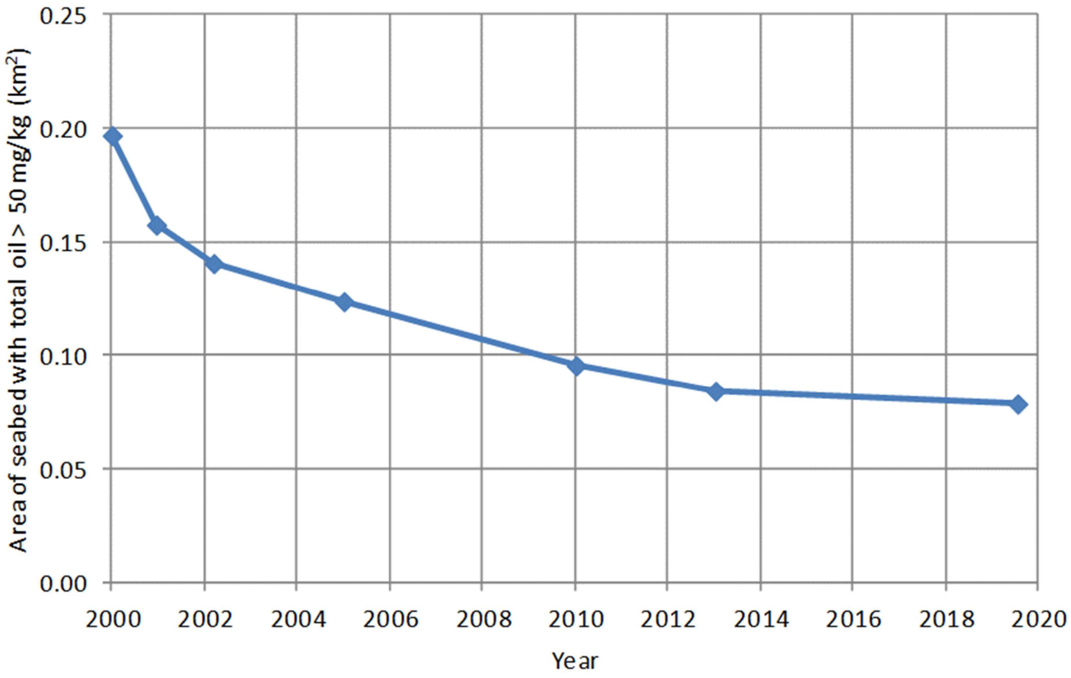
The OSPAR Recommendation 2006/5 states: *"The persistence should be assessed on the basis of the area of the seabed where the concentration of oil remains above 50 mg/kg and the duration that this contamination level remains. The unit used should be square kilometre years (km^2yrs). The results of this process should be compared against the following thresholds: Persistence over the area of seabed contaminated: 500 km^2yr."*

Modelling predicted the area of seabed for which the concentration of oil exceeds 50 mg/kg (contaminated footprint) over the 20-year restitution period (Genesis, 2013b). The contaminated area multiplied by the duration (footprint and persistence) was calculated, beginning in 2000, at the end of discharge period. Modelling results predict that the area of seabed where THC exceeds 50 mg/kg would decrease to approximately 0.079 km^2 by 2020, from an initial area of 0.20 km^2 in 2000 (Figure 8.2; Genesis 2013b). The area of persistence was calculated as 1.7 km^2years, which is well below the OSPAR criterion of 500 km^2years (Genesis, 2013b).

Analysis of survey data from the drill cuttings pile and surrounding sediments indicates that the NNP cuttings pile falls below both OSPAR thresholds (Genesis, 2013a; Fugro ERT, 2011). As such, no further action is required with regard to the OSPAR Recommendation 2006/5 and the cuttings pile may be left in situ to degrade naturally. The UKOOA drill cuttings initiative found that the potential environmental impact of a cuttings pile is not considered to be significant if the pile characteristics fall below the two OSPAR thresholds (UKOOA, 2002a).

If undisturbed, the core of drill cuttings pile is expected to physically persist on the seabed for undetermined length of time and its chemical and biological footprint is expected to be detectable for hundreds of years diminishing slowly over time (Genesis, 2013b).

The total volume of hydrocarbons estimated to be contained within all the North Sea cuttings piles is around 160,000 tonnes (from 30 years of discharge) (UKOOA, 2002a). The cumulative impact for all North Sea cuttings piles is small compared with other inputs to the North Sea, e.g. annual input of hydrocarbons from all piles at 330 tonnes to the water column in the North Sea equates to 0.5% of that from other sources at circa 65,000 tonnes (UKOOA, 2002a).



Source: Genesis (2013b)

Figure 8.2: Area of seabed (km^2) exceeding 50mg/kg predicted over 20 years, in the event the NNP pile was left in situ

Benthic impacts

Leaving the cuttings pile in situ will result in their natural degradation, with contaminants leaching at a relatively low rate into the water column. The long-term presence of the cuttings pile and the contaminant persistence would result in a continued, albeit relatively low, impact on sediment quality and local benthic communities.

Oil and associated contaminants (such as PAH and APEs) will continue to leach through the layers of the cuttings pile continually re-contaminating the surface layers of the pile as they start to biodegrade. The core accumulation of the pile, if left in situ, therefore has the potential to cause toxic effects to demersal organisms through continued leaching of hydrocarbons. The area of sediment impacted with total hydrocarbons over 50 mg/kg shrinks over time and is predicted to be limited to 0.079 km^2 around discharge point after 20 years (Genesis, 2013b).

Sessile demersal species would be at the greatest risk, with other benthic deposit feeding organisms at risk of bioaccumulation through the food chain. The chemical and biological extent of the pile is expected to diminish gradually over time and be limited to small releases spatially contained within the footprint of the bulk of the pile material. PAHs and APEs associated with cuttings piles within the anoxic deeper layers may be very persistent. If these drill cuttings are disturbed and redistributed, the release of PAH, APEs and their derivatives have the potential to cause biological effects such as toxicity and endocrine disruption to benthic and demersal organisms (BMT Cordah, 2016e).

Fish and shellfish impact

Leaving the cuttings pile in situ will result in their natural degradation, with contaminants leaching at a relatively low rate into the water column. The long-term presence of the cuttings pile and the contaminant persistence would result in a continued, albeit relatively low, impact on demersal fish species. The potential impacts to fisheries associated with the disturbance of the cutting pile and hydrocarbon/ contaminant persistence are discussed in Section 8.4.1.

8.5. Transboundary and Cumulative Impacts

Following completion of the NNP DP the only inventory and facilities that will be left post decommissioning will be the drill cuttings pile and the associated derogated jacket footings.

The total footprint area following post decommissioning of the NNP drill cuttings pile is 0.0236 km^2. After 30 years of discharges, the total area of seabed experiencing disturbance due to all cuttings piles within the North Sea was estimated to be 1,605 km^2 or 0.23% of the total area of the North Sea (CEFAS, 2001a) and therefore NNP cuttings pile contributes 0.002% of this total. For comparison, an area of seabed that is affected by fishing, dredging and spoil dumping amounts to approximately 130,000 to 369,000 km^2 per year (up to 50% of the North Sea CEFAS, 2001a). The potential cumulative environmental impact of leaving the pile in situ is not considered to be significant (UKOOA, 2002a).

The NNP is located 23 km west of the UK/ Norway median line. Decommissioning activities are not anticipated to create any transboundary impacts.

8.6. Mitigation Measures

Table 8.3 below summarises the potential sources of impact and planned mitigation measures.

Table 8.3: Summary of potential sources of seabed disturbance and the proposed mitigation measures.

Potential sources of impact	Planned mitigation measures
Anchoring operations	To minimise adverse effects of anchor operations CNRI will develop anchor plan/ pre-planning of anchor pattern. Rolling anchors or piggyback anchors will be used to minimise impact on seabed. The area will be pre-surveyed to aid anchor plan. Post-decommissioning as-left survey will be carried out and remedial intervention will be carried out in the event of any anchor mounds or scars.
Drill cuttings pile management	Drill cuttings management options have been considered in detail (CNRI, 2016d). The outcome from the CA process concluded that leaving the cuttings pile in situ is the most environmentally justified method for decommissioning compared with methods that involve extensive disturbance of the cuttings pile and re-suspension of OBM contaminated sediments into the environment.

8.7. Conclusions

The high-level risk assessment undertaken for the NNP decommissioning activities concluded that seabed disturbance may result in impacts of a moderate significance (Section 5). Detailed quantification provided within this section has enabled an assessment of the identified potential impacts in accordance with CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314) (Tables 5.1 to 5.4) and a consideration of the likely significance of these impacts upon sensitive receptors.

The environmental impacts to the seabed emerging from the proposed NNP decommissioning activities and the natural degradation of the cuttings pile left in situ, include:

- Anchoring activities will result in short-term and localised disturbance.
- The long-term degradation of footings leading to falling jacket members and single piles may result in a relatively small disturbance of the drill cuttings pile. The collapse of all the piles will result in risk above 5% within at most 450 m of the disturbance site and after 10 years, areas with risk above 5% will persist only in immediate vicinity (within 20 m) of the cuttings pile.
- Long-term impacts from leaving the pile in situ are considered to be localised and not of significance. The area of sediment impacted with total hydrocarbons over 50 mg/kg decreases over time and is predicted to be limited to 0.079 km^2 around discharge point after 20 years. Environmental risk to the water column from leaching is predicted to be below the 5% risk value such that it is not considered to pose a significant risk to pelagic organisms.

In summary, due to the localised nature of the decommissioning activities and with the identified mitigation measures in place, the overall significance of the impact of sediment disturbance is considered to be **low**. This is based upon the likelihood of occurrence of effects being 'possible' (Table 5.1) and consequence of effects being 'slight' (Table 5.2). Degradation of the footings will result in greater sediment disturbance than anchoring activities or leaving the pile in situ, however this disturbance will be localised over existing contaminated sediment and the collapse of all structural piles would need to take place to result in a noticeable impact.

9. SOCIOECONOMIC IMPACTS

This section focuses on the broader socioeconomic considerations of the decommissioning of the NNP and drill cuttings pile. Socioeconomics is a subset of EIA that is concerned with the human dimensions of the environment and seeks to identify the social and economic impacts on people and their activities (Morris and Therivel, 2009).

9.1. Regulatory Context

Societal impacts generated from the proposed activities associated with the decommissioning of the NNP and the drill cuttings pile will be managed in accordance with current legislation, guidelines and standards, as detailed in Appendix A.

9.2. Approach

The EIA scoping report (BMT Cordah, 2016a) and a risk assessment (Section 5) identified potential socioeconomic impacts associated with the NNP decommissioning operations as:

- Physical presence of decommissioning vessels causing potential interference to commercial fishing activities.
- Damage to or loss of gear as a result of subsea obstructions left in situ, posing potential snagging risks.
- Onshore impacts associated with the deconstruction, disposal, manufacture and recycling of materials on or near-shore.

Some of the information to compile this section has been taken from the socioeconomic impact study prepared by SFF Services (2016). The report provides a detailed assessment of commercial fishing activities in the northern North Sea between the Shetland Islands and Norway, relevant to the NNP and associated pipelines and assesses the impacts of various decommissioning options.

The onshore decommissioning yard has not been identified and will be determined during the contracting process. Therefore, the onshore impacts associated with decommissioning are covered at a high level in this assessment and will be subject to further assessment once a decommissioning yard has been selected.

9.3. Sources of Potential Impacts

The following provides a description of the issues associated with the proposed decommissioning operations that were identified as having a socioeconomic impact.

9.3.1. Interference to Fishing Activities

During the decommissioning operations, there will be potential for navigational conflicts between fishing vessels and decommissioning vessels transiting to and from the site. This could include towed gear vessels being required to alter towing direction, or the fouling of fixed gear markers.

The interference by decommissioning vessels has the potential to impact more fishing vessels than those operating in the immediate vicinity of the NNP, depending upon the location of the decommissioning port(s).

The majority of fishing activity in the vicinity of the NNP is by vessels towing mobile gear. It is expected that any interaction with vessels would result in changes in fishing patterns rather than damage to fishing gears and any loss of income would not be significant. Table 9.1 provides SFF Services definition of the sensitivity of fixed gear vessels to interference. The magnitude of effect is dependent upon the location of the decommissioning port and the precautionary approach has assumed that transit routes will be in the vicinity of fixed and towed gear.

Table 9.1: Criteria used to define the sensitivity of fixed gear vessels to interference

Characteristic	Commercial Fisheries
Adaptability of the receptor	Low: Fishing vessels are required to amend fishing practices slightly but no significant change
Tolerance of the receptor	Low: Outside of peak fishing periods
Recoverability of the receptor	Medium: Temporary (i.e. during decommissioning period)
Value of the receptor	Negligible: Very low loss of economic value of fishery

Source: SFF Services (2016)

As the mandatory 500 m safety zone will remain around the NNP throughout the decommissioning operations, the majority of the decommissioning vessels will be located within this zone and their effect on fishing vessels is therefore likely to be small. The magnitude of effect will therefore be dependent on the number of days decommissioning vessels are present in the vicinity of NNP outside the 500m safety zone.

9.3.2. Damage to or Loss of Gear

Once decommissioning has been completed, there is the potential for fishing gear to snag on subsea obstructions which have been left in situ, such as the jacket footings. The core of the drill cuttings pile is located within the footprint of the jacket footings and therefore unlikely to present a snagging hazard, however there is the potential for fishing gear to tow through the periphery of the pile which may result in low level contamination of either fishing gear or the catch therein.

Vessels operating demersal gear have the highest risk associated with fastening gear on obstructions due to the nature of their activity. The majority of activity in the vicinity of the NNP is by vessels operating demersal gear, therefore the risks associated with fastening gear on subsea obstructions will be highest for these vessels.

There is also potential for pelagic and fixed gear to snag on subsea obstructions. The risks associated with pelagic and fixed gears are considered to be lower than demersal gear however, due to the nature of the activities and the relatively low level of fishing activity occurring within the vicinity of the NNP.

SFF Services (2016) defined the sensitivity of demersal, pelagic and fixed gear vessels to loss or damage of gear (Table 9.2).

Table 9.2: Criteria used to define the sensitivity of demersal, pelagic and fixed gear vessels to loss or damage of gear

Characteristic	Commercial Fisheries
Demersal Gear Vessels	
Adaptability of the receptor	Medium: Fishing vessels are limited in their ability to adapt and there is a discernible reduction in activity in the area
Tolerance of the receptor	Medium: During peak fishing periods
Recoverability of the receptor	High: Permanent
Value of the receptor	Low: Low loss of economic value of fishery
Pelagic Gear Vessels	
Adaptability of the receptor	Low: Fishing vessels are required to amend fishing practices slightly but no significant change
Tolerance of the receptor	Low: Outside of peak fishing periods
Recoverability of the receptor	High: Permanent
Value of the receptor	High: High loss of economic value of fishery
Fixed Gear Vessels	
Adaptability of the receptor	Low: Fishing vessels are required to amend fishing practices slightly but no significant change
Tolerance of the receptor	Low: Outside of peak fishing periods
Recoverability of the receptor	High: Permanent
Value of the receptor	Negligible: Very low loss of economic value of fishery

Source: SFF Services (2016)

9.3.3. Onshore Impacts

All structural material retrieved from the NNP will be transported to shore for dismantling, and recycling or disposal as appropriate.

Licensed contractors at licensed sites would undertake processing and there would be few impacts from the controlled operations. CNRI's Duty of Care extends beyond the quayside to ensure that onshore licensed disposal sites undertake all dismantling activities in a responsible manner. The environmental impacts that may be experienced at any onshore site selected for receiving and dealing with material from the NNP would be short-lived, localised and managed, and similar to those that have previously arisen during past commercial activities at the site.

9.4. Impacts on Sensitive Receptors

SFF Services (2016) identified the following receptors that may potentially be impacted by the proposed decommissioning activities include:

- Mackerel and herring by pelagic trawlers.
- Mixed demersal species by demersal trawlers.
- Mixed species by vessels operating fixed gear (I e. longliners and gillnetters).

This section describes the effects on these receptors from the identified socioeconomic impacts associated with the NNP decommissioning operations.

9.4.1. Interference to Fishing Activities

The number of days that decommissioning vessels will be on site to undertake the removal of the topsides and partially remove the NNP jacket (111 days) is low (CNRI, 2016c). Due to the low number of days decommissioning vessels can potentially interfere with fishing activity, the magnitude of effect is considered to be low, and the potential to interfere with fishing activity (significance of effect) is considered minor (SFF Services, 2016). During this period of 111 days, navigational aids will be in place and a 500m zone will be in force.

During the periods of time when the platform is unmanned and up until jacket removal, navigational aids will be in place and a 500 m safety zone will be in force. This will minimise any risks to fishermen and potential interference to fishing will be reduced to as low as reasonably practicable with these controls in place. Navigational aids will be managed under an approved Consent to Locate and their maintenance will be described within an approved Safety Case. In addition, they will be installed in such a way that they can be accessed in order to monitor, conduct maintenance and rectify any issues.

Partial removal of the NNP jacket will result in the footings remaining elevated to between 52.5 m and 63.5 m above the seabed, and with the drill cuttings pile left in situ. At this point, the mandatory 500 m safety zone will no longer apply. This allows for fishing activities potentially to be undertaken in close vicinity to the remaining jacket footings. The presence of the footings will prevent fishing vessels from operating within the boundaries of the NNP, and therefore the majority of the drill cuttings pile will not impact upon commercial fishing activities, however there may be a low risk of contamination to fishing gears on the periphery of the drill cuttings pile which extends outside the protection of the jacket footings.

Further, Linley et al. (2007) found that subsea offshore structures can act as fish aggregation devices (FADs), attracting various fish species, which could potentially attract fishermen aiming to increase their catch by targeting shoals of fish aggregated around the footings. It should be noted, however, that the ultimate decision to fish in the vicinity of subsea obstructions lies with the skipper of a vessel.

The potential for interference to fishing activities as a result of partial removal of the NNP jacket is detailed within Table 9.3.

Table 9.3: Impact significance of interference to fishing activities from the partial removal of jacket

Impact	Receptor	Sensitivity of receptor	Magnitude of effect	Significance of effect
Interference to fishing activities resulting from partial removal of the NNP jacket using conventional HLV	Fixed gear vessels	Low	Low	Minor

Source: SFF Services (2016)

9.4.2. Damage to or Loss of Gear

NNP jacket footings

The partial removal of the NNP jacket will result in the footings remaining elevated above the seabed posing as a snagging risks to commercial fishing nets, and resulting in the potential for damage or loss of fishing gear. After decommissioning, the remaining jacket footings will cover a very discrete area of the seabed (4,833 m^2), however, with the footings extending from the seabed it is considered that vessels towing demersal gear have the potential to snag on the footings. The magnitude of effect on these vessels is considered to be medium (Table 9.4; SFF Services, 2016). However, given the overall footprint of the footings is relatively small and CNRI's commitment to identify and maintain the location of the site on navigational aids such as FISHSafe, the likelihood of incidences occurring is reduced.

For vessels towing pelagic gear it is considered they have the potential to be fastened. However, the majority of these vessels carry high specification sonar equipment on varying frequencies which can identify snagging risks and, therefore, the magnitude of effect on these vessels is considered to be low.

It is considered unlikely that fixed fishing gear will fasten on the footings, due to the small area covered by the infrastructure and the nature of the fixed gear activities. The magnitude of effect on these vessels is therefore considered to be low.

Table 9.4: Impact significance of damage to of loss of gear from the partial removal of jacket

Impact	Receptor	Sensitivity of receptor	Magnitude of effect	Significance of effect
Damage or loss of gear due to partial removal of the NNP jacket	Demersal vessels	Medium	Medium	Moderate
	Pelagic vessels	Medium	Low	Minor
	Fixed gear vessels	Low	Low	Minor

Source: SFF Services (2016)

Drill cuttings pile

The drill cuttings pile has a maximum height of 11.93 m with the majority of cuttings located under the platform, spreading out evenly in all directions. MBES mapping showed that the pile sits almost entirely under the platform and tails off slightly more in the southeasterly direction (Section 2; CNRI, 2016d).

It is considered that the presence of the footings will prevent fishing vessels from operating within the boundaries of the NNP, and therefore the majority of the drill cuttings pile will not impact upon commercial fishing activities. However, fishing gears may interact with the drill cuttings that are located outside of the NNP footprint. Field studies designed to trawl over a known cuttings pile and measure the dispersion of cuttings resulting from the trawling activities were conducted by the Fisheries Research Services in 2000. The results indicated that trawling activities disturbed relatively little material to a significant height into the water column.

Contamination would be spread by trawling activities, but not in amounts or at rates that are likely to pose serious wider contamination or toxicological threats to the marine environment (CNRI, 2016d). Therefore, fishing gear interactions with the redistributed cuttings pile would be unlikely to result in an impact to the sediments and commercial fishing, the severity of which would only be slight, and therefore would not present a significance risk.

Studies conducted by UKOOA have shown that catches close to the cutting piles have about the same level of hydrocarbons and other contaminants in their tissues as catches from those away from the platforms (UKOOA, 2002b). In contrast, SFF have reported that decommissioning trawl sweeps undertaken over the

Hutton TLP cuttings pile resulted in the gears and doors (starboard and port) being covered in a muddy substance with a very strong oily smell (SFF, 2003).

9.5. Transboundary and Cumulative Impacts

NNP is located approximately 23 km from the UK/ Norwegian median line. The NNP and drill cuttings pile are localised and within UK waters, so there will be no transboundary impacts.

There are a number of oil and gas infrastructures in the North Sea which could potentially undergo decommissioning during the timescale of the NNP decommissioning. There is also potential for construction activities to occur in the area as a result of oil and gas exploration.

There are a number of existing oil and gas installations within close proximity to the NNP. Cumulative impacts to fisheries may occur if the extent of an area impacted is significant with respect to the total area available for fishing. As the decommissioning activities proceed, new areas of sea will become available to fisheries, reducing the overall cumulative impact to fisheries and resulting in a positive impact.

9.6. Mitigation Measures

Mitigation measures to minimise societal impacts are detailed in Table 9.5.

Table 9.5: Mitigation measures

Potential source of impact	Planned mitigation measures
Physical presence of decommissioning vessels causing potential interference to other users of the sea.	• Prior to commencement of operations, the appropriate notifications will be made and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Appropriate navigation aids will be used in accordance with the consent to locate conditions to ensure other users of the sea are made aware of the presence of vessels. • The number of vessels travelling to or standing by NNP will be kept to the minimum
Damage to or loss of gear as a result of subsea obstructions, decommissioned in situ, posing potential snagging risks.	• On-going consultation with fisheries representatives. • Post-decommissioning seabed clearance and an overtrawlability survey will be conducted. • UK Hydrographical Office and Kingfisher informed.

9.7. Conclusions

There will be **minor** impact to fishing activities during the decommissioning operations in the NNP area. This impact will be reduced by minimising the number of vessels travelling to, or standing by, NNP once it has been decommissioned.

Potential damage or loss of demersal fishing gear as a result of the partial removal of the jacket will be minimised by notifying the appropriate organisations of any subsea structures left in place after decommissioning. Disturbance of the cuttings pile in the near-term is unlikely due to its location.

10. ACCIDENTAL EVENTS

Throughout the NNP decommissioning, CNRI will ensure that all parties adhere to the CNRI Infield Safety Procedures. However, in the event of an accidental event CNRI have a number of mitigation strategies to ensure that the impact to the environment is reduced as far as is reasonably practicable.

Three types of accidental event present the most likely worst case impacts to the environment:

- Hydrocarbon release.
- Chemical spill.
- Dropped objects.

These events will be discussed in further detail and strategies to prevent or limit their impact presented. During the decommissioning process minor spills such as leaks, loss of fluid from machinery or hoses on the platform will be addressed through the on-site implementation of CNRI's Infield Safety Procedures. This type of minor accidental event has been excluded from this assessment.

10.1. Regulatory Context

The consequences of potential oil or chemical releases from the proposed NNP decommissioning activities will be managed in accordance with current legislation and standards as detailed within Appendix A.

10.2. Hydrocarbon Releases – Assessment Methodology

There is a potential for certain NNP decommissioning activities to result in the accidental release of hydrocarbons, resulting in environmental impacts (Section 5). In order to assess these impacts, a consideration of the potentially significant impacts and the associated magnitude and risk has been made. In conjunction with an understanding of the sensitive receptors, it has been possible to assess the significance of these environmental impacts.

This sub-section examines the potential impacts of an accidental hydrocarbon release during the decommissioning of the NNP.

10.2.1. Sources of Potential Impacts

All offshore activities carry the potential risk of a hydrocarbon loss to the marine environment. During the period from 1975 to 2005, a total of 16,930 tonnes of oil was discharged from 5,225 individual spill events in the UKCS (UKOOA, 2006). Analysis of spill data between 1975 to 2005 shows that 46% of spill records related to crude oil, 18% to diesel and the remaining 36% to condensates, hydraulic oils, oily waters and other materials (UKOOA, 2006). During 2012 on the UKCS, a total of 248 oil spills were reported to DECC, of which 8% were greater than 455 litres (ACOPS, 2013).

The potential sources of hydrocarbon spillages from the NNP have been identified through a risk assessment (Section 5) and the knowledge and experience developed within CNRI and oil and gas industry operations in the North Sea. Based on this knowledge the following scenarios have been identified:

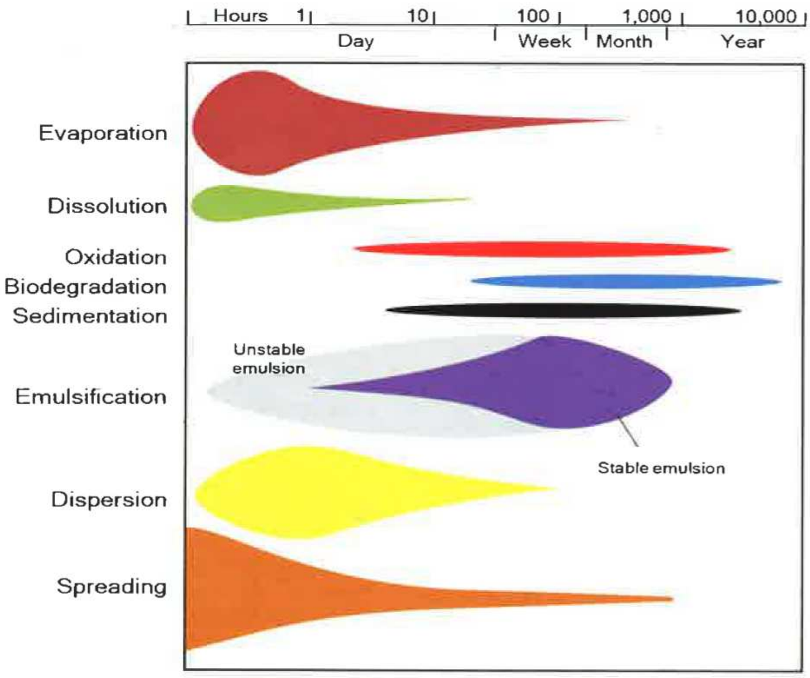
- Worst case sinking of a vessel due to collision, releasing diesel to the sea.
- Diesel spill from a vessel.
- Loss of fluids from subsea structures or topside.
- Accidental bunkering fuel (diesel or aviation) spillage during refuelling.

- Diesel tank remedial loss.

The assessment considered that the probability of a well blowout is low as wells will have undergone plug and abandonment. In addition, the topsides will have been engineered down and cleaned and are not expected to contain hydrocarbons. Pipelines will be cleaned and disconnected and therefore a subsea release is low probability. However, the potential impacts of a hydrocarbon spillage on sensitive receptors have been investigated in detail in the following sections, based upon using a worst case scenario which far exceeds the volume of potential loss during the proposed decommissioning programme.

Behaviour of oil at sea

When oil is released to the marine environment, it is subjected to a number of processes including: spreading, evaporation, dissolution, emulsification, natural dispersion, photo-oxidation, sedimentation and biodegradation (Figure 10.1; Table 10.1).



Source: ITOPF (2012)

Figure 10.1: Schematic representation of the fate of a typical Group 2 or 3 crude oil spill, showing changes in the relative improtance of weathering processes with time

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important early on in a spill whilst oxidation, sedimentation and biodegradation are more important in later stages. The behaviour of crude oil released at depth will depend on the immediate physical characteristics of the release, on subsequent plume dispersion processes and metocean conditions (DTI, 20001; ITOPF, 2012).

Table 10.1: Overview of the main weathering fates of oil at sea

Weathering process	Description
Evaporation	Lighter components of oil evaporate to the atmosphere.
Dispersion	Waves and turbulence at the sea surface can cause a slick to break up into fragments and droplets of varying sizes which become mixed into the upper levels of the water column.
Emulsification	Emulsification occurs as a result of physical mixing promoted by wave action. The emulsion formed is usually very viscous and more persistent than the original oil and formation of emulsions causes the volume of the slick to increase between three and four times and slows and delays the other processes which cause the oil to dissipate.
Dissolution	Some compounds in oil are water soluble and will dissolve into the surrounding water.
Oxidation	Oils react chemically with oxygen either breaking down into soluble products or forming persistent tars. This process is promoted by sunlight.
Sedimentation	Sinking is usually caused by the adhesion of sediment particles or organic matter to the oil. In contrast to offshore, shallow waters are often laden with suspended solids providing favourable conditions for sedimentation.
Biodegradation	Sea water contains a range of micro-organisms that can partially or completely breakdown the oil to water soluble compounds (and eventually to carbon dioxide and water).

Source: DTI (2001)

Properties of NNP hydrocarbons

The fate and effect of a spill is dependent on the chemical and physical properties of the hydrocarbons. Hydrocarbons used in or produced by the Ninian Northern field include diesel, aviation fuel and Ninian crude. The Ninian crude has a specific gravity of 0.843, and is classified as an ITOPF Group II oil. This indicates the oil will remain afloat on the sea surface in the event of a spill to sea. In addition, Group II or can lose up to 40% by volume through evaporation but because of their tendency to form viscous emulsions, there is an initial volume increase as well as curtailment of natural dispersion (ITOPF, 2012).

Diesel and aviation fuel have very high levels of volatile components, evaporating quickly on release. The low asphaltene content in these fuels prevents emulsification, reducing persistence of them in the marine environment. Diesel characteristics and subsequent behaviour when released means that it may not represent a significant threat to the environment when compared to a Ninian crude oil spill.

10.2.2. Impact Assessment and Oil Spill Modelling

An accidental hydrocarbon release can result in a complex and dynamic pattern of pollution distribution and impact in the marine environment. As there are a variety of natural and anthropogenic factors that could influence an accidental spill, each spill is unique. Long-term effects reported range from none detected (e.g., after the Ekofisk blowout in 1977) to chemical contamination but no acute biological effects detectable (e.g., after the wreck of the Braer in 1993) (DTI, 2001). The extent of an environmental impact of a spill depends on several factors including:

- Location and time of the spill.
- Spill volume.
- Hydrocarbon properties.
- Prevailing weather/ metocean conditions.
- Environmental sensitivities.

- Efficacy of the contingency plans.

Overview of modelling undertaken in the NNP Oil Pollution Emergency Plan (OPEP)

Oil spill modelling has been undertaken for the Ninian field, and included within the NNP Oil Pollution Emergency Plan (OPEP). Oil spill modelling was undertaken using the SINTEF Oil Spill Contingency and Response (OSCAR) model, following the most recent OPEP Guidance (DECC, 2015). Amongst the scenarios modelled, the worst-case scenario relevant to this ES is a well blowout of Ninian crude (loss of 109.16 m^3 per day for 137 days resulting in a total discharge of 19,454.9 m^3). However, at the time of decommissioning there will be no crude oil, and therefore it can be assumed that the modelling exceeds the volume of potential loss from NNP.

The modelling results for this discharge predicted that the spatial extent of surface contamination is relatively significant and spread from the north of Denmark until the Norwegian Sea. However, the spatial extent corresponding to a probability of surface contamination >50% is restricted to a smaller area around the release location. Due to the high persistence of the Ninian crude, it is expected that a high amount of oil might remain on the sea surface.

Oil spill modelling for a diesel spill has not been modelled under this OPEP, however, it is acceptable to assume that an accidental release of diesel might result in a loss of a relatively small volume (< 2,000 m^3). This may cause limited impact on the marine environment due to the diesel's characteristics, its high volatility and low persistence. It is estimated that the impact to marine biological resources would be localised and those impacted are likely to be subjected to toxic short-term non-persistent effects.

10.2.3. Impact on Sensitive Receptors

In order to determine the significance level of impacts resulting from an accidental hydrocarbon release, the magnitude of which has been previously quantified within this Section 10.2, there is a requirement to understand the sensitive receptors. The potential for short-term and long-term impacts are assessed for the major taxonomic groups relevant to the northern North Sea marine environment, to determine the potential scale of interaction within the vicinity of an accidental oil spill. Given the nature of this hypothesised event, potential socioeconomic and shoreline impacts are also considered.

Biological receptors

Although there is only a small likelihood of a hydrocarbon spill from the NNP, there is a potential risk to organisms in the immediate marine environment if a spill were to occur. Section 3 provides a more detailed description of the environmental sensitivities in NNP area. The following section highlights the biological receptors that may be impacted from a potential oil spill incident. Table 10.2 summarises the potential effects of oil spills to marine life during the NNP decommissioning operations.

Table 10.2: Summary of potential impacts to main biological receptors

Biological receptor	Effects and communities at risk
Plankton	Localised effects due to toxicity. Impacts on communities are unlikely due to natural variability, high turnover and seasonal fluctuation.
Benthos	The impact from the Ninian crude and diesel to benthic species or the seabed would be localised. The 2011 survey and seabed sampling indicate that the sediments of the Ninian Northern survey area comprised of Holocene sediments of fine sands. Generally, macrofauna in the Ninian Northern area were dominated by polychaetes (70.1% of taxa, and 72.4% of individual animals identified, respectively), followed by molluscs (20.9% of taxa and 24.7% of individuals) and echinoderms (4.7% of taxa and 0.7% of individuals) (Fugro ERT, 2011). Those benthic communities may be affected by gross contamination, with recovery taking several years. Mortality would be dependent on oil sensitivity potentially leading to structural change in the community. The subsurface release of Ninian crude or the surface release of diesel is unlikely to impact the benthic communities, therefore the risk is considered minimal.
Fish, spawning and nursery grounds	The NNP lies within spawning grounds for cod, Norway pout, haddock, saithe and sandeels and within nursery grounds for haddock, Norway pout, sandeel, whiting, anglerfish, European hake, herring, ling, mackerel, spurdog, and blue whiting (Ellis et al., 2010; Coull et al., 1998). Adult fish are expected to avoid the affected area, but if affected, hydrocarbons may result in tainting of the fish, and hence in a reduction of commercial value. Eggs and larvae may be affected, but such effects are generally not considered to be ecologically important because eggs and larvae are distributed over large sea areas. Demersal species may be influenced by habitat pollution.
Seabirds	The most sensitive times of year for birds in the NNP area (Block 3/3 and surrounding blocks) are January, March, July, September, October and November when vulnerability to oil pollution is "high" in some of the area. Vulnerability ranges from "moderate" to "low" for the remainder of the year. The overall seabird vulnerability to surface pollution in the NNP area is "low (JNCC, 1999). Physical fouling of feathers, damage to eyes and toxic effects of ingesting hydrocarbons can result in direct and indirect fatalities. Effects would depend on species present, their abundance, reliance on particular prey species and the time of year. Diving birds such as auks and gannets are particularly susceptible. Species most affected may be guillemots, razorbills and puffins that spend large periods of time on the water, particularly during the moulting season when they become flightless (DTI, 2001).
Marine mammals	The main marine mammal species occurring in the NNP area are minke whale, long-finned pilot whale, killer whale, white-beaked dolphin and harbour porpoise, with most sightings occurring in the summer months (Reid et al., 2003; UKDMAP, 1998). Potential effects may include inhalation of toxic vapours, eye/skin irritation and bioaccumulation. Ingestion of oil can damage the digestive system or affect liver and kidney function. Loss of insulation through fouling of the fur of young seals and otters increases the risk of hypothermia. Oil contamination can impact food resources directly through prey loss or indirectly through bioaccumulation. However, it is expected that marine mammals would avoid the area if a spill were to occur.
Protected habitats and species	There are no known Annex I habitats in the immediate vicinity (within a 50 km radius) of NNP (Table 3.15, Fugro ERT, 2011). Of the Annex II species, listed in Section 3 (Table 3.14) the harbour porpoise is the only species sighted within the NNP area. It was observed in very high numbers in February and July, in medium numbers in August and in low numbers in January, April, May, June, September and December (UKDMAP, 1998; see Section 3.3.5).

Both planktonic and benthic communities are less likely to be influenced by an accidental spill occurring on the sea surface (such as a diesel spill). However other communities including fish, birds and marine mammals may incur a greater impact from a surface spill. As previously stated, a hydrocarbon spill from the NNP is an unlikely event given the absence of crude in the facility at the time of decommissioning. Based on the considerations presented within this section, it can be considered that any impact will be of low significance.

Shoreline impact

The results of the oil spill modelling for the NNP OPEP predict that crude oil spills will reach either Scotland (including Orkney and Shetland Islands) or the Norwegian coastline. Sweden and Denmark coastlines might also be impacted by crude spill however the probability of beaching calculated by the modelling are relatively low (<5%). The modelling also revealed a maximum volume of beaching of 100 m^3 during the winter season after 167 days (CNRI, 2016e). The magnitude of this event in combination with the probability of occurrence therefore lends consideration to an event of low significance. Based on its low persistency in the marine environment and the distance of the NNP from shore, it is likely that any surface diesel spill will result in impact on shoreline of low significance.

Socioeconomic impact

A number of sectors may be influenced by a potential spill from the NNP. Table 10.3 describes the main socioeconomic receptors that could be affected by an accidental hydrocarbon release during the decommissioning operations.

Table 10.3: Summary of main socioeconomics receptors

Receptor	Risks and status at the NNP
Fisheries	Fishing is one of the primary economic activities in the EU and it supports other shore-based activities including fish processing and boat construction. The impacts to offshore fishing are limited for the period that oil remains on the surface as access to fishing grounds would be limited. There is the potential for fish that come into contact with oil to become tainted precluding sale. There is no UKCS evidence of any long-term effects of oil spills on offshore fisheries. The total number of days' effort in the NNP area (ICES rectangle 50F1) was highest in 2013 with 279 days and lowest in 2015 with 202 days. The fishing effort was dominated by the trawls, seine nets and surrounding nets (Scottish Government, 2016e). Mackerel and saithe dominated catch composition by weight of UK landings from UK and foreign vessels in the NNP area (ICES rectangle 50F1) for 2013 to 2015. Mackerel made up 24% to 57% of the catch in 50F1. Other species landed included cod, monkfish, haddock, ling, European hake, whiting, megrim and catfish (Scottish Government, 2016e).
Tourism	Coastal tourism can be adversely affected by oil pollution events owing to reduced amenity value. Impact can be further influenced by public perception and media coverage.
Shipping	The overall vessel traffic in the vicinity of the NNP is considered to be moderate (DECC, 2014). Shipping lanes are used by shuttle tankers, supply and standby vessels serving the offshore oil installations in the area. Although all of the above may potentially be impacted by an oil spill, the impacts will likely last only whilst there is oil on the sea surface, as this may restrict access. However, it is unlikely that there will be any long-term socioeconomic impacts on this industry.

10.2.4. Transboundary and Cumulative Impacts

There is a very low probability that a diesel spill would cross into international sectors. It is likely that even that a Tier 1 spill may cross the Norway/ UK median line. The probability of a Tier 2 or Tier 3 diesel spill is low and potential impact is considered to be insignificant.

However, the modelling predicts that Ninian crude spill will cross the Norwegian median line relatively quickly (after 15 hours in winter). The spill will also cross the Danish, German, Swedish and Faroese Water after 30 days, based on the oil spill modelling output.

In the event of an oil spill entering Norwegian waters, it may be necessary to implement the NORBRIT Agreement (the Norway-UK Joint Contingency Plan). The NORBRIT Agreement sets out command and control procedures for pollution incidents likely to affect both parties, as well as channels of communication and available resources. The Marine and Coastguard Agency (MCA) Counter Pollution and Response Branch also have agreements with equivalent organisations in other North Sea coastal states, under the Bonn Agreement 1983. Applicable international arrangements are further described in Appendix A.

Cumulative effects arising from the NNP decommissioning activities have the potential to act additively with those from other oil and gas activity, including both existing activities and new activities, or to act additively with those of other human activities (e.g., fishing and marine transport of crude oil and refined products) (DTI, 2004).

Any hydrocarbon discharge as a result of the decommissioning activity would be expected to disperse rapidly in the immediate environment without the potential to combine with other discharges from concurrent incidents. It is difficult to predict whether the impacts from an oil spill to the marine ecology of the affected area would be cumulative. This would depend on previous disturbances or releases at specific locations. Cumulative effects of overlapping "footprints" for detectable contamination or biological effects are considered to be unlikely. No significant synergistic effects are currently identified (DTI, 2004).

10.2.5. Mitigation Measures

Mitigation and management primarily focus on preventing or minimising the probability of an accidental spill and secondly, reducing the consequences of the event through optimum and efficient containment and release response. During decommissioning, minor non-routine and emergency events such as minor leaks, drips and spills from machinery and hoses on the platform, from vessels or at onshore sites, could cause a localised impact. The accidental release of small quantities of oil would be minimised as far as possible through appropriate management procedures and mitigation measures. The effects of such releases could be rectified quickly on site and they would be managed through vigilance, operational, inspection and emergency procedures, and specific safeguards such as on-site clean-up equipment and containment measures.

The response to all spills is detailed in the OPEP (CNRI, 2016e). Table 10.4 lists the planned measures to prevent or reduce the likelihood of a spill occurring during decommissioning of NNP. Based on the estimated volumes of diesel and crude, the CNRI response capability for both counter pollution and containment is capable of providing an appropriate level of response to a spill. The mitigation measures and contingency plans in place would consider all foreseeable spill risks and would ensure that the spill risk is reduced to as low as reasonably practicable.

Table 10.4: Planned mitigation measures for hydrocarbons releases

Potential source of impact	Planned mitigation measures
All oil spills	Hydrocarbon inventories will be minimised prior to removal and transport to disposal yard. In addition, the use of pipeline capping for instance, could be stated to avoid a release during the transportation. The OPEP has been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. The OPEP details responsibilities for initial response and longer term management, and will be updated as needed to reflect any change in operations and activities associated with decommissioning. There are three planned levels of response, depending on the size of the spill: • Tier 1 - standby vessel equipped with dispersants and spraying equipment; • Tier 2 - air surveillance and dispersant spraying through Oil Spill Response Ltd. (OSRL); and • Tier 3 - clean-up equipment and specialist staff available through OSRL. In addition, CNRI have specialist oil spill response services provided by OSRL and are members of the Oil Pollution Operator's Liability (OPOL) Fund.
Vessel collision	Local shipping traffic would be informed of proposed decommissioning activities and a standby/ support vessel would monitor shipping traffic at all times.
Spill from a vessel beyond the 500 m exclusion zone	In the event of an accidental spill to sea, vessels will implement their SOPEP.

10.2.6. Conclusions

The high-level risk assessment undertaken for the NNP decommissioning activities concluded that an accidental hydrocarbon release may result in impacts of a moderate significance (Section 5). Numerical modelling produced for the NNP production phase activities has enabled further assessment of identified potential impacts in accordance with CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314) (Tables 5.1 to 5.4). This in turn has enabled a consideration of the likely significance of these impacts upon relevant sensitive receptors.

The conclusions from the impact assessment for an accidental hydrocarbon release are that the:

- Worst-case scenario at NNP area would result from a well blowout of Ninian crude. However, at the time of decommissioning there is unlikely to be any crude present at the NNP.
- A diesel spill will disperse and dilute quickly and is therefore unlikely to impact coastlines.
- Crude spill will predominately impact Scotland and Norway, with a maximum beaching volume of 100 m^3 modelled under the worst-case scenario for NNP
- The probability of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area. Thus this potential event can be considered of **low** significance (based upon the likelihood of occurrence of effects being 'unlikely' (Table 5.1) and consequence of effects being 'moderate' (Table 5.2)).
- OPEPs response will provide the direction to effectively manage the spill in case of an accidental event.

10.3. Chemical Releases – Assessment Methodology

There is a potential for certain NNP decommissioning activities to result in an accidental chemical release, resulting in environmental impacts (Section 5). In order to assess these impacts, a consideration of the potentially significant impacts and the associated magnitude and risk has been made. In conjunction with an understanding of the sensitive receptors, it has been possible to assess the significance of these environmental impacts.

An accidental chemical release can result in a complex and dynamic pattern of pollution distribution and impact to the marine environment. The number of factors that could influence an accidental spill, both natural and anthropogenic, renders each spill unique. Potential sources of impact are presented in the following sections, and include a review of the sensitive receptors that may be influenced. In many cases, both impacts and receptors have been detailed in the hydrocarbon release section (Section 10.2). Where the chemical release impacts differ from those described in the hydrocarbon release section, they will be discussed in further detail.

10.3.1. Sources of Potential Impacts

There is a potential for certain NNP decommissioning activities to result in the accidental release of chemicals, resulting in environmental impacts (Section 5). In order to assess these impacts, a consideration of the potentially significant impacts and the associated magnitude and risk has been made. In conjunction with an understanding of the sensitive receptors, it has been possible to assess the significance of these environmental impacts.

Technical failure remains the leading cause of chemical spills in the North Sea. The primary sources of loss to the environment are from spills of hydraulic fluids or chemicals. The potential sources of chemical spillages from the decommissioning of NNP have been identified through the ENVID workshop and the knowledge and experience developed from CNRI and oil and gas industry operations in the North Sea (See Section 10.2.1). Based on this knowledge the scenario identified is the accidental loss of fluids from subsea or topside removal.

10.3.2. Impacts on Sensitive Receptors

In order to determine the significance level of impacts resulting from an accidental chemical release, there is a requirement to understand the sensitive receptors. Chemical release into the marine environment may impact sensitive receptors in different ways, depending on the following factors:

- Spill volume.
- Chemical toxicity.
- Chemical solubility.
- Persistence in the environment.
- Biodegradability of the compound.
- Potential for bioaccumulation in the food chain.
- Partitioning of individual components.

Biological receptors

Section 3 and Table 10.2 provide a comprehensive description of the biological receptors in the NNP area sensitive to potential chemical spills. Due to the rapid dispersion and dilution of chemicals upon discharge or release, few biological receptors are noticeably impacted. The most sensitive receptors are the planktonic communities. Plankton (phytoplankton, zooplankton and fish larvae) are likely to come into direct contact with discharged chemicals, with zooplankton appearing to be the most vulnerable particularly at the early stages of development. However, the impact of a chemical spill is not likely to impact beyond the immediate vicinity of the discharge point because:

- The likely credible maximum volume of chemicals that may be subject to a spill event would be very low.
- Discharge is likely to be dispersed and diluted rapidly by the receiving environment.
- Many of the compounds are volatile or soluble and are removed from the water by evaporation and dilution.
- Biological Oxygen Demand (BOD) is likely to be within the capacity of ambient oxygen levels.

The preceding discussion, combined with knowledge on the magnitude of this event in combination with the probability of occurrence therefore lends consideration to an event of low significance.

Socioeconomic receptors

The main socioeconomic receptors relevant to a hydrocarbon spill are presented in Table 10.3 and in most cases; this information is also pertinent to chemical spills. Dispersion, dilution and potentially very small volumes spilt will result in localised impact areas. No significant socioeconomic impacts are foreseen for fisheries, tourism, oil and gas, or shipping.

10.3.3. Transboundary and Cumulative Impacts

The majority of chemical spills are unlikely to result in an environmental impact due to a combination of rapid dispersion and dilution of the chemicals and the depth and distance from shore (>100 km) of the NNP. The potentially spilt volumes are unlikely to pose any noticeable risk to residual, cumulative or transboundary impacts.

10.3.4. Mitigation Measures

The impacts of all the chemicals that may be used or discharged offshore during decommissioning will be assessed and reported to BEIS in a relevant Portal Environmental Tracking System (PETS) application.

The proposed mitigation measures to reduce the likelihood of chemical spills to the environment are presented in Table 10.5.

Table 10.5: Planned mitigation measures for chemical releases

Potential source of impact	Planned mitigation measures
Chemical spills from NNP decommissioning activities	• CNRI will conduct all operations in a controlled manor with trained personnel using suitable equipment. All vessels will have suitable skill kits and an efficient spill response process is in place. • CNRI routinely swap out perishable equipment such as hoses, and is implemented by a management programme in order to ensure their integrity. • Prior to transfer, visual checks are undertaken by trained personnel in communication with the standby vessel. • Observed leaks are reported and dealt with immediately by competent personnel and reported to the appropriate authorities.

10.3.5. Conclusions

The high-level risk assessment undertaken for the NNP decommissioning activities concluded that an accidental chemical release may result in impacts of a moderate significance (Section 5). A more detailed consideration of the magnitude and probability of occurrence has enabled further assessment of identified potential impacts in accordance with CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314) (Tables 5.1 to 5.4). This in turn has enabled a consideration of the likely significance of these impacts upon relevant sensitive receptors.

The impact assessment for an accidental chemical release has concluded that the:

- Chemical spills will disperse and dilute quickly, with only localised effects to planktonic communities.
- Probability of a chemical spill occurring is low and will not significantly add to the overall spill risk in the area. Thus this potential event can be considered of **low** significance (based upon the likelihood of occurrence of effects being 'very unlikely' (Table 5.1) and consequence of effect being 'slight' (Table 5.2)).

10.4. Dropped Objects – Assessment Methodology

There is a potential for certain NNP decommissioning activities to result in the loss of objects, resulting in environmental impacts (Section 5). In order to assess these impacts, a consideration of the potentially significant impacts and the associated magnitude and risk has been made. In conjunction with an understanding of the sensitive receptors, it has been possible to assess the significance of these environmental impacts. Depending on its size a dropped object may present a hazard to shipping and subsea infrastructure, and to fishing activities such as trawling. Dropped objects may also impact on the seabed community within the drop zone. Dropped objects can vary in size from tools to large sections of topsides infrastructure or the loss of a vessel.

Acoustic and ROV surveys of seabed, drill cuttings pile, pipelines and infrastructure were conducted (ISS, 2011). A debris map of the 500 m area was produced and any possible targets such as seabed features identified (ISS, 2011).

10.4.1. Sources of Potential Impact

The likely worst case scenario which imposes the greatest environmental and socioeconomic impact for a dropped object would be the loss of a large section of jacket or the topside from the removal phases of the project. As a result of an accident, in extreme circumstances, a section of the upper jacket or the topside could fall to the seabed during the latter stages of the cutting operations, or whilst being transferred to a vessel.

This type of event may cause localised effects in the water column, on the seabed or to the benthos. The extent and severity of these effects would depend on the object lost and the amount of seabed and sediment disturbed.

10.4.2. Impacts on Sensitive Receptors

In order to determine the significance level of impacts resulting from a dropped object, there is a requirement to understand the sensitive receptors. Potential impacts on biological and socioeconomic receptors from of an accidental dropped object are described in the following paragraphs.

Biological receptors

In the event of a dropped object, the dominant receptors are the infaunal and epibenthic communities within the drop zone. A comprehensive survey has provided a detailed description of the resident benthic community below NNP (Fugro ERT, 2011). Whilst the impact of a dropped object on the immediate drop zone may be significant, the effect would be localised. The benthic community beyond 500 m from NNP is indicative of and comparable in diversity and composition with surrounding areas of the North Sea (as detailed in Section 3). Therefore, the impact of a dropped object would have no significant impact on the wider community. No other biological receptors would be impacted by a dropped object.

Socioeconomic receptors

The lifting of the jacket on to the HLV would require passing the jacket above adjacent pipelines, however these would be cleaned and disconnected, and therefore of limited risk to the marine environment.

Any dropped objects will be recovered during decommissioning operations and an independent seabed clearance survey will be conducted once decommissioning operations have been completed to verify that a clean seabed has been left (excluding infrastructure that is expected to remain in place e.g. jacket footings). Due to the presence of the pipelines that will be subject to a further decommissioning programme, an overtrawlability survey will be conducted once the Ninian field has been decommissioned.

No impacts relating to other socioeconomic receptors have been identified from dropped objects.

10.4.3. Transboundary and Cumulative Impacts

In case of a potential loss of objects during the decommissioning process, the impacts will be temporary and will only cause disturbance to a very localised area of seabed and the associated water column. They will not have any residual effects and will not contribute to cumulative or transboundary impacts.

10.4.4. Mitigation Measures

Appropriate mitigation measures in the event of a dropped object should be implemented during the proposed NNP decommissioning operations (Table 10.6).

Table 10.6: Planned mitigation measures for dropped objects

Potential source of impact	Planned mitigation measures
Dropped object event from NNP decommissioning activities	• Where practicable all efforts will be made by CNRI to minimise the number of dropped objects. During the cleaning and preparation for removals programme, items will be secured to prevent loss wherever practicable. • Post-decommissioning surveys will be undertaken to assess the presence and potential recoverability of any lost objects from NNP wherever practicable. The recovery of such debris will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea wherever possible.

10.4.5. Conclusions

The high-level risk assessment undertaken for the NNP decommissioning activities concluded that dropped objects may result in impacts of a moderate significance (Section 5). Further assessment of the identified activity (magnitude and occurrence of event) and the potential impacts was undertaken in accordance with the CNRI Management of Aspects and Impacts Procedure (SHE-PRO-314) (Tables 5.1 to 5.4). This in turn has enabled a consideration of the likely significance of these impacts upon relevant sensitive receptors.

In summary, it is considered that this event has a **low** significance, based upon the likelihood of occurrence of effects being 'very unlikely' (Table 5.1) and consequence of effects being 'moderate' (Table 5.2), and the following conclusions:

- Worst case scenario would be the loss of a major portion of the jacket or the topside during lifting operations.
- Depending on the size of the item, dropped objects may present a hazard to shipping and subsea infrastructure and fishing activities such as trawling.
- Post decommissioning surveys will provide locations of dropped objects and assist in their removal where practicable.

11. WASTE

The activities involved in the decommissioning of the NNP will generate quantities of controlled waste, defined in Section 75(4) of the Environmental Protection Act 1990 as 'household, industrial and commercial waste or any such waste'. For example, some activities will involve the manual removal of all accommodation infrastructure and chemicals stored within the offshore structure, whereas other activities will involve the individual lift of major components onto a barge for subsequent dismantling within controlled conditions onshore at dedicated facilities. The sequence and quantities of controlled waste generated at any one time will depend on the processes used for dismantling, such as offshore deconstruction, reverse installation or heavy lift and single lift, and the subsequent treatment and disposal methods.

Three key challenges associated with waste management for the NNP are:

- The generation of large quantities of controlled waste within short timeframes which requires detailed planning to manage the logistics associated with the transport to shore, temporary storage and onward treatment/ disposal of materials.
- The potential for large quantities of so-called "problematic" materials to be generated due to the cross–contamination of non-hazardous waste with substances that have hazardous properties that result in the material being classified as special waste. Special waste is defined as material that has one, or more, properties that are described in the Hazardous Waste Directive (91/689/EEC) as amended by Council Directive 94/31/EC. Outside of Scotland such material is referred to as hazardous waste.
- The problems associated with materials with unknown properties at the point of generation. These quantities of "unidentified waste" require careful storage and laboratory analysis to determine whether they are special waste or non-hazardous waste.

In accordance with the Petroleum Act 1998 Guidance Notes (DECC, 2011) which affirms that the disposal of such installations should be governed by the precautionary principle, CNRI will assume the worst case, especially when dealing with hazardous and unidentified wastes, and choose waste treatment options in accordance with the Waste Management Strategy (Section 11.9).

11.1. Waste Generation

Typical non-hazardous waste will include scrap metals, concrete, plastics and wood that are not cross-contaminated with special waste and can therefore be removed and recovered for reuse or recycling. Special waste will include Waste Electrical and Electronic Equipment (WEEE), oil contaminated materials, asbestos, batteries and chemicals. Many types of special waste identified during decommissioning are routinely generated during production and maintenance of offshore installations. However, the decommissioning process may generate significantly greater quantities of both non-hazardous waste and special waste when compared to routine operations and as such requires careful management.

The likely types and quantities of materials associated with NNP are provided within Section 2:

- Topsides decommissioning (Table 2.2).
- Jacket decommissioning (Table 2.3).

- Materials associated with well decommissioning (Table 2.4).

11.1.1. Radioactive Waste

Radioactive wastes including sources (level control sources on vessels) and NORM (for example from pipework and sand from vessels) will be managed in line with current legislative requirements (Appendix A). The Radioactive Substances Act 1993 Amendment (Scotland) Regulations 2011 regulates the handling, storage, transfer and disposal of such waste. CNRI has an existing procedure in place for managing radioactive waste and the local rules for working with radioactive materials will be revised to include the removal and transportation of radioactive materials during decommissioning in consultation with the Scottish Environment Protection Agency (SEPA).

11.1.2. Wastes Generated during Engineering-Down and Cleaning

Post CoP, cleaning of the NNP topsides will be required during the EDC phase to remove hydrocarbons, NORM, process chemicals, sand scale, sludge and other contaminants from within process systems prior to the module separation activities. While the base case scope for this cleaning is for no deep cleaning activities to be undertaken offshore, the removal of sludge and sand from vessel internals will be required to reduce the possibility of a significant recharge of the process systems with residual hydrocarbons.

During the EDC phase, the NNP topsides' process and utilities system vessels and pipework will be drained, flushed, purged and vented. These initial cleaning activities will remove gross hydrocarbons liquids, chemicals, gases and other hazardous inventories from the system. Where necessary, bulk loose deposits (sand, sludge, etc.) will be removed from major vessels.

The disposal route proposed for effluent arising from the drain down and flushing of hydrocarbon systems is via the closed drains system to the oil surge tanks. The disposal of these fluids from the oil surge tanks will be subject to detailed design and engineering and managed in accordance with appropriate legislation. In addition, these fluids will be handled in line with the Waste Management Strategy (Section 11.9.).

After this initial flushing, draining, purging and venting phase, residual hydrocarbons and contaminants will remain in situ until removal at a fully-permitted onshore disposal facility. The residual contaminants will not be free fluids and will be fully contained to prevent any leaks during transit.

11.1.3. Disposal of Marine Growth

Subsea inspection and marine growth surveys of the NNP were carried out in 2003 and 2011 by CNRI. An assessment of marine growth concluded that the NNP jacket supports an extensive cover of marine growth, including the presence of *L. pertusa* (Section 3; BMT Cordah, 2016c). This marine growth could be removed offshore and disposed at sea or onshore and composted, used as a fertilizer and/ or sent to a landfill.

Prior to jacket removal, a study assessing the options for managing marine growth removal offshore and its disposal onshore will be undertaken with the following objectives:

- To characterise and compare the key attributes of onshore/ offshore removal options on the basis of environmental and technical criteria.

- To assess the risk of introducing alien invasive species to coastal areas.
- To investigate potential odour issues at decommissioning yards and identify measures to avoid or mitigate if required.

CNRI have undertaken consultation with JNCC regarding the presence of *L. pertusa* on the legs of the NNP (Section 4). JNCC advised, that under the Habitats Directive, it is clear that the habitats listed for protection should be natural, and therefore the marine growth on the infrastructure does not need to be considered by itself under the Habitats Directive. JNCC, did however, consider it important that CNRI assesses whether decommissioning the NNP will impact any other, natural *L. pertusa* communities in the surrounding area. It is found that mortality as a result of decommissioning operations would not be considered as an issue of significant concern for the ES.

11.2. Regulatory Context and Corporate Standards

There is no waste related legislation that specifically covers decommissioning activities, but some aspects of existing waste legislation are relevant (Appendix A). Whether a material or substance is 'waste' is determined by EU law. The EU Waste Framework Directive (WFD) (2006/12/EC) defines 'directive waste' as "any substance or object in the categories set out in Annex 1 of the Directive which the holder discards or intends or is required to discard". Annex 1 provides a list of definitions and includes a general category – "Any materials, substances or products which are not contained in the above categories".

It is the responsibility of the producer or duty holder to decide whether a substance or object is waste. The action of removal and transfer of redundant installations and infrastructures during decommissioning to shore falls within the legal definition of waste; and the responsibility for determining whether a substance or object is waste lies with the Operator. Having determined the substance or object is waste, subsequent storage, handling, transfer and treatment of the waste generated is then governs by a number of regulations. CNRI have prepared a Permits, Licenses, Authorisations, Notifications and Consents (PLANC) register of legislation for decommissioning, including relevant waste legislation.

CNRI's Safety, Health and Environmental Management System (SHEMS) provides a means to comply with SHE legislation and industry standards, manage SHE risks in the business and deliver continual improvement in SHE performance. CNRI recognise that the waste management activities arising from decommissioning will have associated SHE risks and will therefore ensure that the identification, control and minimisation of these risks is addressed as part of the Company's SHE risk management process, for example through the CA and HAZID processes.

11.3. Waste Management

The Petroleum Act 1998 Guidance Notes (DECC, 2011) require that the decommissioning decisions are consistent with the waste hierarchy and the Decision recognises that, in line with the waste hierarchy, the reuse of an installation is first in the order of preferred decommissioning options. Demonstration of how CNRI intends to implement the waste hierarchy is included in the NNP DP.

An extensive review of the operational equipment and components by CNRI, has identified 12 items that could possibly be reused for NCP or NSP (WGPSN, 2011). Furthermore, CNRI have identified 269 items that can be sold for reuse wherever possible, directly, through platform broker, or decommissioning contractor.

Non-hazardous materials, such as scrap metal, concrete, plastics and wood not contaminated with hazardous (special) waste, shall be removed and recovered for reuse or recycling. Steel and other scrap metal are estimated to account for the greatest proportion of materials inventory from the NNP topsides, jacket and well abandonment. Recycling is therefore expected to be the most significant endpoint for materials recovered from the NNP (Table 11.1).

Table 11.1: Predicted fate of NNP waste

Facility	Recommended decommissioning option	Total weight of waste by type (tonnes)	% of waste produced**	Destination
Wells	P&A and conductor recovery	Metals – 3,670	~94%	• Recondition and reuse
		Non-hazardous – 216		
Topsides	Full Removal (single lift or reverse installation)	Metals – 11,124	~89%	• Recycling • Reused • Incinerated • Landfill • Treatment for NORM
		Plastics – 649		
		Wood – 5		
		Non-hazardous – 220		
		Hazardous (special) – 454		
Jacket	Partial removal (multiple lifts)	Metal – 13,998	~80%	• Recycling • Landfill
		Non-hazardous – 1,563		
		Marine growth – 2,117		

*Based on the values provided within Section 2, which identifies negligible quantities for other materials.
**The percentages do not include the footings
Source: CNRI (2016a)

Where necessary, hazardous waste resulting from the dismantling of the NNP shall be pre-treated to reduce its hazardous properties or, in some cases, render it non-hazardous prior to recycling or landfilling. Under the Landfill Directive, pre-treatment will be necessary for most hazardous wastes which are destined to be disposed of to landfill sites. Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site.

11.3.1. Waste Management Strategy

CNRI has prepared a Waste Management Strategy (WMS) outlining aims and objectives with respect to the management of waste generated from decommissioning the NNP. The WMS also outlines the international and national regulatory framework and explains how CNRI's future decommissioning activities will comply with these legal requirements and meet other company policy obligations (BMT Cordah, 2016f).

11.3.2. Environmental Management System

The management of waste generated from operations and drilling activities is already addressed by CNRI through an ISO14001 certified Environmental Management System (EMS) (Section 12). The EMS includes a documented procedure for waste management which is designed to ensure that all waste generated during CNRI's offshore production and drilling operations are managed according to the Company's SHE policy and relevant legislation.

Specifications to manage the waste generated during decommissioning will conform to the requirements of CNRI's EMS. In order to achieve this, it will be necessary to:

- Undertake a review of the EMS and update it to ensure that significant environmental impacts and legislative requirements as a result of waste generation and treatment during decommissioning are adequately recorded and assessed, and any requirements for operational controls or other management actions are identified.
- Prepare a waste management plan for individual decommissioning projects/ phases.

11.3.3. NNP Specific Waste Management Plan

A NNP specific waste management plan (NNPWMP) will be developed to translate the WMS into individual project plans with defined actions, roles and responsibilities. The scope of the NNPWMP will cover the decommissioning programme for the selected removal options and disposal routes.

The aims of the NNPWMP will be to provide a comprehensive source of information on waste management for the NNP decommissioning project, to provide information and data to illustrate management system control and an auditable trail for legislative compliance.

The NNPWMP will be a written plan and be maintained as a controlled document. It will include and reference other project documents, plans and procedures, such as project risk management plans and change control procedures. The onshore decommissioning yards where the NNP will be dismantled for recycling and disposal, has not been identified, and will be determined during the platform removal contracting process.

11.3.4. Contractor Management

Waste management activities include: handling, storage and treatment of waste offshore; transfer of waste to a waste treatment or dismantling yard for further storage; handling and treatment as appropriate; and then further transfer to the final disposal or treatment point. Contractors and sub-contractors on behalf of CNRI will conduct many of these activities. Although CNRI will not be undertaking the actual physical work, the legal liability, i.e. Duty of Care, for all waste generated from decommissioning remains with CNRI throughout all these activities.

The selection and management of contractors by CNRI is managed through the contractor control processes and procedures. Specific actions to support the management and minimisation of waste generated by contactors during decommissioning will include:

- Ensuring that waste management issues are included during the contract procurement process, for example, consideration of contractor’s past SHE performance during the procurement process.
- Ensuring that waste management issues are covered within the contractor interface documents, for example, SHE performance measurement including waste key performance indicators (KPIs) and competency training.
- Engaging with contractors to identify effective technical solutions that support waste minimisation with the reuse and recycling of waste, where possible.

The procedures and processes for waste and contractor management will be embedded in the EMS with the NNPWMP detailing actions, roles and responsibilities of personnel from within CNRI and the various contractors working on an individual decommissioning project.

11.3.5. Measuring and Monitoring Performance

Measuring and monitoring performance is an important element of an EMS and CNRI have a number of mechanisms in place to do this. With respect to the management and minimisation of waste during decommissioning the key areas for action are as follows:

- Monitoring legislative compliance.
- Measuring performance in achieving waste minimisation.

A number of methods will be used to ensure effective monitoring of waste management activities including, for example, auditing of contractors and disposal sites.

11.4. Conclusions

In summary, with the identified mitigation measures in place, the overall significance of the impact of waste from the project is considered to be **low**. This is based upon the likelihood of occurrence of effects being ‘possible’ (Table 5.1) and consequence of effects being ‘slight’ (Table 5.2) as there may be a small increase in waste going to landfill.

12. ENVIRONMENTAL MANAGEMENT

CNRI corporate policies details the means by which CNRI will manage the environmental aspects of the NNP decommissioning. This section catalogues the commitments made in support of the decommissioning proposals and provides a delivery mechanism for these commitments.

12.1. CNRI Policies

CNRI takes all reasonable precautions to achieve the goal of harm-free operations. The Environmental Protection Policy (Figure 12.1) and Health and Safety Policy (Figure 12.2) are CNRI's public commitments to conducting business in a manner that protects the health and safety of people and preserves the integrity of the environment within which we operate.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Canadian Natural

CORPORATE STATEMENT ON ENVIRONMENTAL PROTECTION

Environmental protection is a fundamental value of Canadian Natural Resources Limited (Canadian Natural). The Corporation recognizes that every employee and contractor has a vital role to play in identifying, minimizing and mitigating environmental impacts from our operations. Canadian Natural's commitment to environmental management will be incorporated into business activities through the following guiding principles:

- Ensure all employees and others engaged on Canadian Natural's behalf are aware of the commitment to minimizing and managing environmental impacts resulting from Canadian Natural's operations;
- Provide strong leadership to the identification, assessment and management of environmental risks at all levels of the organization and promote a participative culture;
- Proactively identify, evaluate, minimize and mitigate the environmental impacts of Canadian Naturals' business throughout all aspects of our operations;
- Identify significant changes affecting environmental management systems, respond appropriately to issues and concerns and provide a mechanism for feedback;
- Ensure appropriate processes are developed and implemented to prevent pollution, including waste and emission management programs;
- Ensure that effective emergency response measures are in place and provide prompt and effective response to any emergency situation;
- Investigate environmental incidents effectively to prevent recurrence and communicate and implement lessons learned across all parts of the organization, including those from the experiences of others;
- Communicate with the public regarding Canadian Natural activities;
- Ensure that Canadian Natural operations comply with government regulations, industry guidelines and company policies and procedures concerning environmental management; and
- Use energy and other resources efficiently at Canadian Natural operations.

Canadian Natural's management will be responsible for developing specific operational procedures and standards that are consistent with this policy and are accountable for the maintenance, regular review and interpretation of this policy. Canadian Natural expects its suppliers, partners and business associates to have compatible environmental procedures and values.

Canadian Natural's management is committed to achieving continual improvement in environmental performance through annual environmental objectives and targets. Performance is reviewed and corporate status reports are presented regularly to management and the Board of Directors.

Steve Laut
President

Tim McKay
Chief Operating Officer

Next Review Date: June 16, 2017

Figure 12.1: CNRI Environmental Protection Policy Statement

CNQ-OVR-POL-LM-000001_r1

Canadian Natural

CORPORATE STATEMENT ON HEALTH & SAFETY

Canadian Natural Resources Limited (Canadian Natural) is committed to conducting its operations in a manner that will protect the Health and Safety of their employees, contractors and the public. By integrating Health and Safety into all aspects of Canadian Natural operations with the goal of "No Harm to People – No Safety Incidents" in the workplace, Canadian Natural will:

- Provide the right resources to execute the requirements of the Safety Management System in line with our Health and Safety statement;
- Comply with government regulations, industry guidelines, best management practices and company policies and procedures in the planning, design and operation of Canadian Natural wells, facilities and equipment;
- Provide strong leadership to the identification, assessment and management of Health and Safety risks at all levels of the organization and promote a participative culture;
- Proactively identify significant changes affecting health and safety systems, respond appropriately to issues and concerns and provide a mechanism for feedback;
- Provide appropriate training and equipment to Canadian Natural employees, enhancing their ability to recognize hazards and minimize risk during company operations;
- Require contractors working for Canadian Natural to be adequately supervised, trained and competent in the duties they perform;
- Ensure that effective emergency response measures are in place and provide prompt and effective response to any emergency situation; and
- Investigate health and safety incidents and near misses effectively to prevent recurrence, and ensure lessons learned, including those from the experiences of others, are effectively communicated and implemented across all parts of the organization.

Managers and supervisors are responsible for identifying safety needs, communicating safety hazards, investigating hazardous conditions and accidents, providing training, and ensuring equipment is properly maintained. They are responsible to respond to safety concerns raised by employees, contractors and the public.

Employees share the responsibility to work in a manner that will safeguard themselves with equal concern for co-workers, contractors and the public. They are responsible to identify and mitigate hazards, refuse and report work that is unsafe.

Canadian Natural's management is committed to achieving Safety Excellence through continuous improvement. Annual safety performance objectives and targets are tracked and corporate status reports will be presented regularly to the management and Board of Directors.

Steve Laut
President

Tim McKay
Chief Operating Officer

Delivering Safety Excellence
Canadian Natural
Doing it Right!

Next Review Date: June 16, 2017

Figure 12.2: CNRI Health and Safety Policy Statement

12.2. The CNRI Management System

CNRI's Safety, Health and Environmental Management System (SHEMS) is the means by which CNRI will:

- Comply with SHE legislation and industry standards.
- Manage SHE risks in the business.
- Deliver continuous improvement in SHE performance.

The scope of the CNRI SHEMS is offshore oil and gas exploration, development and decommissioning activities and associated onshore support. The system structure conforms to the broad principles of the Health and Safety Executive (HSE) publication Successful Health and Safety Management HS(G)65 and meets the requirements of general and offshore installation-related regulations.

In the North Sea, all of CNRI's directly managed platforms (Ninian Central, Ninian Northern, Ninian Southern and Tiffany) are certified to ISO 14001:2004. The SHEMS implemented on CNRI's offshore installations and within the onshore support organisation can be represented as a pyramid (Figure 12.3). The CNRI SHEMS will be updated to encompass decommissioning activities, with the PLANC register and WMS for decommissioning forming part of the EMS.

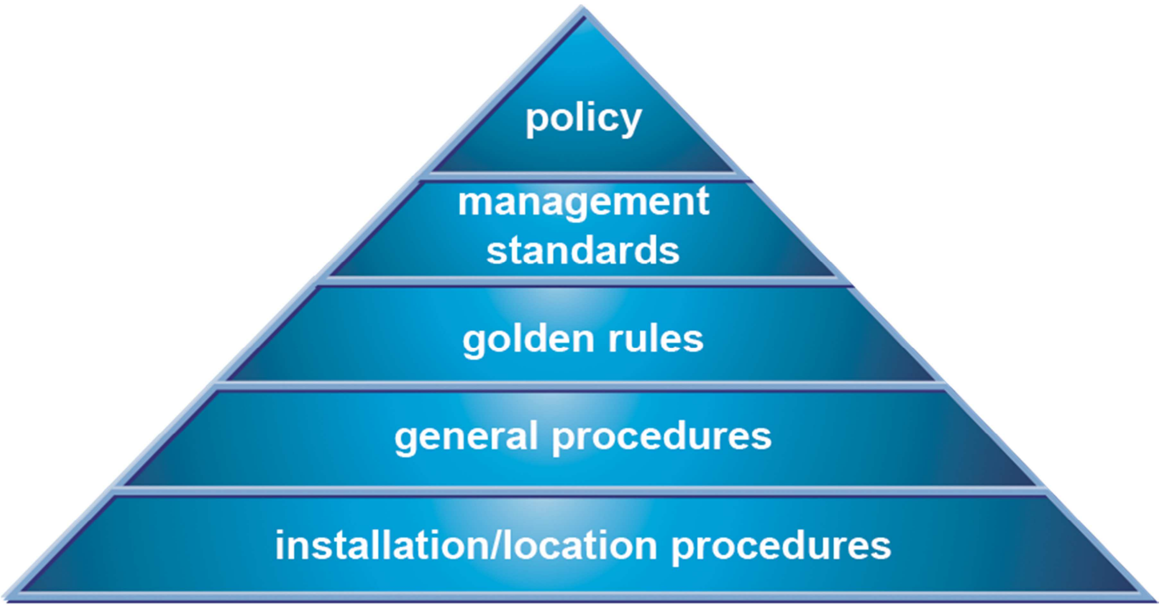

Figure 12.3: The CNRI SHEMS

12.3. CNRI Management Standards

CNRI has ten Management Standards directly supporting the Environmental Protection and Health and Safety Policies. These describe expectations and requirements for performance in relation to key aspects of SHE management. The Management Standards allow for some flexibility in terms of SHEMS implementation, to permit different parts of the company to meet these expectations in different ways, depending on particular legal and other business drivers.

The ten Management Standards are:

1. Leadership and Commitment.
2. Performance Management.
3. Managing SHE Risks.
4. Competence and Personal Development.
5. Communication and Involvement.
6. Working with Third Parties.
7. Change Management.
8. Information and Documentation.
9. Emergency Preparedness.
10. Incident Reporting, Investigation and Analysis.

12.4. CNRI General and Installation-Specific Procedures

CNRI General Procedures support specific Management Standards and, where documented procedures are needed, they describe the arrangements in place to meet the appropriate standard, for example incident reporting or oil spill response. These procedures are intended to provide consistency across the organisation; they are applicable to any operation and are generally not specific to any one location or installation.

Installation- and location-specific procedures are particular to an operation or activity. They define the arrangements that CNRI have determined are needed to conform to General Procedures and thus meet the spirit and intent of the Management Standards.

12.5. Register of Commitments

A Register of Commitments has been developed to address each aspect of the NNP Decommissioning Project (Table 12.1) and provides a summary of key management and mitigation measures identified during the EIA process.

This register will form part of the Decommissioning Environmental Management Plan (Section 12.6) and will be integrated into the relevant project phases. Mitigation measures identified and commitments made will also be embedded into the following documents to ensure appropriate execution and management:

- Detailed engineering specifications.
- Contracts.
- Execution plans.

Table 12.1: Register of Commitments

Issue	Commitment	Project Phase	
		Design	Execution
Environmental responsibilities	Key environmental responsibilities, duties, communication, reporting and interface management arrangements of CNRI and the main contractors involved in the decommissioning activities will be agreed, documented and communicated at the appropriate stages of the project.	✓	✓
EMS	The contractors will have in place EMSs that align with the CNRI EMS.	✓	✓
	Vessels will be subject to audits as part of CNRI selection and pre-mobilisation and management system requirements.	✓	✓
Delivery of commitments	The commitments made within this ES will be incorporated into operational work programmes, plans and procedures. Programmes will be tracked to ensure that commitments and mitigation measures are implemented throughout the project.	✓	✓
Atmospheric emissions	Vessels will be audited as part of selection and pre-mobilisation.		✓
	Vessels will use ultra-low sulphur fuel in line with MARPOL requirements.		✓
	Work programmes will be planned to optimise vessel time in the field.	✓	✓
	Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems.	✓	✓
	All mitigation measures will be incorporated into contractual documents of subcontractors.	✓	
Underwater noise	During decommissioning operations, regular observations for marine mammals in the area will be made and the cetacean observation logs made available to JNCC.		✓
	Offshore vessels will avoid concentrations of marine mammals and maintain a steady course and speed when possible.		✓
	The operation of well-maintained equipment during the decommissioning activities will ensure that the noise of operating machinery is kept as low as possible during the decommissioning operations.		✓
	The number of vessels travelling to, or standing by, NNP will be kept to the minimum.		✓
Seabed disturbance	Cutting and lifting operations of subsea equipment will be controlled and any impact on seabed sediment will be minimised.		✓
	Drill cutting pile disturbance will be minimised.		
	Post-installation surveys of the seabed will be carried out to identify significant anomalies and dropped objects.		✓
Socioeconomic	Other sea users will be alerted to the decommissioning activities by consultation.	✓	
	Kingfisher alerts, notices to mariners, use of guard vessels, and fisheries liaison officers will be issued, where appropriate.		✓
	The number of vessels travelling to, or standing by, NNP will be kept to the minimum.		✓
Waste	Waste management plan will be developed	✓	✓
	Regular internal and third party audits will be carried out to assess the effectiveness of and conformity to, waste management procedures.		✓
	Staff will undergo appropriate training and will be notified of the separation and disposal requirements for each category of waste.		✓
Dropped objects	All efforts will be made to minimise dropped objects lost overboard.		✓

Issue	Commitment	Project Phase	
		Design	Execution
	Surveys will be undertaken to assess the presence and potential recoverability of any lost objects from the NNP wherever practicable.		✓
	Where possible, dropped objects will be recovered. Should dropped objects remain on the seabed, H.M Coastguard will be informed immediately of any potential hazard to shipping, and a navigation warning issued.		✓

12.6. Decommissioning Environmental Management Plan

The Decommissioning Environmental Management Plan (DEMP) summarises the mitigation measures and commitments made within this ES and translates these into specific actions with identified owners. An example DEMP issue is illustrated within Table 12.2 and this will be developed as the project evolves including, for example, to accommodate terms and conditions specified in project approval or stakeholder concerns.

12.6.1. Roles and Responsibilities

The roles and responsibilities of CNRI, contractors and subcontractors will be clearly identified and the interrelationship between these entities defined. The organisational chart for the current project phase is focussed on the roles required to manage the planning phase including the Decommissioning Programme and the EIA process. As contracts are awarded over the next two years, the organogram will evolve to incorporate the different project phases, for example, EDC, Removals Contract, etc., which will be managed accordingly.

12.6.2. Contractor Interface

Contractor interface documents will be developed to manage environmental commitments during decommissioning. The interface document will detail the management organisation, the communication and reporting lines and the division of responsibilities during operational and emergency situations.

12.7. Staff Training and Awareness

Training and competency is managed through individual contracts and CNRI stipulating minimum standards of training and competency that are required for personnel to undertake work on CNRI's behalf. These comprise both industry-standard training/awareness and technical Standards which are usually to OPITO level. Compliance with this is demonstrated at quarterly performance reviews. Contractors are also independently audited regularly with training and competency forming a key part of these audits. In addition, contractors working offshore have a platform-specific induction which includes specific Health, Safety and Environmental content.

12.8. Environmental Monitoring

Decommissioning operations will be conducted under the relevant licences and permits applied for by CNRI. Monitoring and reporting to the regulator and internally will be conducted in accordance with relevant legislation and these licences. For example, discharges to sea from chemicals and residual hydrocarbons will be permitted appropriately and any accidental discharges to sea will be reported and investigated through CNRI's incident investigation process.

CNRI have arrangements in place for monitoring SHE performance and compliance with legislation, company policy, standards and procedures. Two approaches to monitoring are applied: active (providing feedback on performance) and reactive (providing information on incidents, accidents and near misses). Appropriate performance measures will be established for monitoring progress against achievement of defined goals and targets and appropriate arrangements shall be in place to ensure the effective collation and reporting of this performance data.

12.9. Performance Monitoring (Inspection, Audit and Corrective Actions)

Monitoring will be performed by internal and external parties. The scope and frequency of internal monitoring depends on an assessment of risks performed by line managers, process owners and corporate staff functions. Internal monitoring consists of three main categories: follow-up, verification, and internal audit.

Auditing associated with decommissioning will be identified and scheduled prior to and during ongoing decommissioning operations in the CNRI SHEMS Audit Programme.

Table 12.2: Example of a typical DEMP issue

Issue	Source of impact	Mitigation	Action	Responsibility	Timing	Verification
Odour generation from decay of organic matter	Onshore cleaning of marine growth from jacket, conductors using high pressure jet cleaners	• Use of chemicals to neutralise odour • Ensure that cleaning is undertaken in as short a time as possible	• Audit of disposal yards to assess options • Ensure that contractor scope of work addresses specific environmental issues	Safety, Health and Environmental Advisor	Before contract award and throughout decommissioning	• Audit of disposal yards during decommissioning • Regular interface communication and meetings with contractor • Performance reports to be provided by contractor

13. CONCLUSIONS

An EIA is an important management tool used by CNRI to ensure that environmental considerations are incorporated into decommissioning planning and decision making. This ES presents the findings of an EIA for the recommended options for the decommissioning of the NNP topside, jacket and drill cuttings pile. The EIA/ ES provides sufficient information to enable an evaluation to be made of the environmental consequences of the proposed activities.

The marine environment where the NNP is located is typical of the northern North Sea. Whilst recognising there are certain times of the year when populations of seabirds, fish spawning and commercial fisheries are vulnerable to oil pollution, the area is not considered particularly sensitive to the proposed decommissioning activities.

There are no known Annex I habitats in the NNP area. Although *Lophelia pertusa* has colonised the NNP, it would not have occurred without the presence of the platform and therefore the location does not constitute an Annex I habitat (Section 5).

Harbour porpoise were the only Annex II species of the Habitats Directive recorded within and around the NNP. They exhibit very high abundance in February and July, medium in August and low numbers throughout January, April, May, June, September and December (UKDMAP, 1998).

Interactions between the proposed decommissioning activities and the local environment were identified and used in combination with an assessment of all potentially significant impacts and outputs from the stakeholder consultation to inform the EIA. The resultant key environmental issues which required assessment were:

- Energy use and atmospheric emissions (Section 6).
- Underwater noise generated during decommissioning activities (Section 7).
- Seabed disturbance during decommissioning operations - vessels anchoring (Section 8).
- Disturbance of drill cuttings (Section 8).
- NNP cuttings pile management (Section 8).
- Presence of vessels causing potential interference with other users of the sea (Section 9).
- Partial removal of jacket footings to fishermen (Section 9).
- Management of marine growth on NNP jacket (Section 11).
- Landfill disposal and associated impacts (Section 11).
- Non-routine events – spillage of hydrocarbons, chemicals and dropped objects (Section 10).

Mitigation to avoid and reduce the above environmental concerns is in line with industry best practice. CNRI has an established EMS, which will ensure that proposed mitigation measures are implemented (Section 12).

Overall, the ES has evaluated the environmental risk reduction measures to be taken by CNRI and concludes that CNRI have, or intend to, put in place sufficient safeguards to mitigate environmental risk and to monitor the implementation of these safeguards.

Therefore, it is the conclusion of this Environmental Statement that the recommended options to decommission the NNP topside, jacket and drill cuttings pile can be completed without significant impacts to the environment.

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Appendix A. Summary of Environmental Legislation

This appendix presents a summary of the key regulatory drivers applicable to the NNP decommissioning project as well as the policy, legal, and administrative framework within which this ES was carried out.

Regulatory Body	Legislation	Summary of Requirements
BEIS, MMO, Marine Scotland	Petroleum Act 1998	The Petroleum Act 1998 sets out requirements for undertaking decommissioning of offshore installations and pipelines including preparation and submission of a Decommissioning Programme.
	Energy Act 2008	Part III of the Energy Act 2008 amends Part 4 of the Petroleum Act 1998 and contains provisions to enable the Secretary of State to make all relevant parties liable for the decommissioning of an installation or pipeline; provide powers to require decommissioning security at any time during the life of the installation and powers to protect the funds put aside for decommissioning in case of insolvency of the relevant party.
	Food and Environment Protection Act 1985 Marine (Scotland) Act 2010 Marine and Coastal Access Act 2009	The Marine and Coastal Access Act (MCAA) and Marine (Scotland) Act will replace and merge the requirements of FEPA Part II (deposits to the sea) and the Coast Protection Act (navigation). FEPA Part II remains in force in Scottish territorial waters to cover reserved activities (within 3 n miles). Many offshore sector activities are exempt from the acts; however certain activities including deposits of substances or articles in the seabed during decommissioning operations are covered.
BEIS/ OSPAR	OSPAR Recommendation 2006/5 on a management regime for offshore cuttings piles	This recommendation outlines the approach for the management of cuttings piles offshore. The first stage of the Recommendation is to be carried out within two years of the Recommendation coming into effect with the second stage completed in a predetermined timeframe laid out in stage 1. This Recommendation entered into force from 30 June 2006.
	OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations	Lays down the general principle of forbidding the dumping and the leaving wholly or partly in place of disused offshore installations in the maritime area covered by the OSPAR Convention. The Decision recognises potential difficulties in removing large steel jackets weighing more than 10,000 tonnes and concrete gravity base structures and provides a facility for derogation from the main rule of complete removal such that the option of leaving the jacket footings or concrete structure in place may be considered.
SEPA	Special Waste Regulations 1996 Special Waste Amendment [Scotland] Regulations 2004	The Special Waste Regulations only apply in Scotland. They impose procedures for Special Waste that add to those already under the Duty of Care, including requirements for transportation and disposal within a strict documented framework. The Regulations provide a new definition of Special Waste in accordance with the EC Hazardous Waste Directive (91/689/EEC). The Hazardous Waste List has been expanded and refined and is now included in the European Waste Catalogue.

Regulatory Body	Legislation	Summary of Requirements
SEPA	Transfrontier Shipment of Waste Regulations 2007	The international movement of waste is controlled by means of Council Regulation No. 1013/2006/EC on shipment of waste (the "WSR"). The Transfrontier Shipment of Waste Regulations 2007 gives effect to certain aspects of the WSR into UK law, nominate the competent authorities for the UK and provide them with their respective enforcement powers. The UK Plan for Shipments of Waste sets out Government policy on shipments for disposal. The Regulations are enforced by the Scottish Environmental Protection Agency (SEPA) in Scotland (Environment Agency (EA) in England and Wales and Northern Ireland Environment Agency (NIEA) in Northern Ireland). The regulations apply to decommissioned offshore installations. The Secretary of State is the competent authority for the offshore area. Operators should consult the appropriate agency when considering decommissioning activities that involve transboundary movements of waste.
	Transfrontier Shipment of Waste and Spent Fuel Regulations 2008	The Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008 (TFSRWR 2008) transpose Council Directive 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel. TFSRWR 2008 makes it an offence to ship radioactive waste and spent fuel. TFSRWR 2008 makes it an offence to ship radioactive waste or spent fuel into or out of the UK inless authorized by the appropriate authority. The new Regulations came into force on 25th December 2008 and are administered by SEPA in Scotland (EA in England and Wales and the Chief Inspector in Northern Ireland). They replace and revoke the previous UK regulatory regime (the Transfrontier Shipment of Radioactive Waste Regulations 1993) and some transfers of radioactive waste across international bounderies which were previously regulated are now exempted.
	Radioactive Substances Act 1993 Radioactive Substances Act 1993 Amendment (Scotland) Regulations 2011 Special Waste Amendment Scotland Regulations 2005	RSA 1993 regulates keeping and use of radioactive material and makes provisions for its accumulation and disposal. Prohibits disposal except as authorised by SEPA. Certificate of Authorisation for Onshore Disposal of Radioactive Waste requires registration for any offshore accumulation of waste prior to onshore disposal. Permitted onshore disposal routes for solid radioactive waste will be detailed in the Certificate. Authorisations must be displayed on the installation. Prior to disposal ofshore, sample of the material must be taken and analysed for radioactivity levels and type. The regulations apply to offshore installations and the preparation of a decommissioning programme and should identify whether the selected disposal route requires such an authorization and that the selected facility has one. It is likely that the new disposal routes will require an application for authorisations.
IMO	International Maritime Organisation (IMO) Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone 1989 (IMO Resolution A.672 (16))	These Guidelines and Standards represent the "generally accepted international standards" as mentioned in UNCLOS, Article 60, which prescribes that any installations or structures which are abandoned or disused shall be removed to ensure safety of navigation and to prevent any potential effect on the marine environment.

Table A.2: General

Regulatory Body	Legislation	Summary of Requirements
Maritime and Coastguard Agency (MCA)	MARPOL 73/78	The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes and covers pollution by oil, chemicals, harmful substances in packaged form, sewage and garbage. The MCA has regulatory authority over those aspects of the offshore oil and gas industry that fall under the MARPOL Convention 73/78, including machinery space discharge, sewage discharges and garbage at sea. The Convention currently includes six technical Annexes: • Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983) • Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983) • Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992) • Annex IV Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003) • Annex V Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988) • Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005)

Table A.3: Environmental Impact Assessment

Regulatory Body	Legislation	Summary of Requirements
BEIS	Council Directive on the Assessment of the Effects of Certain Public and Private Activities on the Environment - 85/337/EEC (the EIA Directive) as amended by Directives 97/11/EC, 2003/35/EC, 2009/31/EC and 2011/92/EU EC Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment	The EIA Directive (85/337/EEC) has been in force since 1985 and applies to a wide range of defined public and private projects, which are defined in Annexes I and II: Annex 1: all projects listed in Annex I are considered as having significant effects on the environment and require a mandatory EIA. Typical projects include, for example: Extraction of petroleum and natural gas for commercial purposes where the amount extracted exceeds 500 tonnes/day in the case of petroleum and 500,000 cubic metres/day in the case of gas. Pipelines with a diameter of more than 800 mm and a length of more than 40 km: • For the transport of gas, oil, chemicals; • For the transport of carbon dioxide (CO_2) streams for the purposes of geological storage, including associated booster stations. Installations for storage of petroleum, petrochemical, or chemical products with a capacity of 200,000 tonnes or more. Annex 2: EIA is discretionary with the national authorities decide whether an EIA is needed. This is done by the "screening procedure", which determines the effects of projects on the basis of thresholds/criteria or a case by case examination. The EC Directive 2014/52/EU revokes the 85/337/EEC and the 97/11/EC Directives and amends the 2003/35/EC directive. The 2014/52/EU amends and strengthens the quality of the environmental impact assessment procedure and lists two classes of project to which the Directive applies: Annex 1 Projects for which environmental assessment (EA) is mandatory; and Annex 2 projects for which EA is discretionary. Under 2014/52/EU, oil and gas developments are listed as Annex 1 projects.
	The Offshore Petroleum Production and Pipe-lines (Assessment of Environmental Effects) Regulations 1999 (as amended)	These Regulations implement the EIA Directive with regard to the offshore oil and gas industry. The Regulations require an environmental impact assessment (EIA) and the associated public consultation document (Environmental Statement (ES)) to be submitted for certain projects, these are: • Developments which will produce 500 tonnes (approximately 3,750 barrels) or more per day of oil or 500,000 cubic metres or more per day of gas (not including well testing). • Pipelines of 800 mm diameter and 40 kilometres or more in length. Other activities are subject to a discretionary process where either an ES or a permit (seeking a Direction that an ES is not required) needs to be submitted. Typically this discretionary approval covers: • The drilling of all wells; • Developments, either stand-alone or incremental, producing less than 500 tonnes of oil per day or 500,000 cubic metres of gas per day; • Construction of pipelines of less than 800 mm diameter and 40 kilometres in length. Although there is currently no statutory requirement to undertake an EIA at the decommissioning stage, a decommissioning programme will nevertheless need to be supported by an EIA. The ES submitted for the development under the EIA regulations requires the applicant to consider

Regulatory Body	Legislation	Summary of Requirements
		the long term impacts of the development and these include the impacts arising from decommissioning.
BEIS	Environmental Approval for Revised Production Consents under PPD (Revised)	The EC Directive 2012/92/EU on the assessment of the effects of certain public and private projects on the environment forced an amendment of the EIA regulations. An ES may now also be required for a modification to a project or revision to production consent, unless the modification or revision decreases production, has no change on production levels or increases production only by a small amount. Prior to applying to EDU (Energy Development Unit) to request a consent revision or renewal that involves an increase in the production level, the applicant should assess the proposed increase against the EIA thresholds (*), as follows: • If the average requested annual rate of production represents an increase of greater than 500 tonnes of oil per day or 500,000 cubic metres of gas per day, an EIA Direction or ES will be required. • If the increase in production does not exceed the base year i.e. the first year of the consent in subsequent years then an EIA Direction or ES will not be required. • If the increase is for an increase in the base year production then an EIA Direction or ES will be required. • If the increase in subsequent years exceeds production in the base year, an EIA Direction or ES will be required. Revised guidance relating to Environmental Submissions was issued by DECC on the 21st of July 2011 highlighted changes that have been made to relevant regulations following the Gulf of Mexico incident. The guidance highlighted the fact that EIAs must include a detailed assessment of the potential environmental impact of a hydrocarbon release, broadly based on OPEP (Oil Pollution Emergency Plan) requirements but including significant additional information to the mitigation measures in place to prevent and the potential environmental impacts of the release.
	OSPAR Recommendation 2010/5 on assessments of environmental impact in relation to threatened and/or declining species and habitats	The purpose of this Recommendation is to support the protection and conservation of species and habitats on the OSPAR List of threatened and/or declining species and habitats, through assessments of environmental impacts of human activities. When assessments of environmental impacts of human activities that may affect the marine environment of the OSPAR (Oslo and Paris Conventions) maritime area are prepared, Contracting Parties should ensure they take account of the relevant species and habitats on the OSPAR List of threatened and/or declining species and habitats (OSPAR Agreement 2008/6).

Table A.4: Territorial Waters

Regulatory Body	Legislation	Summary of Requirements
-	Territorial Sea Act 1987 Territorial Waters Order	Defines the extent of the territorial sea adjacent to the British Islands.

Table A.5: Atmospheric Emissions

Regulatory Body	Legislation	Summary of Requirements
MCA	MARPOL 73/78 Annex VI the Prevention of Air Pollution from Ships	Annex VI is concerned with the control of emissions of ozone depleting substances, NOx, SOx, and VOCs and require ships (including platforms and drilling rigs) to be issued with an International Air Pollution Certificate following survey. This annex set limits on sulphur oxide and nitrogen oxide emissions from ship exhausts as well as particulate matter and prohibit deliberate emissions of ozone depleting substances. Emissions arising directly from the exploration, exploitation and associated offshore processing of seabed mineral resources are exempt from Annex VI, including the following: • Emissions resulting from flaring, burning of cuttings, muds, well clean-up emissions and well testing. • Release of gases entrained in drilling fluids and cuttings. • Emissions from treatment, handling and storage of reservoir hydrocarbons. • Emissions from diesel engines solely dedicated to the exploitation of seabed mineral resources.
BEIS	Petroleum Act 1998 The Petroleum (Current Model Clauses) Order 1999	The objective of this Act is to conserve gas, as a finite energy resource, by avoiding unnecessary wastage during the production of hydrocarbons in the UKCS. The actual Model Clause may vary depending on when the Block Licence was granted, but in recent licences flaring is covered by Paragraph 3 of Model Clause 21, and this states that the Licensee shall not flare any gas from the licensed area or use gas for gas lift except with written consent. If intending to flare gas during the operational phase of the field, flare consent will need to be obtained.
	The Energy Act 1976	This Act is mostly used for issue of vent consents, although it also covers some flaring which has not been permitted under licence model clauses. The VOC emissions from offshore loading are covered by the Vent Consent requirements under the Energy Act 1976.
	The National Emission Ceilings Regulations 2002	There regulations transpose EC Directive on national emission ceilings for certain atmospheric pollutants 2001/81/EC into UK law and set national ceilings and a requirement for the development of a reduction programme for SOx, NOx and VOCs and set out the UK government commitment for achieving a reduction of atmospheric emissions by 2010 and thereafter not to exceed the amounts specified in the Schedule of that pollutant.
	The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (as amended 2010 and 2014)	These regulations implement Annex VI of MARPOL (the International Convention for the Prevention of Pollution from Ships 73/78) in the UK. The 2014 amendments further stipulate the 2010 amendments, primarily implementing provisions concerning the sulphur content of marine fuels contained in Council Directive 1999/32/EC. The Directive sets maximum sulphur content for fuel including heavy fuel oil and gas oil including marine fuel.
	Climate Change Act 2008 Climate Change (Scotland) Act 2009	The Act sets up a framework for the UK to achieve its long-term goals of reducing greenhouse gas emissions and to ensure actions are taken towards adapting to the impact of climate change. The Act enables a number of elements, including amongst others; setting medium and long-term emissions reduction targets in statute, introduction of a system of carbon budgeting which constrains the total amount of emissions in a given time period, a new reporting framework for annual reporting of the UK's greenhouse gas emissions, creation of an independent advisory body (the Committee on Climate Change). As a result of the Act and the 2009 Order, the current legally-binding targets

Regulatory Body	Legislation	Summary of Requirements
		for the net UK carbon account are: 34% reduction by 2020 and 80% reduction by 2050, against a 1990 baseline.
BEIS	Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2001 (as amended): Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010) Offshore Combustion Installations (Prevention and Control of Pollution) (Amendment) Regulations 2007 EC Directive 2010/75/EU (Industrial Emissions Directive)	These regulations implement Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC) in the context of offshore oil and gas combustion installations. The aim of IPPC is to consider environmental impacts holistically and to achieve a higher level of environmental protection. The Regulations apply only to combustion installations with a combined rated thermal input exceeding 50 MW(th) and a PPC Permit will be required in order to operate a qualifying offshore installation. The permit will be granted with conditions that include provisions based on best available techniques, emission limits, and monitoring requirements. The 2007 Amendment Regulations implement the amendments made to EC Directive 96/61 by the Public Participation Directive 2003/35/EC and bring in tighter requirements for public consultation as part of the permit application process. The Council Directive 96/61/EC is now replaced by the Industrial Emissions Directive (EC Directive 2010/75/EU). However the new directive has not yet been implemented in the UK. The Industrial Emissions Directive came into force on 6 January 2011 and merges seven directives into one including the Integrated Pollution Prevention and Control (IPPC) Directive and Large Combustion Plant (LCP) Directive. The main thrust of the directive is to increase the use of "best available techniques" (BATs), an obligation to ensure that industrial operators use the most cost-effective techniques to achieve a high level of environmental protection. Member States have 2 years in which to implement the Directive into national legislation.
	The Fluorinated Greenhouse Gases Regulations 2015	The objective of these Regulations is to reduce the emissions of fluorinated gases including hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride as covered by the Kyoto Protocol. These gases have been developed to replace ozone depleting substances such as CFCs and HCFCs but are long-lived powerful greenhouse gases. The Regulations include requirements on the leakage detection and labelling requirements of systems such as refrigeration systems, air-conditioning units and heat pumps that use these gases. Fluorinated gases are also used for fire fighting offshore. The 2015 Regs revoke and replace the 2009 Regs. Come into force 19th March 2015. The main provisions in the Regulations cover: containment through responsible handling during use, recycling and end-of-life recovery; reporting on quantities produced, supplied, used and emitted.
	The Ozone-Depleting Substances Regulations 2015	These regulations replace and consolidate the Ozone-Depleting Substances (Qualifications) Regulations 2009 (S.I. 2009/2016) and the Environmental Protection (Controls on Ozone Depleting Substances) Regulations 2011 (S.I. 2011/1543)). These Regulations make provision in the UK for EC Regulation 1005/2009 which controls the production, impact, export, placing on the market, recovery, recycling, reclamation and destruction of substances that deplete the ozone layer.

Table A.6: Access to Environmental Information and Public Participation

Regulatory Body	Legislation	Summary of Requirements
BEIS	Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC The Environmental Information (Scotland) Regulations 2004	This Directive transposes the first pillar of the Aarhus convention on access to information into EU legislation. This Directive requires all public authorities to provide members of the public with access to environmental information, and to actively disseminate the environmental information they hold. The information must be provided to any person at their request, without them having to prove an interest and at the latest within two months of the request being made. The Directive is implemented in Scotland by The Environmental Information (Scotland) Regulations 2004.
	Public Participation Directive (PPD) 2003/35/EC	Provides for public participation in the preparation of environmental plans, programmes and projects with significant environmental impacts. See section on environmental impact assessment.

Table A.7: Conservation and Biodiversity

Regulatory Body	Legislation	Summary of Requirements
BEIS, JNCC, SNH, DEFRA	The Offshore Marine Conservation (Natural Habitats, &c.) (Amendment) Regulations 2012	These Regulations make provision for implementing the Birds Directive and Habitats Directive in relation to marine areas where the United Kingdom has jurisdiction beyond its territorial sea. The Regulations make provision for the selection, registration and notification of sites in the offshore marine area (European Offshore Marine Sites) and for the management of these sites. Competent authorities are required to ensure that steps are taken to avoid the disturbance of species and deterioration of habitat in respect of the offshore marine sites and that any significant effects are considered before authorisation of certain plans or projects. Provisions are also in place for issuing of European Protected Species (EPC) licences for certain activities and for undertaking monitoring and surveillance of offshore marine sites. The Amendment Regulations make various insertions for new enactments (e.g. new Birds Directive) and also devolve certain powers to Scottish Ministers. Most recent amendments to the 2007 and 2010 regulations are: • The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2011; • The Conservation of Habitats and Species (Amendment) Regulations 2011.
	The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 as amended (2007)	Secretary of State set out these Regulations to consider whether a “Habitats Regulatory Assessment” should be undertaken prior to granting a licence under the Petroleum Act 1998. Habitats Regulatory Assessment is the formal assessment by the Competent Authority of the impacts of a plan or project on the integrity of (a) Natura 2000 site(s). Habitats Regulatory Assessment is a process separate from the EIA requirements, but which should run alongside and concurrently with the EIA requirements. The 2007 amendments also extend this requirement to all UK waters. These regulations implement European Directives for the protection of habitats and species in relation to oil and gas activities carried out in whole or in part on the UKCS. In particular these are the Council Directive 92/43 on the conservation of natural habitats, wild fauna and flora and Council Directive 79/409 on the conservation of wild birds. The 2007 amendments extend the requirements to all UK waters.
	Marine and Coastal Access Act 2009 Marine (Scotland) Act 2010 Marine Licensing (Exempted Activities) (Scottish Inshore and Offshore Regions) Amendment Order 2012	These two Acts introduce a framework for the development of a new planning system for the marine area and ensure greater protection for the marine environment and biodiversity. However, oil and gas activities are generally exempted from the Act(s) since an environmental regime/regulator is already in place under DECC. The Act(s) will apply to a number of activities e.g: removal of materials from the seabed (including structures), deposit of materials during decommissioning, disturbance of the seabed, use of explosives and installation of certain types of cables. DECC will retain responsibility for offshore installation enforcement activities, and the Marine Management Organisation & Devolved Authorities will take responsibility for "at sea" enforcement of oil and gas activities. The Amendment Order details a number of activities exempt from the requirement for a MCAA licence.
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Table A.8: Emergency Response

Regulatory Body	Legislation	Summary of Requirements
BEIS	The Offshore Installations (Emergency Pollution Control) Regulations 2002	The Regulations give the Representative of the Secretary of State for Energy and Climate Change (SOSREP) powers to intervene in the event of an incident involving an offshore installation where there is, or may be, a risk of significant pollution, or where an operator is failing or has failed to implement effective control and preventative operations.
	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended)	Under these Regulations, it is an offence to make an unlawful release of oil, i.e. a release of oil other than in accordance with the permit granted under these Regulations for oily discharges (e.g. produced water etc.). However, it will be a defence to prove that the contravention arose because of something that could not have been reasonably prevented, or that it was due to something done as a matter of urgency for the purposes of securing the safety of any person. PON 1 reporting.
	OSPAR Recommendation 2010/18 on the prevention of significant acute oil pollution from offshore drilling activities	This recommendation came into force in September 2010 and establishes a process for assessing the relevance of the results of the US and EC reviews of the Macondo well incident with a view to taking additional action by the OSPAR Commission if needed and within the scope of the Convention. Under the recommendation, contracting parties are required to: • As a precaution continue or, as a matter of urgency, start reviewing existing frameworks, including the permitting of drilling activities in extreme conditions; and continue to evaluate this on a case by case basis and prior to permitting; • Take extra care to apply all relevant learning from the Deepwater Horizon accident; • Report on this ongoing activity to OSPAR; and • Based on the reviews undertaken, contracting parties should individually and jointly, if needed, take further action within the scope of the OSPAR Convention.
	Merchant Shipping Act 1995	The Merchant Shipping Act 1995 implements in the UK the OPRC Convention. The aim of the OPRC Convention is to increase the level of effective response to oil pollution incidents and to promote international co-operation to this end. The Convention applies to ships and offshore installations and requires operators to have in place Oil Pollution Emergency Plans (OPEP), which are approved by the body that is the National Competent Authority for the Convention.
	The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation) Regulations 1998 (as amended)	The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 introduce into UK law the oil spill planning requirements and legal oil spill reporting requirements of the OPRC Convention. The 2015 amendments expand upon the definitions of “combined operation” and “connected infrastructures”.

Table A.9: Environmental Liability

Regulatory Body	Legislation	Summary of Requirements
SEPA, Marine Scotland and SNH	Directive 2004/35/EC of the European Parliament and the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.	The Environmental Liability Directive enforces strict liability for prevention and remediation of environmental damage to 'biodiversity', water and land from specified activities and remediation of environmental damage for all other activities through fault or negligence. The EC has published a communication (the Communication) on "facing the challenge of the safety of offshore oil and gas activities". The European Commission is set to review the liability regime applicable to offshore petroleum activities and is: • Proposing amendments to the Environmental Liability Directive (2004/35/EC, as amended by Directive 2006/21/EC) so that it covers environmental damage to all marine waters (as defined in the Marine Strategy Framework Directive 2008/56/EC). • Re-considering introducing a mandatory requirement for operators to provide financial security in the event that a major accident occurs. • Considering, in a guidance document interpreting existing legislation, the applicability of the Waste Framework Directive (2008/98/EC) to oil spills.
	The Environmental Liability (Scotland) Regulations 2009 (as amended)	These Regulations implement the EC Environmental Liability Directive in Scotland. The regulations oblige operators of certain activities to take preventative measures where there is an imminent threat of environmental damage, and to remediate any environmental damage caused by their activities. The 2015 amendments define "genetically modified orgainisms" and stiupilates further description of "water damage".

Table A.10: Chemicals, drainage and oily discharges

Regulatory Body	Legislation	Summary of Requirements
BEIS, Marine Scotland, CEFAS	The Offshore Chemicals Regulations 2002 (as amended)	The Offshore Chemicals Regulations 2002 implement the OSPAR Decision (2000/2) and OSPAR Recommendations (2000/4 and 2000/5) introducing a Harmonised Mandatory Control System for the use and reduction of the discharge of offshore chemicals. The Regulations introduced a permit system for the use and discharge of chemicals offshore and include a requirement for site specific risk assessment. Chemicals used offshore must be notified through the Offshore Chemical Notification Scheme (OCNS) and chemicals are ranked by hazard quotient, using the CHARM model. Applications for permits are made via the submission of the relevant Master Application Template (MAT) (i.e. chemicals for drilling: DRA; pipelines: PLA; production: PRA; decommissioning: DCA; and workovers and well interventions: WIA). Amendments in 2011 to the Offshore Chemicals Regulations and the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2010. The principal aim is to make unlawful unintentional releases of chemicals and oil that arise through accidents / non-operational discharges by broadening accordingly the definitions of "offshore chemical" and "discharges" and incorporating a new concept of "release".
	Convention for the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention) OSPAR Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles.	The OSPAR Convention (in particular Annex III) is the main driver for reductions in oily discharges to the North Sea. The UK as a contracting party to the Convention is therefore obliged to implement any Decisions and Recommendations made by the Commissions. Certain decisions made under the earlier Paris Convention still stand. OSPAR Decision 2000/3 that came into effect on 16 January 2001 effectively eliminates the discharge of organic phase fluids (OPF) (oil based (OBF) or synthetic based (SBF) drilling fluids) or cuttings contaminated with these fluids. Use of OPF is still allowed provided total containment is operated. The use of diesel-oil-based drilling fluids is prohibited. The discharge of whole OPF to the sea is prohibited. The mixing of OPF with cuttings for the purpose of disposal is not acceptable. The discharge of cuttings contaminated with oil based fluids (OBF) (includes OBF and SBF) greater than 1% by weight on dry cuttings is prohibited. The use of OPF in the upper part of the well is prohibited. Exemptions may be granted by the national competent authority for geological or safety reasons. The discharge into the sea of cuttings contaminated with synthetic fluids will only be authorised in exceptional circumstances. Authorisations to be based on the application of BAT/BEP. Best Available Techniques described within the Decision include recycling, recovery and reuse of muds. The OSPAR 2006/5 Recommendation sets out measures to reduce pollution from oil/ chemicals from cuttings piles.
	The Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 (as amended) Merchant Shipping (Prevention of Oil Pollution) (Amendment) Regulations 2001	These Regulations give effect to Annex I of MARPOL 73/78 (prevention of oil pollution) in UK waters and have been amended by the Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009 described above. They address oily drainage from machinery spaces on vessels and installations. The North Sea is designated a "Special Area", within which the limit for oil in discharged water from these sources is 15ppm. Vessels and installations are required to hold a valid UKOPP (UK Oil Pollution Prevention) or IOPP (International Oil Pollution Prevention Certificate). Vessels and drilling rigs are also required to hold a current, approved Shipboard Oil Pollution Emergency Plan (SOPEP) which is in accordance with guidelines issued by the Marine Environment Protection Committee of the International Maritime Organisation (IMO).

Regulatory Body	Legislation	Summary of Requirements
BEIS, Marine Scotland, CEFAS	Merchant Shipping Act 1995 International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78	Arrangements for Survey and Certification Part VI of the Merchant Shipping Act, 1995 makes provision for the prevention of pollution from ships. It implements in the UK the requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. MARPOL defines ships to include offshore installations and relevant provisions of MARPOL are applied to offshore installations. Annex 1 of MARPOL relates to prevention of oil pollution and has provisions for machinery space drainage that are applied to offshore platforms: Vessels of 400 GT or above (which includes FSU) are permitted to discharge processed water (i.e. Oily Drainage Water) from Machinery Space Drainage as long as the oil content without dilution, does not exceed 15 ppm of the oil in water.
	PARCOM Recommendation 86/1 of a 40 mg/l Emission Standard for Platforms	The PARCOM Recommendation 86/1 provision of a 40 mg/l performance standard for platforms is applicable, and remains in force for discharges of displacement water, drainage water and ballast water, which are not covered under MARPOL. The maximum concentration of dispersed oil must not exceed 100 mg/l at any time.
	The REACH Enforcement Regulations 2008	These enforce Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) which require chemical users to demonstrate the safe manufacture of chemicals and their safe use throughout the supply chain. Under REACH, the users of chemicals as well as their manufacturers and importers have a responsibility to ensure that the risks to both human health and the environment are adequately assessed.
	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended)	These Regulations replaced the Prevention of Oil Pollution Act 1971 (“POPA”) and are a mechanism to continue implementation on the UKCS of OSPAR Recommendation 2001/1. Discharges of reservoir oil associated with drilling from a floating storage unit (FSU) must be covered by an Oil Discharge Term Permit (OTP), whereas discharges from a production installation are covered by an Oil Discharge Life Permit (OLP). Operators are required to regularly report actual oil discharge in order that adequate monitoring can be achieved. These regulations do not apply to those discharges regulated under the Offshore Chemicals Regulations 2002, the Merchant Shipping

Regulatory Body	Legislation	Summary of Requirements
		(Prevention of Oil Pollution) Regulations 1996 (as amended) or the Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008. Amendments in 2011, via the Offshore Chemicals Regulations and the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2010 introducing new concept of "release " and " offshore installation" which encompasses all pipelines . The concentration of dispersed oil in produced water discharges as averaged over a monthly period must not exceed 30 mg/l, whereas the maximum permitted concentration must not exceed 100 mg/l at any time. The quantity of dispersed oil in produced water discharged must not exceed 1 tonne in any 12 hour period.

Table A.12: Low specific activity (LSA) contaminated waste (sand, sludge and scale) and Radioactive waste

Regulatory Body	Legislation	Summary of Requirements
SEPA	Radioactive Substances Act 1993 The Radioactive Substances Act 1993 Amendment (Scotland) Regulations 2011	Onshore and offshore storage and disposal of naturally occurring radioactive materials (NORM) is regulated under the Radioactive Substances Act. Operators are required to hold, for each relevant installation, an Authorisation to store and dispose of radioactive waste such as low specific activity scale (LSA) which may be deposited in vessels and pipework. The authorisation specifies the route and methods of disposal. Records of disposal are required. The offshore use, storage and disposal of radioactive sources are regulated under the same legislation. A Registration Certificate is required to keep; transport and use sources and records must be kept. Additionally, different radionuclides have different activity thresholds over which the containing sources qualify as a High Activity Sealed Source (HASS). As of January 2008, and if applicable, HASS records must be reported to SEPA or the EA and maintenance of an inventory is required. The keeping, storage and disposal of radioactive waste requires authorisation. The Radioactive Substances Act 1993 has been superseded by the Environmental Permitting (England and Wales) Regulations 2010 in England and Wales but it has remained in place in Scotland. However, in Scotland there have also been consultations regarding a future exemptions regime under The Radioactive Substances Act 1993. These consultations have resulted in the Radioactive Substance Exemption (Scotland) Order 2011. This order will revoke and replace a series of exemption orders (in Scotland) made under the Radioactive Substances Act 1993 ("the Act") and its predecessor (the Radioactive Substances Act 1960) in order to rationalise the current system of exemptions and bring it into line with the structure and terminology used in the Basic Safety Standards Directive.

Table A.13: Environmental Management Systems

Regulatory Body	Legislation	Summary of Requirements
BEIS	OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry	All Operators controlling the operation of offshore installations on the UKCS are required to have in place an independently verified Environmental Management System designed to achieve: the environmental goals of the prevention and elimination of pollution from offshore sources and of the protection and conservation of the maritime area against other adverse effects of offshore activities and to demonstrate continual improvement in environmental performance. OSPAR recognises the ISO 14001: 2004 & EMS international standards as containing the necessary elements to fulfil these requirements. All operators are also required to provide a public statement of their environmental performance on an annual basis.

Table A.14: Licensing

Regulatory Body	Legislation	Summary of Requirements
BEIS Marine Scotland	Petroleum Act, 1998 as amended The Petroleum Licensing (Exploration and Production) (Seaward and Landward Areas) Regulations 2004 (as amended) The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008	These Regulations consolidate with amendments the provisions of the Petroleum (Production) Regulations 1982 (as amended) in relation to (a) applications to the Secretary of State for petroleum production licences in respect of seaward areas and (b) applications to the Secretary of State for petroleum exploration licences in respect of seaward areas and landward areas below the low water line. This Act vests all rights to the nation's petroleum resources to the Crown and provides the basis for granting licences to explore for and produce oil and gas. Production licences grant exclusive rights to the holders to “search and bore for and get petroleum” in specific blocks. Licences generally contain a number of environmental restrictions and conditions. Under the terms of a Licence, licence holders require the authorisation of the Secretary of State prior to conducting activities such as installing equipment or drilling of wells in the licence area. Consent to flare or vent hydrocarbons is also required from DECC under the terms of the Model Clauses incorporated into Production Licences. Licence conditions will include environmental issues e.g. time constraints in sensitive areas. The model clauses of the licence require the licensee to appoint a fisheries liaison officer.
	Marine & Coastal Access Act 2009	The Marine & Coastal Access Act has gained Crown Assent, thus becoming an Act of Parliament and entering UK law. The Act provides executive devolution to Scottish Ministers of the new marine planning and conservation powers in the offshore region (12-200 nautical miles), coinciding with the existing executive devolution of marine licensing. The Scottish Bill will legislate for marine planning, licensing and conservation activities in the inshore region.

Table A.15: Ballast water

Regulatory Body	Legislation	Summary of Requirements
MCA	International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) – adopted 2004	Objective to prevent, minimise and ultimately eliminate the transfer of harmful aquatic organisms and pathogens though control and management of ships’ ballast water and sediments. Helsinki and OSPAR Commissions General Guidance on the Voluntary Interim has set out an application of the D1 Ballast Water Exchange Standard. Under this regulation, all tankers > 150 GRT and all ships > 400 GRT in the UK are required to have in place United Kingdom Oil Pollution Prevention Certificate (UKOPP) or IOPP Certificate and Ballast Water Exchange Management plan. It is required all vessels entering the North East Atlantic to exchange the ballast water at least 200 nm from the nearest land and at least 200 metres deep.

Table A.16: Transboundary Impacts

Regulatory Body	Legislation	Summary of Requirements
BEIS	Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991)	The 1991 UNECE Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention) requires any country that has ratified the convention to consider the transboundary environmental effects of industrial projects and activities, including offshore hydrocarbon exploration and productions activities. The Convention requires that if the activity is found to cause a significant adverse transboundary impact then the party undertaking the activity shall, for the purpose of ensuring adequate and effective consultations, notify any potentially affected country as early as possible.