Exploration Drilling WA-343-P Environment Plan Summary

PLN - Plan

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Term, abbreviation or acronym	Meaning
°C	degrees Celsius
ACF	Australian Conservation Foundation
AFMA	Australian Fisheries Management Authority (Cwlth)
AHO	Australian Hydrographic Office
AHSV(s)	anchor-handling supply vessel(s)
AIMS	Australian Institute of Marine Science
AIS	automatic identification system
ALARP	as low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian marine park formerly Commonwealth marine reserve
AMSA	Australian Maritime Safety Authority (Cwlth)
APASA	Asia-Pacific Applied Science Associates
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
ARP	applied research program
AS/NZS	Australian/New Zealand Standard
ASBTIA	Australian Southern Bluefin Tuna Industry Association
ATSI	Aboriginal and Torres Strait Islanders
bbl	barrel(s)
BIA	Biologically Important Area
bpm	barrels per minute
BoM	Bureau of Meteorology
BOP	blow-out preventer
BSL	below sea level
BWM	ballast water management
CAMBA	China-Australia Migratory Bird Agreement
CASA	Civil Aviation Safety Authority
CFC(s)	Chloroflurocarbon(s)
CHARM	chemical hazard assessment and risk management
ChemAlert	INPEX operated chemical management system, which provides information on a chemical product’s environmental criteria.
CMST	Centre for Marine Science and Technology
CMT	crisis management team
COLREGs	International Regulations for Preventing Collisions at Sea 1972
CSV	construction support vessel
Cwlth	Commonwealth
DAWR	Department of Agriculture and Water Resources (Cwlth)
dB	decibel
DBCA	Department of Biodiversity, Conservation and Attractions (WA) formerly the Department of Parks and Wildlife (DPaW)
DEE	Department of the Environment and Energy (Cwlth) (formerly the Cwlth Department of the Environment)
DER	Department of Environment Regulation (WA)
DEWHA	Department of the Environment, Water, Heritage and the Arts
DIIS	Department of Industry, Innovation and Science

Term, abbreviation or acronym	Meaning
DMIRS	Department of Mines, Industry Regulation and Safety WA (formerly Department of Mines and Petroleum)
DoE	Department of the Environment (Cwlth)
DP	dynamically positioned
DPaW	Department of Parks and Wildlife now known as DBCA
DPIR	Department of Primary Industry and Resources formerly the Department of Primary Industries and Fisheries DPIF (NT)
DPIRD	Department of Primary Industries and Regional Development (WA)
DSWEPaC	Department of Sustainability, Environment, Water, Population and Communities
EEZ	exclusive economic zone
EIAPP	Engine International Air Pollution Prevention
EIS	environmental impact assessment
EMBA	environment that may be affected
ENVID	environmental impact identification
EP	environment plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)
ERP	emergency response plan
ERT	emergency response team
EXT	Australian External Territory
FTO	fishing tour operator
g/m^2	grams per square metre
g/m^3	grams per cubic metre
GHG	greenhouse gas
GT	gross tonnes
ha	hectare
HAZID	identification of drilling operations risks and hazards
hi-vis	high viscosity
HLV	heavy lift vessel
hp	horse power
HPHT	high pressure, high temperature
HQ	hazard quotient
HSE	health, safety and environment
HSEQ-MS	health, safety, environment and quality management system
Hz	hertz
IAP	incident action plan
IAP2	International Association for Public Participation
IAPP	International Air Pollution Prevention
IBA	important bird area
ILC	International Land Corporation
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organization
IMS	invasive marine species
IMT	incident management team
INPEX	INPEX Browse E&P Pty Ltd
IOGP	International Association of Oil and Gas Producers
IOPP	International Oil Pollution Prevention

Term, abbreviation or acronym	Meaning
ISPPC	International Sewage Pollution Prevention Certificate
ISO	International Organization for Standardization
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
KEF	key ecological feature
kg/m^3	kilograms per cubic metre
kHz	kilohertz
km	kilometre(s)
KPI(s)	key performance indicator(s)
L	litre(s)
LAO	linear alpha olefins
LAT	lowest astronomical tide
LC_{50}	Lethal concentration 50. Lethal concentration in which 50% of the population will be killed in a given period of time
LEL	lower explosive limit
LLI	long lead item
LLR	lower limits of reporting
FLNG	floating liquefied natural gas
m^2	square metres
m^3	cubic metres
m^3/d	cubic metres per day
m/s	metres per second
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973/1978
MDRT	measured depth below the rotary table
mg/L	milligrams per litre
MJ	megajoule (equal to one million (10^6) joules, or approximately the kinetic energy of a one megagram (tonne) vehicle moving at 160 km/h)
MMscf	million standard cubic feet
MMscf/d	million standard cubic feet per day
MMO	marine mammal observer
MNES	Matters of National Environmental Significance
MNP	marine national park
MoC	management of change
MODU	mobile offshore drilling unit
MoU	memorandum of understanding
MP	marine park
MSI	Maritime Safety Information
NatPlan	National Plan for Maritime Environmental Emergencies
nm	nautical miles
NMR	north marine region
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NOx	mono-nitrogen oxides
NT DIPL	Northern Territory Department of Infrastructure, Planning and Logistics
NWMR	north-west marine region

Term, abbreviation or acronym	Meaning
OCNS	Offshore Chemical Notification Scheme
ODLC	Offshore Drilling Logistic Coordinator
ODS(s)	ozone-depleting substance(s)
OECD	Organisation for Economic Cooperation and Development
OEM	original equipment manufacturer
OGP	Oil and Gas Producers
OIE	offset installation equipment
OIM	offshore installation manager
OOC	oil-on-cuttings
OPEP	oil pollution emergency plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cwlth)
OPGGS (E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cwlth)
OSMP	Operational and Scientific Monitoring Program
OSPAR	The 1992 OSPAR Convention ("Convention for the protection of the marine environment of the north-east Atlantic")
OSRL	Oil Spill Response Limited
OSTM	oil spill trajectory modelling
OWD	oil-in-water dispersions
OWS	oil-water separator
OWRP	oiled wildlife response plan (NT)
PAH(s)	polycyclic aromatic hydrocarbon(s)
PEAR	people, environment, assets and reputation
permit area	WA-343-P
PDCA	plan, do check, act
PLONOR	pose little or no risk (to the environment)
POLREP	(marine) pollution report
POTS Act	Protection of the Sea (Prevention of Pollution from Ships) Act 1983
ppb	Parts per billion
PPE	personal protective equipment
ppm	parts per million
ppt	parts per thousand
PPRR	prevention, preparedness, response, and recovery
PSI	pounds per square inch
PSV	platform supply vessel
PSZ	petroleum safety zone
PTW	permit to work
QA/QC	quality assurance and quality control
Ramsar Convention	The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention)
RCC	rescue coordination centre
RO	reverse osmosis
ROKAMBA	Republic of Korea- Australia Migratory Bird Agreement
ROV	remotely operated (underwater) vehicle
RWIS	relief well injection spool
SBM	synthetic-based mud
SCE	solids control equipment

Term, abbreviation or acronym	Meaning
SDS	safety data sheet
SEEMP	Ship Energy Efficiency Management Plan
SFRT	subsea first response tool kit
SIMA	spill impact mitigation assessment
SIMOPs	simultaneous operations
SITREP	situation report
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	shipboard oil pollution emergency plan
SOx	sulfur oxides
SPL	sound pressure level
SSDI	subsea dispersant injection
STP	sewage treatment plant
SWMR	south-west marine region
T	tonne
TD	total depth
t/d	tonnes per day
TVD	total vertical depth
UNEP	United Nations Environment Programme
US EPA	(United States) Environmental Protection Agency
VOC(s)	volatile organic compound(s)
VSP	vertical seismic profiling
WA	Western Australia
WA-343-P	Exploration permit area within the Browse basin
WA DoT	Department of Transport (WA)
WA EPA	Western Australian Environmental Protection Authority
WAFIC	Western Australian Fishing Industry Council
WBM	water-based mud
WHA	world heritage area
WHO	World Health Organisation
WOMP	well operations management plan
WSF	water-soluble fraction
WTBF	western tuna and billfish fishery
wt/wt	weight per weight
WWCI	Wild Well Control Inc
µg/L	micrograms per litre
µPa	micropascal

1 INTRODUCTION

1.1 Scope

As titleholder on behalf of its joint venture participants, INPEX Browse E&P Pty Ltd. (INPEX) is proposing to drill an exploration well in exploration permit area WA-343-P, in the Browse Basin (Figure 1-1). Drilling of the exploration well is a minimum work obligation of the WA-343-P exploration pemit.

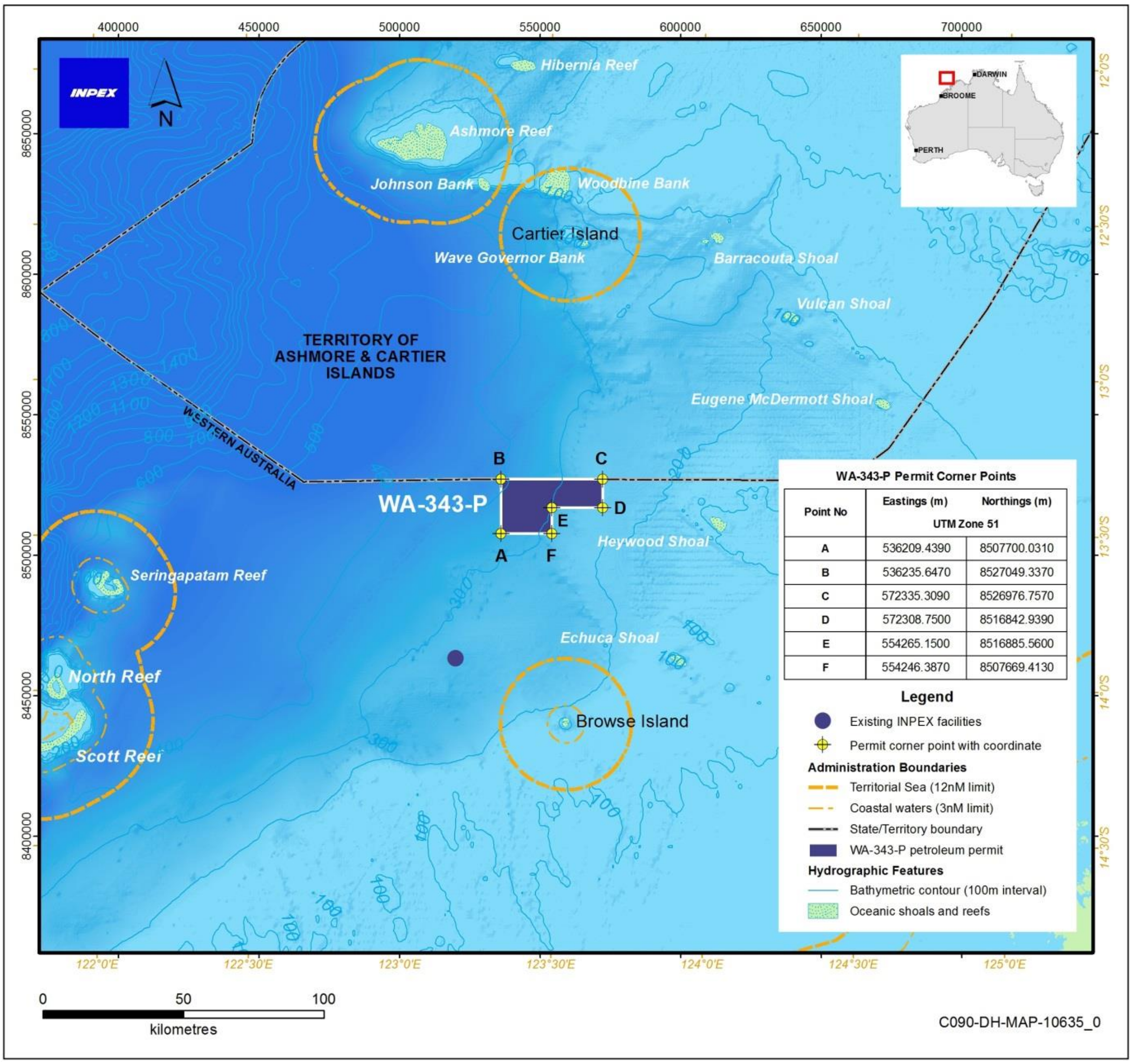

Figure 1-1: Location of WA-343-P exploration permit area

The permit area is wholly within Commonwealth waters located approximately 400 km north of Derby, Western Australia. The petroleum activity will consist of a pre-drill site survey, and the drilling and evaluation of an exploration well including vertical seismic profiling (VSP) within WA-343-P, where water depths are approximately 350 m.

Following a pre-drill site survey, drilling will be conducted using either a semi-submersible mobile offshore drilling unit (MODU) which will be anchored to the seabed or a dynamically positioned (DP) MODU. It is anticipated that two anchor handling supply vessels (AHSVs) and one platform supply vessel (PSV) will be needed to provide support for the drilling activity. Personnel transfers to and from the MODU will be by helicopter several times per week.

The pre-drill site survey is expected to commence in H2 2019, with drilling scheduled to commence during 2020. The activity start date is subject to MODU availability, operational efficiencies, weather and analysis of geophysical data collected during the pre-drill site survey.

The scope of this Environment Plan (EP) does not include the movement of vessels, helicopters or MODUs outside of the exploration permit area (e.g. travel to and from WA-343-P). These activities will be undertaken in accordance with other relevant maritime and aviation legislation; most notably, the *Navigation Act 2012* (Cwlth) and *Civil Aviation Act 1988* (Cwlth).

1.2 Overview of activity description

Table 1-1: Overview of the activity description

Item	Description
Exploration permit area	WA-343-P
Basin	Browse
Anticipated hydrocarbon	Gas and condensate
Location	Wholly located within Commonwealth waters, approximately 400 km from Derby, Western Australia in the North-West Marine Region of the Timor Sea. The location of the exploration well is yet to be finalised; however, it will fall within the boundaries of the WA-343-P permit area.
MODU and vessels	Survey vessel MODU Support vessels
Activities	Pre-drill site survey and drilling of an exploration well in WA-343-P.
Activity commencement	Pre-drill site survey H2 2019 Drilling H1 2020
Anticipated duration	Pre-drill site survey: 7-10 days Drilling: 120 - 150 days

1.3 Titleholder details

INPEX Browse E&P Pty Ltd is a joint titleholder of exploration permit WA-343-P along with Total E&P Australia Exploration Pty Ltd. INPEX has been nominated as the single titleholder for the purposes of taking eligible voluntary actions under subsection 775B of the *Offshore Petroleum and Greenhouse Gas Act 2006* (OPGGS Act), such as making submissions.

In accordance with Regulation 15(1) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations), details of the titleholder are described in Table 1-2. INPEX will be responsible for ensuring that activities covered in this EP are carried out in accordance with the OPGGS (E) Regulations, this EP and other applicable Australian legislation.

Table 1-2: Titleholder details

Name	INPEX Browse E&P Pty Ltd (INPEX)
Business address	Level 22, 100 St Georges Tce, Perth, WA 6000
Telephone number	+61 8 6213 6000
Fax number	+61 8 6213 6455
Email address	enquiries@inpex.com.au
ABN	65 165 711 017

In accordance with Regulation 15(2) of the OPGGS (E) Regulations, details of the titleholder's nominated liaison person are provided in Table 1-3.

Table 1-3: Titleholder nominated liaison officer

Name	Eric Law
Position	Senior Environmental Advisor
Business address	Level 22, 100 St Georges Tce, Perth, WA 6000
Telephone number	+61 8 6213 6000
Email address	eric.law@inpex.com.au

2 ACTIVITY DESCRIPTION

As per the requirements of Regulation 13(1) of the OPGGS (E) Regulations, the following subsections provide a comprehensive description of the petroleum activity, including location, operational details, and any additional information relevant for consideration of the environmental risks and impacts associated with the activity.

2.1 Location and timing

The well is a vertical offshore exploration well that will be drilled in the Browse Basin exploration permit WA-343-P, located in Western Australia (Figure 1-1). As a pre-cursor to the drilling activity, a pre-drill site survey will be undertaken at the proposed well location within the permit. The objective of the survey is to evaluate the environment at the planned drilling location and confirm it is suitable for mooring a semi-submersible MODU. The site survey is provisionally planned to be undertaken in H2 2019 with drilling planned for during 2020. Activity start dates are subject to MODU and vessel availability.

2.2 Pre-drill site survey

The scope of the pre-drill site survey is to obtain a range of geophysical data for both the proposed well location and contingency blow-out relief well locations to enable the identification of any geohazards and allow completion of the required anchoring capacity assessments. The survey will be performed across an area of up to approximately 44 km^2 centered on multiple well locations i.e. the proposed exploration well location and up to four possible relief well locations, surveyed as a precaution.

The survey vessel contractor has yet to be confirmed; however, they will be selected in accordance with the INPEX contractor management requirements.

The survey will be undertaken using a multi-purpose, DP survey vessel that will use marine diesel fuel. The survey vessel is expected to be approximately 35 m in length. Vessel speeds during survey data acquisition are expected to be low (typically < 5 knots). Due to the short duration of the survey (approximately 7-10 days), vessel refueling, crew changes or anchoring are not anticipated to be required. The survey vessel is expected to be mobilised from either Broome, Darwin or Exmouth.

2.3 Drilling activities

The well will be drilled in approximately 350 m water depth and is planned to reach a total depth (TD) of approximately 5,500 m MDRT (measured depth below the rotary table). The main target of the well are Jurassic Sandstones. The well is designed as a High Pressure – High Temperature (HPHT) exploration well. After reaching total depth it is planned to conduct a wireline evaluation programme and then permanently abandon the well. Drilling activities are anticipated to last approximately 120 - 150 days dependent on potential delays due to unfavourable weather or operational issues.

2.4 Indicative drilling method

The well design is considered to be a type common to the Browse Basin with the casing configuration detailed in

Table 2-1.

Table 2-1: Well details

Well section description	Section depth (m) [Well TD (mMDRT]	Drilling fluid type	Volume of fluid disposed with cuttings (m^3)	Volume of cuttings discharged (m^3)
44" well-bore diameter; 36" conductor complete with a low pressure housing	449 [449]	WBM, sea water + high-viscosity (hi-vis) gel sweeps. At TD, the hole will be displaced with hi-vis gel mud. While drilling riserless, all returns will be to the seabed. Fluid remaining at the end of these hole sections will be used on the next hole section.	240	60
26" well-bore diameter; 20" surface casing complete with 15,000 psi high pressure housing	538 [987]		715	220
17 ½" well-bore diameter; 13 $^{3}/_{8}$" intermediate casing	1573 [2560]	WBM, gel polymer. This hole section will be drilled with a closed circulating system, (i.e. returns from the well will be circulated back to the MODU and then pumped back down the well). At the end of this section all remaining WBM will discharged overboard.	1350	300
12 ¼" well-bore diameter; 9 $^{5}/_{8}$" intermediate casing	1827 [4387]	Low toxicity SBM.	225	160

Well section description	Section depth (m) [Well TD (mMDRT]	Drilling fluid type	Volume of fluid disposed with cuttings (m^3)	Volume of cuttings discharged (m^3)
		Technical justification for SBM use: This hole section will penetrate massive claystone sections including the Jamieson, Echuca Shoals and Lower Echuca Shoals formations. These formations, particularly the Jamieson formation, are known to contain highly reactive claystones. The use of WBM in these formations is known to result in borehole breakout and well-bore collapse which will possibly result in the loss of the hole section and compromising the well objectives. SBM has much lower levels of reactivity with shales and as such is much less likely to destabilise them during drilling, tripping and running casing. SBM containment management systems, shale shakers and cuttings dryers will be used to minimise the amount of SBM discharged to the environment as residual oil-on-cuttings. At the end of the section, the mud will be retained and used on the next hole section. At the end of drilling, all the recaptured SBM will be returned to the vendor for reuse.		
8 ½" well-bore diameter (drilled through the primary and secondary targets) Or Contingent 7" drilling liner	1088 [5475]	Low toxicity SBM. **Technical justification for SBM use:** This hole section will also penetrate massive claystone sections as described above for the 9 $^5/_8$" section and is applicable here. Furthermore, the anticipated bottom hole temperatures when drilling the reservoir section are expected to be approximately 165°C during circulation and 214°C when circulation ceases. It is unlikely that a WBM system would be stable at these temperatures.	120	45

Well section description	Section depth (m) [Well TD (mMDRT]	Drilling fluid type	Volume of fluid disposed with cuttings (m³)	Volume of cuttings discharged (m³)
Contingent 6" well-bore diameter drilled through the primary and secondary targets; (no casing or liner run).	1088 [5475]	Low toxicity SBM. **Technical justification for SBM use:** As described above for 8 ½" hole section.	80	35

2.5 Drilling fluids and chemical selection

A description of the chemical selection procedure for drilling fluids is presented in Section 8. The proposed mud system formulations and proposed chemicals to be used may change during the activity as new products are required. Indicative OCNS or CHARM HQ rankings have been used where possible. Any new products will be selected in accordance with the selection and approval process, and the list will be reviewed periodically and updated.

2.6 Drill cuttings

WBM drill cuttings will either be discharged directly to the seabed (while drilling the riserless 44" and 26" diameter sections) or brought up to the MODU (while drilling the subsequent 17 ½" diameter section). Cuttings brought up to the MODU will be directed over solids control equipment (SCE), which comprises vibrating screens (shale shakers), and to centrifuges, and then discharged overboard. Where SBM is used, SCE will also include cuttings dryers. Except for residual fluid on drill cuttings, no SBM will be discharged into the marine environment. Details of the SCE equipment are provided below.

Shale shakers

Shale shakers primarily remove large amounts of cuttings from drilling mud by directing it from the well to flow over vibrating wire-cloth screens. The screens remove the cuttings after which the mud is directed back to the MODU mud-storage pits.

Centrifuges

Following the processing by shale shakers, the mud will be directed to centrifuges which are used to separate barite and remove fine solids (those below 4.5 to 6 microns). Centrifuges use a rotating bowl to create high centrifugal forces to effect the separation of coarse and fine particles from the mud. Solids from the centrifuge are discharged to sea and the mud recirculated into the fluid system.

Cuttings dryer and dryer centrifuge

While using SBM, a circulating system will be active that processes the SBM over shale shakers and through centrifuges. These allow the SBM fluid component to be separated from the cuttings and captured for continuous recirculation into the fluid system during drilling.

2.7 Cementing

Cementing operations are undertaken to ensure well integrity, through the following mechanisms:

- cementing the casing and conductor in place

- sealing the annulus between the casing string and the formation
- sealing a lost circulation zone
- setting a plug in an existing well from which to sidetrack
- plugging and abandoning the well.

Cement is transported as dry bulk to the MODU by the support vessels and is mixed with water in the cementing unit immediately before use to form a wet grout or a cement slurry which is then injected down the well by high-pressure pumps.

2.8 Wireline formation evaluation

The wireline formation evaluation program consists of a firm "dry hole" program and a contingent "success case" program within the planned 8 ½ inch hole section and contingent 6-inch hole section. The "success case" program will be run if gas bearing reservoir quality sandstones are confirmed by either mud-logging and/and or Logging While Drilling (LWD) analysis.

The subsurface geology of the area around the well will be "profiled" using a technique called vertical seismic profiling (VSP). This technique uses a sound source suspended in the water column and recorders located down-hole to provide a high-resolution seismic image of the immediate vicinity of the well.

The sound source used for VSP is similar to, but much smaller than, those used during seismic surveys. Typically, a total array volume of 0.02 m^3 (~1200 cubic inches) is used, but a smaller acoustic source with a total array volume of 0.012 m^3 (~750 cubic inches) may also be employed. The sound pressure level will be 232 dB re 1 μPa@1m with a frequency range of 5–125 Hz.

The acoustic source array is discharged 5–10 m below sea surface approximately five times at approximately 20-second intervals, with recordings taken down-hole at a specific depth. Additional recordings are made at 5–7 minute intervals as the down-hole tool is repositioned within the well. The total duration of VSP activities (excluding soft starts) is estimated to take approximately 18 hours but will be dependent on the results of the well which is being profiled and the schedule of activities. VSP measurements are used primarily for correlation with existing seismic data.

2.9 Gas venting

During drilling of the well, a kick may occur in the reservoir. A kick is an undesirable influx of formation fluid into the well-bore. The most credible scenario has been calculated for the exploration drilling campaign as a 25 barrel gas condensate release from the 8 ½" hole section. The resultant effect would be a release of 0.124 MMscf of gas via the mud-gas separator to the atmosphere during well control operations.

2.10 Well abandonment

On completion of the drilling and wireline evaluation activities, the well will be permanently plugged and abandoned in accordance with the Well Operations Management Plan (WOMP). A two barrier philosophy for permanent abandonment will be maintained in compliance with INPEX barrier standards (INPEX Well Integrity Standard (0000-AD-STD-60003)).

Well abandonment activities will also be undertaken in accordance with the requirements of the OPGGS Act and the OPGGS (Resource Management and Administration) Regulations 2011.

2.11 Contingent drilling activities

A number of contingencies, detailed in Table **2-2**, may be required if any operational or technical issues arise during the drilling activity. These contingencies do not represent significant risk or impacts but may generate additional volumes of drilling fluids and cuttings which would need to be appropriately managed.

Table 2-2: Drilling contingencies

Contingency	Contingency establishment	Description	Environmental considerations
Well re-spud	In the event that operational or technical issues are encountered while drilling.	The process of beginning to drill a well. The location of the re-spud would typically be within the immediate area of the original well at a safe location.	The net environmental effect will be limited to an increase in the volume of cuttings generated. In a worst-case scenario, this could be a doubling of the estimated 280 m^3 of drill cuttings from the first two sections of the well-bore. There may also be some additional temporary, localised damage to benthic habitat. Should a well re-spud be required, the original well will be permanently plugged and abandoned.
Sidetrack	In some instances, the option of a sidetrack instead of a re-spud might be pursued when operational issues are encountered.	The process of drilling a secondary well-bore away from an original well-bore.	The net environmental effect will be limited to an increase in the volume of cuttings generated. This volume of cuttings would, at a worst case, be equivalent to cuttings generated from a single section of the well, i.e. maximum 300 m^3 of drill cuttings.
Lost circulation	Circulation is said to be lost when the drilling fluid flows into one or more geological formations instead of returning up the annulus.	A number of contingencies are available when lost circulation occurs, depending on the severity: • minor losses may be controlled with the use of fluid-loss control materials such as bentonite and/or polymers, or other additives	The net environmental effect would be a change in the water quality at the point of discharge. Depending on the volume of discharge, this could potentially form a temporary plume before it is dispersed back to ambient levels.

Contingency	Contingency establishment	Description	Environmental considerations
		• severe losses will require the use of fluid-loss control materials such as bentonite and/or polymers and the addition of bridging agents such as ground calcium carbonate and fibrous material • pull back, cement the zone where the losses occurred, and drill through the cement and recommence drilling the well.	

2.12 Semi-submersible MODU and supporting vessels and aircraft

The exact MODU (and MODU contractor) to undertake the drilling activity has yet to be confirmed, however due to water depths in the permit area, it will be a semi-submersible MODU, with an expected complement of between 100 and 140 personnel. The MODU will maintain position either using DP or it will be anchored. While on location, a PSZ with a 500 m radius will be maintained around the MODU to control activities and reduce the risk of marine collisions, as required under the OPGGS Act. Marine Safety Information (MSI) notifications will be issued via AMSA, while the Australian Hydrographic Office (AHO) will issue a Notice to Mariners. The MODU will be supported by two to three vessels, as well as regular helicopter flights from the mainland.

The AHSVs and the PSV will be used to transport equipment, materials and fuel between the MODU and the port of Broome, the marine supply base for the activity. The AHSVs will be used to deploy and accurately position anchors for the MODU if required. The vessels will also conduct safety lookouts for helicopter landings and take-offs; monitor the 500 m PSZ maintained around the MODU; and provide support in the event of emergencies.

Aviation support will be based at Broome International Airport. Helicopters based in Broome will be used to transfer personnel to and from the MODU several times per week. The transfer frequency may vary depending on MODU manning, the operational phase of the well, and the specification (capacity) of the helicopters contracted.

2.13 Anchoring

If a moored semi-submersible MODU is used to drill the well, a minimum of eight anchors will be deployed by AHSVs and lowered to the seabed. The MODU will then winch in the slack from the mooring lines to the required tension. Anchors will be spread in a radial pattern extending from the MODU, the size of the anchor spread will be dependent on the MODU selected and the mooring analysis conducted during the well planning stage. Vessels will not moor at the well location; and will use DP instead. Additionally, no anchoring would occur if a DP MODU is used to drill the well.

3 EXISTING ENVIRONMENT

3.1 Regional setting

The permit area (WA-343-P) is situated in the northern Browse Basin, approximately 400 km north of Derby, Western Australia. In the event of a worst-case unplanned oil spill, the environment that may be affected (EMBA) covers a considerably larger area than the permit area where planned activities will occur.

The spatial extent of the EMBA was determined using stochastic spill modelling. This considered the worst-case credible hydrocarbon scenarios identified for the activity in context of defined hydrocarbon exposure thresholds used to determine impacts to fauna and/or habitats for surface hydrocarbons, entrained oil and dissolved aromatic hydrocarbons.

The resulting EMBA is the sum of 300 overlaid modelling runs (100 per season) for worst-case spill scenarios, during all seasons (wet, transitional and dry) and under different hydrodynamic conditions (e.g. currents, winds, tides, etc.). As such, the actual area that may be affected from any single spill event would be considerably smaller than represented by the EMBA.

The EMBA has been used to identify relevant values and sensitivities that may be affected and has been used as the basis for the EPBC Protected Matters Database search.

3.1.1 Australian waters

Australia's offshore waters have been divided into six marine regions in order to facilitate their management by the Australian Government under the EPBC Act. The permit area is located entirely within the North-west Marine Region (NWMR). The EMBA intersects with the NWMR, the North Marine Region (NMR) and with a small portion of the South-west Marine Region (SWMR). The relevant key features of the NWMR, NMR and SWMR in the context of the permit area and worst-case EMBA are further described in subsequent sections of this EP Summary.

3.1.2 External Australian Territories

External Australian territories located within the EMBA include Ashmore and Cartier Islands, Christmas Island and the Cocos (Keeling) Islands.

Christmas Island covers approximately 135 km^2, of which approximately 60% has been declared a National Park (Geoscience Australia 2018b). The island is the summit of a submarine mountain, which rises steeply from sea level to a central plateau. The plateau reaches heights of up to approximately 360 m and consists mainly of limestone and layers of volcanic rock. Surrounding the island is a narrow tropical reef which plunges steeply to the ocean floor. Within 20 m of the shoreline, there are steep drop-offs reaching depths of approximately 500 m within about 200 m beyond the edge of the reef (Geoscience Australia 2018b). There is a diverse range of aquatic wildlife associated with the reef, and these undersea formations. Christmas Island is known for its population of red crabs (*Gecarcoidea natalis*) and there are more than 20 species of terrestrial and intertidal crabs (Geoscience Australia 2018b; DEE 2018m). The Dales and Hosnies Spring Ramsar sites are located on Christmas Island.

The Cocos (Keeling) Islands are a series of 27 coral islands formed into two large coral atolls situated in the Indian Ocean, with a total land area of 14 km^2 (Geoscience Australia 2018c). The territory is one of the remaining pristine tropical island groups in the Indian Ocean region with abundant wildlife, particularly seabirds. The Islands also have land crabs, turtles, a range of flora and a marine environment with a wide variety of corals, fish, molluscs, crustaceans and other species (Geoscience Australia 2018c). The northern atoll consists of North Keeling Island and the marine area extending 1.5 km around the Island forms Australia's most remote Commonwealth National Park, the Pulu Keeling National Park which is also a Ramsar site. The Cocos (Keeling) Islands provide important habitat for green turtles with a 20 km internesting buffer surrounding the Pulu Keeling National Park (October to April) (DEE 2017a).

3.1.3 International waters

The EMBA extends into the international waters of the Lesser Sunda Ecoregion and locations along the Indonesian shoreline. The Indonesian archipelago lies between the Pacific and Indian oceans and bridges the continents of Asia and Australia and comprises of over 17,000 islands (Huffard et al. 2012). The archipelago is divided into several shallow shelves and deep-sea basins (ABD 2014). Indonesian waters, especially the eastern part of the archipelago, play an important role in the global water mass transport system, in which warm water at the surface conveys heat to deeper cold waters. The water mass transport from the Pacific to the Indian Ocean through various channels in Indonesia is known as the Indonesian Throughflow.

The Lesser Sunda Ecoregion, located at the southern end of the Coral Triangle, encompasses the chain of islands and surrounding waters from Bali, Indonesia to Timor-Leste including East Nusa Tenggara (Indonesia’s southernmost province). This region contains suitable habitat for corals and is considered important for coral endemism, particularly the areas of Bali-Lombok, Komodo and East Flores. The Indonesian coastline is rich in tropical marine ecosystems such as sandy beaches, mangroves, coral reefs and seagrasses (Hutomo & Moosa 2005). The majority of the West Timor coastline features a narrow fringing coral reef community with four dense areas of mangrove communities occurring primarily along the south coast (Allen & Erdmann 2013). The Timor-Leste coastline also features mangrove communities surrounding entrances to rivers primarily on the south coast, whilst the north and eastern coasts comprise a higher degree of coral reef communities (Allen & Erdmann 2013).

3.2 Key ecological features

The Australian Government has identified parts of the marine ecosystem that are of importance for a marine region’s biodiversity or ecosystem function and integrity, referred to as key ecological features (KEFs). One KEF is located within WA-343-P, and a further 17 located within the EMBA. A description of each of this KEFs is provided in Table 3-1.

Table 3-1: **Key ecological features located in WA-343-P and/or the EMBA**

KEF name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Continental slope demersal fish communities	The level of endemism of demersal fish species in this community is the highest among Australian continental slope environments. The demersal fish species occupy two distinct demersal community types associated with the upper slope (water depth of 225–500 m) and the mid-slope (750–1,000 m) (DEE 2018n). Although poorly studied, it is suggested that the demersal-slope communities rely on bacteria and detritus-based systems comprised of infauna and epifauna, which in turn become prey for a range of teleost fish, molluscs and crustaceans (Brewer et al. 2007). Higher-order consumers may include carnivorous fish, deepwater sharks, large squid and toothed whales (Brewer et al. 2007). Pelagic production is phytoplankton based, with hot spots around oceanic reefs and islands (Brewer et al 2007). Bacteria and fauna present on the continental slope are the basis of the food web for demersal fish and higher-order consumers in this system. Therefore, loss of benthic habitat along the continental slope at depths known to support demersal fish communities could lead to a decline in species richness, diversity and endemism associated with this feature (DSEWPaC 2012a). Other potential concerns with regard to pressure on this KEF include climate change (increasing sea temperature/ocean acidification), habitat modification due to fishing gear and commercial fishing by-catch resulting in the potential to diminish the species richness and diversity of these communities (DEE 2018n).	Yes	Yes
Carnonate bank and terrace system of the Van Diemen Rise	The carbonate bank and terrace system of the Van Diemen Rise KEF is located approximately 550 km north-east from WA-343-P at its closest point, and to the north-west of the Tiwi Islands (the two principal islands of which are Melville Island and Bathurst Island). This KEF supports a complex system of shallow carbonate banks and shoals over a limestone terrace, strongly dissected by tidal channels and paleo-river channels (including the >150 m deep Malita Shelf Valley). Shallow, clear waters provide for a deep euphotic zone, the depth to which sufficient light for photosynthesis penetrates into the ocean. Therefore, enhanced benthic primary production and localised upwellings generated by interactions between the complex topography and tidal currents encourage phytoplankton productivity and aggregations of fish. The banks, shoals and channels offer a heterogeneous environment of shallow to deep reef, canyon, soft sediment and pelagic habitats to a diverse range of tropical species of predominantly Western Australian affinities (DSEWPaC 2012b).	No	Yes
Pinnacles of the Bonaparte Basin	The Pinnacles of the Bonaparte Basin KEF is located approximately 420 km east of WA-343-P, at its closest point. This KEF consists of an area containing limestone pinnacles, up to 50 m high (above the surrounding seabed) and is located in the western Joseph Bonaparte Gulf on the mid-to-outer edge of the shelf (DSEWPaC 2012b). They represent 61% of the limestone pinnacles in the NWMR and 8% of limestone pinnacles in the Australian EEZ (Baker et al. 2008). The pinnacles of the Bonaparte Basin are thought to be the eroded remnants of underlying strata. It is likely that the vertical walls generate local upwelling of nutrient rich water, leading to phytoplankton productivity that attracts aggregations of planktivorous and predatory fish, seabirds and foraging turtles (DSEWPaC 2012b). As the pinnacles provide areas of hard substrate in an otherwise relatively featureless, soft sediment environment they are presumed to support a high number of species. Associated communities are thought to include sessile benthic invertebrates including hard and soft corals and sponges, and aggregations of demersal fish species such as snapper, emperor and grouper (Brewer et al. 2007). The pinnacles are thought to be a feeding area for flatback, loggerhead and olive ridley turtles, while green turtles may traverse the area. Freshwater and green sawfish as well as humpback whales may also occur in the area (Donovan et al. 2008). However, sawfish are more likely to be found in nearshore and estuarine areas, not within the areas of the KEF that intersect the EMBA.	No	Yes
Shelf break and slope of the Arafura Shelf	The shelf break and slope of the Arafura Shelf KEF is located approximately 750 km north-east of WA-343-P, at its closest point. The Arafura Shelf is an area of continental shelf up to 350 km wide and mostly 50–80 m deep, comprising of sea-floor features such as canyons, terraces, the Arafura Sill and the Arafura Depression. The shelf break and slope of the Arafura Shelf is characterised by continental slope and patch reefs, and hard substrate pinnacles (DSEWPaC 2012b). The ecosystem processes of the feature are largely unknown in the region; however, the Indonesian Throughflow and surface wind-driven circulation are likely to influence nutrients, pelagic dispersal and species and biological productivity in the region. Biota associated with the feature is typical of that found elsewhere in tropical waters around Northern Australia, Indonesia, Timor-Leste and Malaysia (DSEWPaC 2012b).	No	Yes

KEF name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Tributary canyons of the Arafura Depression	The tributary canyons of the Arafura depression KEF is located approximately 1,100 km north-east of WA-343-P, at its closest point. The KEF comprises of a series of shallow canyons approximately 80–100 m deep and 20 km wide that lead into the Arafura Depression, which consists mainly of calcium carbonate–based sediments e.g. carbonate sand and subfossil shell fragments (DSEWPaC 2012b). The largest of the canyons extend some 400 km from Cape Wessel into the Arafura Depression, and are the remnants of a drowned river system that existed during the Pleistocene era. Sediments in this feature are mainly calcium-carbonate rich, although sediment type varies from sandy substrate to soft muddy sediments and hard, rocky substrate. Marine turtles, deep sea sponges, barnacles and stalked crinoids have all been identified in the area (DSEWPaC 2012b).	No	Yes
Ancient coastline of 125m depth contour	The ancient coastline at 125 m depth contour KEF runs diagonally in a north-easterly direction, approximately 50 km south of WA-343-P, at its closest point. Parts of the ancient coastline, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments. The topographic complexity of the escarpments may facilitate vertical mixing of the water column, providing relatively nutrient rich local environments. The ancient coastline is an area of enhanced productivity, attracting baitfish which, in turn, supplies food for migrating species (DSEWPaC 2012a). While there is little information available on the fauna associated with the hard substrate of the escarpment, it is likely to include sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates representative of hard substrate fauna in the NWMR (DSEWPaC 2012a).	No	Yes
Ashmore Reef and Cariter Island and surrounding Commonwealth waters	The Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF is located approximately 80 km north of WA-343-P, at its closest point. The KEF is recognised for its ecological functioning and integrity (high productivity), and biodiversity (aggregations of marine life) values, which apply to both the benthic and pelagic habitats within the feature. Ashmore Reef is the largest of only three emergent oceanic reefs in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The waters surrounding Ashmore Reef and Cartier Island are important because they are areas of enhanced productivity in relatively unproductive waters (DSEWPaC 2012a).	No	Yes
Canyons linking the Argo Abyssal Plain with Scott Plateau	The canyons linking the Argo Abyssal Plain with the Scott Plateau KEF is located approximately 400 km west of WA-343-P, at its closest point. The Bowers and Oats canyons are major canyons on the slope between the Argo Abyssal Plain and Scott Plateau. The canyons cut deeply into the south-west margin of the Scott Plateau at a depth of approximately 2,000–3,000 m, and act as conduits for transport of sediments to depths of more than 5,500 m on the Argo Abyssal Plain. Benthic communities at these depths are likely to be dependent on particulate matter falling from the pelagic zone to the seafloor. The ocean above the canyons may be an area of moderately enhanced productivity, attracting aggregations of fish and higher order consumers, such as large predatory fish, sharks, toothed whales and dolphins. The canyons linking the Argo Abyssal Plain and Scott Plateau are likely to be important features due to their historical association with sperm whale aggregations (DSEWPaC 2012a).	No	Yes
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	The canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF is located approximately 1,300 km south of WA-343-P, at its closest point. Cape Range Peninsula and the Cuvier Abyssal Plain are linked by canyons, the largest of which are the Cape Range Canyon and Cloates Canyon. These two canyons are located along the southerly edge of Exmouth Plateau adjacent to Ningaloo Reef and are unique due to their close proximity to the North West Cape (DSEWPaC 2012a). The Leeuwin Current interacts with the heads of the canyons to produce eddies resulting in delivery of higher nutrient, cool waters from the Antarctic intermediate water mass to the shelf (Brewer et al. 2007). Strong internal tides also create upwelling at the canyon heads (Brewer et al. 2007). Thus the canyons, the Exmouth Plateau and the Commonwealth waters adjacent to Ningaloo Reef interact to create the conditions for enhanced productivity seen in this region (DSEWPaC 2012a). The canyons are also repositories for particulate matter deposited from the shelf and sides of the canyons and serve as conduits for organic matter between the surface, shelf and abyssal plains (DSEWPaC 2012a). The soft bottom habitats within the canyons themselves are likely to support important assemblages of epibenthic species. Biological productivity at the head of Cape Range Canyon in particular, is known to support species aggregations, including whale sharks, manta rays, humpback whales, sea snakes, sharks, large predatory fish and seabirds. The canyons are thought to be significant contributors to the biodiversity of the adjacent Ningaloo Reef, as they channel deep water nutrients up to the reef, stimulating primary productivity (DSEWPaC 2012a).	No	Yes
Carbonate Bank and Terrace System of the Sahul Shelf	The carbonate bank and terrace system of the Sahul Shelf KEF is located in the western Joseph Bonaparte Gulf, approximately 185 km north-east of WA-343-P, at its closest point. The KEF is recognised for its biodiversity values (a unique seafloor feature with ecological properties of regional significance), which apply to both its benthic and pelagic habitats. The banks consist of a hard substrate with flat tops. Each bank occupies an area generally less than 10 km2 and is separated from the next bank by narrow sinuous channels up to 150 m deep (DSEWPaC 2012a).	No	Yes

KEF name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
	Although little is known about the bank and terrace system of the Sahul Shelf, it is considered to be regionally important due to its continuous and large expanse, as well as the ecological role it is likely to play in the biodiversity and productivity of the Sahul Shelf (DSEWPaC 2012a). The banks support a high diversity of organisms, including reef fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter-feeders (Brewer et al. 2007). They are foraging areas for loggerhead, olive ridley and flatback turtles. Humpback whales and green and freshwater sawfish are also likely to occur in the KEF (Donovan et al. 2008). However, due to their ecology, sawfish (generally estuarine rather than open-ocean species), are not expected to be present within open-ocean environments.		
Commonwealth waters adjacent to Ningaloo Reef	The Commonwealth waters adjacent to Ningaloo Reef KEF is located approximately 1,350 km south of WA-343-P, at its closest point. This KEF is defined for high levels of productivity and aggregations of marine life. Ningaloo Reef extends almost 300 km along the Cape Range Peninsula to the Red Bluff and is globally significant as the only extensive coral reef in the world that fringes the west coast of a continent. Commonwealth waters adjacent to the reef are thought to support the rich aggregations of marine species at Ningaloo Reef through upwellings associated with canyons on the adjacent continental slope and interactions between the Ningaloo and Leeuwin currents (Brewer et al. 2007, DSEWPaC 2012a). The narrow continental shelf (10 km at its narrowest) means that the nutrients channelled to the surface via canyons are immediately available to reef species. Terrestrial nutrient input is low, hence this deep-water source is a major source of nutrients for Ningaloo Reef and therefore very important in maintaining this system (DSEWPaC 2012a). The reef is known to support an extremely abundant array of marine species including over 200 species of coral and more than 460 species of reef fish, as well as molluscs, crustaceans and other reef plants and animals (DSEWPaC 2012a). Marine turtles, dugongs and dolphins frequently visit the reef lagoon. The Commonwealth waters around Ningaloo also include areas of potentially high and unique sponge biodiversity (DSEWPaC 2012a). Upwellings on the seaward side support aggregations such as whale sharks and manta rays (these waters are the main known aggregation area for whale sharks in Australian waters). Humpback whales are seasonal visitors to the outer reef edge and sea snakes, sharks, large predatory fish and seabirds also utilise the reef and surrounding waters.	No	Yes
Exmouth Plateau	The Exmouth Plateau KEF is located approximately 1,150 km south of WA-343-P, at its closest point. The Exmouth Plateau KEF is a regionally and nationally unique tropical deep sea plateau with ecological properties of regional significance and covers an area of 49,310 km^2. The plateau ranges in water depths from 800 to 4,000 m (DSEWPaC 2012a). The plateau's surface is rough and undulating at 800–1,000 m depth. The northern margin is steep and intersected by large canyons (e.g. Montebello and Swan canyons) with relief greater than 50 m. The western margin is moderately steep and smooth, and the southern margin is gently sloping and virtually free of canyons (DSEWPaC 2012a). The Exmouth Plateau is thought to play an important ecological role by acting as a topographic obstacle that modifies the flow of deep waters that generate internal tides, causing upwelling of deeper water nutrients closer to the surface (Brewer et al. 2007). Sediments on the plateau suggest that biological communities include scavengers, benthic filter feeders and epifauna. Fauna in the pelagic waters above the plateau are likely to include small pelagic species (Brewer et al. 2007).	No	Yes
Glomar Shoals	The Glomar Shoals KEF is located approximately 1,000 km south of WA-343-P, at its closest point. The Glomar Shoals are a submerged littoral feature on the Rowley Shelf at depths of 33–77 m (Falkner et al. 2009). The shoals consist of a high percentage of marine-derived sediments with high carbonate content and gravels of weathered coralline algae and shells (McLoughlin & Young 1985). The area's higher concentrations of coarse material in comparison to surrounding areas are indicative of a high-energy environment subject to strong sea-floor currents (Falkner et al. 2009). Cyclones are also frequent in this area of the north-west and stimulate periodic bursts of productivity as a result of increased vertical mixing. While much of the biodiversity associated with the Glomar Shoals has not been studied the fish of Glomar Shoals are probably a subset of reef-dependent species, and anecdotal and fishing industry evidence suggests they are particularly abundant (DSEWPaC 2012a).	No	Yes
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	The Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals KEF is located approximately 550 km south-west of WA-343-P, at its closest point. The Rowley Shoals are a collection of three atoll reefs, Clerke, Imperieuse and Mermaid, which are located approximately 300 km north-west of Broome. The KEF is regionally important in supporting high species richness, higher productivity and aggregations of marine life associated with the adjoining reefs themselves (Done et al. 1994; DSEWPaC 2012a). The reefs provide a distinctive biophysical environment in the region as there are few offshore reefs in the north-west. They have steep and distinct reef slopes and associated fish communities. Enhanced productivity contributes to species richness due to the mixing and resuspension of nutrients from water depths of 500-700 m into the photic zone (DSEWPaC 2012a). In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done et al. 1994). The reefs associated with the Rowley Shoals are further described in sections 3.3 and 3.6.	No	Yes

KEF name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	The Seringapatam Reef and Commowealth water in the Scott Reef Complex KEF is located approximately 150 km west of WA-343-P, at its closest point. This KEF comprises Seringapatam Reef, Scott Reef North and Scott Reef South. Scott and Seringapatam reefs are part of a series of submerged reef platforms that rise steeply from the seafloor. The total area of this KEF is approximately 2,400 km^2 (DSEWPaC 2012a). Seringapatam Reef is a small circular-shaped reef, the narrow rim of which encloses a relatively deep lagoon. Much of the reef becomes exposed at low tide. There are large boulders around its edges, with a few sandbanks, which rise about 1.8 m above the water, on the west side. The reef covers an area of 55 km^2 (including the central lagoon). Scott Reef North is a large circular-shaped reef composed of a narrow crest, backed by broad reef flats, and a deep central lagoon that is connected to the open sea by two channels. The reef and its lagoon cover an area of 106 km^2. Scott Reef South is a large crescent-shaped formation with a double reef crest. The reef and its lagoon cover an area of 144 km^2. Scott and Seringapatam reefs are regionally significant because of their high representation of species not found in coastal waters off WA, and for the unusual nature of their fauna which has affinities with the oceanic reef habitats of the Indo-West Pacific, as well as the reefs of the Indonesian region. The coral communities at Scott and Seringapatam reefs play a key role in maintaining the species richness and subsequent aggregations of marine life identified as conservation values for this KEF. Scott Reef is a particularly biologically diverse system and includes more than 300 species of reef-building corals, approximately 400 mollusc species, 118 crustacean species, 117 echinoderm species, and around 720 fish species (Woodside 2009). Scott and Seringapatam reefs, and the waters surrounding them, attract aggregations of marine life, including humpback whales and other cetacean species, whale sharks and sea snakes (Donovan et al. 2008; Jenner et al. 2008; Woodside 2009). Two species of marine turtle, the green and hawksbill, nest during the summer months on Sandy Islet (a small sand cay), located on Scott Reef South. These species also internest and forage in the surrounding waters (Guinea 2006). The reef also provides foraging areas for seabird species, such as the lesser frigatebird, wedge-tailed shearwater, brown booby and roseate tern (Donovan et al. 2008).	No	Yes
Wallaby Saddle	The Wallaby Saddle KEF is located approximately 1,850 km south of WA-343-P, at its closest point. The KEF is recognized for its high productivity and aggregations of marine life. The Wallaby Saddle is an abyssal geomorphic feature located on the upper continental slope at a depth of 4,000–4,700 m (DSEWPaC 2012a). The feature connects the north-west margin of the Wallaby Plateau with the margin of the Carnarvon Terrace (DSEWPaC 2012a). The KEF is situated within the Indian Ocean water mass and is thus differentiated from systems situated to the north, that are dominated by transitional fronts or the Indonesian Throughflow (DSEWPaC 2012a). Little is known about the KEF; however, the area is considered one of enhanced productivity and low habitat diversity (Brewer et al. 2007). The KEF is associated with historical aggregations of sperm whales (DSEWPaC 2012a).	No	Yes
Western demersal slope and associated fish communities of the Central Western Province	The Western demersal slope and associated fish communities KEF is located over 1,750 km south of WA-343-P, at its closest point. The KEF is defined as a key ecological community for its high levels of biodiversity and endemism with the western demersal slope providing important habitat for demersal fish communities. A diverse assemblage of demersal fish species below a depth of 400 m is dominated by relatively small benthic species such as grenadiers, dogfish and cucumber fish. Unlike other slope fish communities in Australia, many of these species display unique physical adaptations to feed on the sea floor (such as a mouth position adapted to bottom feeding), and many do not appear to migrate vertically in their daily feeding habits (DSEWPaC 2012c).	No	Yes

3.3 Australian marine parks

Australian Marine Parks (AMPs) have been established around Australia as part of the National Representative System of Marine Protected Areas (NRSMPA). The primary goal of the NRSMPA is to establish and effectively manage a comprehensive, adequate and representative system of marine reserves to contribute to the long-term conservation of marine ecosystems and protect marine biodiversity. WA-343-P does not overlap any AMPs. The AMPs that overlap the EMBA and their IUCN categories are outlined with a further description provided in Table 3-2.

Table 3-2: Australian Marine Parks within the EMBA

AMP name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Abrolhos Marine Park	The Abrolhos Marine Park is located in the SWMR and covers an area of approximately 88,000 km^2. Water depths in the marine park (MP) range from less than 15 m to 6,000 m (Parks Australia 2018a). The Abrolhos MP is located approximately 1850 km from WA 343-P and only intersects with the southernmost part of the EMBA. The MP provides important foraging areas for several threatened and migratory bird species and comprises of important migration habitat for the protected humpback whale and pygmy blue whales (Director of National Parks 2018a). The Abrolhos MP has the second largest canyon on the west coast, the Houtman Canyon and provides many examples of diverse seafloor features including: southern most banks and shoals of the North-west region, deep holes and valleys, slope habitats, terrace and shelf environments (Director of National Parks 2018a). The MP is adjacent to the Shark Bay World Heritage Property.	No	Yes
Arafura Marine Park	The Arafura MP in the NMR is Australia's most northerly marine park and covers an area of approximately 23,000 km^2 (Parks Australia 2018b). The boundary of Arafura MP borders Australia's EEZ and is located approximately 1,000 km from WA-343-P. The Arafura MP includes canyons that are remnants of an ancient drowned river system (the tributary canyons of the Arafura Depression). The canyons funnel deep, nutrient-rich ocean waters upward, boosting marine life in the MP (Director of National Parks 2018c). Marine life found in the MP includes Spanish mackerel, whale sharks, sawfishes as well as marine turtles and deep-sea sponges (Parks Australia 2018b).	No	Yes
Argo-Rowley Terrace Marine Park	The Argo-Rowley Terrace MP covers an area of approximately 146,000 km^2 and is the largest AMP in the north-west (Parks Australia 2018c). Its eastern boundary is approximately 350 km from WA-343-P. The reserve is an important area for sharks, which are found in abundance around the Rowley Shoals, and provides important foraging areas for migratory seabirds and the endangered loggerhead turtle (Director of National Parks 2018b).	No	Yes
Arnhem Marine Park	Arnhem MP covers an area of 7,125 km^2 with water depths of less than 15 m to 70m (Parks Australia 2018d). It is located in the NMR, approximately 1,100 km from WA-343-P. Due to the presence of localised upwellings resulting from tidal eddies, internal currents and the presence of pinnacles on the seafloor, a large range of marine fauna is present within the MP. The MP provides important breeding and foraging habitats for birds including bridled terns (Director of National Parks 2018c).	No	Yes
Ashmore Reef Marine Park	Ashmore Reef MP is in the NWMR and is located 130 km north WA-343-P. It covers an area of 583 km^2 and the site is also a designated "wetland of international importance" under the Convention on Wetlands of International Importance (Ramsar Convention) especially as Waterfowl Habitat (Parks Australia 2018e). Ashmore Reef is an atoll-like structure with low, vegetated islands, sand banks, lagoon areas, and surrounding reef. It is the largest of only three emergent oceanic reefs present in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The reef exhibits a higher diversity of marine habitats compared with other North West Shelf (NWS) reefs, and supports an exceptionally diverse fauna, particularly for corals and molluscs (Director of National Parks 2018b). The reef and its surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of birds. It has major significance as a staging point for wading birds migrating between Australia and the northern hemisphere, including 43 species listed on one or both of the China–Australia Migratory Bird Agreement (CAMBA) and the Japan–Australia Migratory Bird Agreement (JAMBA). Ashmore Reef supports some of the most important seabird rookeries on the NWS, including colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns. It provides important staging points/feeding areas for many migratory seabirds (Parks Australia 2018e; Director of National Parks 2018b).	No	Yes
Carnarvon Canyon Marine Park	The Carnarvon Canyon MP is in the NWMR and is located approximately 1,700 km from WA-343-P. Water depths range from 1,500 m to 6,000 m and the MP covers an area of approximately 6,000 km^2 (Parks Australia 2018f).	No	Yes

AMP name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
	This MP is less well studied than other MPs in the NWMR but is thought to be where tropical and temperate species meet carried by the currents travelling north and south along the WA coast. Given the range in depths from 1500 m to 6,000 m, the MP is thought to provide habitat for a range of benthic and demersal species. The Carnarvon Canyon is a single channel canyon with seabed features that include slope, continental rise and deep holes and valleys. Habitats at the base of the Carnarvon Canyon comprise of soft sediments thought to suitable for deep-sea bristle worms, sea cucumbers and sea-pens (Parks Australia 2018f; Director of National Parks 2018b).		
Cartier Island Marine Park	Cartier Island MP is located in the NWMR approximately 95 km north of WA-343-P and covers an area of 172 km^2 (Parks Australia 2018g). The reserve includes Cartier Island and the area within a 4 nautical-mile radius of the centre of the island, to a depth of 1 km below the seafloor. It is an IUCN Category Ia Sanctuary Zone with water depths from less than 15 m to 500 m (Director of National Parks 2018b). Cartier Island is an unvegetated sandy cay surrounded by a reef platform. The island and its surrounding waters support prolific seabird rookeries, many species of which are migratory and have their main breeding sites on the small isolated islands. Seabirds at Cartier Island include colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red footed boobies, roseate terns, crested terns and lesser crested terns (Parks Australia 2018g). Much like Ashmore Reef, Cartier Island is an important staging point/feeding area for many migratory seabirds. The island also supports significant populations of feeding and nesting marine turtles and a high abundance and diversity of sea snakes (DSEWPaC 2012a). Cartier Island is part of the Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF (Section 3.2).	No	Yes
Eighty Mile Beach Marine Park	The Eighty Mile Beach MP is located in the NWMR and is approximately 625 km from WA-343-P. The MP covers an area of approximately 11,000 km^2 (Parks Australia 2018h). The MP provides habitat for endangered sawfishes, and food supplies for the migratory shorebirds that use the adjacent Eighty Mile Beach, one of the most important shorebird sites in Australia. The MP also provides important foraging areas adjacent to the nesting areas for marine turtles and includes part of the migratory pathway of the protected humpback whale (Director of National Parks 2018b). The reserve provides protection for the shelf, including terrace and banks and shoal habitats, with depths ranging from 15 m to 70 m (Parks Australia 2018h).	No	Yes
Gascoyne Marine Park	The Gascoyne MP is located in the NWMR and is approximately 1,300 km from WA-343-P. The MP covers an area of approximately 82,000 km^2 (Parks Australia 2018i). The canyons in the MP are believed to be associated with the movement of nutrients from deep water over the Cuvier Abyssal Plain onto the slope where mixing with overlying water layers occurs at the canyon heads. These canyon heads, including that of Cloates Canyon, are sites of species aggregation and are thought to play a significant role in maintaining the ecosystems and biodiversity associated with the adjacent Ningaloo Reef (Director of National Parks 2018b). The MP therefore provides connectivity between the inshore waters of the Ningaloo MP and the deeper waters of the area (Parks Australia 2018i).	No	Yes
Joseph Bonaparte Gulf Marine Park	The Joseph Bonaparte Gulf MP is located in the NMR, approximately 500 km from WA-343-P, on the WA-NT waters border. It occupies an area of approximately 8,600 km^2 with water depths ranging from less than 15 m to 100 m (Parks Australia 2018j). Key conservation values of the reserve include (Parks Australia 2018j; Director of National Parks 2018c): important foraging area for threatened and migratory marine turtles (green and olive ridley), and the Australian snubfin dolphin examples of the shallow water ecosystems and communities of the North West Shelf Transition Province, the second largest of all the provincial bioregions on the shelf, which includes the extensive banks that make up the Sahul Shelf, broad shelf terraces and the shallow basin in the Joseph Bonaparte Gulf (including the Cambridge-Bonaparte, Anson Beagle and Bonaparte Gulf mesoscale bioregions).	No	Yes
Kimberley Marine Park	The Kimberley MP is located approximately 135 km to the south and east of WA-343-P and occupies an area of approximately 74,500 km^2 (Parks Australia 2018k). This MP provides an important migration pathway and nursery areas for the protected humpback whale, and foraging areas for migratory seabirds, migratory dugongs, dolphins and threatened and migratory marine turtles (Director of National Parks 2018b). It is adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles (Parks Australia 2018k).	No	Yes

AMP name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Mermaid Reef Marine Park	The Mermaid Reef MP is located approximately 550 km south west of WA-343-P and is near the edge of Australia's continental slope, surrounded by waters that extend to a depth of over 500 m. Mermaid Reef MP covers an area of approximately 540 km^2 and is the most north-easterly of three reef systems forming the Rowley Shoals (Parks Australia 2018l). Mermaid Reef is totally submerged at high tide and therefore falls under Australian Government jurisdiction. The other two reefs of the Rowley Shoals, Clerke Reef and Imperieuse Reef are managed by the WA Government. Mermaid Reef (and the other Shoals) supports over 200 species of hard corals and 12 classes of soft corals with coral formations in pristine condition. The shoals are an important area for sharks, including the grey reef shark, the whitetip reef shark and the silvertip whaler; important foraging area for marine turtles; toothed whales; dolphins; tuna and billfish; and an important resting and feeding site for migratory seabirds (Parks Australia 2018l; Director of National Parks 2018b).	No	Yes
Montebello Marine Park	The Montebello MP covers an area of approximately 3,400 km^2. It is located approximately 1,100 km from WA-343-P and includes part of the migratory pathway for the protected humpback whale; foraging areas for vulnerable and migratory whale sharks; foraging areas adjacent to important nesting sites for marine turtles; and breeding sites of migratory seabirds (Parks Australia 2018m). The MP includes shallow shelf environments with depths ranging from 15 to 150 m and provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features. In addition, the 125 m ancient coastline KEF is included within the Montebello MP (Section 3.2). The Montebello Islands comprise over 100 islands, the majority of which are rocky. Other marine habitats within the marine park include coral reefs, mangroves, intertidal flats, extensive sheltered lagoonal waters, and shallow algal and seagrass reef platform extending to the south of the Montebello Islands to the Rowley Shelf (Director of National Parks 2018b). The complex seabed and island topography create a unique environment where these diverse habitats occur in close proximity to each other. The marine park's natural values include breeding habitat for seabirds, internesting, foraging, mating, and nesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks (Director of National Parks 2018b).	No	Yes
Ningaloo Marine Park	Ningaloo MP covers approximately 300 km along the west coast of the Cape Range Peninsula, with an area of approximately 2,500 km^2 (Parks Australia 2018n). Located in the NWMR and situated approximately 1,350 km from WA-343-P, Ningaloo Reef is the longest fringing reef in Australia forming a discontinuous barrier that encloses a lagoon that varies in width from 200 m to 7 km. Gaps that regularly intercept the main reef line provide channels for water exchange with deeper, cooler waters (DSEWPaC 2012a). It is the only example in the world of extensive fringing coral reef on the west coast of a continent. It is included in the adjacent Western Australian Ningaloo Marine Park (State Waters), which lies between the Ningaloo Marine Park and the WA coast (DSEWPaC 2012a). The Ningaloo MP provides important habitat (foraging areas) for vulnerable and migratory whale sharks, contains part of the migratory pathway of the protected humpback whale and provides foraging habitat and migratory pathway for pygmy blue whales (Director of National Parks 2018b). Significant areas of the MP are used by foraging marine turtles given the proximity of important internesting sites. The MP also provides breeding, calving, foraging and nursing habitat for dugong (Parks Australia 2018n). The Ningaloo MP contains the Ningaloo Coast World Heritage Property and the Ningaloo Coast National Heritage listing.	No	Yes
Oceanic Shoals Marine Park	WA-343-P is located approximately 300 km from the Oceanic Shoals MP. The MP occupies an area of approximately 72,000 km^2 with water depths from less than 15 m to 500 m (Parks Australia 2018o). The Oceanic Shoals MP is the largest marine park in the NMR. The reserve is an important resting area for turtles (internesting) for the threatened flatback turtle and olive ridley turtle. It is also an important foraging area for the threatened loggerhead turtle and olive ridley turtle (Director of National Parks 2018c).	No	Yes
Roebuck Marine Park	The Roebuck MP is located in the NWMR approximately 525 km from WA-343-P and is approximately 300 km^2 in size (Parks Australia 2018p). It includes part of the migratory pathway for the protected humpback whale as well as foraging areas adjacent to important nesting sites for flatback turtles, foraging areas for migratory seabirds, and foraging habitat for dugong (Director of National Parks 2018b). The reserve provides protection for shallow shelf habitats ranging in depth from 15 to 70 m and is adjacent to important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish, as well as foraging and calving areas for Australian snubfin, Indo-Pacific humpback and Indo-Pacific bottlenose dolphins (Parks Australia 2018p).	No	Yes

AMP name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Shark Bay Marine Park	Shark Bay Marine Park in the NWMR covers an area of approximately 7,500 km^2 (Parks Australia 2018q). Only partial intersected by the southernmost extent of the EMBA, the MP is located over 1,600 km from WA-343-P. Water depths range from less than 15 m to 220 m (Director of National Parks 2018b). The MP supports a range of species and habitats include breeding habitat for seabirds, internesting habitat for marine turtles, and a migratory pathway for humpback whales. The MP and adjacent coastal areas are also important for shallow-water snapper (Parks Australia 2018q; Director of National Parks 2018b). Shark Bay MP has a world-renowned population of over 10,000 dugongs, the largest population in the world that feed on vast seagrass meadows (Parks Australia 2018q). Additionally, the MP comprises of stromatolites at Hamelin Bay (outside of the EMBA) that are the oldest and largest living fossils in the world providing one of only four places where living marine stromatolites exist.	No	Yes

3.4 State and Territory reserves and marine parks

There are no State or Territory marine parks/reserves located within WA-343-P. The EPBC Act Protected Matters search identified a total of 38 State and Territory reserves within the EMBA. A description of these State or Territory marine reserves/parks is provided in Table 3-3.

The relevant State and Territory reserves within the EMBA are described below. Should any new State or Territory marine park/reserve management plans come into effect, the impacts of these changes will be assessed in accordance with Section 8 of this EP Summary.

Table 3-3: State or Territory Reserve/Marine Parks within the EMBA

State/Territory reserve/marine park name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Adele Island Nature Reserve	Adele Island is a declared nature reserve to protect the seabird breeding colonies, and is located approximately 230 km from WA-343-P. It is a hook-shaped island off the central Kimberley coast, located around 97 km north-northwest of Cape Leveque. The island covers an area of 2.17 km^2. Its surrounding sand banks sit atop a shallow-water limestone platform, surrounded by an extensive reef system (CCWA 2010). Adele Island is an important site for breeding seabirds with several species listed under the JAMBA, CAMBA and Republic of Korea–Australia Migratory Birds Agreement (ROKAMBA). There are known breeding colonies for masked booby (*Sula dactylatra*), red-footed booby (*Sula sula*), brown booby (*Sula leucogaster*), pied cormorant (Phalacrocorax varius), Australian pelican (*Pelecanus conspicillatus*), greater frigatebird (*Fregata minor*), lesser frigatebird (*Fregata ariel*), Caspian tern and lesser crested tern (CCWA 2010). The seabird colonies at Adele Island tend to have peak breeding periods from May to July; however, birds may also be present during the non-breeding season (DEWHA 2008). A study undertaken as part of an Applied Research Program (ARP) between INPEX and Shell in the Browse Basin, reported 12 species of seabird were found to breed at Adele Island in the 2014/2015 season. An additional eight species of seabird were considered non-breeding visitors. Twenty-six migratory shorebird species and three Australian resident shorebird species were also reported as using the reserve (Clarke 2015).	No	Yes
Bedout Island	Bedout Island is a Class 'A' nature reserve off the Pilbara coast of WA. Located approximately 830 km from WA-343-P and 96 km north-east of Port Headland. The island covers an area of approximately 0.4 km2 and was designated in 1975 (Protected Planet 2018a). The island is an undulating sand cay recognised as an Important Bird Area (IBA) and provides important habitat for breeding birds including the masked booby (Sula dactylatra), white-bellied sea eagle (Haliaeetus leucogaster), brown noddy (Anous stolidus) and several species of terns (crested, lesser crested, roseate and sooty) (Birdlife International 2018a).	No	Yes
Browse Island Nature Reserve	Browse Island is the nearest landform to WA-343-P (68 km away at its closest point) and is a Class 'C' nature reserve. It is an isolated sand cay surrounded by an intertidal reef platform and shallow fringing reef. The purpose of this reserve (#41775) is conservation, navigation (a lighthouse is present on the island), communication, meteorology and survey. The Browse Island reef complex is an outer shelf, biohermic structure rising from a depth of approximately 200 m. It is a flat-topped, oval-shaped, platform reef with the largest diameter being about 2.2 km. The island is a triangular, vegetated sandy cay, standing just a few metres above high tide level. It measures approximately 700 m by 400 m. Reef habitats at Browse Island are not diverse as confirmed by a study undertaken as part of the ARP for INPEX and Shell. In the study, a low level of diversity in invertebrates was reported. Soft corals and sponges were noted but reported levels were not considered abundant (Olsen et al. 2018). Rocky shore habitat on the island is represented only by exposed beach rock, and there are no intertidal sand flats. The lagoon habitat is poorly developed, with poor water circulation, and it shows evidence of recent infill and high mortality. The reef platform, especially on the western side, is high and barren in many places. Only the reef crest and seaward ramp habitats around the edge of the reef support moderately rich assemblages of molluscs. The shallow subtidal zone is narrow and supports relatively small areas of well-developed coral assemblages (INPEX 2010). Green and flatback turtle (*Chelonia mydas* and *Natator depressus*) nesting occurs during the summer months and Browse Island also provides habitat for seabirds and shorebirds. Further, the island (inclusive of a 20 km buffer) has been classified as critical habitat for green turtles from November to March under the Recovery Plan for Marine Turtles in Australia (DEE 2017a). It is thought that the Scott-Browse green turtles are a distinct genetic unit, nesting only at Scott Reef (Sandy Islet) and Browse Island. It is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). The DEE has not listed Browse Island as a marine avifauna BIA. However, colonies of nesting crested terns (Thalasseus bergii) were observed nesting on the north-western side of the island in a colony of approximately 1,000 birds (Olsen et al. 2018). Browse Island has also been recognised, through stakeholder consultation between INPEX and the DBCA, as an important location for seabirds and specifically green turtles, known to be part of a genetically distinct management unit.	No	Yes
Christmas Island Nature Park	The values and sensitivities of Christmas Island are described in sections 3.1.2 and 3.6.	No	Yes
Eighty Mile Beach Marine Park	The Eighty Mile Beach Marine Park covers an area of 2,000 km^2 and overlaps the Eighty Mile Beach Ramsar site (described in Section 3.6) (DPaW 2014). The MP extends from the highwater mark to the limit of state waters (3 nm) and is bordered by the Eighty Mile Beach MP (Section 3.3).	No	Yes

State/Territory reserve/marine park name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
	The intertidal sand and mudflat communities of Eighty Mile Beach are considered important for other species and ecosystems in and around the marine park. The flats have a high diversity of infauna living within the substrate and are covered with a surface film of microscopic algae and cyanobacteria (microphytobenthos). Studies indicate that microphytobenthos form the basis of food webs for a large variety of organisms, ranging from benthic invertebrates to shorebirds and fish (Bennelongia 2010; DPaW 2014).		
Lacepede Islands	The Lacepede Islands are a Class 'C' nature reserve, located 400 km south of WA-343-P, and 120 km north west of Broome. The purpose of this reserve is the conservation of flora and fauna, navigation, communication, meteorology and survey. The Lacepede Islands are a 12 km long chain of four islands known as West Island, Middle Island, Sandy Island and East Island. They are all small, low spits of coarse sand and coral rubble, lying atop a platform coral reef. They are treeless but support low vegetation. INPEX (2010) identified these islands as the largest green turtle (Chelonia mydas) breeding rookery along the Kimberley coastline. The Recovery Plan for Marine Turtles in Australia recognises these islands as a major important nesting area (DEE 2017a). The Lacepede Islands support over 1% of the world populations of brown boobies (Sula leucogaster) and roseate terns (Sterna dougallii). The breeding colony of brown boobies, of up to 18,000 breeding pairs, is possibly the largest in the world. Core foraging habitat of the brown boobies was reported to range from 50 km – 90 km from the colony with the furthest recorded as approximately 120 km north-west of the Lacepede Islands (Cannell et al. 2018). Up to 20,000 roseate terns have been recorded there (Birdlife International 2018b). Other birds breeding on the islands include masked boobies, Australian pelicans, lesser frigatebirds, eastern reef egrets, silver gulls, crested, bridled and lesser crested terns, common noddies, and pied and sooty oystercatchers. Visiting waders include grey-tailed tattlers, ruddy turnstones, great knots and greater sand plovers (Birdlife International 2018b).	No	Yes
Lalang-garram/Camden Sound Marine Park	The Lalang-garram / Camden Sound Marine Park is located in the Buccaneer Archipelago of the Kimberly coast, approximately 300 km from WA-343-P. The marine park covers an area of approximately 7,050 km^2 (DPaW 2013a). The marine park is located approximately 150 km north of Derby and 300 km north of Broome and lies within the traditional country of three Aboriginal native title groups. It is under joint management between DBCA and the Traditional Owners. The marine park includes a principal calving habitat and resting area for the humpback whale (Megaptera novaeangliae) and a wide range of other protected species, including marine turtles, snubfin and Indo-Pacific humpback dolphins, dugong, saltwater crocodiles and several species of sawfish. The park also includes a wide range of marine habitats and associated marine life, such as coral reef communities, rocky shoal and extensive mangrove forests (DPaW 2013a). Within the marine park, mangroves and their associated invertebrate-rich mudflats are an important habitat for migratory shorebirds from the northern hemisphere. Up to 35 species of migratory shorebirds potentially occur in the marine park, which are subject to the JAMBA, CAMBA and ROKAMBA migratory bird agreements and are listed as migratory species under the EPBC Act. Many other bird species may also be found in mangrove habitat with nesting occurring in the dense mangrove foliage and birds seeking prey around the roots of mangrove trees. (DPaW 2013a).	No	Yes
Montebello Island Marine Park	The Montebello Islands MP is an 'A' Class reserve and covers an area of approximately 583 km2 and its northern and western boundaries follow the seaward extent of Western Australian state waters (DEC 2007). The DPIRD have identified the Montebello Islands as a high value area with respect to the management of the invasive marine species, Didemnun perlucidum, as this species has not been recorded in the waters of the MP but is widely distributed along the WA coastline (DPIRD 2017). The values and sensitivities of the Montebello Islands are described in Section 3.3.	No	Yes
North Kimberley Marine Park	The North Kimberley Marine Park is located approximately 200 km south of WA-343-P. This park extends all the way from the northern boundary of the Camden Sound Marine Park to the Northern Territory border (DPaW 2016a). The park was declared in December 2016 and is the second largest marine park in Australia spanning approximately 18,540 km2. This vast area has a complex coastline with many gulfs, headlands, cliff-lined shores and archipelagos. Extensive tidal flats have formed in places, some associated with the mouths of the numerous rivers that drain to the coast. Marine ecosystems include extensive fringing mangrove forests and remote and virtually untouched coral reefs and sponge gardens which in turn support a wide range of marine life (DPaW 2016a). The park supports populations of Manta rays (Manta spp.), dugongs (Dugong dugon) and six species of threatened marine turtle found in Australia. Cetaceans that are known to utilise the area include humpback whales (Megaptera novaeangliae), Indo-Pacific humpback dolphins (Sousa chinensis) and snubfin dolphins (Orcaella heinsohni) (DPaW 2016a). Saltwater crocodiles (Crocodylus porosus), and a variety of fish, sharks, rays and sea snakes also inhabit the waters of this park. A wide variety of seabirds also utilise the offshore islands and intertidal flats for breeding and foraging. Nature based tourism, commercial and recreational fishing and remote seascapes are also identified as values within the park's management plan (DPaW 2016a).	No	Yes

State/Territory reserve/marine park name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
North Laland-garram Marine Park	The North Lalang-garram Marine Park, located approximately 200 km south of WA-343-P, includes the waters from the edge of Cape Wellington (WA mainland) to the WA state waters boundary, and several islands, including Booby Island, Duguesclin Island and Jackson Island. Its northern boundary adjoins the North Kimberley Marine Park, and its southern boundary adjoins the Lalang-garram / Camden Sound Marine Park. This parks geology, wide variety of habitats, ecological values and sensitivities (DPaW 2016b) are virtually identical to that described above for the North Kimberley Marine Park (DPaW 2016a).		
Pulu Keeling National Park	The values and sensitivities of Pulu Keeling National Park are described in section 3.1.2 and 3.6.	No	Yes
Rowley Shoals Marine Park	The values and sensitives associated with the Rowley Shoals Marine Park are described in sections 3.2 and 3.3.	No	Yes
Vernon Islands	The Vernon Islands are located in the Clarence Strait, north of Darwin, (approximately 850 km from WA-343-P). There are three major islands making up the Vernon Islands group, plus a large reef and numerous lesser reefs and sand islands (Tiwi Land Council 2013). The islands are low lying, with a maximum height of 4 m above mean sea level. There are small areas of sandy beach and each island has numerous small creeks that enable access inland past the mangrove thickets. Much of the area around the islands, including the reefs, is exposed at lower tides (Tiwi Land Council 2013). Sediments around the Vernon Islands are gravel dominated, due to the very strong tidal currents, experienced every day in the Clarence Strait (Smit et al. 2000). Significant coral reefs are established within the intertidal and subtidal zone of the Vernon Islands, dominated by Acropora and Montipora spp. Extensive coralline algal terraces have also developed at the Vernon Islands reef complex. Extensive mangrove forests are also found along the Vernon Islands coastline (Smit et al. 2000). The Vernon Islands are also subject to a Beneficial Use Declaration under the Water Act (NT), for aquatic ecosystem protection and recreational water quality and aesthetics (NTG 2010).	No	Yes
Yawuru Nagulagun/Roebuck Bay Marine Park	The Roebuck Bay Marine Park includes an internationally significant wetland for migratory shorebirds in Australia and provides habitats to a range of marine fauna as described in Section 3.4. Within the MP, a high diversity of infauna is present with the mudflats often covered with a surface film of microscopic microphytobenthos. Studies indicate that microphytobenthos form the basis of food webs for a large variety of organisms, ranging from benthic invertebrates to shorebirds and fish (Bennelongia 2010).	No	Yes

3.5 International Marine Parks

In addition to Australian, State/Territory Marine Parks, the EMBA overlaps the Savu Sea Marine National Park. The Savu Sea (Laut Sawu) Marine National Park (MNP) is located within the Lesser Sunda Ecoregion located to the south of the Coral Triangle and covers approximately 35,000 km^2 (MCI 2018; Protected Planet 2018b). It was established in 2009 and has an IUCN Category II status (Protected Planet 2018b). The MNP is split into three management areas; the Pantar Strait Marine Protected Area, the Sumba Strait Marine Area and the Tirosa-Batek Marine Area.

The Savu Sea MNP acts as a marine corridor and migratory pathway for marine fauna and is also an important upwelling zone in the Indo-Pacific region due to the presence of deep ocean trenches (Perdanahardja & Lionata 2017). The MNP area is a known migration route for several cetacean species, including the blue whale and sperm whale (Huffard et al. 2012). Other cetacean species such as pygmy killer whales, melon-head whales, short-finned pilot whales and numerous dolphin species (including Risso's dolphin, Fraser's dolphin, common dolphin, bottlenose dolphin and spinner dolphin) are known to frequent the MNP area (Coral Triangle Atlas 2014). Several species of marine turtle, including the green turtle, hawksbill turtle and leatherback turtle have also been recorded in the MNP area (Huffard et al. 2012).

The Savu Sea MNP provides productive marine habitats that support large populations of fish and artisanal and commercial fisheries. It is estimated that 65% of the East Nusa Tenggara regional fisheries production comes from the Savu Sea (Perdanahardja & Lionata 2017).

3.6 Wetlands of conservational significance

There are no wetlands of conservational significance located within WA-343-P. The EPBC Act Protected Matters search identified a total of 10 wetlands of conservational significance within the EMBA. A description of these wetlands of conservational significance is provided in Table 3-4.

Table 3-4: Wetlands of conservational significance located within the EMBA

Wetland of conservational significance name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Ashmore Reef National Nature Reserve	In addition to being listed as a National Nature Reserve, Ashmore Reef has been designated a Ramsar site due to the importance of the islands in providing a resting place for migratory shorebirds and supporting large breeding colonies of seabirds (Hale & Butcher 2013). Ashmore Reef is located within the EMBA and is approximately 130 km from WA-343-P. The reserve provides a staging point for many migratory wading birds from October to November and March to April as part of the migration between Australia and the northern hemisphere (Commonwealth of Australia 2002). Migratory shorebirds use the reserve's islands and sand cays as feeding and resting areas during their migration. The values of this wetland (habitat which supports migratory birds) are described above in Section 3.3.5.	No	Yes
Cobourg Peninsula	The Cobourg Peninsula Ramsar site is situated in the NT, 200 km north-east of Darwin, and covers an area of approximately 2,200 km2. It is approximately 950 km from WA-343-P. The site includes freshwater and extensive intertidal areas but excludes subtidal areas. The wetlands are mostly tidal and numerous creeks flow into the tidal areas. The northern coastline of the Peninsula has isolated bays, rocky headlands and beaches. The intertidal and coastal areas consist of extensive dunes, fringing coral and rocky reefs, sand and mudflats, with few areas of mangroves and seagrass communities. In contrast, the southern coastline and islands are dominated by mangrove communities associated with large mudflats (DEE 2018e). An abundance of fauna use the wetlands including a large variety of birds, frogs, marine turtles, mammals and reptiles including the saltwater crocodile. The dugong lives in the marine area surrounding the Peninsula. The peninsula is in a remote location and there has been minimal human impact on the site (DEE 2018e).	No	Yes
Eighty Mile Beach	The Eighty Mile Beach Ramsar site comprises a 220 km beach between Port Hedland and Broome with extensive intertidal mudflats and Mandora Salt Marsh, located 40 km east (Hale & Butcher 2009) totalling approximately 1,750 km2. Eighty Mile Beach is characterised by extensive mudflats supporting an abundance of macroinvertebrates which provide food for large numbers of shorebirds. Eighty Mile Beach is one of the most important sites for migratory shorebirds in the East Asian Australasian Flyway, with 42 migratory shorebird species recorded at this location. It is estimated that 500,000 shorebirds use Eighty Mile Beach as a migration terminus annually (Hale and Butcher 2009), and more than 472,000 migratory waders have been counted on the mudflats during the September to November period. The location of Eighty Mile Beach makes it a primary staging area for many migratory shorebirds on their way to and from Alaska and eastern Siberia (Hale & Butcher 2009). Although many birds move further on their journey, others remain at the site for the non-breeding period. It is one of the most important sites in the world for the migration of the critically endangered Great Knot (Calidris tenuirostris). Eighty Mile Beach also supports a high diversity and abundance of wetland birds (Hale & Butcher 2009). This includes 42 species that are listed under international migratory agreements CAMBA (38), JAMBA (38) and ROKAMBA (32) as well as an additional 22 Australian species that are listed under the EPBC Act. The Mandora Salt Marsh area contains an important and rare group of wetlands (Lake Walyarta and East Lake), including raised peat bogs, a series of small permanent mound springs and the most inland occurrence of mangroves in WA (Hale & Butcher 2009). The Mandora Salt Marsh lakes fill predominantly from rainfall and runoff in the wet season then dry back to clay beds. Flatback turtles, listed as vulnerable under the EPBC Act, regularly nest at scattered locations along Eighty Mile Beach.	No	Yes
Hosnies Spring	The Hosnies Spring Ramsar site is located in the Australian External Territory of Christmas Island in the Indian Ocean and covers an area of approximately 2 km2. Christmas Island is approximately 1,950 km from WA-343-P. Hosnies Spring is a small area of shallow freshwater streams and seepages, 20-45 m above sea-level on the shore terrace of the east coast of the island. The Ramsar site consists of a stand of two species of mangroves and also includes surrounding terrestrial areas with rainforest grading to coastal scrub, and an area of shoreline and coral reef (DEE 2018f). While mangroves of this group are distributed widely across the region, on Christmas Island the species are rare. The stand represented at Hosnies Spring is most unusual in that it occurs high above sea level (24-37 m) on an inclined surface, the mangroves are unusually tall (up to 30-40 m high) and because it appears that the stand has persisted at the site for approximately 120,000 years. The stand is maintained by the permanent freshwater spring (DEE 2018f). The site is an example of a specific type of wetland unique to Christmas Island and perhaps unique worldwide. Hosnies Spring also provides part of the restricted habitat of the blue crab which is protected on the island. Hosnies Spring is isolated and relatively inaccessible so there is minimal human impact on the area (DEE 2018f).	No	Yes

Wetland of conservational significance name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Pulu Keeling National Park	The Pulu Keeling National Park Ramsar site is located in the Australian External Territory of Cocos (Keeling) Island in the Indian Ocean and covers an area of approximately 26 km^2. The Cocos Islands are approximately 2,900 km from WA-343-P. The Cocos (Keeling) Islands are a group of 27 coral islands forming two atolls 24 km apart. North Keeling Island, with an area of 1.2 km^2, is part of the Cocos Islands. The Ramsar site includes the marine area surrounding the Island along with the terrestrial area of North Keeling Island, matching the boundary of Pulu Keeling National Park. As an island atoll in its most natural state, North Keeling is a significant biological resource and is internationally important for the conservation of biodiversity. The Ramsar site is one of the few remaining islands where rats have not yet been introduced and is generally unaffected by feral animals (DEE 2018g). The Ramsar site is also an internationally significant seabird rookery. Fifteen species of birds recorded on the island are listed under international migratory bird agreements and 15 seabird species use the atoll for nesting. The breeding colony of the dominant bird species, the red-footed booby, is one of the largest in the world. It is also the main locality of the endangered, endemic Cocos buff-banded rail. The island is home to a number of crabs and is used by the threatened green turtle and hawksbill turtle. Green turtles also occasionally nest on North Keeling Island. Some 525 fish species are recorded from the Cocos Islands, including the angelfish, which has only been recorded from these islands and Christmas Island. There are no mammals on the island, although marine mammals visit the surrounding waters (DEE 2018g). Current use of the Ramsar site includes scientific research, and tourism activities such as scuba diving, snorkelling and surfing.	No	Yes
Roebuck Bay	The Roebuck Bay Ramsar site is located at Roebuck Bay near Broome in northern WA totalling 34,119 ha. Roebuck Bay has a large tidal range which exposes around 160 km^2 of mudflat, covering most of the Ramsar site (DEE 2018d). The intertidal mud and sand flats support a high abundance of bottom dwelling invertebrates (between 300—500 benthic invertebrate species), which are a key food source for waterbirds (DEE 2018d). The site is one of the most important migration stopover areas for shorebirds in Australia and globally. For many shorebirds, Roebuck Bay is the first Australian landfall they reach on the East Asian Australasian Flyway. Mangrove swamps line the eastern and southern edges of the site and extend up into the linear tidal creeks (DEE 2018d). They are important nursery areas for marine fishes and crustaceans, particularly prawns. Extensive seagrass beds occur in the bay, providing an important feeding ground for dugongs and loggerhead and green turtles (Bennelongia 2009). Flatback turtles nest in small numbers, while marine fish (including sawfish) regularly breed in the tidal creeks and mangroves. Dolphins also regularly use the site (DEE 2018d).	No	Yes
The Dales	The Dales Ramsar site is located in the Australian External Territory of Christmas Island and covers an area of approximately 580 ha and is located on the western side of the Island. The western boundary of the Ramsar site extends 50 m seaward from the low water mark and incorporates part of the coastline (DEE 2018h). The Dales are located within the Christmas Island National Park which is managed by Parks Australia. The Ramsar site has a near-pristine system of seven watercourses collectively known as The Dales. The Dales contain numerous wetland types including surface and karst features, and inland and coastal wetlands (DEE 2018h). The Dales also supports a number of unique ecological and geomorphic features and a significant number of seabirds including Abbott's booby (Papasula abbotti), red-footed booby (Sula sula) and the brown booby (Sula leucogaster), all of which breed at the site (DEE 2018h). Vegetation in The Dales ranges from tall plateau rainforest to lower coastal vegetation. Migratory or vagrant bird species use The Dales as a staging site during migration, and a landfall for vagrant bird species outside their range (DEE 2018h).	No	Yes
Finniss Floodplain and Fog Bay System	The Finniss Floodplain and Fog Bay System Ramsar site is an example of a beach-fringed curved bay with continuous intertidal mudflats (DEE 2018j). The site is a major breeding area for magpie goose (Anseranas semipalmata) and during the dry season acts as a refuge area for water birds. It is also a migration stop-over area for shorebirds and a major breeding area for saltwater crocodile (DEE 2018j). There are extensive paperbark swamps and small areas of samphire near the estuaries and the south-west part of the bay. This Ramsar site is also recognised as an IBA with the intertidal mudflats of Fog Bay reported to support many species of shorebird and waterbird colonies (Birdlife International 2018c).	No	Yes

Wetland of conservational significance name	Description	Present in WA-343-P (Yes/No)	Present in EMBA (Yes/No)
Mermaid Reef	Although not a Ramsar site, Mermaid Reef is identified as a Nationally Important Wetland in the EPBC Act Protected Matters search. The intertidal and subtidal reef system and associated ecological values and sensitivities are described above in Section 3.3. It is considered that marine avifauna which roost on the islands within Clerke and Imperieuse Reef may forage at Mermaid Reef.	No	Yes
Yampie Sound Training Area	Identified as a Nationally Important Wetland, Yampi Sound Training Area is located 140 km north of Derby in the Kimberley Region of WA. The area contains coastal habitats such as mangroves and low-lying coastal flood plains (DEE 2018k). Several bird species have been recorded in the area including the Little Tern (Sternula albifrons) (DEE 2018k).	No	Yes

3.7 Physical environment

Air temperatures recorded at Browse Island, the closest Bureau of Meteorology (BOM) climatological station to WA-343-P, shows a maximum temperature of 33.3 degrees Celsius (°C) and a minimum of 21.6 °C (BOM 2018). Air temperatures in the Browse Basin remain warm throughout the year with means and maxima ranging from 26–30 °C and 32–35 °C, respectively (INPEX 2010).

The climate of northern Australia shows two distinct seasons: winter, from April to September; and summer, from October to March. There are rapid transitional periods between the two main seasons, generally in April and September/October (RPS MetOcean Pty Ltd 2011). The region has a pronounced monsoon season between December and March, which brings with it heavy rainfall. Heaviest rainfall is typically associated with tropical cyclones.

Data from the permit area indicates that during summer (October to March), the winds blow predominantly from the west, and in winter (May to August) the winds blow predominantly from the east. During transitional conditions (April and September), wind directionality is more variable and wind speeds are generally lower than in the other seasons. Peak wind speeds in all seasons are around 19 m/s, with the peaks most commonly observed in summer (RPS 2018).

Broad-scale oceanography in the north-west Australian offshore area is complex, with major surface currents influencing the region, including the Indonesian Throughflow, the Leeuwin Current, the South Equatorial Current, and the Eastern Gyral Current. The Indonesian Throughflow current is generally strongest during the south-east monsoon from May to September (Qiu et al. 1999). The Indonesian Throughflow is a key link in the global exchange of water and heat between ocean basins. It brings warm, low-nutrient, low-salinity water from the western Pacific Ocean, through the Indonesian archipelago, to the Indian Ocean. It is the primary driver of the oceanographic and ecological processes in the region (DSEWPaC 2012a).

The surface waters of the region are tropical year-round, with surface temperatures of ~26 °C in summer and ~22 °C in winter (DSEWPaC 2012a). The baseline monitoring in the Ichthys Field area recorded surface water temperatures of ~30 °C in summer (March) and ~26–27 °C in winter (July) (INPEX 2010).

The tides are semidiurnal, with two daily high tides and two daily low tides (McLoughlin et al. 1988). Both the semidiurnal and diurnal tides appear to travel north-eastwards in the deep water leading to the Timor Trough before propagation eastwards and southwards across the wide continental shelf. The NWMR experiences some of the largest tides along a coastline adjoining any open ocean in the world. Mean sea level in the vicinity of the permit area is about 2.7 m above lowest astronomical tide (LAT), with a spring tidal range of about 5.0 m.

Summertime tropical cyclones generate waves propagating radially out from the storm centre. Depending upon the storm size, intensity, relative location and forward speed, tropical cyclones may generate swell with periods of 6–10 seconds (s) from any direction and with wave heights of 0.5–9.0 m. During severe tropical cyclones, which can generate major short-term fluctuations in current patterns and coastal sea levels (Fandry & Steedman 1994; Hearn & Holloway 1990), current speeds may reach 1.0 m/s and occasionally exceed 2.0 m/s in the near-surface water layer. Such events are likely to have significant impacts on sediment distributions and other aspects of the benthic habitat.

The sea wave climate within WA-343-P reflects the seasonal wind regime, with waves predominantly from the west in summer and from the east in winter (RPS 2018). In winter, 40% of significant wave heights are less than 1 m and 10% exceed 2 m.

Water depth within the permit area is approximately 350 m. Studies using sub-bottom profiling, multibeam echo-sounder and sidescan sonar have been undertaken by INPEX at the Ichthys Field approximately 60 km south of WA-343-P and in areas close to Heywood and Echuca shoals and south-east towards the Kimberley coast (INPEX 2010). These studies indicated that seabed topography is relatively flat and featureless and the geology is generally homogeneous through the region.

Soft substrates in the Browse Basin and continental shelf are typical of deep-sea, outer continental shelf and slope benthic habitats found along the length of the NWS (RPS 2007). This habitat generally supports a diverse infauna dominated by polychaetes and crustaceans typical of the broader region and this is reflected in survey results which indicate the epibenthic fauna is diverse but sparsely distributed (RPS 2008). Deep-sea infaunal assemblages of this kind are very poorly studied on the NWS but are likely to be widely distributed in the region (INPEX 2010).

Areas of mud and fine sand are widespread on the outer shelf and slope in the Browse Basin indicating that it is a depositional area where fine sediments and detritus accumulate. The distribution of seabed type shows some correlation with water depth, with sediments becoming coarser as water depth increases (INPEX 2010). However, there are also large sand waves in parts of the basin, showing that, locally, there are strong seabed currents. The sand waves are likely to move in response to seasonal changes in the currents and the substrate instability is expected to limit the development of infaunal communities in this habitat.

During surveys of the nearby Ichthys Field, to the south-west of the permit area, no obstructions were noted on the seafloor and no features such as boulders, reef pinnacles or outcropping hard layers were identified (INPEX 2010; Fugro Survey Pty Ltd 2005). In general, the seabed sediments grade from soft featureless sandy silts to gravelly sand.

Based on the data from the Ichthys Field and surrounding areas in proximity to WA-343-P, the seabed is suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities.

3.8 Biological environment

3.8.1 Planktonic communities

Plankton abundance and distribution is patchy, dynamic and strongly linked to localised and seasonal productivity (Evans et al. 2016). The mixing of warm surface waters with deeper, more nutrient-rich waters (i.e. areas of upwelling) generates phytoplankton production and zooplankton blooms. In the offshore waters of north-western Australia, productivity typically follows a ‘boom and bust’ cycle. Productivity booms are thought to be triggered by seasonal changes to physical drivers or episodic events, which result in rapid increases in primary production over short periods, followed by extended periods of lower productivity.

The Indonesian Throughflow has an important effect on biological productivity in the northern areas of Australia and Indonesia. Generally, its deep, warm and low nutrient waters suppress upwelling of deeper, comparatively nutrient-rich waters, thereby forcing the highest rates of primary productivity to occur at depths associated with the thermocline (generally 70 – 100 m depth). When the Indonesian Throughflow is weaker, the thermocline lifts, and brings deeper, more nutrient-rich waters into the photic zone, which results in conditions favourable to increased productivity. Consequently, plankton populations have a high degree of temporal and spatial variability. In tropical regions, higher plankton concentrations generally occur during the winter months (June to August).

In waters surrounding Indonesia, seasonal peaks in phytoplankton biomass are linked to monsoon related changes in wind. When the winds reverse direction (offshore vs. onshore), nutrient concentrations decrease/increase because of the suppression/enhancement of upwelling (NASA 2018). Annual variability of phytoplankton productivity in waters surrounding Indonesia is heavily influenced by the El Niño-Southern Oscillation climate pattern (NASA 2018). For example, phytoplankton productivity around Indonesia increases during El Niño events.

The waters of north-western Australia, encompassing the Ichthys Field, are generally considered to be of low productivity in comparison with other global oceanic systems. This is largely due to the relatively low-nutrient, shallow water environment. Planktonic community densities recorded in the Ichthys Field, approximately 60 km from WA-343-P are considered to be very sparse and are indicative of offshore waters where no significant nutrient sources exist. The most common plankton classes recorded from the sampling in the nearby Ichthys Field development area were the Prasinophyceae (68%), followed by the Bacillariophyceae (30%), the Dinophyceae (1%) and the Cryptophyceae (<1%), all of which are common throughout the region (INPEX 2010). Given the relative proximity and similar remote open ocean environment, plankton density and species present in WA-343-P is expected to be the same as those recorded in the Ichthys Field.

3.8.2 Benthic communities

A number of banks, shoals and reefs exist within the Browse Basin. The closest to WA-343-P are Heywood and Echuca shoals that are located approximately 62 km to the east and 75 km to the south-east respectively. Browse Island is the nearest intertidal habitat which, at its closest point, is located 68 km south of the permit area (INPEX 2010).

The shoals and banks within the EMBA are characterised by abrupt bathymetry, rising steeply from the surrounding shelf to horizontal plateau areas typically 20–30 m deep (AIMS 2012). Substrate types tend to differ from patches of coarse sand, to extensive fields of rubble and rocks, limited areas of consolidated reef and occasional isolated rock or live coral outcrops.

The submerged shoals within the EMBA can support diverse tropical ecosystems, including phototrophic benthos typical of tropical coral reefs. The shoals support a diverse biota, including algae, reef-building corals, hard corals and filter-feeders. In general the flora and faunal assemblages are typical of the oceanic reefs of the Indo–West Pacific region (INPEX 2010), with many of the species in common with those found at the Ashmore, Cartier and Scott Reef complexes.

Coral reefs within the region can be categorised into three general groups: fringing reefs, large platform reefs, and intertidal reefs. Corals are significant benthic primary producers that play a key ecosystem role in many reef environments and have an iconic status in the environments where they occur.

Coral reefs considered to have significant value within the EMBA include:

- Ashmore Reef
- Cartier Island
- Seringapatam Reef
- Scott Reef
- Hibernia Reef
- Rowley Shoals
- Mermaid Reef
- Ningaloo Reef

These reefs, in particular Ashmore Reef, are recognised as having the highest richness and diversity of coral species in Western Australia (Mustoe & Edmunds 2008, cited in Department of State Development 2010). Ningaloo Reef is the longest fringing reef in Australia and the Rowley Shoals and Scott Reef also support very high coral species diversity. The intertidal reefs surrounding the outer islands of the Bonaparte Archipelago also exhibit very high coral species diversity (INPEX 2010). Coral reefs associated with Browse Island (the nearest coral reef to WA-343-P) are discussed in Section 3.4.

There is no seagrass within WA-343-P due to water depth (approximately 350 m) and lack of suitable habitat.

Seagrasses occur in EMBA along the mainland coastline of the NT and WA and within the protected coastal areas of islands, including the Tiwi Islands, outer Darwin Harbour and in the waters surrounding the Van Diemen Gulf adjacent to Arnhem Land (Roelofs et al. 2005). The closest seagrasses to the permit area are located at Ashmore Reef, approximately 130 km north of WA-343-P, where a high coverage of seagrass supports a small dugong population (Whiting & Guinea 2005).

The largest known seagrass locations for the NWMR have been reported from around the Buccaneer Archipelago located north of the Dampier Peninsula (Wells et al. 1995).

There are no islands within WA-343-P, with the closest intertidal habitat located at Browse Island (68 km south of the permit area). However, within the EMBA there are many islands that occur including numerous small islands and literally thousands of islands along the Australian and Indonesian coastlines.

In the offshore waters of the EMBA there are multiple islands which have an associated Commonwealth or state marine park/reserve status. The values and sensitivities associated with the shorelines of these islands are described in sections 3.3, 3.4, 3.5 and 3.6.

Sandy beaches are the dominant shoreline habitat on all the offshore islands within the EMBA and provide significant habitat for turtles and seabird nesting above the high tide line.

Mangrove communities make up a common shoreline habitat along the northern Western Australian coastlines with extensive mangrove communities along the Australian and Indonesian coastline within the EMBA and they commonly occur in sheltered coastal areas in tropical and sub-tropical latitudes.

3.8.3 Marine fauna

Species of conservation significance

Species of conservation significance within the EMBA were identified through a search of the EPBC Act Protected Matters Database (including a 1 km buffer).

The search identified a total of 47 "listed threatened" species and 89 "listed migratory" species that potentially use, or pass through the EMBA.

In addition, 180 "listed marine" species were identified, of which 33 are "whales and other cetaceans" that may occur at, or immediately adjacent to, the area.

Table 3-5 presents the marine species that are "listed threatened" species or "listed migratory species". Note that true terrestrial species have not been listed in Table 3-5 on the basis that the outer extent of the EMBA was defined by entrained and dissolved hydrocarbons in the water column (refer Section 8).

The DEE has, through the marine bioregional planning program, identified, described and mapped biologically important areas (BIAs) for protected species under the EPBC Act. BIAs spatially and temporally define areas where protected species display biologically important behaviours (including breeding, foraging, resting or migration), based on the best available scientific information. These areas are those parts of a marine region that are particularly important for the conservation of protected species. Note, there are no BIAs that intersect the permit area, with the closest BIAs being for whale shark foraging located approximately 15 km east, and marine avifauna foraging around Cartier Island and Ashmore Reef, with the outer extent of the BIA approximately 10 km from the northern boundary of the permit area. A number of BIAs overlap the EMBA, including BIAs relevant to:

- marine turtles
- cetaceans
- whale sharks
- marine avifauna.

Table 3-5: Listed threatened and/or migratory species under the EPBC Act potentially occurring within the EMBA

Species	Common name	Conservation status	Migratory
Marine mammals			
Balaenoptera borealis	Sei whale	Vulnerable	Migratory
Balaenoptera edeni	Bryde’s whale	N/A	Migratory
Balaenoptera musculus	Blue whale	Endangered	Migratory
Balaenoptera physalus	Fin whale	Vulnerable	Migratory
Eubalaena australis	Southern Right Whale	Endangered	Migratory
Megaptera novaeangliae	Humpback whale	Vulnerable	Migratory
Balaenoptera bonaerensis	Antarctic Minke Whale	N/A	Migratory
Orcinus orca	Killer whale	N/A	Migratory
Physeter macrocephalus	Sperm whale	N/A	Migratory
Dugong dugon	Dugong	N/A	Migratory
Orcaella brevirostris / Orcaella heinsohni	Irrawaddy dolphin/ Australian snubfin dolphin	N/A	Migratory

Species	Common name	Conservation status	Migratory
Sousa chinensis	Indo-Pacific humpback dolphin	N/A	Migratory
Tursiops aduncus	Spotted bottlenose dolphin	N/A	Migratory
Marine reptiles			
Caretta caretta	Loggerhead turtle	Endangered	Migratory
Chelonia mydas	Green turtle	Vulnerable	Migratory
Dermochelys coriacea	Leatherback turtle	Endangered	Migratory
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory
Lepidochelys olivacea	Olive Ridley turtle	Endangered	Migratory
Natator depressus	Flatback turtle	Vulnerable	Migratory
Crocodylus porosus	Saltwater crocodile	N/A	Migratory
Aipysurus apraefrontalis	Short-nosed seasnake	Critically Endangered	N/A
Aipysurus foliosquama	Leaf-scaled seasnake	Critically Endangered	N/A
Sharks, fish and rays			
Rhincodon typus	Whale shark	Vulnerable	Migratory
Carcharodon carcharias	Great white shark	Vulnerable	Migratory
Carcharias taurus	Grey nurse shark	Vulnerable	N/A
Glyphis garricki	Northern river shark	Endangered	N/A
Glyphis glyphis	Speartooth Shark	Critically Endangered	N/A
Pristis clavata	Dwarf sawfish	Vulnerable	Migratory
Pristis pristis	Northern sawfish, Freshwater sawfish, Largetooth sawfish	Vulnerable	Migratory

Species	Common name	Conservation status	Migratory
Pristis zijsron	Green sawfish	Vulnerable	Migratory
Anoxypristis cuspidata	Narrow sawfish	N/A	Migratory
Isurus oxyrinchus	Shortfin mako	N/A	Migratory
Isurus paucus	Longfin mako	N/A	Migratory
Lamna nasus	Porbeagle, Mackerel Shark	N/A	Migratory
Manta alfredi	Reef manta ray	N/A	Migratory
Manta birostris	Giant manta ray	N/A	Migratory
Marine avifauna			
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	N/A
Calidris canutus	Red Knot	Endangered	Migratory
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Migratory
Calidris tenuirostris	Great Knot	Critically Endangered	Migratory
Charadrius leschenaultii	Greater Sand Plover	Vulnerable	Migratory
Charadrius mongolus	Lesser Sand Plover	Endangered	Migratory
Diomedea amsterdamensis	Amsterdam Albatross	Endangered	Migratory
Diomedea exulans	Wandering Albatross	Vulnerable	Migratory
Fregata andrewsi	Christmas Island Frigatebird, Andrew's Frigatebird	Endangered	Migratory
Hypotaenidia philippensis andrewsi	Buff-banded Rail (Cocos (Keeling) Islands), Ayam Hutan	Endangered	N/A
Limosa Lapponica baueri	Bar-tailed Godwit	Vulnerable	Migratory

Species	Common name	Conservation status	Migratory
Limonsa lapponica menzbieri	Northern Siberian Bar- tailed Godwit	Critically Endangered	Migratory
Macronectes giganteus	Southern giant petrel	Endangered	Migratory
Macronectes halli	Northern giant petrel	Vulnerable	Migratory
Numenius madagascariensis	Eastern curlew	Critically Endangered	N/A
Papasula abbotti	Abbott's Booby	Endangered	Migratory
Phaethon lepturus fulvus	Christmas Island White-tailed Tropicbird, Golden Bosunbird	Endangered	N/A
Pterodroma arminjoniana	Round Island Petrel, Trinidade Petrel	Critically Endangered	N/A
Pterodroma mollis	Soft-plummaged Petrel	Vulnerable	N/A
Rostratula australis	Australian Painted Snipe	Endangered	N/A
Sternula nereis nereis	Australian Fairy Tern	Vulnerable	Migratory
Thalassarche carteri	Indian Yellow-nosed Albatross	Vulnerable	Migratory
Thalassarche cauta cauta	Shy Albatross	Vulnerable	Migratory
Thalassarche cauta steadi	White-capped Albatross	Vulnerable	Migratory
Thalassarche impavida	Campbell Albatross	Vulnerable	Migratory
Thalassarche melanophris	Black-browed Albatross	Vulnerable	Migratory
Anous stolidus	Common noddy	N/A	Migratory
Apus pacificus	Forktailed swift	N/A	Migratory
Ardenna carneipes	Flesh-footed Shearwater	N/A	Migratory

Species	Common name	Conservation status	Migratory
Ardenna pacifica	Wedge-tailed Shearwater	N/A	Migratory
Calonectris leucomelas	Streaked shearwater	N/A	Migratory
Fregata ariel	Lesser frigatebird	N/A	Migratory
Fregata minor	Great frigatebird	N/A	Migratory
Hydroprogne caspia	Caspian tern	N/A	Migratory
Sterna anaethetus	Bridled tern	N/A	Migratory
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory
Phaethon rubricauda	Red-tailed tropicbird	N/A	Migratory
Sterna dougallii	Roseate tern	N/A	Migratory
Onychoprion anaethetus	Little tern	N/A	Migratory
Sula dactylatra	Masked booby	N/A	Migratory
Sula leucogaster	Brown booby	N/A	Migratory
Sula sula	Red-footed booby	N/A	Migratory
Acrocephalus orientalis	Oriental Reed-Warbler	N/A	Migratory
Actitis hypoleucos	Common Sandpiper	N/A	Migratory
Arenaria interpres	Ruddy Turnstone	N/A	Migratory
Calidris acuminata	Sharp-tailed Sandpiper	N/A	Migratory
Calidris alba	Sanderling	N/A	Migratory
Calidris melanotos	Pectoral Sandpiper	N/A	Migratory
Calidris ruficollis	Red-necked Stint	N/A	Migratory
Charadrius bicinctus	Double-banded Plover	N/A	Migratory

Species	Common name	Conservation status	Migratory
Charadrius veredus	Oriental Plover	N/A	Migratory
Gallinago megala	Swinhoe's Snipe	N/A	Migratory
Gallinago stenura	Pin-tailed Snipe	N/A	Migratory
Glareola maldivarum	Oriental Pratincole	N/A	Migratory
Limicola falcinellus	Broad-billed Sandpiper	N/A	Migratory
Limnodromus semipalmatus	Asian Dowitcher	N/A	Migratory
Limosa limosa	Black-tailed Godwit	N/A	Migratory
Numenius minutus	Little Curlew, Little Whimbrel	N/A	Migratory
Numenius phaeopus	Whimbrel	N/A	Migratory
Pandion cristatus	Eastern Osprey	N/A	Migratory
Philomachus pugnax	Ruff (Reeve)	N/A	Migratory
Pluvialis fulva	Pacific Golden Plover	N/A	Migratory
Pluvialis squatarola	Grey Plover	N/A	Migratory
Thalasseus bergii	Crested Tern	N/A	Migratory
Tringa brevipes	Grey-tailed Tattler	N/A	Migratory
Tringa glareola	Wood Sandpiper	N/A	Migratory
Tringa nebularia	Common Greenshank	N/A	Migratory
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank	N/A	Migratory
Tringa totanus	Common Redshank	N/A	Migratory
Xenus cinereus	Terek Sandpiper	N/A	Migratory

3.9 Socioeconomic and cultural environment

3.9.1 World heritage areas

No world heritage areas (WHAs) were identified as overlapping WA-343-P; however, one WHA, the Ningaloo Coast WHA, overlaps the EMBA.

The Ningaloo Coast was included on the World Heritage List in 2011 (DEE 2018a) and was inscribed for outstanding natural universal values as follows:

- an example of superlative natural phenomena and areas of exceptional natural beauty and aesthetic importance
- outstanding examples representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features
- the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

3.9.2 National heritage places

The West Kimberley

The West Kimberley was included on the National Heritage List in 2011 and has numerous values which contribute to the significance of the property, including indigenous, historic, aesthetic, cultural and natural heritage values (DEE 2018b). The West Kimberley is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands. Of these values, the most relevant to the marine environment is Roebuck Bay, a migratory hub for shorebirds, described in detail in Sections 3.3, 3.4 and 3.6.

The Ningaloo Coast

See the Ningaloo Coast WHA (Section 3.9.1).

HMAS Sydney II and HSK Kormoran shipwreck sites

The naval battle fought in 1941 between the Australian warship HMAS *Sydney II* and the German commerce raider HSK *Kormoran* off the Western Australian coast during World War II was a defining event in Australia's cultural history. The loss of HMAS Sydney II, along with its entire crew of 645 following the battle with HSK Kormoran, remains Australia's worst naval disaster (DEE 2018c).

The HMAS Sydney II and HSK Kormoran are located approximately 290 km west-southwest of Carnarvon and lie on the seabed approximately 22 km apart (DEE 2018c).

3.9.3 Fishing

Commercial fisheries– Australian waters and external Australian territories

Within the EMBA, six Commonwealth-managed fisheries have the potential to operate with four fishery boundaries overlapping WA-343-P as summarised in Table 3-6.

In addition to the Commonwealth-managed fisheries, 39 state/territory-managed commercial fisheries have the potential to operate within the EMBA. Of these, ten fishery boundaries overlap with WA-343-P (Table 3-7). Fisheries highlighted in bold have potential fishing grounds that overlap with WA-343-P, this does not indicate that they are currently active within the permit area; however, there is a potential that they may be in the future.

Table 3-6: Commonwealth-managed commercial fisheries (AFMA-managed)

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
Western Tuna and Billfish Fishery	The Western Tuna and Billfish Fishery targets bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), broadbill swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audax*). The fishery targets areas of reef which are present within the EMBA and mainly use longline fishing gear to catch the targeted species. The Billfish Fishery covers the sea area west from the tip of Cape York in Queensland, around Western Australia, to the border between Victoria and South Australia. Fishing occurs in both the Australian Fishing Zone and adjacent high seas. The fishery also includes the waters surrounding Christmas island and the Cocos (Keeling) Islands. Fishing for tuna and tuna-like species in waters outside 12 nm of the Christmas Island and Cocos (Keeling) Islands fisheries is managed by DPIRD under the Western Tuna and Billfish Fishery Management Plan 2005. In the fishery there are currently 95 boats with statutory fishing rights (AFMA 2018a).
Western Deep Water Trawl Fishery	The Western Deepwater Trawl Fishery is located in water deeper than 200 m off the coast of Western Australia from Exmouth to Augusta (the eastern boundary of the fishery was updated in 2017). The fishery is defined as a mixed species fish trawl fishery due to the wide range of species taken at low volumes. Historical catch data (2014) indicates species include deepwater bugs, orange roughy and ruby snapper. There are 11 fishing permits (maximum number of vessels active at one time) each with a five-year duration in the Western Deepwater Trawl Fishery (AFMA 2018b).
Southern Bluefin Tuna Fishery	The Southern Bluefin Tuna Fishery covers the entire sea around Australia, out to 200 nm from the coast. There are 84 statutory fishing right owners in the fishery. This fishery is managed under a quota system to ensure the species is not subject to overfishing as has happened in the past. Commercial fishers mainly use the purse seine fishing method to catch southern bluefin tuna. With the fish being towed closer inshore and transferred to permanent floating pontoons. The major landing port is Port Lincoln in SA (AFMA 2018c) and therefore does not overlap the EMBA. No catch is taken from the NWS.
Western Skipjack Fishery	The Western Skipjack Fishery covers the entire sea around WA out to 200 nm from the coast. The fishery targets the skipjack tuna (*Katsuwonus pelamis*) and employs the purse seine, pole and line, and longline methods as its techniques. Although 14 permits are in place, the fishery is not currently active (AFMA 2018d).

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
Northern Prawn Fishery	The Northern Prawn Fishery targets banana prawns (*Fenneropenaeus merguiensis, F. indicus*) tiger prawns (*Penaeus esculentus, P. semisulcatus*) and endeavour prawns (*Metapenaeus endeavouri, M. ensis*) in northern Australian waters. The fishery occasionally operates from from Cape York in Queensland to Cape Londonderry in WA and is predominantly active in the shallower waters of the EMBA. To manage the fishery, there are 2 fishing seasons (April –June and August to November). There are currently 52 boats with fishing rights in the fishery (maximum number vessels at one time) and bottom trawl fishing gear is sed in this fishery (AFMA 2018e).
North West Slope Trawl Fishery	The North West Slope Trawl Fishery targets scampi (*Metanephrops australiensis*) and deepwater prawn. The fishery is located in deep water from the coast of the Prince Regent National Park to Exmouth between the 200 m depth contour to the outer limit of the Australian Fishing Zone (AFMA 2018f). There are seven fishing permits (maximum number of vessels active at one time) each with a five year duration in the North West Slope Trawl Fishery. It is the only active fishery in the vicinity of WA-343-P, with reportedly low negligible trawl-fishing in the nearby Ichthys Field; however, catch data is confidential for this fishery (AFMA 2018f).

Table 3-7: State-managed commercial fisheries (WA Department of Primary Industries and Regional Development – managed/NT Department of Primary Industry and Resources)

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
Abalone Managed Fishery (WA)	The Abalone Managed Fishery includes the West Coast Roe's Abalone resource and the South Coast Greenlip / Brownlip Abalone resource. Roe's abalone is found in commercial quantities from the SA border to Shark Bay. The commercial fishery harvest method is a single diver working off a 'hookah' (surface-supplied breathing apparatus) using an abalone 'iron' to prise the shellfish off rocks (WAFIC 2018j). The fishery operates in shallow coastal waters coinciding with abalone distributions (Gaughan & Santoro 2018). Although the area of the fishery overlaps WA-343-P, no fishing effort occurs in the permit area given the water depth, water temperature and lack of suitable habitat.

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
Beche-de-Mer Fishery	Beche-de-mer, also known as sea cucumbers or trepang, are in the Phylum Echinodermata, Class Holothuroidea. They are soft-bodied, elongated animals that usually live with their ventral surface in contact with the benthic substrate or buried in the substrate (2015). Targets two main species; sandfish (Holothuria scabra) and redfish (Actinopyga echinites), animals are caught by diving and a smaller amount by wading
Gascoyne Demersal Scalefish (WA)	The Gascoyne Demersal Scalefish line fishery is the major fishery in the Gascoyne bioregion. The fishery originally targeted pink snapper, but has been developed over the past decade into a broader fishing sector targeting other demersal finfish species including emperors, cods and deeper water species (Gaughan & Santoro 2018). Fishing effort is particularly focused on the entrance to Shark Bay.
Kimberley Gillnet and Barramundi Fishery (WA)	The Kimberley Gillnet and Barramundi Fishery operates in the nearshore and estuarine zones of the North coast bioregion from the WA/NT border to the northern end of Eighty Mile Beach, covering the river systems and tidal creek systems of the Cambridge Gulf, the Ria coast of the northern Kimberley, King Sound, Roebuck Bay and the northern end of Eighty Mile Beach. The fishery targets barramundi and other species taken by the fishery include king threadfin (*Polydactylus macrochir*) and blue threadfin (*Eleutheronema tetradactylum*) (WAFIC 2018d). The fishery is limited to five licences.
North Coast Prawn Fisheries (including **Kimberley Prawn**; Nickol Bay Prawn; **Broome Prawn**; Onslow Prawn).	These North Coast Prawn Fisheries predominantly target banana prawns (*Penaeus merguiensis*) but also catch tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*). These fisheries operate from the north eastern boundary of the Exmouth Gulf Prawn Fishery to Cape Londonderry, in the EMBA (WAFIC 2018c).
Hermit Crab Fishery (WA)	The Hermit Crab Fishery specifically targets the Australian land hermit crab (*Coenobita variabilis*) for the domestic and international live pet trade. The fishery operates throughout the year and is one of two land-based commercial fisheries in WA. The fishery is currently permitted to fish in waters north of Exmouth Gulf with three active licences in 2016 (Gaughan & Santoro 2018).

Commercial fishery (BOLD denotes overlap with WA-343-P)	Fishery summary
Mackerel Managed Fishery (WA)	The Mackerel Managed Fishery uses near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands (WAFIC 2018f). The fishery targets Spanish mackerel (*Scomberomorus commerson*). There are currently 50 licences in the fishery with 15 active in the Kimberley area where the majority of the catch is taken (Gaughan & Santoro 2018).
Marine Aquarium Fish Fishery (WA)	This Marine Aquarium Fish Fishery is typically more active in coastal waters between Esperance and Broome with higher levels of effort around the Capes region, Perth, Geraldton, Exmouth and Dampier (Gaughan & Santoro 2018). More than 950 species of marine aquarium fishes may be accessed, with some operators also permitted to take coral, live rock, algae, seagrass and invertebrates.
North Coast Crab Fishery (Including Kimberley Mud Crab and Pilbara Crab) (WA)	The North Coast Crab Fishery is a trap-based fishery which targets blue swimmer crabs in the Pilbara (the Pilbara Developing Crab Fishery) and mud crabs in the Kimberley (the Kimberley Developing Mud Crab Fishery) (WAFIC 2018b). Catch rates in these fisheries is very low.
Northern Demersal Scalefish Managed Fishery (WA)	The Northern Demersal Scalefish Managed Fishery is primarily a trap-based fishery which targets red emperor and gold band snapper. The fishery operates off the north-west coast of WA in the waters east of longitude 120°E and overlaps the EMBA. The typical catch is in the order of 3,000 tonnes annually, making these fisheries the most valuable finfish sector in the State, with an estimated annual value of at least $12 million (Gaughan & Santoro 2018).
Octopus Interim Managed Fishery (WA)	The Octopus Interim Managed Fishery targets the gloomy octopus (*Octopus tetricus*). The primary harvest method in the fishery is a 'trigger trap'. Catch rate for 2016 in the west coast region was 252 tonnes (Gaughan & Santoro 2018).
Pilbara Fish Trap and Trawl Managed Fishery (WA)	The Pilbara Fish Trap and Trawl Fishery lands the largest component of the catch of demersal finfish in the Pilbara (and North Coast Bioregion) comprising more than 50 scalefish species (Gaughan & Santoro 2018).
Pilbara Line	Pilbara line fishery uses drop line fishing method for fish. The indicator species are bluespotted emperor, red emperor, Rankin cod and ruby snapper. Catches around 45 to 50 scalefish species and some deeper offshore species.

Commercial fishery (BOLD denotes overlap with WA-343-P)	Fishery summary
Shark Bay Prawn/Scallop/ Crab Fisheries (WA)	The Shark Bay Prawn/Scallop/Crab Fisheries utilise low opening otter trawls. The boundaries of the Shark Bay Prawn Managed Fishery and the Shark Bay Scallop Managed Fishery are located in and near the waters of Shark Bay. They are considered as the State's more valuable fisheries with catches valued at $40-50 million annually (Gaughan & Santoro 2018). The Shark Bay Crab Managed Fishery is primarily based in Carnarvon but operates throughout the waters of Shark Bay (Gaughan & Santoro 2018).
Pearl Oyster Managed Fishery (WA)	The Pearl Oyster Managed Fishery is the only remaining significant wild-stock fishery for pearl oysters. It is a quota-based, dive fishery operating in the shallow coastal waters along the NWS (WAFIC 2018e). The main fishing grounds are off Eighty Mile Beach, with smaller catches being taken around the Lacepede Islands (Gaughan & Santoro 2018). The catch for 2016 was reported to be 541,260 oysters harvested over 19,699 dive hours (Gaughan & Santoro 2018).
North Coast Shark Fishery (Cwlth/WA)	The northern shark fisheries comprise the state-managed WA North Coast Shark Fishery in the Pilbara and western Kimberley, and the Joint Authority Northern Shark Fishery in the eastern Kimberley. Target species of the northern shark fisheries include the sandbar, hammerhead, blacktip and lemon sharks (AFMA 2018g). This fishery has not been active since 2008/2009 (AFMA 2018g).
Southern Demersal Gillnet and Demersal Longline Managed Fishery (Cwlth/WA)	The Southern Demersal Gillnet and Demersal Longline Managed Fishery targets mainly sharks with scalefish being a by-product. Gummy (*Mustelus antarcticus*), dusky (*Carcharhinus obscurus*), whiskery (*Furgaleus macki*), and sandbar (*C. plumbeus*) sharks are the main shark species targeted (~80% of the fisheries' shark catch) (Gaughan & Santoro 2018). The fishery operates from 33°S to the WA/SA border.
Specimen Shell Managed Fishery (WA)	The Specimen Shell Managed Fishery is based on the collection of individual shells for the purposes of display, collection, cataloguing, classification and sale. Just over 200 different Specimen Shell species were collected in 2016, using a variety of methods. The main methods are by hand by a small group of divers operating from small boats in shallow coastal waters or by wading along coastal beaches below the high water mark (Gaughan & Santoro 2018). While the fishery covers the entire WA coastline, there is some concentration of effort in areas adjacent to population centres such as Broome and Exmouth in the EMBA.

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
Trochus Fishery (WA)	The Trochus Fishery is a small fishery based on a single target species (*Trochus niloticus*) harvested by hand. The trochus are found on reef tops and are harvested at low tide. The annual harvest in the past decade has ranged between 2 and 15 tonnes. Fishing grounds are located in the remote Kimberley region (WAFIC 2018a)
West Coast Deep Sea Crustacean Fishery (WA)	The West Coast Deep Sea Crustacean Fishery operates predominantly around the entrance to Shark Bay in water depths from 150-1,200 m (Gaughan & Santoro 2018). Catch in 2016 was 153 tonnes dominated by crystal crabs.
West Coast Demersal Scalefish Fishery (WA)	The West Coast Demersal Scalefish Fishery is split into five management areas and operates inshore in waters 20-250 m depth and offshore inwater depths > 250 m. Target species include dhufish, pink snapper, eightbar grouper and blue-eye trevalla (WAFIC 2018g). There are 59 licence holders and restrictions apply in the form of maximum umbers of lines and hooks (WAFIC 2018g).
West Coast Demersal Gillnet and Demersal Longline Managed Fishery	Most fishers employ demersal gillnets targeting sharks with a bycatch of scalefish. Demersal longline is also permitted but is not widely used. Gummy (Mustelus antarcticus), dusky (Carcharhinus obscurus), whiskery (Furgaleus macki), and sandbar (C. plumbeus) sharks are the main shark species targeted and account for ~80% of the fisheries' shark catch.
South West Coast Salmon Managed Fishery	South West Coast Salmon Managed Fishery targets Western Australian salmon (*Arripis truttaceus*). This fishery uses beach seine nets. In 2015 and 2016 very large schools of salmon were observed in south-western waters and as far north as Exmouth, which is further north than ever previously reported.
West Coast Nearshore Net Fishery (WA)	The West Coast Nearshore Net Fishery mainly uses beach seine nets to target sea mullet, mulloway, Australian herring, yellowfin, whiting and southern garfish (WAFIC 2018h). The nearshore fishery is managed primarily by restricting numbers and gear, size limits and through seasonal, time and area closures (WAFIC 2018h).

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
West Coast Rock Lobster Fishery (WA)	The West Coast Rock Lobster Fishery targets the western rock lobster (*Panulirus cygnus*) between Shark Bay and Cape Leeuwin using baited traps (pots) with a commercial and recreational fishing season (DPIRD 2018). The fishery operates under a quota system based on entitlement to use pots held by licensed fishers and the relevant share of the total allowable catch set for the various zones of the fishery (WAFIC 2018i). For each commercial fishing season the total allowable catch across all zones is set annually (DPIRD 2018).
Aquarium Fishery (NT)	The Aquarium Fishery extends from the NT inland estuarine and marine waters out to the outer boundary of the Australian Fishing Zone, excluding Aboriginal sacred sites and other closed areas. The fishery targets freshwater and marine species including fish, plants and invertebrates using hand collections or small scoop nets. In 2016, there were 11 licences with only 3 boats active. (NTSC 2018f).
Barramundi Fishery (NT)	The Barramundi Fishery extends from the high water mark out to 3 nm and targets barramundi (*Lates calcarifer*) and king threadfin (*Polydactylus macrochir*) using gillnets, with the season running from 1 February to 30 September. As of 2016, there were 14 licences in the fishery. The area covered by the fishery covers some parts of the EMBA; namely, around the Tiwi Islands. According to the Northern Territory Seafood Council (NTSC), many areas are excluded from the fishery defined by fishery closure lines, protection zones and various National Parks and Marine Parks (NTSC 2018d).
Coastal Line Fishery (NT)	The Northern Territory's Coastal Line Fishery mainly targets black jewfish (*Protonibea diacanthus*) and golden snapper (*Lutjanus johnii*) (AFMA 2018g). The fishery extends along the NT coast between the high water mark and15 nm out from the low water mark. The western zone extends from the WA border to the Cobourg Peninsula. It is restricted to 52 licences. The main species taken are black jewfish and golden snapper with the total catch limited to 145 tonnes and 4.5 tonnes respectively (NT DPIF 2018a).
Coastal Net Fishery (NT)	The Coastal Net Fishery targets a range of species, particularly mullet, blue threadfin (*Eleutheronema tetradactylum*), shark and queenfish (*Scomberoides commersonnianus*) (AFMA 2018g). As with the Coastal Line Fishery, the Coastal Net Fishery operates inshore, extending from the high water mark out to 3 nm. There are five current licences with mullet being the primary species taken in the fishery (NT DPIF 2018b).

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
Offshore Net and Line Fishery (Cwlth/NT)	The Offshore Net and Line Fishery targets blacktip sharks (*Carcharhinus tilstoni*, *C. limbatus* and *C. sorrah*) and grey mackerel (*Scomberomorus semifasciatus*) (AFMA 2018g). The fishery extends from the NT high water mark out to the Australian Fishing Zone. However, most fishing occurs in the coastal zone within 12 nm of the coast, and immediately offshore in the Gulf of Carpentaria. The fishery is restricted to 17 licences (NT DPIR 2018c).
Pearl Oyster Fishery (NT)	The Pearl Oyster Fishery extends from the NT high water mark to the outer boundary of the Australian Fishing Zone. A total of 138,000 oysters can be collected by hand only each year (NT DPIR 2018d). There are currently 5 licences in the fishery.
Trepang Fishery (NT)	The Trepang Fishery area extends from the NT high water mark out to 3 nm. There are 6 licences in the Trepang Fishery, with only one or two boats active over the past few years. Trepang are typically harvested by hand from the intertidal and subtidal zones within the EMBA. The main species targeted is the sandfish (*Holothuria scabra*), commonly found in coastal areas with soft sediments and seagrass beds. There is no closed season for the fishery, although harvesting generally takes place from around April to November due to better water clarity and decreased temperatures (NTSC 2018a).
Demersal Fishery (Cwlth/NT)	The Demersal Fishery targets mainly red snappers (*Lutjanus malabaricus, L. erythropterus*) and gold-band snappers (*Pristipomoides spp.).* Painted sweetlips (*Diagramma pictum*) and cods (Family Serranidae) are key byproduct species. Drop lines, traps and trawl are the main gear types used in the fishery (AFMA 2018g). The fishery extends 15 nm from the low water mark to the outer boundary of the Australian Fishing Zone (NTSC 2018e). In 2016, there were 19 licences with only 9 active.
Spanish Mackeral Fishery (NT)	The Spanish Mackerel Fishery targets Spanish mackerel (*Scomberomorus commerson*) within Territory waters from the high water mark out to the outer boundary of the Australian Fishing Zone; however, most effort is generally focused around reefs, headlands and shoals. The fishery is restricted to 15 licences (NT DPIR 2018e).

Commercial fishery **(BOLD denotes overlap with WA-343-P)**	**Fishery summary**
Timor Reef Fishery (Cwlth/NT)	The Timor Reef Fishery primarily targets the higher-valued gold-band snapper (*P. multidens*) and other Pristipomoides species. Significant quantities of red snappers (*L malabaricus, L. erythropterus*), red emperors (*L. sefcae*) and cods (Family Serranidae) are also harvested (AFMA 2018g). In 2016 there were 16 licences but only 7 were active (NTSC 2018c). The fishery operates from north-east of Darwin to the WA/NT border and to the outer limit of the Australian Fishing Zone (NTSC 2018c).
Small Pelagic (and Squid) Fishery (NT)	The Small Pelagic (and Squid) Fishery targets Loligo squid and a range of small pelagic fish with the majority of the catch comprising of spotted sardine (*Amblygaster sirm*), large mouthed mackerel (*Rastrelliger kanagurta*), small spot herring (*Herklotsichthys lippa*), goldstripe sardine (*Sardinella gibbosa*) and ditchelee (*Pellona ditchela*). There is currently one active licence with approximately 40-50 days per year of effort using purse seine nets.
Fishing Tour Operator Fishery (NT)	Commercial fishing tour operators (FTOs) are managed by NT DPIR and operate under specific licence conditions including reporting of catch and effort statistics. The fishery operates in non-tidal and tidal waters from the NT boundary to the outer limit of the Australian Fishing Zone generally in areas that are accessible to the general public. They predominately operate near to population centres. The most common species include barramundi, golden snapper, stripey snapper, saddletail snapper and grass emperor (NTG 2016).
Cocos (Keeling) Islands Marine Aquarium Fish Fishery	The Cocos (Keeling) Islands Marine Aquarium Fishery covers waters of the Australian Fishing Zone within the 12 nm territorial waters of Cocos (Keeling) Islands, excluding the waters of North Keeling National Park. The fishery is managed by DPIRD and is the only regulated fishery operating within the 12 nm boundary around the Cocos (Keeling) Islands (Hourtson 2010). The target species is the Yellowheaded Angelfish (*Centropyge joculator*) which is endemic to the Cocos (Keeling) Islands and Christmas Island (Gaughan & Santoro 2018). The angelfish are collected using hand or scoop net or seine net of specific dimensions. There is only one licence issued for the fishery (Gaughan & Santoro 2018).
Christmas Island Line Fishery	The Christmas Island Line Fishery operates within the 0-12 nm zone around Christmas Island and is managed by DPIRD on behalf of the Commonwealth government.

Commercial fishery (BOLD denotes overlap with WA-343-P)	Fishery summary
	The fishery primarily targets pelagic species, mainly wahoo (*Acanthocybium solandri*) and yellowfin tuna (*Thunnus albacares*) however some commercial fishing activities are also undertaken for demersal fish species, mainly deep slope species such as ruby snapper (*Etelis* sp.) (Gaughan & Santoro 2018). The commercial catch for the fishery usually consists of catch data from only two vessels and the exact catch data in many years is not reportable due to confidentiality provisions. The total reported catch for this fishery has been less than 10 tonnes per annum over the last ten years (Gaughan & Santoro 2018).

Commercial fisheries – International waters

Within the international waters of the EMBA, capture fisheries in Indonesia contribute significantly to the national economy's income, foreign exchange, and employment. In 2010, the industry produced 5.4 million tons of fish. To manage the fishery areas, the Indonesian government established 11 fishery management areas covering Indonesia's territorial sea and EEZ (ADB 2014).

Although there are 11 fisheries management areas, lack of enforcement and lack of awareness of the need for sustainable fisheries management have resulted in the degradation of fish stocks in several areas. The use of unsuitable fishing gear has further declined fish stocks in certain areas, especially the coastal zone, which is exploited by 85% of Indonesian fishers. Additionally, foreign fleets threaten fisheries, although it is difficult to obtain accurate data on the number of vessels and their mode of operations (ABD 2014).

Recreational fishing

A wide range of recreational activities occur within the NWMR, NMR and SWMR. Recreational fishing activities peak in winter and are concentrated in coastal waters along the Kimberley and Northern Territory coastlines, generally around the population centres of Broome, Wyndham and Darwin. Fishing charters operate along parts of the mainland coast, including some locations within the EMBA, such as the Tiwi Islands and Flat Top Bank, all of which are readily accessible from Darwin.

Offshore islands, coral reef systems and continental shelf waters are increasingly targeted by fishing-based charter vessels (Gaughan & Santoro 2018). Extended fishing charters are known to operate during certain times of the year to fishing spots off the WA and NT coast, including Scott Reef. Generally, there is little recreational fishing that occurs within WA-343-P because of its distance from land, lack of features of interest and deep waters.

Christmas Island and the Cocos (Keeling) Islands are popular tourist destinations for recreational fishing, snorkeling, and diving. Recreational and artisanal fishing are undertaken around the Cocos (Keeling) and Christmas Islands targeting both finfish and invertebrate species (Gaughan & Santoro 2018).

Traditional fishing

Aboriginal fishing

Traditional fishing occurs along the majority of the Kimberley coastline. The practice of traditional fishing includes taking turtles, dugong, fish and other marine life (DEE 2018o). The EPBC Act Protected Matters Search (Director of National Parks 2018b) identified the following six IPAs:

- Balanggarra IPA (located in the Kimberley region near the WA border including Cape Londonderry)
- Bardi Jawi IPA (located on Dampier Peninsula)
- Dambimangari IPA (located in the Buccaneer Archipelago/Prince Regent area)
- Karajarri IPA (located at the northern end of Eighty Mile Beach)
- Nyangumarta Warrarn IPA (located in the Eighty Mile Beach Marine Park (state))
- Uunguu IPA (600 km north-east of Derby on the far north-west coast of the Kimberley).

These IPAs are all expected to have traditional aboriginal fishing activities ongoing. Other non-designated areas along the WA and NT coastline may also be used for traditional fishing.

Aboriginal communities on the Tiwi Islands, such as Wurrumiyanga on Bathhurst Island have been actively involved in managing their own sea turtle stocks in consultation with the NT government forming an Indigenous marine ranger program. Anecdotal evidence indicates that green turtles are harvested in the water, while eggs of any turtle species are taken periodically. Dugongs are also sometimes taken (DEWR 2006).

Indonesian fishing

The Australian and Indonesian governments signed a memorandum of understanding (MoU) in 1974 (DSEWPaC 2012a) which permits fishing by Indonesian and Timorese fishers, using traditional fishing methods only, in an area of Australian waters in the Timor Sea. The MoU area, which has become known as the "MoU Box", covers Scott Reef and its surrounds, Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks and shoals.

3.9.4 Aquaculture

There are no aquaculture operations in WA-343-P. Aquaculture development in the EMBA is dominated by the production of pearls from the species *Pinctada maxima.* A large number of pearl oysters for seeding is obtained from wild stocks and supplemented by hatchery-produced oysters with major hatcheries operating at Broome and the Dampier Peninsular. The wild shell collection occurs in shallow coastal waters (WAFIC 2018e). All the leases are within 35 m diving depth. Pearl farm sites are located mainly along the Kimberley coast, particularly in the Buccaneer Archipelago, in Roebuck Bay and at the Montebello Islands.

3.9.5 Shipping and ports

Information provided by the Australian Maritime Safety Authority (AMSA) through stakeholder consultation during the development of the EP, identified heavy vessel traffic will pass through the permit area during the activity. Automatic Identification System (AIS) data from May to October 2018 highlights the presence of commonly used transit routes to the south of the permit area used by supply vessels routinely supporting nearby offshore developments in the Browse Basin (INPEX Ichthys and Shell Prelude facilities). Within WA-343-P itself vessel traffic density is greatest in the north western corner of the permit area. The closest ports to WA-343-P are Derby, Broome and Wyndham. The Port of Broome provides supply facilities for the petroleum industry operating in the Browse Basin.

3.9.6 Oil and gas industry

The Browse Basin is subject to considerable exploration activity. The closest operational production facilities to WA-343-P are the INPEX Ichthys facility and the Shell Prelude FLNG facility located approximately 60 km south and 50 km south-west respectively.

The next closest production facility is PTTEP Australia's Montara project in the Vulcan sub-basin, approximately 80 km from WA-343-P at its closest point (NOPTA 2016). The Montara project comprises the Montara field, as well as the Skua, Swift and Swallow fields.

4 STAKEHOLDER CONSULTATION

INPEX has been a member of the Australian business community since 1986 and, during this time, has engaged on a regular basis with stakeholders in WA, the NT and in federal jurisdictions on a broad range of activities. INPEX maintains a corporate webpage (http://www.inpex.com.au) to provide company and project-related information to the public. INPEX also participates in industry forums, conferences and community meetings in order to facilitate opportunities for meaningful engagement about current and future activities.

During the development of the EP, INPEX has utilised existing relationships and points of contact in the region, and reached out to additional stakeholders whose functions, interests or activities may be affected by the proposed activity.

This chapter provides a description of the consultation process undertaken in relation to the proposed petroleum activity both for the development of the EP and for the duration of the activity. The engagement was carried out in accordance with a corporate process and involved the following:

- Stakeholder identification and classification
- Stakeholder engagement
- Stakeholder monitoring and reporting
- Stakeholder grievance management, as applicable.

4.1 Stakeholder identification and classification

As an initial exercise, 'relevant persons' were identified, then classified, to determine a suitable engagement priority and method. Key INPEX personnel met in a workshop to outline the requirement for engagement, established the context of the proposed activities, and identified relevant persons in accordance with Regulation 11A(1) of the OPPGS (E) Regulations 2009 and NOPSEMA's additional clarifications of Regulation 11A(1) as provided in Issues Paper IP1411 (NOPSEMA 2014).

4.2 Stakeholder engagement

A stakeholder engagement plan was developed to register the identified stakeholders, their assigned classification and the proposed manner of engagement (i.e. how, when, where, and by whom), in accordance with INPEX's formal engagement process.

INPEX prepared a consultation information sheet to provide relevant stakeholders with important details of the proposed petroleum activity. The document included the following information:

- description of the activity, including location and map
- schedule
- methodology (i.e. how the activity will be undertaken, as well as general logistics and safety information)
- environmental management approach
- enquiries and feedback information.

The accompanying email (or cover letter) provided more information relevant to the functions, activities or interests of the stakeholder receiving the information sheet, as applicable.

4.3 Stakeholder monitoring and reporting

All queries and feedback from stakeholders were recorded and forwarded for follow up, where applicable. All responses provided to stakeholders were appropriate to the nature of their communication, e.g. technical queries were investigated by area experts and responses provided.

4.4 Stakeholder grievance management

In relation to engagement activities for the EP, all stakeholder enquiries were dealt with as outlined under Section 4.3, therefore, no grievances were recorded in relation to the engagement process nor to the offshore activities described, both within the EP, and those interactions.

4.5 Consultation summary

Table 4-1 provides a summary of all stakeholders engaged on the proposed petroleum activity, and if that stakeholder raised a relevant matter in the course of the engagement. A summary of relevant matters raised by those stakeholders and their feedback is provided in Table 4-2.

Table 4-1: Stakeholder engagement summary

Stakeholder	Relevant matter raised
Commonwealth Government departments and agencies; Ministers of relevant portfolios	
Australian Border Force (Broome, Darwin and Canberra offices)	No
Minister for Infrastructure and Transport (response via Department of Infrastructure, Regional Development and Cities)	Yes
Australian Maritime Safety Authority (AMSA)	No
Minister for Agriculture and Water Resources (jurisdiction for Fisheries)	No
Department of Agriculture and Water Resources (DAWR) Fisheries branch	No
Department of Agriculture and Water Resources (DAWR) Biosecurity branch (Vessels, Aircraft & Personnel and Marine Pest units)	No
Australian Fisheries Management Authority (AFMA)	No
Department of Defence (RAN Australian Hydrographic Office – AHO)	No
Minister for the Environment	No
Department of Environment and Energy (DEE)	No

Stakeholder	**Relevant matter raised**
Office of the Director of National Parks	Yes
Department of Foreign Affairs and Trade (DFAT)	No
Minister for Resources and Northern Australia	No
Department of Industry, Innovation and Science (DIIS)	No
National Offshore Petroleum Titles Administrator (NOPTA)	No
Northern Territory Government departments or agencies	
Department of Environment and Natural Resources (DENR)	No
Department of Tourism and Culture - Parks and Wildlife Commission (NT PaWC)	No
Department of Infrastructure, Planning and Logistics -Transport - Marine Safety Branch (DIPL)	Yes
Department of Primary Industry and Resources - Fisheries branch (some joint communications with Northern Territory Seafood Council)	No
Department of Primary Industry and Resources – Aquatic Biosecurity Branch	No
Department of Primary Industry and Resources – Mining and Energy branch	No
Western Australian Government departments and agencies; Ministers of relevant portfolios	
WA Minister for the Environment	No
Department of Biodiversity Conservation and Attractions (DBCA) – Environmental Management Branch	No
Department of Water and Environmental Regulation (DWER) – Hazard Management and Contaminated Sites Branches	No
Department of Transport (WA DoT) – Marine Safety Branch	Yes
WA Minister for Fisheries (response via Department of Primary Industries and Regional Development (DPIRD) – Sustainability and Biosecurity branch)	Yes

Stakeholder	Relevant matter raised
Department of Primary Industries and Regional Development (DPIRD) – Fisheries branch, Aquatic Environment unit	No
Department of Primary Industries and Regional Development (DPIRD) – Fisheries branch, Sustainability and Biosecurity unit	No
Department of Planning, Lands and Heritage (DPLH) – Aboriginal Heritage unit	No
WA Minister for Mines and Petroleum	No
Department of Mines, Industry Regulation and Safety (DMIRS)	No
Shire of Broome	No
Shire of Derby / West Kimberley	No
Shire of Wyndham / East Kimberley	No
Kimberley Ports Authority	No
National Native Title Tribunal, relevant Aboriginal and Torres Strait Islander land councils and prescribed bodies corporate, traditional owners and relevant land councils in areas potentially impacted by the operations activities	
National Native Title Tribunal	No
Indigenous Land Corporation	No
Northern Land Council	No
Larrakia Nation Aboriginal Corporation (LNAC)	No
Tiwi Land Council	No
Kimberley Land Council	No
Bardi and Jawi Niimidiman Aboriginal Corporation (prescribed body corporate) (represents traditional owners in Dampier Peninsula and other areas)	No
Wanjina-Wunggurr (Native Title) Aboriginal Corporation	No

Stakeholder	Relevant matter raised
(represents traditional owners in Kalumburu and other areas)	
Nyamba Buru Yawuru Ltd (Yawuru Native Title Holders Aboriginal Corporation) (represents traditional owners of Broome)	No
Djarindjin Aboriginal Corporation (Dampier Peninsula)	No
Kooljaman at Cape Leveque (Dampier Peninsula)	No
Lombadina Aboriginal Corporation (Dampier Peninsula)	No
Buurabalayji Thalanyji Aboriginal Corporation	No
Dambimangari Aboriginal Corporation	No
Karajarri Traditional Lands Association (Aboriginal Corporation)	No
Miriuwung and Gajerrong Aboriginal Corporation	No
Ngarluma Aboriginal Corporation	No
Nyangumarta Karajarri Aboriginal Corporation	No
Yamatji Marlpa Aboriginal Corporation on behalf of: • Pilbara Coastal Native Title Holders and Claimants • Murchison - Gascoyne Coastal Native Title Holders and Claimants	No
Yindjibarndi Aboriginal Corporation RNTBC	No
Commonwealth-managed fisheries stakeholders	
Commonwealth Fisheries Association (CFA)	No
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	Yes

Stakeholder	Relevant matter raised
Individual licence/permit holders in the following fisheries: • North West Slope Trawl Fishery • Western Tuna and Billfish Fishery	Yes - Western Tuna and Billfish Fishery only
Western Australian-managed fisheries stakeholders	
Western Australian Fishing Industry Council (WAFIC) (also represents Commonwealth-managed fisheries located offshore WA)	Yes
Pearl Producers Association of Western Australia (PPA)	No
Individual licence/permit holders in the following fisheries: • Joint Authority Northern (North Coast) Shark Fishery • Mackerel Managed Fishery (Area 1) • Northern Demersal Scalefish Fishery (Area 2) • Pearl Oyster Managed Fishery (Zone 3) through PPA • Specimen Shell Managed Fishery.	No
Recreational fishing associations	
Recfishwest (WA)	No
Environmental, heritage and marine research groups	
Australian Institute of Marine Science (AIMS)	No
Centre for Whale Research (WA) Inc.	No
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	No
Conservation Council of WA	No
Western Australian Marine Science Institution (WAMSI)	No
World Wildlife Fund for Nature (WWF)	No
Oil spill response	

Stakeholder	Relevant matter raised
Australian Marine Oil Spill Centre (AMOSC)	No
RPS Asia-Pacific Applied Science Associates (RPS APASA)	No
Oil Spill Response Limited (OSRL)	No
Other businesses and industries (and representative bodies)	
Australia's North West Tourism	No
Broome Chamber of Commerce	No
KRED Enterprises	No
Nyamba Buru Yawuru Ltd	No
Larrakia Development Corporation	No
Foreign government authorities	
Indonesian Ministry for Marine Affairs and Fisheries	No

4.6 Relevant matters raised by stakeholders

Within the stakeholder correspondence log, INPEX's assessment of merit is presented, with each stakeholder response assigned to one of the following categories:

- not a relevant matter – general correspondence only
- not a relevant matter – correspondence does not relate to the stakeholder's functions, interests or activities being affected by the petroleum activity
- relevant matter – stakeholder has requested information or provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into the appropriate sections of the EP
- objection / claim / concern raised by stakeholder regarding the petroleum activity and the stakeholder's functions, activities or interests. However, this matter was not assessed as having merit and the matter has not been considered further in the EP. The stakeholder has been informed of this decision and reasons provided
- objection / claim / concern raised by stakeholder regarding the petroleum activity and the stakeholder's functions, activities or interests. This matter has merit and reasonable basis for being addressed in the EP. The matter has been assessed in the EP. The outcomes of the assessment have been shared with the stakeholder.

Table 4-2: Summary of relevant matters, objections, claims or concerns from stakeholder consultation

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
Authority, Commonwealth Government	Minister for Infrastructure and Transport (via Department of Infrastructure, Regional Development and Cities)	On 29 November 2018, the Department contacted INPEX (on behalf of the Minister) contacted INPEX to advise that they had sought advice from AMSA regarding the proposed activity in WA-343-P. The Department forwarded the following information/recommendations from AMSA: • a vessel chart plot of permit block WA-343-P and surrounds overlaid with AIS data from the last 6 months. • Advised that heavy vessel traffic will pass through the permit block during activities. • Encouraged INPEX to provide the exact location of the well so that more up to date vessel traffic plot can be provided. • Requested INPEX notify AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings 24-48 hours before operations commence. • Advised on requirement to contact the Australian Hydrographic Office.	On the 19 December 2018, INPEX responded to the Department (copied to the Minister) advising that the coordinates of the well location (expected to be finalised in Q1 2019) would be provided to AMSA and the AHO. A summary of the controls relating to marine notifications described in the EP was also forwarded. On 11th June 2019, INPEX updated the Department to confirm that the project schedule has been revised and the exact location of the well is not yet available. INPEX confirmed that a commitment is provided for in this EP that once the exact well location is available it will be provided to AMSA and AHO (Table 9-3).
Authority, Commonwealth Government	Office of the Director of National Parks (DNP)	On 6 February 2019, DNP contacted INPEX to provide information and requests related to the respective exploration drilling and oil spill response management activities. DNP noted the following in its email: • The planned activities do not overlap any Australian Marine Parks (AMPs). WA-343-P is a minimum of 80 km to Cartier Island, Ashmore Reef and Kimberly Marine Parks. Therefore, there are no authorisation requirements from the DNP.	On 19 February 2019, INPEX responded to the Office of the DNP advising that the matters they had outlined had been considered and addressed within the EP and OPEP.

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
		• In preparing its EP and OPEP, INPEX should consider the AMPs. In the context of the management plan objectives and values, INPEX should ensure that the EP: – identifies and manages the impacts and risks on marine park values to an acceptable level and has considered all options to avoid them or reduce them to as low as reasonably practicable; and – clearly demonstrates that the activity will not be inconsistent with the management plan. • DNP do not require further notification of progress made in relation to this activity unless details regarding the activity changes and result in an overlap with a marine park or for emergency responses. • In emergency situations, DNP should be made aware as soon as possible of oil/gas pollution incidences which occur within or are likely to impact on a marine park.	
Authority, Western Australia, state/local authority	Department of Transport – Marine (WA DoT)	On 30 October 2018, WA DoT requested the opportunity to provide feedback on the WA-343-P Oil Pollution Emergency Plan via document review and/or a face to face meeting.	INPEX provided a marked-up copy of the OPEP and the required information as specified in the WA DoT Offshore Petroleum Industry Guidance Note (version 4 Sept 2018) on 23 January 2019. Email response by WA DoT on 22 February 2019 requested:

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
			• Future consultations should ensure section or page references are provided to where relevant information can be found in documents prepared for regulatory submission. • Compliance with WA DoTs Industry Guidance Note September 2018. This response required no changes to be made to the OPEP.
Authority, Western Australia, state/local authority	WA Minister for Fisheries, via the Department of Primary Industry and Regional Development (DPIRD) – Sustainability and Biosecurity branch	On 26 November 2018, INPEX received a letter from DPIRD Sustainability and Biosecurity branch on behalf of the WA Minister for Fisheries. DPIRD highlighted commercial fishing interests that exist in, or in close proximity to WA-343-P. DPIRD also recommended that INPEX maintain ongoing consultation with WAFIC, Recfishwest and other fishers to include notification of start and end dates of activity and any exclusion zones. Potential risks associated with the pre-drill survey, highlighted by DPIRD included seabed disturbance and underwater noise. Data regarding spawning and aggregation times was also provided to INPEX from DPIRD. Other recommendations made to INPEX by DPIRD included the management of biosecurity risks and oil pollution risks with respect to potential impacts on spawning grounds and nursery areas for key fish species in the area.	INPEX responded to DPIRD via letter dated 5 December 2018 confirming: The commercial fisheries identified have been captured in Section **3.9.3** and potential impacts and risks applicable to these fisheries have been assessed. Ongoing consultation will be undertaken in accordance with Section 4.7of this EP Summary. Sections 6.9 and 6.5 provide an impact and risk assessment for seabed disturbance and underwater noise respectively. These assessments consider fish spawning and aggregation times and within these sections multiple mitigative controls are described to demonstrate that impacts and risks are managed to ALARP and acceptable levels. Biosecurity management controls are described Section 6.7 and incorporate those recommendations made by DPIRD.

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
			The Oil Pollution Emergency Plan (OPEP) and associated Operational and Scientific Monitoring Program (OSMP) include DPIRDs recommendations.
Authority, Western Australia, state/local authority	Department of Primary Industry and Regional Development (DPIRD) – Aquatic Environment branch	INPEX emailed DPIRD Aquatic Environment branch on 11 September 2018 regarding fisheries determination process and proposed engagement of WA-managed fisheries. A follow-up email was sent on 28 September 2018.	On 28 September 2018, DPIRD Aquatic Environment advised the fisheries determination process had changed. Oil and gas titleholders could now download data files directly from the Department's online website/Fishcube system, to map which fisheries overlap the areas of interest for the proposed petroleum activity.
		Telephone call and email (29 October 2018) to Aquatic Environment branch to request an opportunity to brief the Department on this and other proposed offshore exploration activities INPEX believed would be of significant interest to the Department.	No response received.
		On 7 December 2018, INPEX emailed DPIRD Aquatic Environment branch to advise the following: • The outcome of INPEX's online/Fishcube fish mapping exercise (potentially relevant fisheries). • Revised plan to utilise WAFIC's consultation service to review identified fisheries for 'relevancy', and to engage licence holders and industry associations in relevant commercial fisheries. • Outlined WAFIC's engagement approach.	On 11 December 2018, DPIRD Aquatic Environment advised that the engagement program involving WAFIC looks comprehensive and should meet INPEX needs.

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
		• Requested DPIRD's position on INPEX contracting WAFIC's consultation service and WAFIC's proposed engagement approach; requested any other recommendations for engagement with WA-managed fishing stakeholders. Repeated earlier request for opportunity to brief the Department on this and other proposed offshore exploration.	
Commonwealth - managed fisheries	Australian Southern Bluefin Tuna Industry Association (ASBTIA)	On 6 December 2018, WAFIC acting on behalf of INPEX, issued a commercial fisheries specific stakeholder engagement letter to its members. Individual fishery responses were forwarded to INPEX from WAFIC on behalf of its members specifically the Australian Southern Bluefin Tuna Industry Association. On 3 January 2019, ASBITA advised INPEX that its fishing operations are concentrated in the Great Australian Bight and there are no concerns for fishing vessel interaction. They identified their main concern for potential adverse impact on spawning grounds located to the west of the proposed drilling activity. They requested INPEX to ensure all operations are performed to the highest standard to prevent accidental discharges of hydrocarbons and requested INPEX ensure capacity to respond to unplanned discharges.	On 11 January 2019, INPEX responded to ASBTIA to confirm that routine discharges associated with the activity will be regulated under the various Marine Orders, and controls are in place to ensure these discharges are managed properly. INPEX also advised ASBTIA about the INPEX Drilling Chemical Assessment and Approval Process that is used to select drilling chemicals ensuring that they have a low environmental hazard rating. A description of the controls in place (as included in this EP) to prevent unplanned discharges, including loss of well containment was also provided to ASBTIA. INPEX provided examples of the control measures to be implemented and confirmed that INPEX maintains appropriate oil spill response capability as described in the OPEP, that will be assessed by NOPSEMA.

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
Commonwealth - managed fisheries	Western Tuna and Billfish Fishery (WTBF)	On 6 December 2018, WAFIC acting on behalf of INPEX, issued a commercial fisheries specific stakeholder engagement letter to its members. Individual fishery responses were forwarded to INPEX from WAFIC on behalf of its members specifically the Western Tuna and Billfish Fishery. On 4 January 2019, a licence holder from the WTBF, confirmed that given the absence of any seismic survey associated with the drilling activity they had limited concerns. However, they noted a requirement for INPEX vessels to respect the rights of commercial fishing vessels.	On 11 January 2019, INPEX responded to the WTBF licence holder. INPEX confirmed the duration of the activities and the timeframe for which the safety exclusion zone would be in place around the MODU and the absence of any further cautionary zones associated with the activity. INPEX also reiterated its commitment that no recreational fishing would be allowed from any support vessels or vessels associated with this activity including contractors and sub-contractors.
Authority, Western Australia, state/local authority	Western Australian Fishing Industry Council (WAFIC) NB: The meeting content is yet to be validated by WAFIC.	INPEX requested and provided a briefing to WAFIC on this and other proposed exploration activities on 8 November 2018. INPEX explained that fisheries are the most important stakeholders for INPEX to develop relationships with and INPEX recognise the need to share offshore areas and resources. INPEX provided an overview of INPEX Australia acreage, including the Ichthys production permit and other offshore permit areas in the Browse, Bonaparte, Canning and Carnarvon Basins, for which INPEX is either named operator/majority interest titleholder, or has smaller interests in as part of joint ventures with other titleholders. INPEX explained WA-343-P exploration drilling proposal, which includes the drilling of one well in Q3 2019, and a prior site survey. INPEX explained how it has identified and engaged fishing stakeholders during the development of past EPs.	Main points of feedback related to the WA-343-P Exploration Drilling activity: Consultation (generally) • As both industries share the ocean and its resources, WAFIC is looking for better ways for the industries to communicate including on Environment Plan (EP) development, and want to become specialists on consultation. • Stakeholder fatigue within fishing industry arising from O&G industry (primarily EP-related) consultation requests is a significant issue. • Information provided on offshore petroleum activities frequently does not address the concerns of the fishing industry.

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
			• There are many fisheries that will have licence areas that overlap the drilling area but licence holders don’t operate in these areas. Many will not be interested and sending fact sheets to them is an ongoing stakeholder fatigue issue. • WAFIC offers a fee-for-service for consultation, and data on who are relevant parties to the physical activity and the EMBA: o Identification of fisheries with activities relevant to the activity and the EMBA. o Produce a comprehensive report of consultation conducted. o WAFIC has email contact details for licence holders, has established relationships with them, and is successful in getting a response. • Consulting with all fisheries only contributes to stakeholder fatigue. Fisheries that could potentially be impacted by the physical activity should be considered relevant. All fisheries identified as intersecting with the broader area of interest (EMBA) are identified in WAFIC’s report and can be identified in the EP. Consultation for drilling activity

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
			• The INPEX WA-343-P exploration drilling fact sheet (sent to WAFIC 02.11.18) is inadequate for fishing industry consultation. The map is indistinct, and it contains nothing relevant to risks and impact on fisheries. WAFIC expects INPEX to: ○ Provide a map showing overlay for each relevant fishery ○ Address each relevant fishery with proposed management measures to reduce impacts down to ALARP level. ○ Provide assurance of contractors/ subcontractor management (e.g. will make wide berth around commercial fishing activity, won't engage in recreational fishing from vessels, etc.). **Remarks about offshore activities** WAFIC requests that INPEX consider avoiding applying petroleum safety exclusion zones over well heads and around infrastructure. WAFIC understands that Woodside and others have managed without these in place and so they are not necessary. Exclusion zones prevent fisher from accessing what is affectively a fish aggregation structure.

Category, jurisdiction subcategory	Stakeholder	Engagement	Feedback summary
		In response to INPEX's provision of maps and factsheet to WAFIC relating to the proposed activity, on 3 January 2019, WAFIC advised of several points in relation to communication of material information to INPEX personnel, contractors and subcontractors; safety exclusion zone; cautionary zones; rights of commercial fishers in waters outside the exclusion zone and noting that commercial fisheries may potentially be affected should a catastrophic event occur.	INPEX provided a response by email (10 January 2019) addressing the points raised by WAFIC and confirming the presence and duration of the PSZ around the MODU, respecting the rights of commercial fishers that may be operating in areas external to the safety exclusion zone, controls in place for the timely response to an oil pollution emergency.
Authority, Northern Territory, state/local authority	NT Government (Regional harbour master)	INPEX is currently preparing OPEPs for future exploration activities, INPEX is also jointly preparing (with AMOSC, Shell and ConocoPhillips), the NT Oiled Wildlife Response Plan. INPEX sought clarification via telephone and follow up email (16 January 2019) regarding Jurisdictional Authority (J/A) and Control Agency (C/A), for cross jurisdictional oil spill response scenarios. Specifically, if a spill occurs from a petroleum facility in Cwlth Waters, and the spill drifts into NT waters, then who is the J/A and C/A.	Cross jurisdictional arrangements are not explicitly stated in the NT OSCP (2014) or the Darwin Port OSCP (2018). On 17 April 2019 INPEX received clarification from the the NT Department of Environment and Natural Resources in relation to interim arrangements for NT cross jurisdiction response, whilst the NT OSCP is under review. The text provided in this EP and OPEP is consistent with the NT's interim arrangements for cross jurisdictional response. When the new NT OSCP is finalised, or other NT Govt official written advice regarding cross jurisdication response is provided, INPEX will review and ensure OPEPs are updated if required.

4.7 Ongoing stakeholder consultation

In relation to an EP Implementation Strategy, Regulation 14(9) of the OPPGS (E) Regulations 2009 specifies a requirement for consultation with relevant authorities of the Commonwealth, a state or territory, and other relevant interested persons or organisations. Any objections or claims received from stakeholders while the activity is ongoing will be considered and assessed using the same process and criteria described for the stakeholder consultation undertaken during the development of this EP. Mechanisms that provide ongoing opportunities for consultation with stakeholders, in relation to the implementation of this EP, are summarised in Table 4-3.

Table 4-3: Ongoing stakeholder consultation

Stakeholder	Information supplied	Frequency
Australian Border Force, Canberra (Cwlth)	INPEX will report any unusual vessel activity within the area to the Australian Border Force.	As required
Australian Hydrographic Office	INPEX to notify AHO of the exact well location within WA-343-P.	Once exact well location can be confirmed.
	The AHO will be notified of the exact well location, activity commencement and cessation via datacentre@hydro.gov.au, for promulgation of fortnightly Notice to Mariners.	4 weeks prior to commencement and upon completion of the activity.
Department of Agriculture and Water Resources (Cwlth)	INPEX will keep the Department informed of any concerns raised by AFMA or other relevant Commonwealth fishing stakeholders.	As required
Department of Mines, Industry Regulation and Safety (WA)	DMIRS will be notified of the activity commencement and cessation.	As required
Minister for Fisheries (WA)	The Minister requested that any information contained in the biosecurity and marine pest section of the EP is forwarded to all vessel and asset operators associated with the project and relevant personnel are aware of requirements.	As required, prior to commencement of operations
	Minister will be advised of any further consultation if significant changes affecting fisheries occurs.	As required
Minister for Infrastructures and Transport/Australian Maritime Safety Authority (AMSA; Cwlth)	INPEX to notify AMSA of the exact well location within WA-343-P.	Once exact well location can be confirmed.
	Per request by the Federal Minister for Infrastructure and Transport	24-48 hours before operations commence.

Stakeholder	Information supplied	Frequency
	INPEX to notify AMSA's JRCC for promulgation of radio-navigation warnings 24-48 hours before operations commence. (Email: rccaus@amsa.gov.au; Phone: 1800 641 792 or +61 2 6230 6811). AMSA's JRCC require the vessel names, IMO vessel numbers and call signs, and Maritime Mobile Service Identity (MMSI) numbers	
Commercial fishers via Western Australian Fishing Industry Council (WAFIC)	The notification to commercial fishers will include details of the location of the MODU, timing of activities and details of the MODU and vessel (IMO number and call sign, VHF radio and satellite phone details).	Prior to the commencement of activities and following completion.

5 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHODOLGY

In accordance with Division 2.3, Regulation 13(5) of the OPGGS (E) Regulations 2009, an environmental risk assessment was undertaken to evaluate impacts and risks arising from the activities described in Section 3. This section describes the process in which impacts and risks were identified.

An environmental hazard identification (HAZID) workshop was undertaken for the petroleum activity. The workshop involved numerous environmental, health, safety and emergency response personnel, drilling engineers, exploration geologists, logistics and marine advisers.

The workshop was undertaken in accordance with INPEX health, safety and environment (HSE) Risk Management processes. The approach generally aligned to the processes outlined in ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia/ Standards New Zealand, 2009) and Handbook 203:2012 *Managing environment-related risk* (Standards Australia/Standards New Zealand 2012).

The environmental impact and risk evaluation process has been undertaken in nine distinct stages:

1. the establishment of context
2. the identification of aspects, hazards and threats
3. the identification of potential consequences (severity)
4. the identification of existing design safeguards and control measures
5. proposal of additional safeguards (ALARP evaluation)
6. an assessment of the likelihood
7. an assessment of the residual risk
8. an assessment of the acceptability of the residual risk
9. the definition of environmental performance outcomes, standards and measurement criteria.

5.1 Establishment of context

The first stage in the process involved defining the activity, characterising the environment and identifying the particular values and sensitivities of that environment. The outcomes of these are presented in Section 3 Description of Activity and Section 3 Existing Environment, of this EP.

5.2 Identification of aspects, hazards and threats

An assessment was undertaken to identify the aspects associated with the petroleum activity. An aspect is defined by ISO 14001: 2015 *Environmental Management Systems (EMS)* as:

"An element or characteristic of an activity, product, or service that interacts or can interact with the environment".

The aspects were grouped to align with the INPEX HSEQ-MS environment standards. A summary of the aspects identified for the petroleum activity were as follows:

- emissions and discharges
- waste management
- noise and vibration
- loss of containment

- biodiversity and conservation protection
- land disturbance (or seabed disturbance)
- social and cultural heritage protection.

Hazards are defined by the INPEX HSE Hazard and Risk Management Standard as:

"A physical situation with the potential to cause harm to people, damage to property, damage to the environment".

As the definition suggests, for an environmental risk or impact to be realised, there needs to be a chance of exposing an environmental value or sensitivity to a hazard.

Given the various receptors present in the environment, they have been refined to environmentally sensitive or biologically important receptors (values and sensitivities). They have been selected using regulations, government guidance and stakeholder feedback.

For the purposes of the evaluation, environmental values and sensitivities to be considered include the following:

- receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage)
- benthic primary producer habitat, defined by the Western Australian Environmental Protection Authority (WA EPA) Environmental Assessment Guideline No. 3 *Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment* as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals, or mixtures of these groups, are prominent components
- regionally important areas of high diversity (such as shoals and banks)
- particular values and sensitivities as defined by Regulation 13(3) of the OPGGS(E) Regulations 2009:
    - the world heritage values of a declared World Heritage property within the meaning of the EPBC Act
    - the national heritage values of a National Heritage place within the meaning of the EPBC Act
    - the ecological character of a declared Ramsar wetland within the meaning of the EPBC Act
    - the presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act
    - the presence of a listed migratory species within the meaning of the EPBC Act
    - any values and sensitivities that exist in, or in relation to, part or all of:
        - a Commonwealth marine area within the meaning of the EPBC Act – Note that this value and sensitivity includes receptors (e.g. planktonic and benthic communities) that, when exposed, have the potential to affect regionally significant ecological diversity and productivity from benthic and planktonic communities
        - Commonwealth land within the meaning of the EPBC Act.
- biologically important areas associated with EPBC-listed species.

5.3 Identify potential consequence

In the sections 6 and 7, for each aspect, the greatest consequence (or potential impact) of an activity, is evaluated with no additional safeguards or control measures in place. This allows the assessment to be made on the maximum foreseeable exposure of identified values and sensitivities to the hazard taking into account the extent and duration of potential exposure. The consequence is defined using the INPEX Risk Matrix (**Figure 5-1**).

Given that the receptors, identified as particular values and sensitivities are the most regionally significant or sensitive to exposure, these are considered to present a credible worst-case level of consequence to assess against.

5.4 Identify existing design safeguards/controls

Control measures associated with existing design are then identified to prevent or mitigate the threat and/or its consequence(s).

5.5 Propose additional safeguards (ALARP evaluation)

Where existing safeguards or controls have been judged as inadequate to manage the identified hazards (on the basis that the criteria for acceptability is not met as defined in Section 5.8), additional safeguards or controls are proposed.

The INPEX *HSE Hazard and Risk Management Standard* describes the process in which additional engineering and management control measures are identified, taking account of the principle of preferences illustrated in Figure 5-2. The options were then systematically evaluated in terms of risk reduction. Where the level of risk reduction achieved by their selection was determined to be grossly disproportionate to the "cost" of implementing the identified control measures, the control measure will not be implemented, and the risk is considered ALARP. Cost includes financial cost, time or duration, effort, occupational health and safety risks, or environmental impacts associated with implementing the control.

5.6 Assess the likelihood

The likelihood (or probability) of a consequence occurring was determined, taking into account the control measures in place. The likelihood of a particular consequence occurring was identified using one of the six likelihood categories shown in Figure 5-1.

5.7 Assess residual risk

Where additional controls/safeguards are identified, the residual risk is then evaluated and ranked.

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Risk Matrix

Refer to the Risk Management Guideline [0000-A0-GLN-60010] for guidance on how to apply the risk matrix.

LIKELIHOOD TABLE

Time Frame Could be experienced	100 year timeframe or less	50 year timeframe	10 - 20 year timeframe	5 year strategic planning time frame	1 -2 year budget timeframe	Once or more during the next year
Experience History of occurrence in Company or Industry	Unheard of in the industry or in Projects	Has occurred once or twice in the industry or rarely occurs in Projects	Has occurred many times in the industry but not in the company or in <1 out of 100 Projects	Has occurred once or twice in the company or in <1 out of 10 Projects	Has occurred frequently in the company or in many Projects	Has occurred frequently at the location or in every Project
Frequency Continuous Operation	Once every 10 000 – 100 000 years at location	Once every 1,000 – 10 000 years at location	Once every 100 - 1000 years at location	Once every 10 - 100 years at location	Once every 1 - 10 years at location	More than once a year at location or continuously
Probability Single activity	1 in 100 000 – 1 000 000	1 in 10 000 – 100 000	1 in 1000 – 10 000	1 in 100 - 1000	1 in 10 - 100	>1 in 10

CONSEQUENCE TABLE

CONSEQUENCES

Severity Level	Financial NPV	Financial A$	Health & Safety	Environment	Reputation	Cultural & Social Heritage	Legal
A	>$1B	> $5B **Project Schedule** >24 months	>20 fatalities or permanent total disabilities	Regional scale event, permanent impact on environment. Eradication of local populations of protected species	Prolonged international multi-NGO and media and by public protests. Loss of host government support and/ or social licence to operate. Company reputation severely tarnished	Permanent, long-term impact on social structure, and destruction of highly-valued heritage, aesthetic, economic or recreational items	Criminal prosecution, potential jail sentences for directors and senior officers. Civil prosecution, class actions. Heavy fines, threat to licence to operate or future approvals
B	$100M – $1B	$1B – $5B **Project Schedule** 12 – 24 months	2 – 20 fatalities or permanent total disabilities	Large scale event, long term impact on environment. Extensive impact on populations of protected species	International multi-NGO and media condemnation. Host government registers concerns. Prolonged large protests. Company reputation seriously impacted	Widespread disruption to a number of communities with damage to highly-valued heritage, aesthetic, economic or recreational items	Criminal prosecution for directors and senior officers. Civil prosecution and class actions. Heavy fines, threat to licence to operate
C	$10M – $100M	$100M – $1B **Project Schedule** 6 – 12 months	Single fatality or Permanent Total Disability	Medium to large scale event, medium term impact on environment. No threat to overall population viability of protected species	Serious public or national media outcry. Damaging NGO campaign. Large protests. Company reputation impacted	Significant impact to regional communities, and to heritage, aesthetic, economic or recreational items of significant value	Significant, multiple breaches of regulation or licence conditions. Significant litigation and fines
D	$1M – $10M	$10M – $100M **Project Schedule** 1 - 6 months	Major injury or illness, permanent partial disability, lost time injury	Local to medium scale event with short to medium term impact on environment. No threat to overall population viability of protected species	Major adverse national media, public or NGO attention. Significant protests. Asset reputation impacted	Regional community disruption with moderate impact on heritage, aesthetic, economic or recreational values	Serious breach of regulation. Investigation by regulatory authorities. Potential litigation and moderate fines
E	$100K– $1M	$1M – $10M **Project Schedule** 2 - 4 weeks	Minor injury or illness, alternative duties injury, medical treatment injury	Local scale event with short term impact on the environment. Minor and temporary impact on a small portion of the population of protected species	Attention from regional media with heightened concern with local community. Criticism by community or NGOs	Isolated community disruption with limited adverse impact on heritage, aesthetic, economic or recreational values	Minor legal issues. Report provided to regulatory authorities. Potential for minor fines
F	<$100K	<$1M **Project Schedule** <2 weeks	Slight injury or illness, first aid injury	Local scale event with temporary impact on environment. Behavioural responses inconsequential ecological significance to protected species	Short term local concern or complaints. Low level media or regulatory issue	Minor impact on heritage, aesthetic, economic or recreational values	Breach of internal standards. Potential scrutiny by regulatory authorities

Likelihood Level

Severity	6 Remote	5 Highly Unlikely	4 Unlikely	3 Possible	2 Likely	1 Highly Likely
A Catastrophic	6	5	4 Critical Risk	3	2	1
B Major	7	6	5	4	3	2
C Significant	8	7	6 High Risk	5	4	3
D Moderate	9	8	7	6	5	4
E Minor	10	9	8 Moderate Risk	7	6	5
F Insignificant	10	10	9 Low Risk	8	7	6

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Figure 5-1: INPEX risk matrix

Most Preferred ↓ Least Preferred			
	Elimination		Removal of the hazard or sensitive receptor
	Substitution		Replacement of highly hazardous materials / approaches with less hazardous materials / approaches
	Engineering	**Prevention**	Design measures that reduce the likelihood of a hazardous event occuring
		Detection	Design measures that facilitate early detection of a hazardous event
		Control	Design measures that limit the extent/escalation potential of a hazardous event
		Mitigation	Design measures that protect the environment should a hazardous event occur
		Response Equipment	Design measures or safeguards that enable clean-up / response following the realisation of a hazardous event
	Procedures & Administration		Management systems and work instructions used to prevent or mitigate environmental exposure to hazards
	Sensitive Receptor Protection		The lowest level in the hazard management hierarchy which should only be considered when all higher controls in the hierarchy have been exhausted e.g. physical barriers located at the sensitive receptor

Figure 5-2: ALARP options preferences

5.8 Assess residual risk acceptability

Potential environmental impacts and risks are only deemed acceptable once all reasonably practicable alternatives and additional measures have been taken to reduce the potential impacts and risks to ALARP.

INPEX has determined that risks rated as "Critical" are considered too significant to proceed and are therefore, in general, unacceptable. In alignment with NOPSEMA's *Environment Plan Decision Making Guideline* (GL1721 Rev5 June 2018), INPEX considers that when a risk rating of "Low" or "Moderate" applies, where the consequence does not exceed "C" (Significant) and where it can be demonstrated that the risk has been reduced to ALARP, that this defines an acceptable level of impact.

Through implementation of this EP, impacts to the environment will be managed to ALARP and acceptable levels and will meet the requirements of Section 3A of the EPBC Act (Principles of ecologically sustainable development (ESD)) as shown in Table 5-1.

Table 5-1: Principles of ecological sustainable development

Principles of ESD	Demonstration
a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;	The INPEX environmental policy, INPEX *HSE Hazard and Risk Management Standard* and the INPEX HSEQ-MS consider both long-term and short-term economic, environmental, social and equitable considerations.
b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;	No threat of serious or irreversible environmental damage is expected from the activity. Scientific knowledge is available to support this and processes are in place to ensure that INPEX remains up-to-date with scientific publications.

c) the principle of inter-generational equity - that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;	The health, diversity and productivity of the environment shall be maintained and not impacted by the activity.
d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making;	Biological diversity and ecological integrity will not be compromised by the proposed activity.
e) improved valuation, pricing and incentive mechanisms should be promoted.	N/A

Consequently, the potential environmental impacts and risks associated with implementing the activity were determined to be acceptable if the activity:

- complies with relevant environmental legislation and corporate policies, standards, and procedures specific to the operational environment
- takes into consideration stakeholder feedback
- takes into consideration conservation management documents
- does not compromise the relevant principles of ESD; and
- does not exceed the defined acceptable level, in that the environmental risk has been assessed as "Low" or "Moderate", the consequence does not exceed "C – Significant" and the risk has been reduced to ALARP.

6 IMPACT AND RISK ASSESSMENT

Following the environmental impact and risk assessment methodology described in Section 6, the aspects, hazards and threats have been systematically identified. The aspects (and associated hazards) with the potential for impact or risk in relation to the relevant identified values and sensitivities are summarised in this section and in Section 7.

6.1 Light emissions

Table 6-1: Impact and risk evaluation – change in ambient light levels from navigational lighting on MODU and vessels

Identify hazards and threats	
No flaring will be undertaken as part of the activity; however, light emissions associated with MODU and vessel lighting (for navigational and safe working condition requirements) have the potential to disturb light-sensitive marine fauna, specifically turtle and bird species, through localised attraction to light that may result in behavioural changes.	
Potential consequence	**Severity**
Behavioural changes reported in marine turtles exposed to increases in artificial lighting can include disorientation and interference during nesting (Pendoley 2005). Disorientation of adult marine turtles or hatchlings has been known to result in risks to the survival of some individuals through excess energy expenditure or increased likelihood of predation (Witherington & Martin 2000; Limpus et al. 2003). Browse Island (listed as a C-class reserve) is the closest turtle-nesting area (located approximately 68 km south of WA-343-P) and is surrounded by a 20 km internesting buffer for green turtles (DEE 2017a) as described in Section 3. Once turtle hatchlings have reached the ocean, they normally maintain seaward headings by using wave propagation direction as an orientation cue. This is because waves and swells generally reliably move towards shore in shallow coastal areas, therefore swimming into waves usually results in movement towards the open sea (Lohmann & Fittinghoff-Lohmann 1992). While hatchlings and adult turtles can be attracted towards offshore sources of light, such as that generated by MODU and vessels, given the relatively short-duration of the activity (7-10 days survey/ 120-150 days drilling) and distance from the permit area to the closest turtle nesting beaches/internesting area (approximately 68 km/48 km) any behavioural responses due to the activity are considered to be of inconsequential ecological significance to a protected species (Insignificant F).	Insignificant (F)

As described in Section 3, WA-343-P is located within the East Asian–Australasian Flyway, an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008; DEE 2017b). There are no BIAs for marine avifauna within WA-343-P. However, the EMBA overlaps several Ramsar sites (Section 3.6) and a large number of BIAs for many marine avifauna species are present within the region, the closest of which relates to foraging around Ashmore Reef and Cartier Island (approximately 10 km from the northern boundary of WA-343-P). While not an identified BIA, the closest habitat for seabirds from the permit area is Browse Island. Browse Island is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). Colonies of nesting crested terns (>1,000 birds) have been observed on Browse Island (Olsen et al. 2018). Browse Island has also been recognised, through previous INPEX stakeholder consultation with WA DBCA, as an important location for marine avifauna. Lighting from MODUs and vessels has been found to attract seabirds, particularly those that are nocturnally active (BirdLife International 2012). Nocturnal birds are at much higher risk of impact (Weise et al. 2001); however, there are no threatened nocturnal migratory seabirds that use the EEA Flyway (DEWHA 2010). A study by Poot et al. (2008) of offshore oil platforms in the North Sea, found that large flocks of migrating seabirds can be attracted to the lights of offshore oil platforms, particularly on cloudy nights and between the hours of midnight and dawn. Poot hypothesised that when such offshore platforms are located on long-distance bird migration routes, the impact of this attraction could be considered highly significant, as many birds cross the ocean with only small additional fat reserves than required for the transit (e.g. twelve hours of fat reserves for a ten-hour flight). Any delay (e.g. resting on a platform or circling around them) may decrease the bird's resilience and potential survival. Studies conducted in the North Sea indicate that migratory birds may be attracted to offshore lights when travelling within a radius of 3 to 5 km from the light source. Outside this area their migratory paths are likely to be unaffected (Marquenie et al. 2008). There is no published literature of these impacts occurring on the NWS of WA. Migratory shorebirds travelling the EAA Flyway may fly over the permit area, before moving on to the mainland (south) in the spring or Indonesia/Australian External Territories (north) in the autumn. It is possible that migratory birds may use ships and other offshore facilities in order to rest. However, the possibility of this occurring on the MODU or vessels associated with the activity in WA-343-P is low due to the relatively short-duration of the activity and presence of alternative habitat for resting and foraging at Browse Island and Ashmore Reef/Cartier Island resulting in minimal deviation from migratory pathways and limited potential for behavioural disruption. Therefore, any impact to seabirds or migratory birds from lighting of the MODU/vessels is considered to be of inconsequential ecological significance (Insignificant F).	

Identify the likelihood		
Given the distance to the closest turtle nesting beaches (approximately 68 km to Browse Island) and short duration of the activity impacts to turtles from light emissions is Highly Unlikely (5). While impacts to seabirds from lighting of offshore platforms and vessels have been reported in the industry, they have only been recorded for facilities in the northern hemisphere. Given that there are several other permanently moored offshore installations in the vicinity of WA-343-P, with no records published on the attraction of seabirds or negative impacts to migratory seabirds from lighting, the likelihood of impact to these receptors from the lighting of the MODU and vessels is considered Unlikely (4). The presence of alternative resting/foraging habitat (Browse Island) and the short-term duration of the activity (7-10 days survey; 120-150 days drilling) also support this assessment of likelihood.		
Residual risk summary		
Based on a consequence of Insignificant (F) and a worst case likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
N/A no controls identified			

6.2 Atmospheric emissions

Table 6-2: Impact and risk evaluation – atmospheric emissions from MODU and vessels

Identify hazards and threats
Atmospheric emissions produced from the MODU and vessels during the activity have the potential to result in localised changes in air quality and subsequent exposure of marine avifauna to air pollutants. As described in Section 3.4, typical daily fuel usage for a moored or DP MODU is estimated as 30,000 L or 50,000 L respectively. Vessels in transit are estimated to use up to 15,000 L and approximately 5,000 L per day when on standby.

No flaring will be undertaken as part of the activity, however atmospheric emissions will be generated through the use of combustion engines, waste incinerators and ODS containing equipment on board the MODU and vessels. In addition to these sources, emissions associated with unplanned venting of gas from the reservoir may occur during drilling operations, where venting would be undertaken as a well control activity to avoid emergency conditions e.g. in the event of a well-kick. These atmospheric emissions also have the potential to result in localised changes in air quality and subsequent exposure of marine avifauna to air pollutants.	
Potential consequence	Severity
As described in Section 4.9.4, WA-343-P is located within the East Asian–Australasian Flyway, an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008). There are no BIAs for marine avifauna within WA-343-P. However, the EMBA overlaps several Ramsar sites (Section 3.6) and a large number of BIAs for many marine avifauna species are present within the region, the closest of which relates to foraging around Ashmore Reef and Cartier Island (approximately 10 km from the northern boundary of WA-343-P). While not an identified BIA, the closest habitat for seabirds from the permit area is Browse Island. Therefore, it is possible that migratory marine avifauna species may transit near WA-343-P during their migration via the EAA Flyway. In the absence of air quality standards or guidelines specifically for marine avifauna, human health air quality standards and guidelines have previously been used as a proxy for the assessment of atmospheric emissions from offshore production facilities and potential impacts to marine avifauna. The outcome of such assessments concluded that NO_2 concentrations may typically exceed long term (annual average) concentrations within a few kilometres of the emissions source and that short-term (1-hour average) exposure levels may be exceeded within a few hundred metres (i.e. 200-400 m) of the emission source (RPS APASA 2014). This assessment was undertaken for a production facility and therefore any changes in air quality resulting from the temporary presence of the MODU/vessel and equipment emissions in WA-343-P are also predicted to be highly localised given the nature of the emissions are less than those from a production facility. There will be no flaring during the activity; however, there may be temporary increases in emissions (e.g. hydrocarbon gases and H_2S) as a result of venting during a well-control event. This is not expected to result in a significant increase in exposure to marine avifauna as emissions will rapidly disperse following release in the open marine environment and the potential for exposure remains limited to the immediate vicinity of the vents.	Insignificant (F)

<table>
<tr><td colspan="12">If marine avifauna are exposed at all, they are only expected to be exposed to changes in air quality for short periods as they pass close to emissions sources. Chronic exposures are not considered plausible given that marine avifauna would move away (i.e. continue migration or undertake foraging activities elsewhere).

Overall, the consequence of temporary, localised changes in air quality may result in short-term, sublethal effects to a small number of transient marine avifauna individuals and is therefore considered Insignificant (F).</td><td></td></tr>
<tr><td colspan="13">Identify the likelihood</td></tr>
<tr><td colspan="13">The likelihood of marine avifauna approaching and/or resting on exhaust vents on MODU/vessels during the activity and remaining in close enough proximity to be exposed to concentrations of air pollutants that result in symptoms such as irritation of eyes and respiratory tissues and breathing difficulties is considered unlikely. Marine avifauna that may pass by near the MODU and vessels during the short-term activity are unlikely to be in close enough proximity to be exposed to the emissions sources and are therefore unlikely to have any discernible symptoms. It is considered likely that they would move away from any emissions source if they began to experience discomfort or symptoms. No marine avifauna BIAs or critical habitats are located in proximity or within WA-343-P.

With the control measures described above in place, the potential changes to air quality and potential impacts to marine avifauna are reduced. Therefore, the likelihood of the described consequences to marine avifauna occurring is considered Unlikely (4).</td></tr>
<tr><td colspan="13">Residual risk summary</td></tr>
<tr><td colspan="13">Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).</td></tr>
<tr><td colspan="4">Consequence</td><td colspan="4">Likelihood</td><td colspan="5">Residual risk</td></tr>
<tr><td colspan="4">Insignificant (F)</td><td colspan="4">Unlikely (4)</td><td colspan="5">Low (9)</td></tr>
<tr><td colspan="3">Environmental performance outcomes</td><td colspan="4">Environmental performance standards</td><td colspan="3">Measurement criteria</td><td colspan="3">Responsibility</td></tr>
</table>

Risks of impacts to marine avifauna from atmospheric emissions are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Pre-mobilisation HSE inspections confirm MODU/vessel contractors will comply with the MARPOL 73/78 (Annex VI), Navigation Act 2012 – Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, Annex VI (as appropriate to class of vessel), specifically: • International Air Pollution Prevention (IAPP) certificate and emission of NOx (for MODU and vessels 400 GT or above). • IMO type approval certificate has been issued for any onboard incinerators.	Pre-mobilisation HSE inspection documentation demonstrates that that MODU/vessels hold a valid IAPP Certificate and emission of NOx from engines is within specified limits, as appropriate to vessel class. Pre-mobilisation HSE inspection documentation demonstrates that vessels have an IMO type approval certificate for the onboard incinerator.	INPEX Drilling Supervisor
	Personnel responsible for operating incinerators will be trained in incinerator operation and appropriate waste for incineration in accordance with Marine Orders Part 97, the POTS Act and Annex VI of MARPOL 73/78.	Training records for personnel responsible for operating incinerators demonstrate that they are trained in incinerator operation and appropriate waste for incineration.	OIM/vessel master
	Pre-mobilisation HSE inspections confirm the MODU contractor complies with MARPOL 73/78, Annex VI, Regulation 12 - Ozone-Depleting Substances from refrigerating plants and firefighting equipment, which includes: • Maintenance of an ODS Record Book (where applicable).	Pre-mobilisation HSE inspection documentation demonstrates that ODS Record Book (where applicable) is current and maintained, as per MARPOL 73/78, Annex VI, regulation 12.	INPEX Drilling Supervisor

	Pre-mobilisation HSE inspections confirm vessels >400 GT hold a valid International Energy Efficiency (IEE) certificate and a Ship Energy Efficiency Management Plan (SEEMP) compliant with the requirements of Marine Orders – Part 97, the POTS Act and MARPOL 73/78, Annex VI (as applicable to the vessel and engine size, type and class).	Premobilisation HSE inspection records confirm vessels >400 GT have an IEE certificate and a SEEMP that meet the requirements of Marine Orders – Part 97, the POTS Act and MARPOL 73/78, Annex VI (as applicable to the vessel, engine/propulsion size, type and class).	INPEX Drilling Supervisor
	Marine diesel with 3.5% (m/m) sulfur content or less will be used in MODU/vessel engines prior to 1 January 2020 (and 0.5% m/m sulfur content on and after 1 January 2020).	Fuel delivery receipt indicates only low sulfur marine diesel is used.	Offshore Installation Manager (OIM)/Vessel master (INPEX Drilling Supervisor)
	Contractor has a preventative maintenance system to ensure diesel powered, power generation equipment is maintained and operated within OEM specification.	Records show diesel and power generation equipment is maintained in accordance with manufacturers' specifications.	INPEX Drilling Supervisor
	Reporting of greenhouse gas (GHG) emissions	Records show reporting of air emissions to relevant agencies	INPEX Environmental advisor

	INPEX and the MODU contractor will comply with the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 (Cwlth) and the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009, including: • NOPSEMA-approved WOMP • Preparation and acceptance of the MODU Safety Case and Safety Case Revision.	• WOMP approval received from NOPSEMA. • MODU Safety Case acceptance received from NOPSEMA.	• INPEX Drilling Supervisor • Offshore Installation Manager (OIM)
	INPEX will verify that the MODU contractor complies with the requirements of the approved Well Control Bridging Document which aligns requirements (and clarifies. if conflicts exist, which standard takes precedence) between the Contractor Well Control Manual, and INPEX policies and standards including INPEX Well Integrity Standard (0000-AD-STD-60003), Well Operations Standard (0000-AD-STD-60004) and Well Operations Manual (0000-AD-MAN-60002), which covers primary and secondary well control for drilling operations, including: • Planned mud weight overbalance to stop ingress potential (i.e. inflow of formation fluids) into the well.	Summary of compliance with primary and secondary well control in the Well Integrity Standard (0000-AD-STD-60003); Well Operations Standard (0000-AD-STD-60004) and Well Operations Manual (0000-AD-MAN-60002) reported in the daily drilling report.	Offshore Installation Manager (OIM) (INPEX Drilling Supervisor)

	• Leak off or limit testing to confirm that the formation has sufficient strength for planned mud weight with adequate kick tolerance. • Two independent well barriers in place at all times and tested in situ to ensure the system is capable of holding pressure in the well-bore or annulus.		

6.3 Routine discharges to sea

Sewage, grey water and food waste

Table 6-3: Impact and evaluation – MODU and vessels sewage, grey water and food waste discharges

Identify hazards and threats	
Discharging treated sewage effluent, grey water and food waste has the potential to expose planktonic communities to changes in water quality from the introduction of nutrients. Such a decline in water quality has the potential to result in reduced ecosystem productivity or diversity. These intermittent discharges will occur in WA-343-P, which is located in the open ocean and more than 12 nm from the nearest land. The average volume of sewage and greywater expected from the MODU and vessels (including domestic waste water) generated by a person per day is approximately 230 L (based on calculations in Huhta et al. 2009).	
Potential consequence	Severity
A study undertaken to assess the effects of nutrient enrichment from the discharge of sewage in the ocean found that the influence of nutrients in open marine areas is much less significant than that experienced in enclosed, poorly mixed water bodies. The study also found that zooplankton composition and distribution in areas associated with sewage dumping grounds were not affected (McIntyre & Johnston 1975). When sewage effluent, grey water and food waste is discharged there is the potential for localised and temporary, changes in water quality within WA-343-P. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge. Given the deep water (approximately 350 m) location, oceanic currents will result in the rapid dilution and dispersion of these discharges. Therefore, the consequence is considered to be of inconsequential ecological significance (Insignificant F).	Insignificant (F)
Identify the likelihood	
Sewage and garbage discharges for the MODU and vessels will be in accordance with legislative requirements (MARPOL 73/78 Annex IV & V, Marine Orders 95 and 96). Maceration of sewage and food waste to a particle size <25 mm prior to disposal will increase the ability of the discharges to disperse rapidly.	

The effects of sewage discharged to the ocean have been relatively well studied (Gray et al. 1992; Weis et al. 1989) and toxic effects generally only occur where high volumes are discharged into a small and poorly mixed waterbody. The volumes discharged within the permit area are unlikely to cause toxic effects, especially considering the rapid dilution provided by the deep water and ocean currents in the permit area. Based on the expected high dispersion due to the open-ocean environment of WA-343-P, localised impacts to plankton at the point of the planned discharge are considered to be Unlikely (4).
Residual risk summary
Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).

Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Zero discharges of untreated sewage and grey water or unmacerated putrescible waste to the marine environment for the duration of the activity.	Manage and dispose of sewage in accordance with: MARPOL 73/78 Annex IV, Marine Orders – Part 96: Marine Pollution Prevention – Sewage as enacted in the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Part IIIB (as appropriate to vessel class), including: • Current International Sewage Pollution Prevention Certificate (ISPPC). •	Pre-mobilisation HSE inspection confirms that the vessel holds a current ISPPC.	OIM/vessel master

	Manage and dispose of garbage in accordance with: MARPOL 73/78 Annex III, Marine Orders – Part 95: Marine Pollution Prevention – Garbage, as enacted in the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Parts IIIA and IIIC (as appropriate to vessel class), including: • Garbage that has been ground or comminuted to particles <25 mm: >3 nm from the nearest land. • Garbage disposal record book maintained in accordance with Protection of the Sea Act 1983 – Part IIIC	Garbage disposal record book	OIM/vessel master
	Sewage and grey water discharges will be monitored to ensure operational discharge requirements are met.	Operational discharges (planned and unplanned) of sewage and grey water are recorded on the MODU/vessels and demonstrate compliance with all requirements for operational discharge.	OIM/vessel master
	MODU contractor has a preventative maintenance system to ensure STP and macerator is maintained.	Pre-mobilisation and ongoing HSE inspection documentation demonstrate STP and macerator equipment is maintained.	INPEX Drilling Supervisor

Deck drainage, bilge and firefighting foam

Table 6-4: Impact and evaluation – MODU and vessels deck drainage, bilge and firefighting foam discharges

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Contaminated deck drainage and bilge discharges or failure to treat oily water to suitable OIW concentrations before discharge, have the potential to expose marine fauna to changes in water quality and/or result in impacts through direct toxicity. Deck drainage discharge volumes on the MODU and vessels will be intermittent and are dependent on weather conditions and frequency of deck washing. Volumes of bilge water from engines and other mechanical sources found throughout the machinery spaces will also vary between vessels.

The MODU and vessels are equipped with firefighting foam that is a safety critical requirement. The foam systems supply 3% AR-AFFF and 3% FFFP foams which will be used in the event of an incident or (infrequent) maintenance testing. Foam discharges will not be routine, but foam released on to the helideck will be routed to the open-drains system for discharge to sea.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Discharges of oily water will be treated to <15 ppm (v) in accordance with MARPOL requirements. This could introduce hazardous substances (mixture of water, oily fluids, lubricants, cleaning fluids (rig wash), etc.) into the water column, albeit in low concentrations. In turn, this could result in a reduction in water quality, and impacts to transient, EPBC-listed species, plankton and other pelagic organisms such as fish species (demersal fish community KEF or those species targeted commercial fisheries).

Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in the permit area, the potential exposure is likely to be limited to individuals close to the discharge point at the time of the discharge. The closest BIA is the whale shark foraging BIA located approximately 15 km east from the permit area at its closest point. However, based on the levels of whale shark abundance observed in numerous studies (as described in Section 3 Whale shark), the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration.

Worst case impacts to exposed marine fauna may include direct toxic effects, such as damage to lungs and airways, and eye and skin lesions from exposure to oil at the sea surface (Gubbay & Earll 2000). Considering the low concentrations of oil and the location of the discharges in the dispersive open ocean environment, a surface expression is not anticipated; therefore, impacts are considered to be of inconsequential ecological significance to transient, EPBC listed species and are therefore considered Insignificant (F).</td><td>Insignificant (F)</td></tr>
</table>

Planktonic communities in close proximity to the discharge point may be affected if exposed to oily water. Such exposure may result in lethal effects to plankton. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge with inconsequential ecological significance (Insignificant F). There is the potential for individual fishes to be exposed to the discharge; however, this would be limited to those fish present at the sea surface rather than those associated with the demersal fish community KEF. Such exposure is not expected to result in any significant impacts to fishes based on the low toxicity, low volume and high dilution levels; in addition, the highly mobile nature and ability of fishes to move away. The potential consequence on the demersal fish community KEF or commercially targeted fish species will be short-term and highly localised with inconsequential ecological significance (Insignificant F). Firefighting foams generally contain organic and fluorinated surfactants, which can deplete dissolved oxygen in water (Schaefer 2013; IFSEC Global 2014). However, in their diluted form (as applied in the event of a fire), these foams are generally considered to have a relatively low toxicity to aquatic species (Schaefer 2013; IFSEC Global 2014) and further dilution of the foam mixtures in dispersive aquatic environments may then occur before there is any substantial demand for dissolved oxygen (Schaefer 2013; IFSEC Global 2014). To date, limited research regarding the potential impacts of firefighting foam to the marine environment has been undertaken with respect to bioaccumulation and persistence (Suhring et al 2017). Toxicological effects from these types of foams is typically only associated with prolonged or frequent exposures, such as on land and in watercourses near firefighting training areas (McDonald et al. 1996; Moody and Field 2000). As toxicological effects from foams are associated with frequent or prolonged exposures, and any discharges during the activity are expected to be very infrequent and rapidly disperse, it is not expected that any impacts will occur to transient, EPBC-listed species. It is also expected that effects on planktonic communities, if any, would be localised and of a short-term nature (Insignificant F). Additionally, the potential consequences are also considered to be countered by the net environmental benefit that would be achieved through mitigating the potential for a fire resulting in harm to people and the environment.	
Identify the likelihood	
Deck drainage and bilge discharges are treated to a maximum concentration of 15 ppm (v) OIW prior to discharge as specified in MARPOL 73/78, Annex 1. Impacts to the abundance of plankton in the vicinity of the discharge (oily water and firefighting foam) are not expected and are considered Unlikely (4) and will be ecologically insignificant based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters.	

Due to the absence of any known BIAs for mobile, transient EPBC listed species in the permit area, the likelihood of impacts from the discharge after treatment by the OWS and subsequent dilution and dispersion is considered Unlikely (4) and is not expected to result in a threat to population viability of protected species.

Residual risk summary

Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).

Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Zero discharges of deck drainage and bilge to the marine environment if oil in water content exceeds 15 ppm.	MODU/vessel contractors will comply with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Part II (Section 9), as appropriate to the vessel class, including: • Liquids from drains will only be discharged if the oil in water content does not exceed 15 ppm. Any treated water that does not meet the <15 ppm specification will be recycled back to the source tank for retreatment.	Documented use of oil record book to record all oil disposal.	OIM/vessel master
	INPEX will verify that the contractor complies with the *Navigation Act 2012* – Marine Orders - Part 91: Marine Pollution Prevention – Oil, including:	Record of current International Oil Pollution Prevention (IOPP) certificate. Calibration and maintenance records of the OWS.	INPEX Drilling Supervisor

	• Vessels to have International Oil Pollution Prevention (IOPP) certificate to show that vessels have passed structural, equipment, systems, fittings, and arrangement and material conditions. • Oil water separators (OWS) tested and approved as per IMO resolutions MARPOL 73/78 (Annex I).		
	MODU/vessel contractors will manage deck drainage systems including: • Facility for plugging or closing of outboard drains. • Inboard drains routed to oil water separator units, as required. • Maintain MODU drainage systems to restrict leakages and small spills overboard.	Deck drainage plans confirm inboard/outboard drainage Documentation of operational status of MODU deck drainage systems	INPEX Drilling Supervisor
No routine discharge of fire fighting foam	Firefighting foams will only be deployed in the event of an emergency	Incident log	INPEX Drilling Supervisor
	Spill kits will be located around the MODU and vessels to allow clean-up of any spill to the deck.	Inspection records confirm spill kits are available and stocked.	INPEX Drilling Supervisor
	Personnel are made aware of deck spill response requirements.	Training and awareness materials include deck spill response requirements.	INPEX Environmental Adviser

Risks of impacts to marine fauna and planktonic communities from deck drainage, bilge, and firefighting foam are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Rig wash and firefighting foam used will be assessed and approved in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline to minimise potential environmental risks.	Records demonstrate that rig wash and firefighting foam have been assessed and approved in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline.	INPEX Environmental Adviser

Cooling water

Table 6-5: Impact and evaluation – MODU and vessels cooling water discharges

Identify hazards and threats	
Sea water is used as a heat exchange medium for the cooling of machinery engines on the MODU and support vessels. It is pumped aboard and may be treated with biocide (e.g. hypochlorite) before circulation through heat exchangers. It is subsequently discharged from the MODU to the sea surface. Cooling water (CW) discharges to the marine environment will result in a localised and temporary increase in the ambient water temperature surrounding the discharge point. Elevated discharge temperatures may cause a variety of effects, including marine fauna behavioural changes and reduced ecosystem productivity or diversity through impacts to planktonic communities. CW discharge rates vary largely depending on the vessel type. However, as a worst-case, the rate of CW discharge from the MODU during drilling is estimated to be approximately 10,000 – 20,000 m^3 per day on a continuous basis. The temperature of the CW discharge will be approximately 45 °C, in contrast to ambient surface-water temperatures of 26 °C to 30 °C as recorded in the nearby Ichthys Field.	
Potential consequence	Severity
Effects of elevation in seawater temperature may include a range of behavioural responses in transient, EPBC-listed species including attraction and avoidance behaviour. There are no known BIAs or aggregation areas that would result in sedentary behaviour in WA-343-P, and EPBC listed species with the potential to be present in the permit area (within close enough proximity to the discharge to be affected) are considered to be transient in nature (DoE 2015). The closest BIA is for whale shark foraging, which is located 15 km east from WA-343-P. However, the likelihood of whale shark presence within this BIA is considered very low. The activity will occur in an open ocean location in a water depth of approximately 350 m in a dispersive, high current environment. Therefore, potential consequences to transient, EPBC listed species are potentially localised avoidance of thermally elevated water temperatures, with an inconsequential ecological significance to protected species (Insignificant F).	Insignificant (F)

Elevated seawater temperatures are known to cause alterations to the physiological (especially enzyme-mediated) processes of exposed biota (Wolanski 1994). These alterations may cause a variety of effects and potentially even mortality of plankton in cases of prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species, UNEP (1985) indicates that there is no evidence to suggest that lethal effects to plankton from thermal discharges are ecologically significant. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge with inconsequential ecological significance (Insignificant F). The use of biocide (hypochlorite) for the control of biofouling in considered an established and efficient technology for use in offshore environments and is used throughout the world (Khalanski 2002). The effects of chlorination on the marine environment have been summarised by Taylor (2006) who, based on a review of applications using hypochlorite as an antifoulant for the seawater cooling circuits, concluded that: • the chlorination procedure itself does cause the mortality of a proportion of planktonic organisms and the smaller organisms entrained through a cooling water system; however, only in very rare instances, where dilution and dispersion were constrained, were there any impacts beyond the point of discharge • long term exposure to chlorination residues on fish species did not impose any apparent ecotoxicological stress • studies of the impact of chlorination by-products on marine communities, population, physiological, metabolic and genetic levels, indicate that the practice of low-level chlorination on coastal receiving water is minor in ecotoxicological terms. These findings indicate that the toxicity of the CW discharge is negligible at the point of discharge, therefore impacts are limited to thermal effects.	
Identify the likelihood	
CW discharges are expected to rapidly disperse in the open-ocean environment of WA-343-P. These discharges may result in temporary, localised and ecologically insignificant avoidance behaviour in transient, EPBC-listed species in response to elevated water temperatures. However, in the absence of any known BIAs within WA-343-P the likelihood of CW discharges resulting in a threat to the population viability of protected species is considered to be Unlikely (4). Localised impacts to the abundance of plankton within the vicinity of the CW discharges are considered to be Unlikely (4) based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters.	

Residual risk summary		
Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
N/A no controls identified			

Desalination brine

Table 6-6: Impact and evaluation – MODU and vessels desalination brine discharges

Identify hazards and threats	
Potable water will be generated on the MODU and vessels using a reverse osmosis (RO) plant which is supplied with sea water. Potable water is primarily supplied to the accommodation and domestic services areas. It is also supplied for other purposes such as the eyewash and safety shower systems and utilities water systems. Desalination brine produced from the RO process will be discharged to sea on a continuous basis. Discharging desalination brine has the potential to cause changes in water salinity. The estimated volume of brine discharge for the vessels and MODU is estimated to be in the order of 60 - 140 m^3 per day with salinity in the order 50 parts per thousand (ppt) in comparison to ambient seawater with a salinity of 34-35 ppt.	
Potential consequence	Severity
The discharge of desalination brine has the potential to result in increased salinity within the receiving environment. Exposure to increased levels of salinity has the potential to result in impacts to planktonic communities. Azis et al. (2003) reported that effects on planktonic communities in areas of high mixing and dispersion, such as those found in the permit area, are generally limited to the point of discharge only.	Insignificant (F)

Therefore, any potential impacts from an increase in salinity would be localised and temporary given the short-term duration of the discharges associated with the survey (approximately 7-10 days) and drilling activity (approximately 120-150 days). Given the water depths WA-343-P (350 m) and the dynamic marine environment (i.e. tides and currents) it is expected that the brine discharge would rapidly disperse relatively close to the point of discharge. Therefore, the effects of a temporary and highly localised increase in salinity are not expected to result in any significant ecological impacts to planktonic communities (Insignificant F).	

Identify the likelihood
Direct effects on plankton from desalination brine discharges may occur in WA-343-P near the point of discharge but are not expected to result in an ecological impact to planktonic communities in the wider region. Therefore, the likelihood of impact to planktonic communities from these planned discharges is considered Highly Unlikely (5).

Residual risk summary
Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10).

Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
N/A no controls identified	•		

Drill fluids and drill cuttings

Table 6-7: Impact and evaluation – discharges of drill fluids and drill cuttings

Identify hazards and threats	
During drilling operations, drill cuttings consisting of crushed rock fragments are generated. Along with the cuttings, drill fluids (used to lubricate/ cool the drill bit, stabilise the borehole and control pressure) are brought to the surface. The main constituents of drill fluids are either WBM or SBM, and a weighting material (typically barite) (Section 2.4). Barium sulphate (barite) is considered to be relatively inert in the marine environment, and unlikely to be toxic (Neff 2002). The acute toxicity of WBM is also considered to be low (Neff 1987). Various additives may also be added to improve the technical performance of the drill fluids such as viscosifiers, emulsifiers and pH control agents. The chemicals used as additives in the drill fluids are mostly classified as PLONOR (Pose Little or No Risk to the Environment) by OSPAR Commission (2012). Routine discharges of drill fluids and drill cuttings will occur during the drilling activity. Sources of discharge are listed below: • WBM drill cuttings and drilling fluid discharge at the seabed (during riserless sections) • WBM drill cuttings discharge at the sea surface (overboard from the MODU) including bulk discharges of WBM fluid and cuttings at the end of drilling/pit washing and cleaning • SBM drilling cuttings with ≤7% oil-on-cuttings (OoC). Discharged drill cuttings/fluids may impact benthic communities, water quality and associated pelagic receptors within the discharge plume (Bakke et al. 2013). As the drilling activity comprises of a single exploration well, no cumulative impacts from drilling waste discharges associated with multiple wells will occur.	
Potential consequence	Severity
The main impact pathways from the discharge of drill fluids and drill cuttings are associated with smothering of benthic communities and an increase in turbidity within the water column potentially impacting on water quality. Cuttings in suspension may also affect pelagic organisms, sponges, corals and other sessile fauna within the discharge plume (Bakke et al. 2013). Smothering	Minor (E)

Smothering of benthic fauna may occur in locations where the rate of cuttings deposition exceeds the rate at which in situ fauna are able to move up through the sediments. There is generally no agreed threshold point for tolerance to sedimentation as it depends on the species and the structure of the accumulating material. Smit et al. (2008) conducted an extensive literature review of species sensitivity distributions for sediment burial in the marine environment. They reported that the 50% hazardous level for burial of deepwater epibenthic fauna, such as found in WA-343-P, was 54 mm. The discharge of drill fluids and cuttings may result in the smothering of benthic communities in the immediate vicinity of the exploration well in WA-343-P. This may result in burial and low sediment oxygen concentrations caused by increased oxygen consumption and organic enrichment (Neff 2005). Monitoring in the North Sea has not revealed any in situ effects of WBM cuttings on sediment macrofauna community structure, implying that any such effects, if present, will be confined to within 25–250 m from the discharge point (Bakke et al. 2013 and references within). Effects on filter feeding bivalves were reported to be limited to within a distance of 0.5 to 1 km from the discharge (Bakke et al. 2013). Further studies also indicate impacts from drilling (fluids/cuttings) discharges are localised to within 1 km of the wells (Ellis et al. 2012; Purser 2015). While complete smothering of corals in sediment or drill cuttings will cause suffocation, conditions typically generated during the discharge of drill cuttings are unlikely to cause coral death, although this will be dependent on coral morphology (branching) and the capacity to shed sediment through the release of mucus (Allers et al. 2013). The nearest submerged coral communities to WA-343-P are located at Heywood and Echuca Shoals, located approximately 62 and 75 km respectively, and as such these are not expected to be impacted by smothering effects due to the drilling discharges. As described in Section 3, seabed conditions in WA-343-P are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. The presence of sand waves are also expected to limit the development of infaunal communities in this habitat due to substrate instability associated with changes in the currents. Any potential impacts to benthic communities from drilling discharges are expected to be at a local scale and short-term, therefore the consequence is considered to be Minor (E); particularly given the expected re-colonisation through the recruitment of new colonists from planktonic larvae and adjacent sediments. Turbidity and water quality	

Disposal of drill fluids and cuttings discharges overboard at the sea surface may affect other parts of the marine ecosystem such as pelagic organisms and other submerged receptors that may be present within the discharge plume. Discharged drill cuttings and fluids will create a temporary and localised turbid plume, which will gradually dilute as it disperses through the water column as a result of the action of currents. Field observations from drilling campaigns on the NWS have found that plumes associated with drilling discharges at the seabed and sea surface were visible in the upper water column for up to approximately 1 km from the discharge location and for a short time (approximately 24 hours) after discharge (INPEX 2010). Exposure to increased turbidity and potential toxicity is expected to be short term, and intermittent depending on plume behaviour (Bakke et al. 2013). The seabed in WA-343-P is below the photic zone (water depths approximately 350 m) and benthic communities are expected to be largely unaffected from the presence of a discharge plume (reducing light exposure levels), due to the high dispersion and mixing of the drilling cuttings and fluids within the water column. Pelagic species including the demersal fish community KEF which overlaps WA-343-P, fish species targeted by commercial fisheries, and EPBC-listed species transiting the area, are unlikely to be significantly impacted as they are likely to exhibit avoidance behaviour. These receptors may be impacted by increased suspended solids in the water column as an increase in particle load could adversely affect the respiratory efficiency of fish. However, most visual orientated fish/fauna species would likely relocate to an unaffected area to avoid the plume or simply pass unaffected through turbid waters. There is limited evidence that drilling discharges affect fishes in the natural environment, other than references to laboratory experiments, such as those undertaken by Gagnon and Bakhtyar (2013) that reported that acute toxicity of SBMs was generally low for pink snapper (*Pagrus auratus*). The barite to be used for the exploration well in WA-343-P has very low concentrations of mercury and cadmium (less than 1 mg/kg and 3 mg/kg respectively). A study investigating barite solubility and the release of trace metal compounds to the marine environment recorded that <1% of the mercury and 15% of the cadmium dissolved from the barite after one-week exposure in sea water (Crecelius et al. 2007). Considering the low levels of these metals released to sea, and the small initial amounts of these metals present in the barite, it is considered that the discharge of drilling fluids will not have a significant environmental impact on water quality and the marine fauna present within the water column. While turbidity and potential associated toxicity in WA-343-P is likely to increase, up to approximately 1 km from the point of discharge, the plume is expected to rapidly disperse, and any impacts will be localised and of short-term duration (Minor E).	
Identify the likelihood	

Smothering of benthic communities may occur adjacent to the well site albeit limited to an extent ranging to within a couple of hundred metres. With the reported limited benthic community diversity in WA-343-P (Section 3) and distances to sensitive benthic communities (Heywood Shoal 62 km; Echuca Shoal 75 km) any localised loss of benthic communities in the vicinity of the well from smothering are predicted to be relatively temporary based on the expected recovery of benthic communities through re-colonisation aided by seabed currents. Therefore, with the controls in place to minimise toxicity by selecting the least hazardous chemicals coupled with the likely recolonisation within WA-343-P, impacts to benthic communities from smothering are considered to be Highly Unlikely (5). Based on the highly dispersive environment in WA-343-P, short-term and intermittent nature of the discharges, the low levels of associated toxicity and the localised scale of potential impact (<1 km) it is Highly Unlikely (5) that drill fluids and cuttings will have a significant environmental impact on water quality, submerged receptors and marine fauna present within the water column.			
Residual risk summary			
Based on a consequence of Minor (E) and a likelihood of Highly Unlikely (5) the residual risk is Low (9).			
Consequence	Likelihood	Residual risk	
Minor (E)	Highly Unlikely (5)	Low (9)	
Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
All discharges to the marine environment of SBM drill cuttings will be ≤7% wt/wt oil on cuttings (averaged over the SBM sections of the well).	Oil-on-cuttings for SBM cuttings will be ≤ 7%	Daily OoC results recorded in the daily drilling report.	INPEX Drilling Supervisor

Risks of impacts to marine fauna and benthic communities from drill cuttings and drill fluids discharges are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	All SBM on cuttings and WBM that may be discharged to the marine environment will be selected to be least hazardous (while maintaining technical feasibility) and will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold. If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria.	Documentation of chemical assessment confirms that CHARM, OCNS or INPEX pseudo rankings have been used as selection criteria for SBM and WBM fluids operationally discharged to environment.	INPEX Environmental Adviser
	Volumes of drill fluids discharged will be minimised through the use of SCE, which includes recirculation of the mud where possible.	Records of all operational discharges (planned and unplanned) of drilling fluids and cuttings are recorded on the MODU and demonstrate compliance with all requirements for operational discharge.	INPEX Environmental Adviser
	Maintenance of SCE in accordance with the MODU preventive maintenance system	Documentation of planned and completed maintenance and testing of SCE in accordance with the MODU preventive maintenance system.	INPEX Drilling Supervisor

Cement, cementing fluids and additives

Table 6-8: Impact and evaluation – discharges of cement, cementing fluids and additives

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Planned cement discharges at the seabed during the cementing of conductor and surface casing and during well abandonment will occur as part of the drilling activity in WA-343-P. Small volumes (1–2 m^3 of cement per section) may also be discharged as a slurry at the sea surface from circulating cement with the riser installed, or from cleaning of cementing tanks and equipment on the MODU. Contingency discharges of cement may also be required if a cementing job does not meet technical and safety standards. It is intended that any bulk cement remaining at the end of the activity is transferred onshore for disposal/reuse. Should this option not be available, the remaining cement will be mixed and operationally discharged within the well bore or to the marine environment.

The discharge of cement, cementing fluids and additives has the potential to reduce water quality through increasing turbidity or toxicity which may affect organisms within the water column. Seabed cement discharges may result in smothering of benthic communities in the vicinity of the well.

As the activity comprises of a single exploration well, the discharges will be limited to a one-off occurrence with only one well section (surface casing of the 36" section) with cement with returns to the seabed. As described in Section 2.4, it is standard practice to allow some excess cement slurry to overflow when cementing the top-hole section to visually confirm that the annular space between the hole and the casing has been filled. This may typically cover an area of up to 10 m^2. As the drilling activity comprises of a single exploration well, no cumulative impacts from cement discharges associated with multiple wells will occur.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Impact pathways associated with the discharge of cement during drilling operations are associated with smothering of benthic communities in close proximity to the well, and an increase in turbidity or toxicity within the water column potentially impacting on water quality.

Smothering

As described in Table 6-7, discharges at the seabed may result in the smothering of benthic communities in the immediate vicinity of the exploration well in WA-343-P. Discharges of cement (potentially covering up to approximately 10 m^2) will result in burial and loss of benthic communities immediately adjacent to the well, particularly for sessile epifauna.</td><td>Insignificant (F)</td></tr>
</table>

As described in Section 4.8.3, seabed conditions within WA-343-P are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. The presence of sand waves are also expected to limit the development of infaunal communities in this habitat due to substrate instability associated with changes in the currents. Any potential impacts to benthic communities and loss of benthic habitat due to cement discharges are expected to be at a local scale, therefore the consequence is considered to be Insignificant (F); particularly given the context of the potential area impacted < $10m^2$, in comparison to the total area of WA-343-P. There are no sensitive or unique benthic habitats that would be impacted by seabed cement discharges. Turbidity Disposal of cement discharges overboard at the sea surface may affect other parts of the marine ecosystem such as pelagic organisms and other submerged receptors that may be present within the discharge plume. Intermittent discharges of cement, albeit at small volumes (1–2 m^3) may create a temporary and localised turbid plume, which will gradually dilute as it disperses through the water column as a result of the action of currents. Data on the longevity of cement discharge plumes is not available; however plumes associated with drilling muds have been reported to be visible in the upper water column for up to approximately 1 km from the discharge location and for a short time (approximately 24 hours) after discharge (INPEX 2010). Therefore, low volume cement discharges would also be expected to dissipate within this timeframe and exposure to increased turbidity and potential toxicity associated with the discharge is expected to be short term, and intermittent. The seabed in WA-343-P is below the photic zone (water depths approximately 350 m) and benthic communities are expected to be largely unaffected by the presence of a discharge plume (reducing light exposure levels), due to the high dispersion and mixing of the cement discharge within the water column. Pelagic species including the demersal fish community KEF which overlaps WA-343-P; fish species targeted by commercial fisheries; and EPBC-listed species transiting the area, are unlikely to be significantly impacted as they are likely to exhibit avoidance behaviour. These receptors may be impacted by increased suspended solids in the water column as an increase in particle load could adversely affect the respiratory efficiency of fish. However, most visual orientated fish/fauna species would likely relocate to an unaffected area to avoid the plume or simply pass unaffected through turbid waters. The potential for toxicity effects to fish and pelagic organisms is expected to be limited given toxicity is mainly associated with cement additives that are used in minor quantities. Given the dispersive environment in WA-343-P and expected high level of dilution, any exposure is expected to be limited a few individuals within the immediate vicinity of the discharge. Therefore the discharge of cement/cement slurry will not have a significant environmental impact on water quality and the marine fauna present within the water column (Insignificant F).	

Identify the likelihood
Localised smothering of benthic communities and habitats may occur immediately adjacent to the well site from seabed cement returns for an area of up to approximately 10 m^2. With the reported limited benthic community diversity in WA-343-P and the controls in place to minimise toxicity, the loss of sensitive benthic communities from smothering due to cement discharge is considered Highly Unlikely (5). Based on the highly dispersive environment in WA-343-P, the short-term and intermittent nature of the discharges, the low levels of associated toxicity and the localised scale of potential impact (<1 km), it is Highly Unlikely (5) that cement discharges will have a significant environmental impact on water quality and the marine fauna present within the water column.
Residual risk summary
Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (9).

Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Risks of impacts to marine fauna and benthic communities from cement discharges are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	All cementing chemicals that may be discharged to the marine environment will be selected to be least hazardous (while maintaining technical feasibility) and will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold. If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria.	Documentation of chemical assessment confirms that CHARM, OCNS or INPEX pseudo rankings have been used as selection criteria for cementing chemicals operationally discharged to environment.	INPEX Environmental Adviser

	Use dye to provide a pre-indicator of cement overflow to seabed surface which is selected in accordance with the chemical assessment and selection process.	Documentation of chemical assessment confirms that CHARM and OCNS ratings have been used as selection criteria for dye operationally discharged to environment	INPEX Environmental Adviser
	Volumes of cement operationally discharged will be minimised through the implementation of the exploration well cement program.	Records of all operational discharges (planned and unplanned) of cement are recorded on the MODU and demonstrate compliance with the exploration well cement program.	INPEX Environmental Adviser
	Excess bulk cement will be transferred onshore for disposal or reuse.	Records of cement transfers and disposal	INPEX Environmental Adviser

BOP fluids and water-based hydraulic fluids

Table 6-9: Impact and evaluation –discharges of BOP fluids and water-based hydraulic fluids

Identify hazards and threats	
BOP function testing is undertaken approximately weekly or fortnightly during the drilling activity. Generally, an initial pre-deployment function testing is undertaken on deck with no resulting subsea discharge of BOP control fluid. However, function testing will occur subsea, with each test releasing approximately 0.25 m^3 of BOP control fluid. BOP control fluid generally consists of water mixed with a glycol based detergent, or equivalent water based, anti-corrosive additive suitable for open hydraulic systems. BOP control fluid concentrates are typically diluted to 2–3% in water on the MODU. When used at this concentration, BOP control fluid is ranked as a Group E product by the OCNS and, therefore, considered PLONOR. Other control fluids such as water-based hydraulic fluids will also be discharged subsea during the drilling activity which may result in a temporary and localised reduction in water quality.	
Potential consequence	Severity
Discharges of BOP control fluids and other water-based hydraulic fluids could introduce hazardous substances into the water column, albeit in low concentrations. In turn, this could result in a reduction in water quality, and impacts to transient, EPBC-listed species and other pelagic organisms such as fish species (demersal fish community KEF). Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in the permit area, the potential exposure is likely to be limited to individuals close to the discharge point at the time of the discharge. The closest BIA is the whale shark foraging BIA located approximately 15 km east from the permit area at its closest point. However, as described in Section 3 *Whale shark*, based on the levels of whale shark abundance observed in numerous studies, the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration. Considering the low volumes and low levels of associated toxicity of the subsea discharges in the dispersive open environment of WA-343-P, impacts are considered to be of inconsequential ecological significance to transient, EPBC listed species and are therefore considered Insignificant (F).	Insignificant (F)

There is the potential for individual fishes, directly adjacent to the discharge point to be exposed to the control/hydraulic fluids. Such exposure is not expected to result in any significant impacts to fishes based on the low toxicity, low volume and high dilution levels; also the highly mobile nature and ability of fishes to move away. The potential consequence on the demersal fish community KEF will be short-term and highly localised with inconsequential ecological significance (Insignificant F).	

Identify the likelihood
Impacts to the EPBC-listed marine fauna and fish communities in the vicinity of the subsea discharges are not expected and are considered Unlikely (4). This is largely due to the absence of any known BIAs for mobile, transient EPBC listed species in the permit area and the low toxicity and low volumes of the discharged fluids. The open-ocean, highly dispersive environment in the permit area will also result in high levels of dilution further reducing the likelihood of exposure to the identified receptors.
Residual risk summary
Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).

Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility

Risks of impacts to marine fauna from BOP control fluids and hydraulic fluid subsea discharges are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	All BOP control/hydraulic fluids that may be discharged to the marine environment will be to be least hazardous (while maintaining technical feasibility) and will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold. If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria.	Documentation of chemical assessment confirms that CHARM, OCNS or INPEX pseudo rankings have been used as selection criteria for BOP control and hydraulic fluids operationally discharged to environment.	INPEX Environmental Adviser
	Volumes of BOP fluid discharged will be minimised in accordance with equipment and operational requirements.	Records of BOP fluids discharged maintained onboard the MODU.	OIM

6.4 Waste management

Table 6-10: Impact and evaluation – waste management

Identify hazards and threats	
Unsecured or incorrectly stored waste may be windblown or displaced into the ocean where it has the potential to negatively affect marine ecosystems. Wastes can cause contamination of the ocean resulting in changes to water quality (e.g. through the leaching of chemicals from wastes that are displaced) which can cause changes to ecosystem productivity and diversity. Additionally, certain types of waste can cause injury to marine fauna through entanglement or may affect the health of marine fauna if waste materials are ingested.	
Potential consequence	Severity
Improper management of wastes may result in pollution and contamination of the environment. There is also the potential for secondary impacts on marine fauna that may interact with wastes, such as packaging and binding, should these enter the ocean. These include physical injury or death of marine biota (as a result of ingestion, or entanglement of wastes). In the event of an accidental release of waste overboard, the particular values and sensitivities identified as having the potential to be impacted include planktonic communities and transient, EPBC listed species (marine fauna). A change to water quality has the potential to impact planktonic communities found at the sea surface. Impacts associated with the accidental loss of hazardous waste materials to the ocean as a result of leaching from waste would be localised and limited to the immediate area. These are further likely to be reduced due to the dispersive open ocean offshore environment. While plankton abundance in close proximity to the accidental loss location, or leaching waste items may be reduced, this is expected to be of insignificant ecological consequence (Insignificant F).	Insignificant (F)

<table>
<tr><td colspan="3">Marine fauna can become entangled in waste plastics, which can also be ingested when mistaken as prey (Ryan et al. 1988), potentially leading to injury or death. For example, due to indiscriminate foraging behaviour, marine turtles have been known to mistake plastic for jellyfish (Mrosovsky et al. 2009). Seabirds foraging on planktonic organisms, generally at, or near, the surface of the water column may eat floating plastic (DEE 2018l). Other items (e.g. discarded rope) have also been found to entangle fauna, such as birds and marine mammals. The accidental loss of waste to the ocean may result in injury or even death to individual transient EPBC listed species, but this is not expected to result in a threat to population viability of a protected species (Insignificant F).</td><td></td></tr>
<tr><td colspan="4">Identify the likelihood</td></tr>
<tr><td colspan="4">Given the proposed safeguards in place, the absence of any known BIAs and the dispersive open ocean environment in the permit area, impacts to transient EPBC-listed species and planktonic communities, while not expected, are considered Possible (3) in the event of an accidental loss of waste to the ocean.</td></tr>
<tr><td colspan="4">Residual risk summary</td></tr>
<tr><td colspan="4">Based on a consequence of Insignificant (F) and a worst-case likelihood of Possible (3) the residual risk is Low (8).</td></tr>
<tr><td>Consequence</td><td colspan="2">Likelihood</td><td>Residual risk</td></tr>
<tr><td>Insignificant (F)</td><td colspan="2">Possible (3)</td><td>Low (8)</td></tr>
<tr><td>Environmental performance outcomes</td><td>Environmental performance standards</td><td>Measurement criteria</td><td>Responsibility</td></tr>
<tr><td>Zero unplanned discharge of wastes into the marine environment.</td><td>Implementation of garbage management plan.</td><td>Incident report of waste lost overboard.</td><td>MODU OIM/Vessel master</td></tr>
</table>

Risks of impacts to marine fauna and planktonic communities from unsecured, or incorrectly stored waste are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	MODU/vessel waste management plans are in place and comply with MARPOL 73/78 (Annex II and III) requirements (as appropriate to vessel class) for waste management (including recording of amounts).	Garbage record book.	MODU OIM/Vessel master INPEX Environmental Adviser
	Pre-mobilisation HSE inspection of MODU/vessel includes assessment of waste management practices.	Pre-mobilisation and ongoing HSE inspection documentation.	INPEX Environmental Adviser
	Waste management awareness materials communicated to site personnel.	Awareness materials on waste management procedures.	INPEX Environmental Adviser

6.5 Noise and vibration

Table 6-11: Impact and risk evaluation – underwater noise

Identify hazards and threats
Marine fauna may be exposed to several sources of noise emissions during the activity, as summarised below:

• Operation of the MODU (including power generation and drilling) has the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels. Machinery positioned on the deck is above the waterline and therefore the overall noise levels will be low. The level of underwater noise associated with MODUs while not drilling are reported to decrease rapidly with distance from the MODU. In a study by McCauley (1998), it is reported that during non-drilling operations sound levels of 117 dB re 1µPa were recorded at a distance of 125 m from the wellhead and were audible over a distance of 1-2 km. This noise was reported to be associated with the discharging of fluids and the operation of pumping systems and mechanical plant, etc. While actively drilling, sound levels of 115 dB re 1µPa were recorded at a distance of 405 m from the wellhead (McCauley 1998). Other studies have reported measured sound levels of 136 dB re 1 µPa at 100 m distance from drilling activities (Nedwell & Edwards 2004) and Greene (1986) reported 117 dB re 1 µPa at 185 m and 110 dB re 1µPa at 926 m. The noise generated during drilling activities was primarily associated with the use of the drill string. • The pre-drill survey will use underwater acoustic techniques including the use of MBES, side-scan sonar and sub-bottom profiling. The survey will be conducted from a dedicated geophysical survey vessel and have the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels. The different survey devices shall emit various levels of sound at a range of frequencies. MBES and side-scan sonar transmit at high frequencies (approximately 100 – 400 Hz) and produce a highly focussed beam of sound towards the seabed, due to this there is very limited horizontal sound propagation and it is expected to rapidly attenuate. Indicative ranges of sound outputs at source are 163 - 190 dB re 1 µPa at 1 m and 137 - 200 dB re 1 µPa at 1 m, for MBES and side-scan sonar respectively. Sub-bottom profiling systems operate at low frequency (1-16 kHz) directing beans of sound towards the seabed and therefore horizontal sound propagation is limited. Sound outputs at source may range from 142 - 200 dB re 1 µPa at 1 m. • Operating vessels have the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels. Vessel engines and dynamic positioning thrusters are capable of generating sound at levels between 108 and 182 dB re 1 µPa at 1 m at dominant frequencies between 50 Hz and 7 kHz (Simmonds et al. 2004; McCauley 1998). • As part of the well evaluation, a VSP will be undertaken (Section 2.8), which will generate high-intensity, impulsive sound that propagates into the water column with the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels. Sound levels generated during the VSP will be 232 dB re 1 µPa@1 m with a frequency range of 5 – 125 Hz. The VSP will be of short-duration (up to 18 hours).

Potential consequence	Severity

The generation of underwater sound from the pre-drill survey and drilling activities has the potential to impact EPBC-listed marine fauna, specifically marine mammals and turtles. Sudden exposure to very high sound levels or exposure for prolonged periods can result in a permanent threshold shift (PTS) or temporary threshold shift (TTS) in hearing. Noise impact thresholds proposed by the U.S. National Oceanic and Atmospheric Administration and National Marine Fisheries Service (NMFS 2018) for cetaceans, suggest that, for the types of cetacean with the potential to occur in WA-343-P, PTS could occur as a result of peak sound pressure levels of 219 – 230 dB re 1 µPa or prolonged exposure to sound exposure levels of 198 – 199 dB re 1 µPa2·s. TTS could occur at peak sound pressure levels of 213 - 224 dB re 1 µPa or prolonged exposure to sound exposure levels of 168 - 170 dB re 1 µPa2·s (NMFS 2018). Popper et al. (2014) propose conservatively protective sound pressure thresholds of 207 - 213 dB re 1 µPa for potential injury to various types of fish and for marine turtles. With the exception of the VSP, no sources of noise associated with the activity are expected to have the potential to result in PTS or TTS. However, a range of behavioural changes can occur in cetaceans in response to sound pressure levels as low as 120 dB re 1 µPa (Southall et al. 2007). This may include minor responses, such as a momentary pause in vocalisation or reorientation of an animal to the source of the sound, or avoidance responses (Southal et al. 2007). For cetaceans, NMFS (2013) propose a behavioural response threshold of 160 dB re 1 µPa for impulsive sound sources and 120 dB re 1 µPa for continuous sound sources (NMFS 2013). Marine turtles are not reported to use sound for communication, however it is proposed that they may use sound for navigation, avoiding predators and finding prey (Dow Piniak 2012). For received sound pressure levels above 166 dB re 1 µPa, turtles have shown some increased swimming activity and above 175 dB re 1 µPa can become more agitated (McCauley et al. 2000). The 166 dB re 1 µPa level is used as the threshold level for a behavioural disturbance response by turtles (NSF 2011). A limited number of commercially significant fish stocks may be present in WA-343-P that may be exposed to underwater noise emissions. Given the deep waters, commercially significant fish stocks in WA-343-P are primarily limited to highly mobile pelagic species such as tuna and billfish. The water depths and absence of suitable habitats mean WA-343-P is not considered to offer spawning or aggregation habitat for commercially targeted demersal species which occur in the shallower waters on the continental shelf (typically less than 200 m water depth). Deep water scampi (*Metanephrops australiensis*), targeted by the North West Slope Trawl Fishery, may occur on the continental slope in the water depths where WA-343-P is located. Scampi may be fished on the slope in water depths deeper than 200 m but are most commonly found at depths of 420 - 500 m (AFMA 2018h; Harte & Curtotti 2018). Timing of scampi spawning is uncertain, but studies of similar species suggest that spawning occurs in September-October (AFMA 2018h).	Insignificant (F)

MODU and drilling noise Based on the expected noise emissions associated with the MODU and drilling activities, any noise emissions that are typically attributed to behavioral changes are expected to be limited to within a few hundred metres of the MODU, based on recorded drilling sound levels by McCauley (1998), Nedwell & Edwards (2004) and Greene (1986). Underwater noise modelling undertaken for the Ichthys Project (INPEX 2010) to consider noise emissions (albeit for tanker offloading operations rather than drilling activities, reported that low-frequency noise generated would abate to 120 dB re 1 µPa within 8 km of the source location and the area receiving 130–140 dB re 1 µPa was very small, i.e. less than 1 km in radius. Therefore, drilling noise combined with associated vessel and MODU engines and thrusters may result in sound that is detectable above ambient noise levels over several kilometres from the MODU, although behavioural avoidance responses are more likely to occur within 1-2 km. There are no known BIAs or aggregation areas within WA-343-P that could be affected by increased noise levels, and EPBC listed species with the potential to be exposed are considered to be transient in nature (Section 3) with the ability to avoid the source in the open ocean area. The closest BIA to WA-343-P relates to whale shark foraging, located approximately 15 km east of the permit area. Given the distance to the closest BIA for internesting turtles (Browse Island 68 km south of WA-343-P) impacts to marine turtles are not likely to occur. In the unlikely event that behavioural changes did occur they are expected to be limited to individuals, temporary in nature and only for the duration of the MODU being on location in the permit area (120-150 days) and are considered to be Insignificant (F). Furthermore, gradual exposure to continuous noise sources, such as the MODU, are generally regarded as being less harmful and less likely to startle or stress marine fauna than rapid-onset impulsive noise sources (Hamernik et al. 1993; Hamernik et al. 2003; Southall et al. 2007). Pre-drill survey noise MBES and side-scan sonar are high-frequency, low-energy geophysical survey instruments, which are understood to be significantly less intrusive than high-energy seismic survey instruments. Sound source levels produced by these different instruments range from 137–200 dB re 1 µPa at 1 m. The high frequency pulses of sound are produced in a highly directional and narrow beams, which rapidly attenuate outside of the beam (Zykov 2013). The high operating frequencies of MBES and side-scan instruments place the dominant sound frequencies above the auditory range of most other marine fauna species, including cetaceans, turtles and fish, although some instruments may be audible to mid-frequency and high-frequency cetaceans such as some dolphin species (MacGillivray et al. 2013; Zykov 2013). It is not expected that fauna would persist in close proximity to the instruments long enough for impacts to occur. Therefore, no impacts to these species groups are expected and hearing impairment impacts to marine fauna from MBES and side-scan sonar have not been previously reported. Therefore, the consequence is considered to be Insignificant (F).	

Sub-bottom profilers produce directional beams of sound towards the seabed and therefore sound propagation tends to be downwards in the water column with limited horizontal propagation. The sub-bottom profiling system used for the pre-drill survey will operate at low frequency (1-16 kHz) with sound output at source ranging from 142 - 200 dB re 1 μPa at 1 m. Underwater noise modelling of a range of sub-bottom profiling systems reported that sound levels may be audible over several kilometres (Zykov 2013). On this basis, behavioural responses to the sub-bottom profiler may occur in marine fauna limited to within a few kilometres of the survey vessel depending on the hearing range of the receptors. In the absence of any known marine fauna BIAs within the permit area and distances to the cetacean aggregation areas/migration corridors (humpback whale calving BIA approximately 175 km at its closest point and the blue whale migration BIA approximately 40 km at its closest point), and the short duration of the survey (7 – 10 days), any impacts are considered to be Insignificant (F). Vessel noise Based on the expected noise emissions associated with the operation of vessels during the activity in WA-343-P, any noise emissions (ranging from 108 to 182 dB re 1 μPa at 1 m) are not expected to result in PTS or TTS impacts to marine fauna. Although not directly relevant to vessel engine noise, modelling for the Ichthys Project (INPEX 2010) indicated that low frequency noise generated from tanker offloading operations would abate to 120 dB re 1 μPa within 8 km of the source location with the area receiving 130–140 dB re 1 μPa predicted to be less than 1 km in radius. The sound levels produced by smaller support vessels is expected to be less than the levels modelled for offloading tankers, but the sound may be audible to marine fauna over several kilometres, with the likelihood of behavioural impacts increasing in close proximity to the vessels. Gradual exposure to continuous noise sources, such as vessel engines, are generally regarded as being less harmful and less likely to startle or stress marine fauna than rapid-onset impulsive noise sources (Hamernik et al. 1993; Hamernik et al. 2003; Southall et al. 2007). As such, exposure that would result in significant alteration of behaviour is not expected particularly in the absence of any known BIAs or important habitats in the permit area, and as such any impacts are considered to be Insignificant (F). VSP noise	

The VSP will emit high-intensity, impulsive sounds albeit on a temporary basis (< 18 hours). Based upon the sound levels generated during the VSP (232 dB re 1 µPa@1 m) there is the potential for noise impacts to occur (PTS and TTS) in close proximity to the VSP source, with sound levels likely to be above ambient noise levels over several kilometres. Discharging the VSP source at full power may result in PTS for any cetaceans within a few metres of the source and TTS within a few tens of metres of the source. These ranges are comparable to ranges modelled for VSP by Matthews (2012) and reported in Salgado Kent et al. (2016). Prolonged exposure to multiple pulses of the VSP source could result in TTS within a few hundred metres of the source, but such exposures would occur after many minutes or hours and marine fauna are likely to move to avoid such sound exposures before TTS effects occur. In the unlikely event that TTS did occur to marine fauna, it would be limited to a few individuals and the effects will be temporary and recoverable. Salgado Kent et al. (2016) reported that seismic pulses, in the order of that used for the VSP in WA-343-P, will reduce to levels < 120 dB re 1 µPa over approximately 5 – 10 km, therefore a range of behavioral responses may occur within this distance from the VSP source, although actual behavioural avoidance as a result of sound pressure levels greater than 160 dB re 1 µPa is more likely to occur within 1 – 2 km of the source. Given other marine fauna have less sensitive hearing than cetaceans, the range of distances for which noise impacts may occur for other EPBC-listed species is expected to be less. Popper et al. (2014) reported that turtles are highly likely to exhibit a behavioural response when they are near an airgun (tens of metres), a moderate response if they encounter the source at intermediate ranges (hundreds of metres), and a low response if they are far (thousands of metres) from the airgun. Based on the NSF (2011) behavioural response threshold of 166 dB re 1 µPa, turtles may actively swim to avoid the VSP within 1 – 2 km. Potential significant behavioural impacts in fish arising from exposure to seismic pulses is likely to be limited to within tens to hundreds of metres, or within thousands of metres for the most sensitive fish species (Popper et al. 2014). On this basis, it is possible that physical and behavioral impacts may occur from the VSP undertaken in WA-343-P. Potential behavioural responses for various groups of sound sensitive marine fauna are expected, at a worst case, to be limited to several kilometres from the source for the duration of the VSP. The closest BIA to WA-343-P is the whale shark foraging BIA (approximately 15 km east) which largely follows the ancient coastline KEF and has low reported levels of abundance (Section 3). The permit area is located some distance from reported whale BIAs (humpback whale calving BIA approximately 175 km at its closest point; blue whale migration BIA approximately 40 km at its closest point). The closest important turtle habitat is located at Browse Island 68 km away (20 km internesting buffer). Therefore, within the permit area, marine fauna are expected to be transient and able to move away from noise sources and as such any impacts are considered to be Insignificant (F).	

The impact of sound on crustacean species similar to scampi, such as rock lobster, crabs and prawns has been studied with respect to commercial scale seismic surveys, which are significantly louder than VSP sources. Many studies (e.g. Christian et al. 2003; Payne et al. 2008) found no acute or chronic mortality or stress impacts. Research undertaken by Day et al. (2016) on rock lobsters in Australian waters also found no mortality impacts and no impacts to the eggs or hatched larvae of berried females exposed to seismic sound at very close range. Some sub-lethal stress and pathological impacts were observed in these studies although this occurred while lobster were captive in cages and subject to repeat exposures within close proximity to an airgun. Therefore, the effect of VSP on scampi is not expected to result in any mortality or impacts to their eggs or larvae. It is likely that scampi will move to avoid the immediate proximity of the well site during the VSP well evaluation, although in all probability are likely to have moved away from the well site prior to this as a result of drilling vibration and settlement of drill cuttings. The impacts will be highly localised (e.g. hundreds of metres) and limited to the duration of VSP activities (approximately 18 hours). Therefore, the effects of sound to scampi will be negligible and are considered to be Insignificant (F). Pelagic fish species such as tuna and billfish may also be present in WA-343-P but these species are highly mobile and belong to a group of fish with limited sensitivity to sound (Popper et al. 2014; Hawkins & Popper 2016; Carroll et al. 2017). Fish may avoid waters immediately surrounding VSP activities but no impacts to these stocks are expected. Therefore, disturbance to commercially important fish species may occur however, given the absence of any spawning or aggregation habitat within WA-343-P, any impact would be localised to individuals and would not result in any detrimental impacts in stock levels, and as such any impacts are considered to be Insignificant (F).	
Identify the likelihood	
With the above described controls in place and the absence of any BIAs or important habitats in WA-343-P, the likelihood of impacts to marine fauna from noise emissions generated from the MODU, drilling, vessel and pre-drill survey operations are considered Unlikely (4). Despite the distances to important marine habitats, transient marine fauna individuals may be present within the permit area and due to the increased sound source levels and expected propagation distances associated with VSP noise emissions, impacts to marine fauna are considered Possible (3); however, this would be limited to individuals and the timeframe associated with the VSP is considered to be of short duration.	
Residual risk summary	
Based on a consequence of Insignificant (F) and a worst-case likelihood of Possible (3) the residual risk is Low (8).	

Consequence	Likelihood	Residual risk
Insignificant (F)	Possible (3)	Low (8)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Risk of impacts to marine fauna from planned noise emissions are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Vessel contractors comply with relevant requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, within the 500m exclusion zone including: • Supply vessels will not travel greater than 6 knots within 300 m of a whale (caution zone) • Supply vessels will not approach closer than 100 m of a whale.	• Records of breaches of vessel - cetacean interaction requirements outlined in the EBPC Regulations 2000 reported.	INPEX Drilling Supervisor
	INPEX will verify VSP operations are conducted in accordance with EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales which includes: • Implement 30-minute pre start observations to the extent of the observation zone (as defined in Policy Statement 2.1), only start if no whales are sighted within 3 km.	• Records of pre-start observations prior to time of commencement; and soft-start time of commencement and durations. • Records of sound source on standby or VSP shutdown if whales are observed. • Completed MMO records during VSP operations.	INPEX Drilling Supervisor

	• Implement soft start procedures, including a gradual ramp up of acoustic source to full power over 20 minutes only if no whales are sighted within the shutdown zone during the pre-start observations. • While the VSP is operating, both during soft start and operations: visual observations of the observation zone are maintained; if whales are sighted – acoustic source placed on standby; if whales are sighted in the shut-down zone (within 1 km of source)– the acoustic source will be shut down. • An MMO will be on board during VSP operations.		
	Awareness materials for site personnel for avoiding harm to marine fauna.	Record of provision of awareness materials to site personnel.	INPEX Environmental Adviser

6.6 Loss of containment

The activity will require the handling, use and storage of chemicals and hydrocarbon materials which may include, but are not limited to:

- diesel
- hydraulic oil
- BOP control fluid
- grease
- drilling fluids.

Undertaking the activity introduces the potential for loss of containment events. These events may be classified as Level 1, Level 2 or Level 3 incidents.

INPEX defines an emergency condition as:

"an unplanned or uncontrolled situation that harms or has the potential to harm people, the environment, assets, Company reputation or Company sustainability and which cannot, through the implementation of Company standard operating procedures, be contained or controlled."

An evaluation of the environmental impacts and risks associated with emergency conditions is included in Section 7.

A summary of the loss of containment events (and emergency conditions) associated with this EP is presented in Table 6-12. Incident levels are indicative only and classifications have been assigned for the purposes of enabling the risk evaluation to be undertaken. In the event of a spill, the incident level will be classified as described in the OPEP.

Table 6-12: Representative loss of containment events and emergency conditions identified for the petroleum activity

Scenario		Basis of volume calculation	Type	Indicative incident level	Section addressed
Source	Threat				
Management of chemicals and hydrocarbons products on board	Inappropriate use /handling/ spills Failure of hydraulic hoses on equipment	Failure of tote tank, estimated to be in the order of 1 m^3 Failure of hydraulic hoses, estimated to be in the order of < $1m^3$	Various	1	Accidental release overboard
SBM transfers	Spill during transfer	10 m^3 – based on hose failure during transfer	Various	1	Accidental release overboard

Scenario		Basis of volume calculation	Type	Indicative incident level	Section addressed
Source	Threat				
Hydrocarbon transfers	Spill during bunkering	10 m^3 – based on hose failure during transfer	Group II – diesel	1	Accidental release overboard – Table 6-13
Helicopter refuelling	Spill during refuelling on board the MODU	4.4 m^3 – based on volume stored on board the MODU	Group I (i.e. aviation fuel)	1	Accidental release overboard – Table 6-13
Emergency conditions (refer to Section 7)					
Vessels	Collision	250 m^3 – based on capacity of largest single fuel tank (AMSA 2013) Largest survey vessel fuel tank approx. 40 m^3	Group II – diesel	2	Vessel collision
Loss of well containment	Integrity failure	283,198 m^3 based on a rate of 2,178 m^3 per day for a 130-day blowout	Group I – condensate	3	Loss of well containment

6.6.1 Accidental release

Table 6-13: Impact and evaluation – loss of containment: accidental release overboard

Identify hazards and threats	
Several loss of containment events were identified (Table 6-12), including minor spills on board (<1 m^3); failure of hydraulic hoses (<1 m^3); loss of SBM during transfer (10 m^3) and loss of hydrocarbon fuels during bunkering of vessels and helicopters (4.4 m^3 to 10 m^3). Specific predictive modelling was not undertaken for the potential loss of containment events. This was based on the low worst-case volumes (< 10 m^3) and that any predicted impacts are expected to be localised to the point of release. Given the properties of the chemicals involved (predominantly Group I and Group II hydrocarbons), which tend to be more volatile and less persistent in the environment any spills will rapidly disperse at the sea surface. An accidental release overboard resulting in a spill that reaches the marine environment has the potential to result in localised changes to water quality, resulting in impacts to marine fauna and planktonic communities at the sea surface, but no impact on deeper water communities or benthic habitats would be expected.	
Potential consequence	**Severity**
Potential accidental releases overboard from loss of containment events may result in the exposure of marine fauna and plankton near the sea surface, to a range of chemicals and Group I and Group II hydrocarbons. Foreseeable loss of chemicals to the marine environment would be of small volumes (<1 – 2 m^3), and impacts would generally be of low consequence (Insignificant F). Therefore, the focus of this assessment is based on the larger spill volumes associated with loss of SBM and diesel during transfers/bunkering. Given the anticipated volumes (worst case 10 m^3 of diesel or SBM), potential exposure is expected to be localised to the point of discharge in WA-343-P and some of the spilled volume is expected to be at least partially captured within the MODU drainage system, therefore further reducing the potential spill volume. Upon release to the marine environment hydrocarbons will disperse through natural physical oceanic processes, such as currents, tides and waves, and photochemical and biological degradation. Therefore, any surface expression is expected to weather and dissipate in a relatively short time with limited potential for exposure to surfacing marine fauna or plankton at the sea surface.	Insignificant (F)

In the absence of any known BIAs for marine fauna in WA-343-P, any individuals present are likely to be transiting the area for a short duration. The closest BIA to WA-343-P is the whale shark foraging BIA located 15 km away and has low reported low levels of whale shark abundance (Section 3). The closest identified internesting area for marine turtles relates to a 20 km internesting buffer for green turtles at Browse Island, with the interesting buffer located 48 km away from the permit area at its closest point. Given the low volumes, limited duration of exposure due to expected weathering and dispersion in an open ocean environment, the level of consequence is expected to present a local scale event of inconsequential ecological significance (Insignificant F).

As a consequence of their presence close to the water surface, plankton may be exposed to any entrained/dissolved components of any hydrocarbons spilled at the sea surface, particularly in high energy seas where the vertical mixing of oil through the water column would be enhanced. The effects of oil on plankton have been well studied in controlled laboratory and field situations. The different life stages of a species often show widely different tolerances and reactions to oil pollution. Usually, eggs, larval and juvenile stages will be more susceptible than adults (Harrison 1999). Post-spill studies on plankton populations are few, but those that have been conducted, typically show either no effects or temporary minor effects (Kunhold 1978). Given the high temporal and spatial variability in plankton communities, and the small size of the area impacted by an accidental release, the potential consequence in regard to planktonic communities is considered to be Insignificant (F).

Identify the likelihood

Based on the low volumes, expected weathering of spilled chemicals, absence of any important habitats within WA-343-P for marine fauna and in conjunction with the controls in place the likelihood of a loss of containment event causing harm to the identified receptors is considered to be Unlikely (4).

Residual risk summary

Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).

Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility

No incidents of spills reaching the marine environment during transfer, handling or storage of chemicals, hydrocarbons and liquid waste products.	Premobilisation HSE inspection confirm that MODU and vessels >400 GT have SOPEPs compliant with Marine Orders – Part 91, the POTS Act, and Annex I of MARPOL 73/78 (oil) on board.	Premobilisation HSE inspection documentation.	INPEX Environmental Adviser
	Bunding around stored bulk wet chemicals or hazardous liquid waste storage areas in accordance with Australian standards.	Bunding and drainage verified by containment specialist.	INPEX Drilling Supervisor
	Spill kits will be located around the MODU and vessels to allow clean-up of any spill to the deck.	Inspection records confirm spill kits are available and stocked.	INPEX Drilling Supervisor
	Site personnel are made aware of deck spill response requirements.	Records of awareness materials include deck spill response requirements provided.	INPEX Environmental Adviser
	INPEX will verify the contractor implements MODU and vessel bunkering procedures for hydrocarbon and SBM transfers that will include as a minimum: • Completion of PTWs for all diesel and SBM transfers. • Dry break couplings/weak link breakaway couplings and flotation collars are installed on hydrocarbon bulk transfer hoses to prevent entanglement and enable early leak detection.	• Documentation that hydrocarbon and SBM bunkering procedures approved and are implemented, e.g. undertaken during daylight hours and in appropriate sea state etc. • Hose register. • Completed and approved PTW records for all diesel and SBM transfers.	INPEX Drilling Supervisor

	• Hydrocarbon bulk transfer hoses are certified and rated for hydrocarbons and pressure tested and maintained in a hose register. • Bunkering is undertaken during daylight hours, if permit to work in place and weather is good (e.g. suitable sea conditions). Night time bunkering will not be undertaken on a routine basis. This will only be undertaken in fully lit conditions and in favourable sea states. • Preventive maintenance of hydraulic equipment to ensure its integrity.	• Documentation of maintenance recorded in the preventive maintenance system.	

6.7 Introduction of invasive marine species (IMS)

Table 6-14: Impact and evaluation – Introduction of invasive marine species

Identify hazards and threats	
IMS are non-indigenous marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish founder populations. IMS are widely recognised as one of the most significant threats to marine ecosystems worldwide. Shallow coastal marine environments in particular, are thought to be amongst the most heavily invaded ecosystems, which largely reflects the accidental transport of IMS by international shipping to marinas and ports where the preferred artificial hard structures are commonly found. Vessels used for the activity will not be mobilised from overseas; however, mobilisation of the MODU from international waters may occur. This has the potential to act as a pathway for IMS to be translocated into offshore Commonwealth waters, if unmanaged, via the discharge of high-risk ballast water containing IMS (DAWR 2017) and/or via the presence of IMS within biofouling communities on the MODU and/or subsea equipment. Vessels on domestic journeys (e.g. pre-drill survey and support vessels transiting between WA-343-P and WA mainland) may if unmanaged, act as a pathway through the uptake and subsequent discharge of high-risk ballast water containing IMS and/or IMS recruitment on submerged vessel hulls while in the vicinity of confirmed IMS sources. Such sources could include other offshore infrastructure i.e. other vessels or platforms that may have support vessel sharing arrangements; and artificial substrates such as jetties and wharves already colonised by mature IMS, such as in Broome Port. The introduction and establishment of IMS into the marine environment may result in impacts to benthic communities and associated receptors dependent on these including fishing.	
Potential consequence	**Severity**
The introduction and subsequent establishment of IMS could result in changes to the structure of benthic communities leading to a change in ecological function due to predation of native marine organisms and/or competition for resources. Once IMS establish, spread and become abundant in coastal waters some species can have major ecological, economic, human health and social/cultural consequences (Carlton 1996, 2001; Pimental et al. 2000; Hewitt et al. 2011).	Moderate (D)

Benthic communities, shallow water coastal environments in WA marine parks and reserves (the closest of which is Browse Island) and fisheries (commercial (including aquaculture)/ traditional/recreational) all have the potential to be impacted by IMS. Shallow water, coastal marine environments are susceptible to the establishment of invasive populations, with most IMS associated with artificial substrates in disturbed shallow water environments such as ports and harbours (e.g. Glasby et al. 2007; Dafforn et al. 2009a, 2009b). Aside from ports and harbours, other shallow water, pristine environments also at risk include offshore island and shoals such as those found in the EMBA in WA marine parks and reserves as presented in Section 3.4. Many of these marine parks and reserves contain sensitive benthic habitats with a potential to be impacted by invasive populations. In order for an IMS to pose a biosecurity risk once present at a recipient location, viable IMS propagules and/or individuals must be able to transfer from the colonised area (e.g. a vessel hull), survive in the surrounding environment, find a suitable habitat, and establish a self-sustaining population. Vessel operations are a mechanism for such transfer of IMS propagules either through the uptake and discharge of high risk ballast water containing IMS and/or via the presence of IMS within biofouling communities on hulls or submerged equipment. IMS propagules may also be transferred via natural dispersion. Natural dispersal mechanisms could involve a mobile life-history stage (such as actively swimming adults or larval stages) with sufficient swimming capacity and/or larval durations to directly reach suitable habitats in coastal waters. Natural dispersal from offshore locations for IMS with shorter pelagic dispersal capabilities to coastal areas is also theoretically possible via intermediate steps (stepping stone dispersal), where intermediate populations establish in suitable habitats closer inshore, and subsequent generations then spread towards coastal regions. With consideration of the habitat preferences of IMS (shallow water environments), the closest shallow water habitat to the permit area is Browse Island, located approximately 68 km away. However, it is neither disturbed nor contains artificial structures that IMS are reported to prefer. Support vessels transiting between WA-343-P and Broome port have the potential to act as vectors for the transfer of IMS propagules to sensitive benthic habitats in the wider EMBA and this may result in local to medium scale impacts to benthic communities with a consequence rating of Moderate (D).	

The successful introduction of IMS into fishing grounds/areas of aquaculture may result in changes to benthic habitats with the potential to alter faunal assemblages, resulting in decreased ecological diversity or ecosystem health. In turn this may result in an economic loss of revenue. Other fishing activities that may be impacted include traditional fishing known to occur on the Kimberley Coastline at the Balanggarra IPA, Bardi Jawi IPA, Dambimangari IPA, Karajarri IPA, Nyangumarta Warrarn IPA and the Uunguu IPA and recreational fishing that is known to occur around Broome Port. This may result in regional community disruption with a moderate impact on economic or recreational values with a consequence rating of Moderate (D).	

Identify the likelihood		
The MODU (that may be mobilised from international waters) and domestic vessels are not considered a likely source for the introduction and establishment of IMS during the short-term drilling activity. This is due to a number of factors including the controls and procedures in place to manage ballast water exchange and biofouling risks. As such, there is a low potential for biofouling to occur and act as a potential inoculum for the establishment and subsequent spread of IMS. Adherence to the Australian ballast water management requirements including the use of an approved ballast water management method also reduces the potential for the spread of IMS (Highly Unlikely 5). During drilling, support vessels will use Broome Port as the main supply base. The presence of jetties and wharves in the port, providing substrate for IMS, mean that the port could act as a source of IMS inoculum. However, resupply is typically undertaken within a relatively short timeframe (approximately 48 hours) therefore the potential for vessels to become colonised by biofouling communities is reduced. Guidance from DPIRD (Vessel Check Biofouling Risk Assessment Tool) acknowledges that the attachment of biofouling may occur in as short a time frame as 24 hours, however as a 'rule of thumb', 7 days is considered to provide a pragmatic balance between logistical factors versus the risk of a vessel being contaminated with an IMS. With the described controls in place, the potential spread of IMS via support vessels during the activity is considered to be Highly Unlikely (5). Overall, the likelihood of introducing IMS is considered to be Highly Unlikely (5) due to the remote location of the drilling activity (>12 nm from the nearest coastal waters), the short-term duration and the inability of IMS to establish based on water depths within the permit area (approximately 350 m).		
Residual risk summary		
Based on a consequence of Moderate (D) and a worst-case likelihood of Highly Unlikely (5) the residual risk is Moderate (8).		
Consequence	Likelihood	Residual risk

Moderate (D)	Highly Unlikely (5)	Moderate (8)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Prevent introduction and establishment of IMS as a result of the petroleum activity (including through ballast water and biofouling from MODU/vessels).	Support vessels (of appropriate class) will have an antifouling coating applied in accordance with the prescriptions of the International Convention on the Control of Harmful Anti-fouling Systems on Ships (2001) and the *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cwlth).	Support vessels (of appropriate class) have a current International Anti-fouling Systems certificate or a Declaration on Anti-fouling Systems.	INPEX Environmental Adviser
	A biofouling risk assessment will be completed by an independent IMS expert for the MODU and all support vessels, including immersible equipment, prior to mobilisation from international waters. Where required, mitigation measures commensurate to the risk will be implemented to ensure the vessel mobilisation poses a low risk of introducing IMS.	MODU/vessel-specific biofouling risk assessment and any records of mitigation measures implemented confirming the MODU/vessel presents a low risk.	INPEX Environmental Adviser
	A biofouling risk assessment will be completed for the MODU and all support vessels, including immersible equipment, prior to mobilisation from any Australian port. Where required, mitigation measures commensurate to the risk will be implemented to ensure the MODU/vessel mobilisation poses a low risk of introducing IMS.	MODU/vessel-specific biofouling risk assessment and any records of mitigation measures implemented confirming the MODU/vessel presents a low risk.	INPEX Environmental Adviser

	MODU/ vessels operating within Australian seas will manage ballast water discharge using one of the following approved methods of management including (DAWR 2017): • an approved ballast water management system or • exchange of ballast water exchange conducted in an acceptable area or • use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place) or • retention of high-risk ballast water on board the vessel or • discharge to an approved ballast water reception facility or • use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place).	MODU/vessels premobilisation HSE inspection documentation and annual verification reports confirm through ballast water records that an approved ballast water management option has been used. Documentation of DAWR release from biosecurity control or low risk status.	INPEX Environmental Adviser
	MODU and all support vessels will have: • an approved ballast water management plan, unless an exemption applies or is obtained	• Ballast water management plan or record of exemption (if not automatic exemption)	INPEX Environmental Adviser

	• a valid ballast water management certificate, unless an exemption applies or is obtained.	• Valid ballast water management certificate or record of exemption (if not an automatic exemption).	
	MODU and all support vessels will have a biofouling management plan prepared by an independent IMS expert to include elements of performance described in the IMO Guidelines for the Control and Management of Ship Biofouling to Minimize the Transfer of Invasive Aquatic Species (2012 Edition).	• Biofouling record book	INPEX Environmental Adviser

6.8 Interaction with marine fauna

Table 6-15: Impact and risk evaluation – Physical presence of vessels and interaction with marine fauna (vessel strike)

Identify hazards and threats	
The physical presence and use of vessels in the permit area has the potential to result in collision (vessel strike) with marine fauna.	
Potential consequence	Severity

Vessels undertaking the pre-drill site survey and supporting the drilling activity in WA-343-P have the potential to interact with transient, EPBC-listed species; specifically, marine mammals, whale sharks and turtles. This may result in injury or death of marine fauna from vessel strike. Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat overlap (Dolman & Williams Grey 2006). Vessel speed has been demonstrated as a key factor in collisions with marine fauna such as cetaceans and turtles, and it is reported that there is a higher likelihood of injury or mortality from vessel strikes on marine mammals when vessel speeds are greater than 14 knots (Laist et al. 2001; Vanderlaan & Taggart 2007). The potential for vessel strike applies to all marine mammals, whale sharks and turtle species; however, humpback whales are considered to have a higher potential likelihood due to their extended surface time. The potential for collision during the petroleum activity is however reduced as the permit area is located hundreds of kilometres offshore, away from critical habitats such as humpback BIA areas (migration and calving) as shown in Figure 4-4 (located approximately 175 km from WA-343-P at its closest point). The reaction of whales to approaching ships is reported to be quite variable. Dolman and Williams Grey (2006) indicate that some cetacean species, such as humpback whales, can detect and change course to avoid a vessel. Humpback whales are subject to a DEE Conservation Advice which requires the assessment of vessel strike on humpback whales and encourages the implementation of mitigation measures and vessel strike incident reporting to the National Ship Strike Database. As such, control measures are included below, to align with the DEE Conservation Advice and address vessel strike on humpback whales. Another marine mammal with a BIA in the region (approximately 40 km to the west of WA-343-P (Figure 4-4) is the blue whale, which is also subject to a DEE Conservation Management Plan. The Conservation Management Plan identifies that, since 2006, there have been two records of likely ship strikes of blue whales in Australia. In 2009 and 2010, there were blue whale strandings in Victoria, near the Bonney Upwelling with suspected ship strike injuries visible. Where blue whales are feeding at or near the surface, they are more susceptible to vessel strike. However, the open ocean environment allows for whales to invoke avoidance behaviour in threatening situations. The Blue Whale Conservation Management Plan highlights that minimising vessel collision is one of the top four priorities and requires assessment of vessel strike on blue whales, assures that incidents are reported in the National Ship Strike Database, and that control measures proposed will align with these priorities. Whale sharks do not breach the surface as cetaceans do; however, they are known to swim near to the water surface; hence, are susceptible to vessel strike. The foraging area for whale sharks (BIA) is located approximately 15 km to the east of WA-343-P and whale sharks are also subject to a DEE Conservation Advice which notes that the threat to the recovery of the species includes strikes from vessels.	Minor (E)

Turtles transiting the region are also at risk from vessel strike when they periodically return to the surface to breathe and rest. Only a small portion (3–6%) of their time is spent at the surface, with routine dive times lasting anywhere between 15 and 20 minutes nearly every hour. The presence of vessels has the potential to alter the behaviour of individual turtles. Some turtles have been shown to be visually attracted to vessels, while others show strong avoidance behaviour (Milton et al. 2003). Within the EMBA, marine turtle BIAs are known to occur. Following publication of the Recovery Plan for Marine Turtles in Australia, in 2017, habitats critical for the survival of the genetically distinct, 'Scott Reef – Browse Island' green turtle population has been identified. The closest identified habitat to WA-343-P, relates to an internesting area consisting of a 20 km buffer around Browse Island between November and March each year. The BIA does not overlap the permit area which is located approximately 68 km from Browse Island. During the internesting periods studies have shown that green turtles tend to stay relatively close to their nesting beach, approximately 7 km as reported by Pendoley (2005) and generally within 10 km (Waayers et al. 2011). Therefore, any impacts are expected to be localised and of minor consequence at the population level for these mobile and broad-ranging species. Given the expansive open ocean environment of the permit area and the short-term duration of the activity, the potential for the displacement of cetaceans by operational activities is considered to be low. Additionally, there are no recognised feeding or breeding grounds for cetaceans or turtles within WA-343-P. While there is potential for a small number of individual marine fauna to be impacted by vessels associated with the activity, any potential vessel strike to marine fauna is likely to be limited to isolated incidents. As reported by the DEE (2017a), although the outcome can be fatal for individual turtles, vessel strike (as a standalone threat) has not been shown to cause stock level declines. In the event of the death of an individual whale or turtle, it would not be expected to have a significant effect at the population level (Minor E). With reference to the Recovery Plan for Marine Turtles in Australia (DEE 2017a) based on the long life span and highly dispersed life history requirements of marine turtles it is acknowledged that they may be subject to multiple threats acting simultaneously across their entire life cycle, such as increases in background light and noise levels. In considering cumulative impacts of threats on small or vulnerable stocks of marine turtles, it is likely that vessel strike may act as contributor to a stock level decline.	
Identify the likelihood	
Records from 2011 (most recently available data) showed that between six and nine vessel strikes with cetaceans, including non-fatal cases, had been reported in Australian waters in the previous three years, with only a minority occurring in WA (IWC 2011). This suggests that, despite the growing presence of oil & gas activities on the NWS/Timor Sea, and the steady increase (approximately 10% per year) in humpback whale numbers, whale populations have not been affected by collisions with oil & gas vessels.	

The controls described above are commensurate with the level of risk and given the slow vessel speeds, the absence of any known BIAs or critical habitats in WA-343-P the likelihood of a vessel strike causing injury or death to a transient, EPBC-listed species is considered to be Highly Unlikely (5).		
Residual risk summary		
Based on a consequence of Minor (E) and a likelihood of Highly Unlikely (5) the residual risk is Low (9).		
Consequence	Likelihood	Residual risk
Minor (E)	Highly Unlikely (5)	Low (9)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Zero incidents of injury/mortality of cetaceans and turtles from vessel collision for the duration of the drilling activity.	EPBC Regulations 2000 – Part 8 Division 1 Interacting with cetaceans, within the 500m exclusion zone including: • Supply vessels will not travel greater than 6 knots within 300 m of a cetacean (caution zone) • Supply vessels will not approach closer than 50 m to a dolphin and/or 100 m of a whale (with the exception of bow riding).	Records of any breaches of vessel/cetacean interaction requirements outlined in the EBPC Regulations 2000 reported.	Vessel master
	Support vessels will not travel faster than 8 knots within 250 m of a whale shark and not approach closer than 30 m from ahead of a whale shark's direction of travel.	Records of any breaches of vessel/whale shark interaction requirements.	Vessel master

	Awareness materials for site personnel for avoiding harm to marine fauna.	Record of provision of awareness materials to site personnel.	INPEX Environmental Adviser

6.9 Seabed disturbance

Table 6-16: Impact and risk evaluation – Seabed disturbance from seabed sampling, anchoring and well abandonment activities

Identify hazards and threats	
To validate and ground-truth the geophysical pre-drill survey data, approximately eight samples of seabed sediments will be collected within the permit area during the survey (Section 3.2.1). Each sample comprises of approximately 0.13 m^3 of sediment collected using a specialised grab sampler. As described in sections 3.4 and 3.4.1, if a moored MODU is used to complete the drilling activity it will be secured to the seabed through a series of anchors and anchor chains. No vessels will anchor during the activity. For a typical moored semi-submersible MODU, given the expected anchor and anchor chain dimensions (Section 3.4.1) approximately 1,000 m^2 (0.001 km^2) of benthic habitat in the permit area may be disturbed. On completion of the drilling and wireline evaluation activities, the well will be permanently plugged and abandoned. As described in Section 2.10, the conductor and casing will be cut below the sea floor (mudline) and the wellhead removed from the permit area. This process also has the potential to disturb benthic communities at the well location, albeit in an already disturbed area due to discharged drill cuttings (top-hole section) and excess cement returns at the well location.	
Potential consequence	**Severity**
Physical disturbance of the seabed may cause temporary disturbance to benthic habitats and loss of associated infauna and epifauna. Seabed habitat surveys have been undertaken in the vicinity of WA-343-P including the Ichthys Field (approximately 60 km south), Heywood Shoals (62 km east) and Echuca Shoals (approximately 75 km south-east). The results of the surveys observed that seabed topography was relatively flat and featureless (INPEX 2010) with no obstructions or features on the seafloor, such as boulders, reef pinnacles or outcropping hard layers (Fugro Survey Pty Ltd. 2005; RPS 2007). The observed habitat generally supported a diverse infauna dominated by polychaetes and crustaceans typical of the broader region and this was reflected in survey results which indicated that the epibenthic fauna was diverse but sparsely distributed (RPS 2008).	Insignificant (F)

Benthic habitats within WA-343-P are expected to comprise of soft substrate, typical of deep continental shelf seabed habitats which are widely distributed in deeper parts of the Browse Basin (RPS 2007), and commonly found throughout the NWMR (Baker et al. 2008). From extrapolation of the nearby survey data, it is expected that the seabed in WA-343-P will also comprise of heavily rippled sediments suggestive of strong near seabed currents and a lack of seabed features. In general, deep-sea infaunal assemblages are poorly studied on the NSW but are likely to be widely distributed in the region including WA-343-P (INPEX 2010). The total disturbance footprint from the petroleum activity is expected to be approximately 0.001 km^2, which in the context of WA-343-P, covering an area of approximately 600 km^2, represents the disturbance of 0.00017% of the permit area. The activity may result in the mortality of sessile fauna within this footprint and potentially the mortality of benthic infauna associated with the habitat; however, it is considered that potentially impacted benthic habitats and associated biota are well represented in the region. Therefore, any temporary disturbance and losses will represent a very small fraction of the widespread available habitat. Following removal of the MODU anchors and completion of the activity, the soft sediments will be left disturbed; however, based on the short-term duration (120-150 days) upon retrieval of the anchors, benthic habitats would remain viable and are expected to recolonise through the recruitment of new colonists from planktonic larvae and adjacent undisturbed areas. Impacts from grab sampling are expected to be limited due to the small size of area affected by sampling (less than 0.4 m^2). Well abandonment activities may also disturb benthic communities at the well location during the cutting and recovery of the conductor/casing at the mudline; however as described in Table 6-7 and Table 6-8, the discharge of drill cuttings and excess cement adjacent to the well will have already previously disturbed this area and given the short-term duration of the activity (120-150 days) it is not expected to delay the recolonisation and recovery of benthic habitats in that area. Displacement of sediments during anchor deployment/retrieval/well abandonment activities may result in temporary, localised plumes of suspended sediment and subsequent deposition of sediment resulting in smothering of marine benthic habitat and benthic communities in the immediate vicinity. Parts of the ancient coastline KEF, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments (DSEWPaC 2012a). It is considered that the hard substrate of the escarpment is likely to support a range of sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates (DSEWPaC 2012a). The ancient coastline KEF is located, approximately 50 km south of WA-343-P at its closest point. Therefore, benthic communities associated with the KEF are not expected to be impacted as any silt plumes generated would have dissipated over this distance in the presence of near-seabed currents and it is not expected that sedimentation/smothering impacts would occur to benthic communities. This is also expected to be the case for Heywood Shoal and Echuca Shoals located 62 km and 75 km away respectively.	

The potential consequence on benthic communities is a localised impact from physical disturbance within the footprint of the anchors/chains which is expected to be limited given the predicted sparse cover of benthic communities and expected recovery through recolonization. Therefore, it is assessed to be of inconsequential ecological significance (Insignificant F). Several commercially significant fish stocks, considered as key indicator species, were identified as being present in the waters of WA-343-P. Although they may be present, given the deep waters and absence of suitable habitats, WA-343-P is not considered to offer spawning or aggregation habitat. Disturbance to seabed habitats from the petroleum activity is therefore not expected to affect fish spawning habitats (Insignificant F).	

Identify the likelihood
Given the controls in place, the likelihood of impacting benthic communities located at the anchor/chain locations and well site in WA-343-P, is considered to be Possible (3). The pre-drill site survey will confirm that anchor locations do not coincide with any unique benthic habitats. Any temporary impacts are considered to be ecologically insignificant to the wider diversity and productivity of benthic communities in the region, including the ancient coastline KEF, based on the relatively small area potentially impacted i.e. total disturbance footprint relative to the widespread available habitat and short duration with expected recovery.

Residual risk summary
Based on a consequence of Insignificant (F) and a likelihood of Possible (3) the residual risk is Low (8).

Consequence	Likelihood	Residual risk
Insignificant (F)	Possible (3)	Low (8)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
No MODU anchoring to take place in areas which support sensitive primary producer benthic habitat.	Conduct pre-drill site survey to confirm that anchoring locations do not overlap with sensitive benthic communities.	Environmental assessment of pre-drilling survey and MODU location evaluation undertaken before commencement of the drilling activity.	INPEX Environmental Adviser

	INPEX will verify that the contractor prepares and implements a Rig Move and Positioning Plan prior to the MODU arriving in the WA-343-P. The plan shall include: Details of the configuration of the anchors necessary to keep the MODU securely on location and provides anchor-mooring analyses and procedures for anchor mobilisation and retrieval activities. This includes: • planning and verification of well and MODU anchoring locations (including for relief wells) so that well and anchors are all located within the boundaries of permit area WA-343-P. • definition of procedures for anchor deployment and recovery. • anchors will be carried to the deployment location and deployed or retrieved directly using AHSV to minimise drag.	Documentation confirming implementation of the Rig Move and Positioning Plan and any issues with anchor deployment, use and recovery that could increase seabed footprint of anchors.	INPEX Drilling Supervisor

6.10 Physical presence - disruption to other marine users

Table 6-17: Impact and risk evaluation – Physical presence of MODU and vessels resulting in disruption to marine users

Identify hazards and threats	
The physical presence of the survey vessel and MODU with associated support vessels in WA-343-P has the potential to cause disruption to other marine users, including shipping operators and fisheries through the reduction of space available to conduct shipping and fisheries activities in the permit area. The survey and support vessels do not have an associated 500 m exclusion zone, however the MODU is required to maintain a PSZ under the OPGGS Act. The PSZ will remain in place for the duration of the drilling activity while the MODU is on location in WA-343-P (120-150 days). The potential, albeit temporary, interference with and/or exclusion of other users, within the PSZ may result in a loss of revenue for commercial users including fisheries.	
Potential consequence	Severity
Other marine users in the vicinity of WA-343-P may be impacted by MODU and vessel presence (including the presence of the MODU PSZ exclusion) because of the loss of navigable space available to conduct their activities. The implications of such disruptions include changes to sailing routes and journey times, or reduced ability to fish in an area. The worst-case consequence from a loss of access to an area could result in economic losses and/or potential reduction in employment levels. A review of the vessel chart plot provided by AMSA for the period May to October 2018 confirmed the absence of any major shipping lanes within the permit area. Shows that a large proportion of the high-density vessel traffic surrounding the permit area is to the south of WA-343-P. This is related to supply vessels supporting the offshore developments (INPEX Ichthys facility and Shell Prelude FLNG facility) that routinely transit between the offshore facilities and the ports of Darwin and Broome on the mainland. As the facilities are situated 60 km south and 50 km south-west of the permit area respectively, (Section 4.10.6), support vessel transit routes do not intersect WA-343-P. Despite the absence of any shipping lanes or petroleum supply transit routes, vessel traffic will still occur in the permit area, and in some areas of WA-343-P it is still considered to be heavy vessel traffic. As the exact well location within the permit area has not yet been confirmed, any vessels passing through the permit area may temporarily suffer a minor loss of navigable space when the PSZ is in place during the drilling activity (120-150 days). Individual vessels may have to slightly alter their sailing routes to avoid the MODU potentially leading to longer journey times. This is not expected to result in any economic losses associated with this temporary disruption. Therefore, the consequence is considered to be insignificant (F).	Insignificant (F)

Several Commonwealth and state managed fisheries overlap WA-343-P and the EMBA. Fisheries whose permit areas overlap WA-343-P and therefore may potentially have access limitations during the 120-150 day drilling activity are highlighted in bold in Table 4-7 and Table 4-8. In many instances, although the area of the fishery overlaps WA-343-P, no fishing effort actually occurs in the permit area based on the water depth, water temperature and lack of suitable habitat. Of the fisheries overlapping WA-343-P, the North West Slope Trawl Fishery is the only active fishery, however it reportedly fishes at low levels, with only negligible trawl fishing occurring in the nearby Ichthys Field (60 km south) between 2002 and 2009 (AMFA 2018f). Based on the low level of identified commercial fishing activity and the relatively small spatial area occupied by the PSZ in WA-343-P, in comparison to the entire extent of the fishing grounds available to commercial operators, and the relatively short-term duration of the activity (120-150 days), the potential loss of navigable space in which a fishing operator could conduct their activities is considered to be insignificant (F). WA-343-P is situated within the MoU box for Indonesian traditional fishing (DSEWPaC 2012) as shown on Figure 4-2. Therefore, Indonesian fishing vessels may be present in the area when transiting between fishing grounds at Scott Reef and Browse Island; however, transit routes are not expected to overlap WA-343-P as Scott Reef and Browse Island are located approximately 150 km and 68 km from WA-343-P. Therefore, interference and disruption are not expected, and impacts are expected to be insignificant (F). Recreational fishing may also operate off the WA coast during certain times of the year. Generally, there is little recreational fishing that occurs within WA-343-P because of its distance from land, lack of features of interest and deep waters. Therefore, the potential for loss of access to the recreational fishing industry as a result of MODU/vessel physical presence is considered to be of Insignificant consequence (F).	
Identify the likelihood	
The MODU and vessels associated with the petroleum activity in WA-343-P will have an insignificant impact by temporarily (120-150 days) reducing the navigable space available to shipping and fishing operators. The likelihood of loss of access/space in the open ocean resulting in an economic loss or reduction in employment levels is considered to be Highly Unlikely (5). During stakeholder engagement for the EP, shipping operators were not considered as relevant stakeholders to be consulted, as the petroleum activity is outside of any shipping routes/channels. Relevant stakeholders, including fisheries, were consulted throughout the development of this EP and included a specific targeted stakeholder consultation for commercial fisheries through WAFIC. Commercial fisheries will continue to be informed and updated on operational activities being undertaken by INPEX. On this basis, with the controls in place, impacts to economic values from loss of revenue for fisheries due to lack of access to fishing grounds with potential reduction in employment levels is considered Highly Unlikely (5).	

Residual risk summary		
Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10).		
Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Relevant persons (i.e. shipping operators and commercial, traditional, and recreational fisheries) will be identified and any concerns raised will be assessed and those of merit resolved.	Disruption to fishing/shipping and other marine users will be managed by identifying and conducting ongoing stakeholder consultation on an as required basis during the activity.	Stakeholder engagement records demonstrating assessment of stakeholder feedback received and INPEX response (or resolution).	INPEX Environmental Adviser
	Notification to commercial fisheries via WAFIC, 2 weeks in advance of the activity commencing, to include: • timing of the activity • MODU location coordinates • location of PSZ • MODU/vessel IMO numbers and communication details.	Transmittal of notification issued to WAFIC.	INPEX Environmental Adviser
	AHO and AMSA will be informed of the exact well location prior to the activity commencing.	Records of document transmittal to AHO and AMSA.	INPEX Environmental Adviser

	AHO will be notified no less than four working weeks before operations commence for the promulgation of related notices to mariners (via datacentre@hydro.gov.au).	Records of document transmittal to AHO.	INPEX Environmental Adviser
	Notification will be provided to AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings 24-48 hours before operations commence, including following information (via rccaus@amsa.gov.au, ph: 1800 641 792 or +61 2 6230 6811): • Vessel details, including name, call sign and Maritime Mobile Service Identity (MMSI) • Satellite communications details, including INMARSAT-C and satellite telephone • Area of operation • Requested clearance from other vessels • Notification of operations start and end.	Records of document transmittal to AMSA JRCC.	INPEX Environmental Adviser
	MODU and vessels will be fitted with lights, signals, AIS transponders and navigation and communications equipment, as required by the *Navigation Act 2012.*	Records confirm that required navigation equipment is fitted to MODU and vessels to ensure compliance with the *Navigation Act 2012.*	INPEX Environmental Adviser

7 EMERGENCY CONDITIONS

An evaluation of potential spill sources identified during the environmental hazard identification (HAZID) workshops determined various potential emergency conditions related to the activity (Table 6-12). The emergency conditions are summarised in Table 7-1.

Table 7-1: Potential emergency conditions

Scenario		**Hydrocarbon type**	**Release location**
Source	Threat		
Survey and support vessels	Collision	Group II – diesel	Surface
Loss of well containment	Integrity failure	Group I – condensate	Subsea

7.1 EMBA based on oil-spill modelling

Hydrocarbon exposure has the potential to result in both acute and chronic impacts to marine flora and fauna, depending on the sensitivity of organisms exposed and the concentration of exposure. A summary of the range of concentrations of different hydrocarbon exposure thresholds adopted to conservatively identify an area with potential environmental impacts is described in Table 7-2. These thresholds include surface, entrained, dissolved and shoreline accumulation thresholds to account for the different partitioning and fate of oils released in different scenarios as outlined in Table 7-1. Thresholds have been used in stochastic modelling to define the EMBA as described in Section 3, for oil spill planning purposes.

Table 7-2: Hydrocarbon exposure threshold for impact and risk evaluation

Threshold	**Description**
Surface hydrocarbon exposure: 1–10 g/m^2.	Certain socioeconomic receptors, such as oil & gas industry and fishing activities may be affected by safety concerns associated with a light surface expression. Therefore, a surface exposure threshold of 1 g/m^2 is included, for information purposes. However, it is considered too low for ecological impact assessment purposes. The surface oil threshold of 10 g/m^2 to assess environmental impacts is based on research by French-McCay (2009) who has reviewed the minimum oil thickness (0.01 mm) required to impact on thermoregulation of marine species, predominantly seabirds and furred mammals. Seabirds are particularly vulnerable to oil spills because their feathers easily become coated and they feed in the upper water column. Other tropical marine megafauna species are unlikely to suffer from comparable physical oil coating because they have smooth skin. Applying the threshold for the scenarios outlined for this EP therefore, represents a conservative measure to define the EMBA. This threshold has been applied to various industry oil spill impact assessments by French-McCay (2002; 2003) and is recommended in the AMSA guidelines (AMSA 2013).

Threshold	Description
Dissolved and entrained hydrocarbon exposure: 100–500 ppb.	Unplanned spills scenarios in this EP include release of various oil types, both at the sea surface and at the seabed (Table 7-1). These different oil types and release sites/depths affect the recommended thresholds for dissolved and entrained hydrocarbons (see a review by French-McCay 2009). Therefore, a range of concentrations, from 100–500 ppb is included to cover all scenarios provided in this EP. The biological impact of entrained oil cannot be determined directly using available ecotoxicity; however, it can be derived from tests using either water-soluble fraction (WSF) of oil or oil-in-water dispersions (OWD). OWD are prepared by highly turbulent shaking of oil in water, which are allowed to separate before use, so that the test organisms are exposed to the dissolved fractions, as well as any very fine entrained oil droplets that remain in suspension. However, results are conservative because entrained droplets are less biologically available to organisms through tissue absorption than the dissolved fraction (Tsvetnenko 1998). To provide an estimate of the magnitude of toxicity effects from oil exposure to marine biota across a wide taxonomic range, a review was undertaken of global ecotoxicology data for numerous species (115 for fish, 129 for crustaceans, and 34 for other invertebrates) by French-McCay (2002). These were based on both WSF and OWD tests. Under low-turbulence conditions, the total polycyclic aromatic hydrocarbon (PAH) LC_{50} for species of average sensitivity ranges from about 300–1,000 ppb. Under higher turbulence, such as a subsea release, the total PAH LC_{50} decreased to about 64 ppb (French-McCay, 2002). This is close to the 99% species protection threshold of 50 ppb for PAH in the Australian and New Zealand *Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000). Comparatively, the lowest no observed effect concentration (NOEC) level for unweathered Browse condensate from the north-west region was found to be 20 ppm, based on a fish imbalance and tiger-prawn toxicity test (Woodside 2014). To be conservative, a 100 ppb entrained/dissolved threshold is proposed for a subsea release of condensate to account for any ecological impacts in the EMBA. Because it is derived from the WSF and OWD results, it is also proposed for the dissolved hydrocarbon threshold. Although the ANZECC/ARMCANZ water quality guidelines (2000) have the lowest trigger levels for total hydrocarbons in water set at 10 ppb, a relatively long exposure time is required for these concentrations to be significant. The threshold of 100 ppb is considered to indicate the zones where acute exposure could potentially occur over shorter durations, following a spill. For marine diesel, the surface release of the hydrocarbon tends to reduce its potential for solubility, so the toxicity decreases and a threshold up to 1,000 ppb is recommended (French-McCay 2009). To be conservative a 500 ppb entrained/dissolved threshold is proposed for a surface release of marine diesel to account for any ecological impacts in the EMBA.

Threshold	Description
Shoreline accumulation: 100 g/m^2 (where threshold for surface or entrained/dissolved hydrocarbon exposure at that shoreline is also exceeded).	A shoreline accumulation threshold of 100 g/m^2 is also recommended from the review by French-McCay (2009) based on exposure to birds and smothering of invertebrates in intertidal habitats.

As described in Section 3, the spatial extent of the EMBA, used as the basis for the EPBC Protected Matters Database search, was determined using stochastic spill modelling. Based on the defined hydrocarbon exposure thresholds, the resulting EMBA is the sum of 300 overlaid modelling runs (100 per season) for worst-case spill scenarios, during all seasons (summer, winter and transitional) and under different hydrodynamic conditions (e.g. currents, winds, tides, etc.). This technique has been used to provide a highly conservative representation of the EMBA from all potential loss of containment events to ensure that the EPBC Protected Matters Database search includes all potential receptors. As such, the actual area that may be affected from any single spill event would be considerably smaller than that represented by the EMBA. The modelling outputs for each of the worst-case spill scenarios provide sufficient information to inform spill response planning.

It should be noted that when setting up the inputs for the modelling study, the estimated extent of the modelling output is set at a size expected to be sufficient to capture the critical risks. This is balanced with a need for computational efficiency so that arbitrarily huge sizes and long modelling durations (several weeks) can be avoided. Where blowouts with a large spill volume and long duration are assessed using low instantaneous concentration thresholds, an extensive potential migration zone for oil is the result[1].

The model output extent and thresholds used by RPS in this study are comparable to those used for similar studies and result in the furthest western boundary (during the winter season) being cut-off.

For the loss of well containment scenario, surface oil concentrations of 1 g/m^2 (visible surface sheen) may extend up to 1,145 km from the release location, with concentrations of >10 g/m^2 (environmental impact threshold) extending up to 13 km from the release location (RPS 2018). The maximum entrained and dissolved oil concentrations at or greater than the impact threshold concentrations (100 ppb) may travel up to approximately 3,900 km and 3,000 km from the release location respectively (RPS 2018).

For the vessel collision scenario, surface oil concentrations of 1 g/m^2 (visible surface sheen) may extend up to 110 km from the release location, with concentrations of >10 g/m^2 (environmental impact threshold) extending up to 25 km from the release location (APASA 2012). The maximum entrained and dissolved oil concentrations did not exceed the impact threshold concentrations (500 ppb) and therefore the EMBA is dictated by the surface expression only (APASA 2012).

A summary of the modelling outputs (used to inform the EMBA) for loss of well containment and vessel collision scenarios are provided in Section 7.1.1 and Section 7.1.2 respectively, with the impacts and risks associated with the loss of well containment and vessel collision scenarios presented in Table 7-3 and Table 7-4 respectively.

7.1.1 Impact and risk evaluation

Table 7-3: Impact and evaluation – Loss of well containment resulting in a Group I (condensate) spill

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">A subsea release of Group I hydrocarbons has the potential to result in changes to water quality through surface, entrained/dissolved, and shoreline hydrocarbon exposure. The thresholds for impacts associated with surface, entrained/dissolved, and shoreline hydrocarbon exposures are described in Table 7-2.</td></tr>
<tr><td>Potential consequence – surface hydrocarbons</td><td>Severity</td></tr>
<tr><td>The values and sensitivities with the potential to be affected by surface hydrocarbon exposure from a subsea release include:
• commercial, recreational and traditional fisheries including aquaculture (within 1,145 km from the release location based on 1 g/m^2 visible sheen threshold)
• transient, EPBC-listed species (within 13 km from the release location based on 10 g/m^2 impact threshold)
• planktonic communities (within 13 km from the release location based on 10 g/m^2 impact threshold).</td><td>Minor (E)</td></tr>
</table>

The values and sensitivities associated with commercial, recreational and traditional fishing (seafood quality and employment) could be impacted due to a spill from a loss of well containment. Implementing an exclusion zone during a spill response may impede access to fishing areas for a short-to-medium term, and nets and lines could become oiled (ITOPF 2011). Commercial fisheries that operate within WA-343-P and up to 1,145 km from the release location in the permit area that could be exposed to surface hydrocarbons (1 g/m^2) have generally low reported levels of fishing activity and predominantly operate in the shallower waters than WA-343-P. Recreational fishing is concentrated around the population centres of Broome, Wyndham and Darwin as well as other readily accessible coastal settlements along the Kimberley and NT coastlines. Recreational fishing is not known to occur within WA-343-P because of its distance from land, lack of features of interest and deep waters; however, recreational fishing areas outside of the permit area may be exposed to a visible sheen of surface hydrocarbons. Traditional fishing, particularly at Browse Island and Scott Reef could be affected by exposure to surface hydrocarbons. Based on the expected rapid weathering of condensate at the sea surface by evaporation, photooxidation and biodegradation and high potential for entrainment due to wave and wind action, any surface exposure is expected to be limited to a relatively short duration (less than a few days) (RPS 2018). Therefore, the socioeconomic impacts on commercial, recreational and traditional fishing are expected to be short-to-medium term, and the consequence is considered to be Minor (E). There are no marine fauna BIAs located in areas predicted to be exposed to surface expressions above the 10 g/m^2 exposure threshold (within 13 km of the release location); however, a range of marine fauna may still be present within this area albeit on a transient basis. As air-breathers, marine mammals, if they surface, are vulnerable to exposure to hydrocarbon spill impacts through the inhalation of evaporated volatiles. Effects include toxic effects, such as damage to lungs and airways, and eye and skin lesions from exposure to oil (WA DoT 2018a). For the short time that the majority of volatile components of the condensate are present (less than 24 hours; RPS 2018), vapours from the spill are considered the most significant risk to cetacean health, as their exposure can be significant. Vapours, if inhaled, have the potential to damage the mucous membranes of the airways and the eyes. Inhaled volatile hydrocarbons are transferred rapidly to the bloodstream and may accumulate in tissues, such as in the brain and liver, resulting in neurological disorders and liver damage (Gubbay & Earll 2000). Blue whales and humpback whales (baleen whales), that may filter-feed near the surface, would be more likely to ingest oil than gulp-feeders, or toothed-whales and dolphins. Spilled hydrocarbons may also foul the baleen fibres of baleen whales, thereby impairing food-gathering efficiency, or resulting in the ingestion of hydrocarbons, or prey that has been contaminated with hydrocarbons (Geraci & St. Aubin 1988).	

Turtles can be exposed to hydrocarbons if they surface within the spill, resulting in direct contact with the skin, eyes, and other membranes, as well as the inhalation of vapours or ingestion (Milton et al. 2003). Floating oil is considered to have more of an effect on reptiles than entrained/dissolved oil because reptiles hold their breath underwater and are unlikely to directly ingest dissolved oil (WA DoT 2018a). Other aspects of turtle behaviour, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large, pre-dive inhalations, make them vulnerable (Milton et al. 2003; WA DoT 2018a). In addition, hatchlings spend more time on the surface than older turtles, thus increasing the potential for contact with oil slicks (Milton et al. 2003). Marine avifauna have the potential to directly interact with hydrocarbons on the sea surface, in the course of normal foraging activities. Direct contact with surface hydrocarbons may result in dehydration, drowning and starvation and is likely to foul feathers, which may result in hypothermia (Matcott et al. 2019). Birds resting at the sea surface and surface-plunging birds are considered particularly vulnerable to surface hydrocarbons. Impacts may include damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (Clark 1984; WA DoT 2018a). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019). A marine avifauna foraging BIA associated with Ashmore Reef and Cartier Island is located approximately 10 km north of the permit area at its closest point. Based on the predicted limited extent of the surface hydrocarbons (approximately 13 km where concentrations are > 10 g/m^2), the rapid evaporation of volatile components and expected weathering resulting in reduced levels of toxicity, any impacts to transient EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species (Minor E). Plankton may potentially be exposed to hydrocarbons on the sea surface. However, the majority of impacts would be toxicity related, associated with entrained/dissolved hydrocarbons exposure, therefore, the impact evaluation for plankton is provided in the subsection below.	
Potential consequence – entrained/dissolved hydrocarbons	Severity
The values and sensitivities with the potential to be affected by entrained and dissolved hydrocarbon exposure from a subsea discharge include: • commercial, traditional and recreational fisheries including aquaculture • KEFs and associated biodiversity (fish communities, BIAs - sawfish & whale shark foraging) • benthic primary producer habitats / benthic habitats (corals, seagrasses and mangroves) • planktonic communities	Significant (C)

• transient, EPBC-listed species (BIAs - marine mammals, turtles and avifauna). The values and sensitivities associated with commercial, recreational and traditional fishing (seafood quality and employment) could be impacted due to entrained/dissolved hydrocarbons. Implementing an exclusion zone may impede access to fishing areas for a short-to-medium term (ITOPF 2011). The fishing grounds associated with commercial fisheries listed in Section 3, may potentially be exposed to entrained/dissolved hydrocarbons above impact thresholds (500 ppb). Recreational fishing and traditional fishing and aquaculture activities may also be impacted through such exposure. The level of effort in fisheries overlapping the permit area is reported to be low; however, for other fishing/aquaculture activities in the EMBA it is unknown. On this basis, to be conservative, it is assumed that socioeconomic impacts on commercial, recreational and traditional fisheries and aquaculture could result in a significant impact to regional communities leading to significant economic losses. Therefore, the consequence is considered to be Significant (C). The impact to fish communities from exposure to entrained and dissolved hydrocarbons above threshold values, is primarily associated with toxicity. This is linked to seafood quality as described above for commercial, recreational and traditional fishing. The continental slope demersal fish community KEF overlaps with WA-343-P and therefore this KEF may be exposed to the highest concentrations of entrained and dissolved hydrocarbons. In the event of a loss of well containment entrained/dissolved hydrocarbons will be present at all depths of the water column, therefore all fish and sharks within the EMBA (described in Section 3), including pelagic fish, demersal fish communities (such as the continental slope demersal fish community KEF), fish associated with other KEFs, and site attached fish on coral reefs, such as Heywood Shoal, Echuca Shoal and Browse Island, have the potential to be exposed to entrained/dissolved hydrocarbons above the 100 ppb threshold. Chronic impacts to juvenile fish, larvae, and planktonic organisms may occur if exposed to entrained/dissolved hydrocarbon plumes potentially resulting in lethal or sub-lethal effects or impairment of cellular functions (WA DoT 2018a).	

Juvenile fish and larvae may experience increased toxicity upon such exposure to plumes, because of the sensitivity of these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018a). Adult fish exposed to entrained hydrocarbons are likely to metabolise the hydrocarbons and excrete the derivatives, with studies showing that fish have the ability to metabolise petroleum hydrocarbons. These accumulated hydrocarbons are then released from tissues when fish are returned to hydrocarbon free seawater (Reiersen & Fugelli 1987). Given the highly mobile nature of pelagic fish, they are not expected to remain within entrained hydrocarbon plumes for extended periods, and limited acute impacts or risks associated with entrained hydrocarbons are expected. However, within the EMBA there are several sawfish BIAs and a whale shark foraging BIA. Potential effects to whale sharks include damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). As whale sharks are filter-feeders they are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al. 2011). Site attached fish, such as reef fish within the EMBA (refer to Section 3.8.2) may be exposed above the hydrocarbon exposure threshold for a more extended duration. Therefore, medium to large scale, medium term impacts could occur to fish and sharks. As such, the consequence of entrained/dissolved hydrocarbons on fish and shark populations is considered to be Significant (C). Benthic communities in the EMBA including coral reefs, would be exposed to entrained/dissolved hydrocarbons above the impact threshold. Shallow-water communities are generally at greater risk of exposure than deep-water communities (NRC 1985; WA DoT 2018). Exposure of entrained and dissolved hydrocarbons to shallow subtidal corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate-to-high exposure thresholds (Loya & Rinkevich 1980; Shigenaka 2001; WA DoT 2018a), including increased mucus production, decreased growth rates, changes in feeding behaviours and expulsion of zooxanthellae (Peters et al. 1981; Knap et al. 1985). Adult coral colonies, injured by oil, may also be more susceptible to colonisation and overgrowth by algae or to epidemic diseases (Jackson et al. 1989). Lethal and sublethal effects of entrained and dissolved oils have been reported for coral gametes at much lesser concentrations than predicted for adult colonies (Heyward et al. 1994; Harrison 1999; Epstein, Bak & Rinkevich 2000). Goodbody-Gringley et al. (2013) found that exposure of coral larvae to oil and dispersants negatively impacted coral settlement and survival, thereby affecting reef resilience. A loss of well containment that occurred outside of a coral-spawning period may not affect coral planktonic stages, however, a range of locations may be exposed to entrained and dissolved oil concentrations greater than the threshold concentrations. Therefore, due to the potentially large physical extent and high concentrations received, potential impacts to coral reefs are considered to be Significant (C).	

Entrained and dissolved hydrocarbons have the potential to affect seagrasses and macroalgae through toxicity impacts. The hydrophobic nature of hydrocarbon molecules allows them to concentrate in membranes of aquatic plants. Hence the thylakoid membrane (an integral component of the photosynthetic apparatus) is susceptible to oil accumulation, potentially resulting in reduced photosynthetic activity (Runcie & Riddle 2006). However, a layer of mucilage present on most species of seagrass prevents the penetration of toxic aromatic fractions (Burns et al. 1993). Although seagrass and macroalgae may be subject to lethal or sublethal toxic effects, including mortality, reduced growth rates, and impacts to seagrass flowering, several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). For algae, this could be attributed to new growth being produced from near the base of the plant while the distal parts (which would be exposed to the oil contamination) are lost. For seagrasses this may be because 50–80% of their biomass is in their rhizomes, which are buried in sediments, thus less likely to be adversely impacted by hydrocarbons (Zieman et al. 1984). It has been reported by Taylor and Rasheed (2011) that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow. The majority of seagrass locations within the EMBA are distant from WA-343-P with the exception of Ashmore Reef (approximately 80 km north); therefore, the associated received concentrations will be lower; however, still above the threshold that could cause impacts. Based on the above impact assessment and expected recovery, the consequence is considered to be Moderate (D). Mangrove communities within the EMBA, present along WA, NT and international coastlines are also susceptible to entrained oil exposure, with potential impacts, including defoliation and mortality. A study by Duke (2000), on the use of dispersant on surface spills, resulting in an increase in the entrainment of oil showed a positive benefit to mangroves. Therefore, the impacts of entrained/dissolved oil on mangroves is expected to be less than the impacts predicted from surface oiling (Burns et al. 1993; Duke et al. 2000). Mangrove communities are distant from WA-343-P therefore, the associated received concentrations will be lower; however, still above the threshold that could cause impacts. Based on the above impact assessment, the consequence is considered to be Moderate (D).	

As a consequence of their presence close to the water surface, plankton may be exposed to entrained/dissolved hydrocarbon plumes, especially in high-energy seas where the vertical mixing of oil through the water column would be enhanced. The effects of oil on plankton have been well studied in controlled laboratory and field situations. The different life stages of a species often show widely different tolerances and reactions to oil pollution. Usually, eggs, larval and juvenile stages will be more susceptible than adults (Harrison 1999). Post-spill studies on plankton populations are few, but those that have been conducted typically show either no effects, or temporary minor effects (Kunhold 1978). The lack of observed effects may be accounted for by the fact that many marine species produce very large numbers of eggs, and therefore larvae, to overcome natural losses (such as through predation by other animals; adverse hydrographical and climatic conditions; or failure to find a suitable habitat and adequate food). A possible exception to this would be if a shallow entrained/dissolved hydrocarbon plume were to intercept a mass, synchronous spawning event. Recently spawned gametes and larvae would be particularly vulnerable to oil spill effects, since they are generally positively buoyant and would be exposed to surface spills. Hook & Osborn (2012) reported that typically, phytoplankton are not sensitive to the impacts of oil. Although phytoplankton are not sensitive to oil, they do accumulate it rapidly because of their small size and high surface area to volume ratio and can pass oil onto the animals that consume them (Wolfe et al. 1998a & b). This is also applicable to zooplankton, that are reported to accumulate oil via the ingestion of phytoplankton. However, consumption of zooplankton by fish does not appear to be an efficient means of trophic transfer, perhaps because of the metabolism of oil constituents (Wolfe et al. 2001). Under most circumstances, impacts on plankton from surface spills is expected to be localised, with short-term impacts; however, if a shallow entrained/dissolved plume reached a coral-spawning location, such as Browse Island or Scott Reef, during a spawning event, localised short-to-medium term impacts could occur. Therefore, the consequence is considered to be Moderate (D). Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained and dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (AMSA 1998; WA DoT 2018a). Several BIAs overlap the EMBA. There are no BIAs within WA-343-P. However, the EMBA overlaps a large number of BIAs for a number of different marine fauna species (Section 3). Several wetlands of conservational significance and Ramsar sites are also present within the EMBA (refer to Section 3.6), these sites provide important habitat for marine avifauna. In summary, the potential extent of entrained/dissolved hydrocarbon with a concentration >100 ppb may result in widespread exposure to the identified values and sensitivities. There would likely also be cumulative impacts as a result of interactions between surface, entrained/dissolved and shoreline hydrocarbon impacts on the food web and through bioaccumulation up the food chain. On this basis, the potential consequence associated with entrained/dissolved plumes from a loss of well containment is considered to be Significant (C).	
Potential consequence – shoreline hydrocarbons	Severity

As previously summarised, shorelines within the EMBA were predicted to receive shoreline accumulations of hydrocarbons. Those with concentrations in excess of the 100 g/m^2 threshold, from a loss of well containment event, are listed as follows: • Browse Island (643 g/m^2; 9%) * • Scott Reef South (364 g/m^2; 5%) * • Ashmore Reef (2,083 g/m^2; 3%) * • Cartier Island (716 g/m^2; 5%) * • Tiwi Islands (1,232 g/m^2; <1%) * • shorelines within the Lalang-garram/Camden Sound MP (1,384 g/m^2; <1%) * • shorelines on islands at Imperieuse Reef (Rowley Shoals) (1,111 g/m^2;<1%) * • shorelines along the Timor Leste coastline (193 g/m^2; <1%) * • shorelines along the East Indonesian coastline (193 g/m^2; 1%) *. * maximum concentration received and probability of contact across all seasons for the worst-case single replicate from 300 replicate simulations). The worst-case volumes predicted ashore are as follows: • Lalang-Garram/Camden Sound MP (34 m^3 in summer) • Ashmore Reef (26 m^3 in winter) • Imperius Reef (13 m^3 in summer) • Browse Island (12 m^3 in summer) • Cartier Island (9 m^3 in summer) • Scott Reef South (4 m^3 in summer) Modelling results indicated that at all other shoreline locations, shoreline oil accumulation would be <1 m^3.	Moderate (D)

The minimum reported time to contact for all seasons was 96 hours at Ashmore Reef (emergent islands), 98 hours at Cartier Island and 184 hours at Browse Island. All other shoreline contact times were >200 hours. Given this time to reach shorelines, the spill is expected to have undergone several physical and biological weathering processes, such as photo-oxidation and biodegradation (Stout et al. 2016). Impacts to ecological receptors from exposure to weathered oil (waxy flakes and residues) are far less than those associated with exposure to fresh oils, which have higher levels of toxicity (Milton et al. 2003; Hoff & Michel 2014; Woodside 2014; Stout et al. 2016). Therefore, impacts from weathered oil are generally limited to smothering and coating associated with the waxy flakes and residues which generally have low levels of adhesion. Intertidal habitats and marine fauna known to use shorelines are most at risk from shoreline accumulations, due to smothering of intertidal habitats (such as emergent coral reefs) and coating of marine fauna (WA DoT 2018a). Consequently, the particular values and sensitivities with the potential to be exposed to shoreline accumulated hydrocarbons are:

- benthic primary producer habitats/shoreline habitats (intertidal only)
- transient, EPBC-listed species (BIAs - turtles and avifauna).

Benthic primary producer habitats exposed at spring low tides are the most vulnerable to smothering. However, as spills disperse, intertidal communities are expected to recover (Dean et al. 1998). Direct contact of hydrocarbons to emergent corals can cause smothering, resulting in a decline in metabolic rate and may cause varying degrees of tissue decomposition and death. A range of impacts may also result from toxicity, including partial mortality of colonies, reduced growth rates, bleaching, and reduced photosynthesis (Negri & Heyward 2000; Shigenaka 2001). The rate of recovery of coral reefs depends on the level or intensity of the disturbance, with recovery rates ranging from 1 or 2 years, to decades (Fucik et al. 1984, French-McCay 2009). Several wetlands of conservational significance are located within the EMBA. These coastal sites generally include intertidal mudflats and mangroves that provide important foraging, resting and breeding habitats for migratory and shoreline bird species. As described for entrained and dissolved hydrocarbon exposure, mangrove communities within EMBA could potentially be exposed to shoreline oil accumulation above impact threshold concentrations, with potential impacts including defoliation and mortality (Burns et al. 1993; Duke et al. 2000). The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the long-term persistence of oil trapped in anoxic sediments and subsequent release into the water column (Burns et al. 1993). Although given the shortest time to contact locations in the EMBA with mangrove communities are >315 hours (> 13 days), the shoreline accumulations are expected to be highly weathered and comprise of waxy flakes/residues. Lighter oils are reported to penetrate more deeply into mangrove forests than heavier and more weathered oils (Hoff & Michel 2014); therefore, it is considered that the hydrocarbons will be weathered and generally be less toxic in nature (Stout et al. 2016). Given the range of predicted time to contact and expected weathering of any hydrocarbons accumulating on shorelines, any impacts to benthic habitats are expected to be localised and of short to medium term with a Moderate consequence (D).

Marine reptiles, including turtles and crocodiles that utilise shoreline habitats can be exposed to hydrocarbons externally, through direct contact; or internally, by ingesting oil, consuming prey containing oil, or inhaling volatile compounds (Milton et al. 2003). Shoreline hydrocarbons can impact turtles at nesting beaches when they come ashore, with exposure to skin and cavities, such as eyes, nostrils, and mouths. Eggs may also be exposed during incubation, potentially resulting in increased egg mortality and detrimental effects on hatchlings. Hatchlings may be particularly vulnerable to toxicity and smothering, as they emerge from the nests and make their way over the intertidal area to the water (Milton et al. 2003). There are a number of foraging, nesting and internesting BIAs for turtles within the EMBA that have the potential to be exposed to shoreline accumulations above the impact threshold concentration (100 g/m^2). Potential impacts may occur on nesting populations, which may affect species recruitment at a local population level particularly in relation to the green turtles at Browse Island with a small, localised range of habitat (DEE 2017). Given the shortest predicted time for shoreline contact to occur (96 hours for Ashmore Reef) and worst-case predicted concentration (2,083 g/m^2), there is the potential for local-to-medium-scale impacts with medium-term effects on nesting populations of turtles at individual nesting beaches/locations. At locations with longer times for shoreline contact, there is a high potential for hydrocarbons to become weathered. Weathered oil has been shown to have little impact on turtle egg survival, while fresh oil may have a significant impact (Milton et al. 2003). Therefore, given the time to reach shoreline contact and potential for weathering, the potential consequence is considered to be Moderate (D). Birds coated in hydrocarbons can suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (Jenssen 1994; Matcott et al. 2019). Toxic effects may also result where the product is ingested, either through birds' attempts to preen their feathers (Jenssen 1994; Matcott et al. 2019) or ingested as weathered waxy flakes/residues present on shorelines. However, waxy residues are generally considered to be of lower toxicity (Stout et al. 2016; Woodside 2014). Shorebirds foraging and feeding in intertidal zones are at potential risk of exposure to shoreline hydrocarbons, potentially causing acute effects to numerous marine avifauna BIAs, and species present at Ramsar/wetland sites as described above. It is also possible that birds exposed to surface hydrocarbons may be displaced (i.e. fly away) and use nearby shorelines to recover, thereby, potentially increasing their exposure to shoreline hydrocarbons. In the event of a shoreline contact following a loss of well containment, there is the potential for short–to-medium-term impacts on the environment while local populations recover; however, it is not expected that the overall population viability for any protected species would be threatened. Therefore, the potential consequence associated with shoreline hydrocarbon exposure is considered to be Moderate (D). In summary, the potential extent of shoreline accumulation (> 100 g/m^2) may result in exposure to the identified values and sensitivities. There would likely also be cumulative impacts as a result of interactions between surface, entrained/dissolved and shoreline hydrocarbon impacts on the food web and through bioaccumulation up the food chain. On this basis, the potential consequence associated with shoreline accumulation from the identified spill events is considered to be Moderate (D).	

Identify the likelihood					
Likelihood	Given the design and mitigation controls that have been identified to minimise the potential for a loss of well containment, the likelihood of the consequence occurring is considered Highly Unlikely (5) in that it has happened in industry once or twice.				
Residual risk	Based on the worst-case consequence for all hydrocarbon exposure mechanisms (surface/entrained/dissolved/shoreline) Significant (C) and a likelihood of Highly Unlikely (5) the residual risk is ranked as Moderate (7).				
Residual risk summary					
Consequence		Likelihood		Residual risk	
Significant (C)		Highly Unlikely (5)		Moderate (7)	

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
No incidents of loss of hydrocarbons to the marine environment as a result of a loss of well containment	INPEX and MODU contractor will conduct drilling activities in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 and OPGGS (Safety) Regulations 2009 requirements, including: • a NOPSEMA accepted WOMP • a NOPSEMA accepted MODU safety case.	• WOMP approval letter received from NOPSEMA. • NOPSEMA acceptance of MODU safety case.	INPEX Drilling Superintendent

	INPEX will verify that the MODU contractor complies with the requirements of the approved Well Control Bridging Document which aligns requirements (and clarifies if conflicts exist, which standard takes precedence) between the INPEX Well Operations Standard (0000-AD-STD-60004) and Well Operations Manual (0000-AD-MAN-60002) which covers all aspects of primary and secondary well control for floating drilling operations, including: Well design/planning • Assessment of formation pressure and fracture gradient along the length of the well. • Shallow gas analysis and assessment has shown no potential for any shallow hazards. • Planned mud weight overbalance to stop ingress potential (i.e. inflow of formation fluids) into the well. • Kick tolerance – adequate design window to tolerate a kick of a certain volume and safe circulation out of the well. • Assessment of well control equipment requirements to ensure they are suitable and specific for well design, including subsea BOP stacks, well choke and kill systems.	Well design/planning • Proposed well design, and comparison with drilling contractor's equipment to ensure minimum requirements are met and align with the INPEX Well Operations Manual (0000-AD-MAN-60002). BOP system • BOP pressure and function testing prior to installation and at regular intervals for the duration of drilling campaign while installed. The INPEX drilling supervisor or drilling engineer must approve BOP pressure tests and report appropriately. • Inspection and maintenance records show BOP meets INPEX requirements (e.g. shear ram capability, industry standard etc.) and maintained in accordance with MODU preventive maintenance system. Mud logging • Documentation that mud logging unit provides kick detection. • Documentation demonstrates all issues identified, addressed or closed out. Summary of compliance with INPEX Well Integrity Standard (0000-AD-STD-60003) summarised in pre-start environmental audit and annual environmental audit report. Well abandonment	OIM INPEX Drilling Superintendent

	• Well-bore monitoring equipment – two independent systems for monitoring flow and volume from the well-bore shall be provided (by the drilling contractor and the mud logging contractor). BOP system • BOP installed in sections where there is potential for flow from the well. • BOP function and pressure tested prior to use and meets the requirements of the industry standard American Petroleum Institute (API) STD 53 Blowout Prevention Equipment Systems for Drilling Wells (4th edition, November 2012). The INPEX drilling supervisor or drilling engineer must approve BOP pressure tests in accordance with predetermined acceptance criteria. • The drilling contractor shall have a maintenance/inspection program for BOP control equipment which will align with the drilling contractor's well control standard. The BOP will undergo weekly/fortnightly function and pressure testing. • BOP shall have a shear ram capable of shearing the drill pipe in use and sealing the well-bore. • Compliance with INPEX Well Integrity Standard (0000-AD-STD-60003) which requires two tested barriers to allow removal of the BOP. Mud logging	• Compliance with INPEX Well Integrity Standard (0000-AD-STD-60003) and WOMP reported. • Non-conformances reported in monthly environmental performance summary.	

	The mud logging unit shall provide kick detection through the following: • continually manned (24 hrs) during all live, open hole well operation, with appropriate checks and calibration checks on key components • continuous recording of drilling operations, including mud flow out and pressure evaluation, with alarms in place to detect any significant changes. Well abandonment • INPEX will verify compliance with the WOMP which outlines the means by which the well will be plugged and abandoned using a combination of verified barriers.		
Contain the well within 130 days of occurrence of loss of well containment.	Source control activities will be undertaken in accordance with Section 8.7 of this EP.	Records confirm source control activities were implemented, as detailed in Section 8.7 of this EP.	INPEX Drilling Supervisor
	MODU and vessel personnel will demonstrate competence in accordance with the INPEX Competency Assurance and Management Standard (0000-AN-STD-60011).	Training records.	INPEX Drilling Supervisor
	INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and Drilling contractor ERP will be implemented in the event of a loss of well containment.	Records demonstrate Incident and Crisis Management Plans and were implemented following a loss of well containment.	INPEX Drilling Supervisor

	Oil spill and source control response preparedness will be maintained through implementing Sections 7.4 and 7.5. INPEX and Contractor personnel will be trained in the above plans.	Records confirm oil spill and source control response preparedness, is maintained. Records demonstrate personnel are trained in the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and Drilling contractor ERP.	INPEX Environmental Adviser
	In the event of a loss of well containment, resulting in a spill reaching WA/NT state waters/shorelines, INPEX will provide support to WA DoT/NT DIPL in their performance as control agency, including provision of INPEX resources to support the WA/NT IMTs, under the relevant 'cross jurisdictional arrangements', described in the OPEP.	In the event of a loss of well containment, resulting in a spill reaching WA/NT state waters, records confirm INPEX provided support, as requested by WA/NT government.	IMT leader

7.1.2 Impact and risk evaluation

Table 7-4: Impact and evaluation – Vessel collision resulting in a Group II (marine diesel) spill

Identify hazards and threats	
A surface release of Group II hydrocarbons has the potential to result in changes to water quality through surface and shoreline hydrocarbon exposure. The thresholds for impacts associated with surface, entrained/dissolved, and shoreline, hydrocarbon exposures are described in Table 7-2.	
Potential consequence – surface hydrocarbons	**Severity**

The values and sensitivities with the potential to be affected by surface hydrocarbon exposure from a surface release due to a vessel collision include: • commercial, recreational and traditional fisheries including aquaculture (within 110 km from the release location based on 1 g/m^2 visible sheen threshold) • transient, EPBC-listed species (within 25 km from the release location based on 10 g/m^2 impact threshold) • planktonic communities (within 25 km from the release location based on 10 g/m^2 impact threshold). As described in Table 7-3, commercial, recreational and traditional fisheries including aquaculture may be impacted by the presence of exclusion zones and the oiling of nets and lines. The potential extent of the visible sheen associated with the vessel collision scenario is significantly less than for a loss of well containment. There are low levels of recreational and traditional fishing activities in WA-343-P, and no aquaculture (refer Section 3.9.3 and 3.9.4). Based on the low level of reported commercial fishing in the permit area, any socioeconomic impacts are expected to be localised to within 110 km of the release location and temporary in nature given the expected evaporation of Group II hydrocarbons at the sea surface. Therefore, the consequence is considered to be Insignificant (F) There are two marine fauna foraging BIAs located in areas predicted to be exposed to surface expressions above the 10 g/m^2 exposure threshold (within 25 km of the release location), they are associated with whale shark foraging (15 km) and marine avifauna foraging (10 km). A range of other marine fauna may also be present within this area albeit on a transient basis. Impacts to transient, EPBC-listed species are described in Table 7-3. Based on the predicted limited extent of the surface hydrocarbons (approximately 25 km where concentrations are > 10 g/m^2), the rapid evaporation of volatile components and expected weathering resulting in reduced levels of toxicity, any impacts to transient EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species (Minor E). Plankton may potentially be exposed to hydrocarbons on the sea surface. However, the majority of impacts would be toxicity related, associated with entrained/dissolved hydrocarbons exposure. Modelling results predicted that the maximum worst-case entrained hydrocarbon exposure was at Barracouta Shoals (448 ppb), approximately 109 km from WA-343-P. No locations within the EMBA exceeded the impact threshold concentration for entrained hydrocarbons (500 ppb). from a vessel collision. Similarly, exposure to dissolved hydrocarbons above threshold values was not predicted at any location for all seasons (worst-case predicted at Barracouta Shoal (5 ppb)). On this basis no further assessment has been included for entrained/dissolved hydrocarbons from a diesel release at the sea surface.	Minor (E)
Potential consequence – entrained/dissolved hydrocarbons	**Severity**

The maximum entrained oil concentration was predicted as 448 pbb at Barracouta Shoals, in the worst replicate (December to February) which is located approximately 109 km from WA-343-P. Other locations in relatively close proximity to the permit area potentially exposed to entrained hydrocarbons include Heywood Shoals, Browse Island, Vulcan Shoals, Ashmore Reef, Cartier Island, Echuca Shoals and Seringapatam reef. All of these locations were exposed to entrained hydrocarbons below the 500 ppb impact threshold. However, at the site of the vessel collision spill scenario, it is likely that receptors in the permit area may be exposed to entrained and/or dissolved hydrocarbons above threshold values. Therefore, the values and sensitivities with the potential to be affected by entrained/dissolved hydrocarbons from a surface diesel release include: • commercial, traditional and recreational fisheries • KEFs and associated biodiversity (fish communities, BIAs whale shark foraging) • planktonic communities. Fishing grounds that overlap the permit area may potentially be exposed to entrained/dissolved hydrocarbons above impact thresholds (500 ppb). The level of effort in fisheries overlapping the permit area is reported to be low, however for other fishing activities it is unknown. A surface release of diesel is expected to entrain predominantly within the upper water column (top 10 metres) (APASA 2012); therefore, exposure is considered to be relatively limited within the water column. It is considered that socioeconomic impacts on commercial, recreational and traditional fisheries would be limited to isolated disruption with limited adverse impact (Minor E). The impact to fish communities from exposure to entrained and dissolved hydrocarbons above threshold values, is primarily associated with toxicity. This is linked to seafood quality as described above for commercial, recreational and traditional fishing. The continental slope demersal fish community KEF overlaps with WA-343-P and therefore this KEF may be exposed to concentrations of entrained and dissolved hydrocarbons above threshold values. However, as the entrained/dissolved hydrocarbons from a surface release are limited to the upper water column, demersal fish species are unlikely to be exposed. Pelagic fish species and whale sharks foraging near the sea surface are more likely to be exposed. Given the highly mobile nature of pelagic fish, they are not expected to remain within entrained hydrocarbon plumes for extended periods, and limited acute impacts or risks associated with entrained hydrocarbons are expected.	Minor (E)

Potential effects to whale sharks include damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). As whale sharks are filter-feeders they are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al. 2011). The whale shark foraging BIA does not overlap the permit area; however, it is located approximately 15 km east of WA-343-P but with low reporting abundance. Based on the worst-case spill volume (< 250 m^3) and the expected evaporation of the diesel at the sea surface, only short-term impacts are predicted to could occur to fish and sharks. As such, the consequence of entrained/dissolved hydrocarbons on fish and shark populations is considered to be Minor (E). As a consequence of their presence close to the water surface, planktonic communities may be exposed to entrained/dissolved hydrocarbon plumes, especially in high-energy seas where the vertical mixing of oil through the water column would be enhanced. The effects of oil on plankton have been well studied in controlled laboratory and field situations. The different life stages of a species often show widely different tolerances and reactions to oil pollution. Usually, eggs, larval and juvenile stages will be more susceptible than adults (Harrison 1999). Post-spill studies on plankton populations are few, but those that have been conducted typically show either no effects, or temporary minor effects (Kunhold 1978). The lack of observed effects may be accounted for by the fact that many marine species produce very large numbers of eggs, and therefore larvae, to overcome natural losses (such as through predation by other animals; adverse hydrographical and climatic conditions; or failure to find a suitable habitat and adequate food). Impacts on plankton from a surface diesel spill is expected to be localised, with short-term impacts (Minor E).	
Potential consequence – shoreline hydrocarbons	**Severity**
Shorelines within the EMBA were predicted to receive shoreline accumulations of hydrocarbons. Those with concentrations in excess of the 100 g/m^2 threshold, from a vessel collision event are listed as follows: • Cartier Island (1,135 g/m^2; 2%) * • Ashmore Reef (829 g/m^2; 1%) * • Scott Reef (285 g/m^2; ^) * * maximum concentration received and probability of contact across all seasons for the worst-case single replicate from 300 replicate simulations). ^ indicates no direct contact from a single replicate at > 1 g/m^2; therefore, levels of shoreline accumulation are predicted based on hydrocarbons <1 g/m^2 contacting the location over the duration of the modelled simulation.	Minor (E)

The minimum reported time to contact for all seasons was 66 hours at Cartier Island and 138 hours at Ashmore Reef. Given this time to reach shorelines, the spill is expected to have undergone several physical and biological weathering processes, such as photo-oxidation and biodegradation. Impacts to ecological receptors from exposure to weathered oil (waxy flakes and residues) are considered to be less than fresh oil, as described in Table 7-3. Intertidal habitats and marine fauna known to use shorelines are most at risk from shoreline accumulations, due to smothering of intertidal habitats (such as emergent coral reefs) and coating of marine fauna. Consequently, the particular values and sensitivities with the potential to be exposed to shoreline accumulated hydrocarbons are:

- benthic primary producer habitats/shoreline habitats (intertidal only)
- transient, EPBC-listed species (BIAs - turtles and avifauna).

Given the limited range of predicted locations, time to contact and expected weathering of any hydrocarbons accumulating on shorelines, any impacts to benthic habitats (refer to descriptions in Table 7-3), from a vessel collision event are expected to be localised and of short term with a Minor consequence (E).

Impacts to transient EPBC listed species, specifically marine turtles and avifauna (refer to Table 7-3) may include exposure to weathered diesel in excess of impact thresholds (100 g/m^2) at limited locations - offshore islands in relatively close proximity to WA-343-P (Cartier Island, 95 km; Ashmore Reef, 130 km; Scott Reef, 150 km). No contact was predicted for any other locations within the EMBA. This may result in a minor and temporary impact on a small portion of the population of a protected species and the consequence assessed as Minor (E).

Identify existing design safeguards/controls

Marine vessels >400 tonne (t) will carry SOPEPs approved under MARPOL 73/78 Annex 1, Regulation 37.

Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the *Navigation Act 2012*.

PSZ maintained around the MODU in accordance with the OPGGS Act.

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate vessels.	No	Vessels are the only form of transport that can undertake the pre-drill survey and maintain ongoing logistical support to the MODU.

Substitution	None identified.	N/A	N/A
Engineering	Vessels used will have dynamic positioning equipment.	Yes	The use of DP vessels will reduce the potential for vessel collisions. Supply vessels will also be equipped with a backup DP system as a failsafe.
Procedures and administration	AHO and AMSA will be informed of the exact well location in WA-343-P location prior to the activity commencing.	Yes	By informing AHO of the exact well location, navigation charts can be updated to inform third parties of the location of the infrastructure, reducing the risk of accidental third-party interactions with areas of increased vessel activity. Once the exact well location is known, AMSA can provide more specific information regarding vessel traffic density in relation to the well location within WA-343-P.
	Incident management, and emergency response plans in place.	Yes	To ensure the INPEX IMT are prepared and informed, an INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and Drilling contractor Emergency Response Plan (ERP) will be in place and implemented, and personnel trained in their relevant plans.
	Emergency response preparedness will be maintained.	Yes	To ensure that INPEX is prepared to respond to a marine diesel spill originating from a vessel collision event, oil spill and source control response preparedness will be maintained in accordance with Section 8.6 and 9.10 of this EP.
	INPEX will provide all available support to AMSA in AMSA's performance of its combat (control) agency responsibilities for vessel-based spill events.	Yes	INPEX has signed a MOU with AMSA for oil spill preparedness and response (AMSA/INPEX 2013). This MoU acknowledged AMSA's responsibility under the NatPlan as the control agency for vessel-based spill scenarios, and INPEX has acknowledged that it will support AMSA to implement the NatPlan.

	INPEX will provide all available support to WA DoT and NT DIPL in their performance as control agency for a spill which reaches WA waters or NT shorelines, resulting from a vessel collision.	Yes	WA DoT is the control agency for all spills entering WA waters, regardless of the source of the spill. WA DoT has issued the State Hazard Plan – Marine Environmental Emergencies (WA DoT 2018b) which specifies the WA DoT expectations (detailed in Section 2.2.1 of the OPEP). In summary, the WA DoT will require INPEX to work in partnership to ensure an adequate response is provided across the entire incident as reflected in the INPEX IMT organisation chart (Figure 9-5). This may include: • WA DoT nominating officers to facilitate aligned communications, shared situational awareness and coordinated response actions with the INPEX IMT. • WA DoT establishing an Incident Control Centre in Fremantle and INPEX providing a number of Emergency management support personnel to work within the WA DoT IMT (The INPEX IMT would still function and lead the response in Commonwealth waters and liaise with WA DoT IMT). Similarly, the NT Department of Infrastructure, Planning and Logistics (NT DIPL) is the control agency for all spills arriving on NT shorelines and would also be consuted when INPEX is control agency for spills on NT waters. Regardless of the source or impact of the spill, INPEX would provide the same level of support to the NT government.
	Stakeholder engagement plan.	Yes	As required by the OPGGS (E) Regulations 2009, INPEX has implemented a stakeholder engagement plan to inform stakeholders of the description of the activities, schedule, regulatory requirements, and details for directing enquiries and feedback (refer Section 5.2). Through implementation of the engagement plan other marine users are kept informed of potential interactions with vessels and the location of the gazetted PSZ.

	AHO will be notified of the exact well location, activity commencement and cessation.	Yes	By informing AHO start date of the activity, information will be included in the promulgation of fortnightly Notice to Mariners. Notice to Mariners provide commercial shipping operators with information regarding activities or hazards in the region and will include details of the relevant vessels.
	Notification to AMSA's Joint Rescue Coordination Centre (JRCC)	Yes	The AMSA JRCC will be advised of the activity details for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the activity.

Identify the likelihood	
Likelihood	Reported industry statistics indicate vessel failures are considered rare with 37 collisions reported out of a total of 1200 marine incidents in Australian waters between 2005 and 2012 (most recent data) (ATSB 2013). AMSA provided feedback during the initial stakeholder engagement as part of this EP (Section 5). They stated that the permit area may have high vessel traffic density. However, in relation to the nearby operational offshore facilities (Ichthys and Prelude), WA-343-P is not considered to have high vessel traffic density, further reducing the likelihood of a vessel collision. A ship collision risk assessment was undertaken to support the nearby INPEX Ichthys Project. The study determined collision frequencies and impact energies for passing (third-party) vessels, infield vessels and offloading tankers. The annual frequency of a collision with a passing vessel – i.e. one not within the control of INPEX – imparting at least 150 MJ (sufficient impact energy) is 3.5×10^{-7}, or once every 2.9 million years. The results of this study and similar level of vessel density in WA-343-P is considered comparable for this EP. On this basis and given the controls that have been identified to minimise the potential for vessel collision and subsequent loss of containment, the likelihood of the consequence occurring is considered Highly Unlikely (5).
Residual risk	Based on the worst-case consequence for all applicable hydrocarbon exposure mechanisms (surface/shoreline) Minor (E) and a likelihood of Highly Unlikely (5) the residual risk is ranked as Low (9).

Residual risk summary		
Consequence	Likelihood	Residual risk

Minor (E)	Highly Unlikely (5)	Low (9)

Environmental performance outcomes	**Environmental performance standards**	**Measurement criteria**	**Responsibility**
No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision.	Vessels will be fitted with lights, signals, AIS transponders and navigation and communications equipment, as required by the *Navigation Act 2012.*	Records confirm that required navigation equipment is fitted to MODU/vessels to ensure compliance with the *Navigation Act 2012.*	INPEX Environmental Adviser
	Vessels used will have dynamic positioning equipment. Vessels will also be equipped with a backup DP system as a failsafe.	Records confirm that vessel have DP equipment and fail-safe system in place.	INPEX Environmental Adviser
	A 500 m PSZ, issued by NOPSEMA, will be maintained around the MODU.	Gazette notice of PSZ. Records of reporting of unauthorised entry into the PSZ.	OIM
	AHO and AMSA will be informed of the exact well location in WA-343-P location prior to the activity commencing.	Records of document transmittal to AHO and AMSA.	INPEX Environmental Adviser
	In accordance with the stakeholder engagement plan, other marine users will be notified of MODU/vessel presence through ongoing stakeholder consultation on an as required basis during the activity.	Stakeholder engagement records.	INPEX Drilling Supervisor
	AHO will be notified no less than four working weeks before operations commence for the promulgation of related notices to mariners (via datacentre@hydro.gov.au).	Records of document transmittal to AHO.	INPEX Environmental Adviser

	Notification will be provided to AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings 24-48 hours before operations commence, including following information (via rccaus@amsa.gov.au, ph: 1800 641 792 or +61 2 6230 6811): • Vessel details, including name, call sign and Maritime Mobile Service Identity (MMSI) • Satellite communications details, including INMARSAT-C and satellite telephone • Area of operation • Requested clearance from other vessels • Notification of operations start and end.	Records of document transmittal to AMSA JRCC.	INPEX Environmental Adviser
	Premobilisation HSE inspection confirm that MODU and vessels >400 GT have SOPEPs compliant with Marine Orders – Part 91, the POTS Act, and Annex I of MARPOL 73/78 (oil) on board.	Premobilisation HSE inspection documentation.	INPEX Environmental Adviser
	INPEX Australia Incident Management Plan (0000-AH-PLN-60005) and INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and will be implemented in the event of a vessel collision. INPEX personnel will be trained in the above plans, as defined in Section 9.10 of this EP.	Records demonstrate Incident and Crisis Management Plans and were implemented following a vessel collision. Records demonstrate personnel are trained in the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004).	INPEX Drilling Supervisor

Risks of impacts to commercial, traditional and recreational fisheries, emergent benthic primary producer habitats (intertidal corals, mangroves, macroalgae and seagrasses), turtle BIAs, marine avifauna BIAs, transient, EPBC-listed species and planktonic communities from Group I or II hydrocarbon spills are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	Emergency response preparedness will be maintained through implementing Sections 8.6 and 9.10 of this EP.	Records confirm response preparedness, as detailed in Sections 8.6 and 9.10 of this EP, is maintained.	INPEX Environmental Adviser
	In the event of a vessel collision, resulting in a spill reaching WA/NT state waters, INPEX will provide all available support to WA DoT/NT DIPL in their performance as control agency, including provision of INPEX resources to support the WA/NT IMTs, under the relevant 'cross jurisdictional arrangements' described in the OPEP and in accordance with Figure 9-5.	In the event of a vessel collision, resulting in a spill reaching WA/NT state waters, records confirm INPEX provided support, as requested by WA/NT government.	IMT leader
	In the event of a vessel collision, INPEX will provide all available support to AMSA in its performance as combat (control) agency responsibilities in accordance with the AMSA/INPEX MoU.	In the event of a vessel collision, records confirm INPEX provided support, as requested by AMSA, in accordance with the MoU.	IMT leader

7.2 Spill Impact Mitigation Assessment

INPEX has developed a series of Strategic Spill Impact Mitigation Assessments (SIMA) for each maximum credible spill scenario relevant to INPEX Australia's exploration and production activities in the Browse Basin.

The strategic SIMAs are:

- condensate/gas well blowout – long duration subsea release
- condensate spill – instantaneous surface release
- MGO/diesel spill – instantaneous surface release
- intermediate/heavy fuel oil spill – instantaneous surface release.

The SIMA process has been developed as a pre-spill planning tool for all INPEX EPs, to facilitate response option selection and support the development of the overall response strategies by identifying and comparing the potential effectiveness and impacts of oil spill response options (IPIECA 2017a). The strategic SIMA assists in the assessment of the impact mitigation potential and in making a transparent determination of response strategies that are considered most effective at minimising oil spill impacts (IPIECA 2017a). The framework includes environmental considerations as well as a range of shared values such as ecological, socio-economic and cultural aspects (IPIECA 2017a).

7.2.1 SIMA process

The SIMA process as outlined in the "Guidelines on implementing spill impact mitigation assessment (SIMA)" (IPIECA 2017a) has four stages:

1. Compile and evaluate data relevant for relevant oil spill scenarios including fate and trajectory modelling, identification of resources at risk and determination of safe and feasible response options.
2. Predict outcomes/impacts for the "No Intervention" (or "natural attenuation") option as well as the effectiveness (i.e. relative mitigation potential) of the feasible response strategy for each scenario.
3. Balance trade-offs by weighing and comparing the range of benefits and drawbacks associated with each response strategy, compared to 'No Intervention', for the spill scenario.
4. Select the best response strategies to form the response plan for the scenario, based on which best combination of response strategies will minimise the overall spill impacts and promote rapid recovery.

INPEX have generated strategic SIMAs, one which addressed a subsea condensate release in the Browse Basin and another which addresses a Group II (marine diesel) surface release from a vessel collision in the Browse Basin/NW WA region.

Predictive oil spill modelling (E.g. outputs from various INPEX Brose Basin oil spill modelling reports) have been used to support the strategic SIMAs through defining generic oil weathering characteristics for each broad type of spill scenario.

The resource compartments presented in each SIMA reflect the values and sensitivities described in Section 3. The resource compartments have been defined as broad habitat types which support protected species, rather than focusing on individual protected species. This approach is recommended by IPIECA (2017a).

For each generic spill scenario, a relative impact score has been assigned to each resource compartment, for the 'no intervention' option. A supporting justification for each relative impact score for each resource compartment is also presented in the SIMA.

For each SIMA, eight oil spill response strategies were considered, including operational monitor and evaluation, containment and recovery, protect and deflect, shoreline clean-up, chemical dispersant, pre-contact wildlife response, post-contact oiled wildlife response (OWR) and in-situ burn.

For each response strategy, the impact mitigation potential was assessed against each resource compartment and given a score on a scale of '-3' to '+3', where a negative score reflects additional impact and a positive score reflects mitigation of impact (balance trade-offs). A supporting justification for each impact modification score for each response strategy against each resource compartment is also presented in the SIMA.

Each impact mitigation score was evaluated with no timing or resource limitations or weather constraints on the response strategy effectiveness (these factors are further considered in the oil spill response arrangements and capability evaluation, provided in the relevant EP, as related to the EP specific spill scenario).

Those response strategies with an overall positive score, and therefore represent a mitigation of impact from the spill, are then selected for further assessment in the relevant EP. Those response options with an overall negative score have been discounted and are not further evaluated in the relevant EP.

It should be noted that it is unlikely that a single response strategy will be completely effective in a large spill scenario, hence it is expected that multiple response strategies may be utilised in the event of a Level 2/3 spill.

In order to select appropriate oil spill response strategies applicable to the oil spill scenario described in this EP INPEX's strategic SIMAs for a subsea condensate spill and MGO/diesel surface spill have been reviewed and assessed in Section 7.3.

7.3 Oil spill response arrangements and capability evaluation

The response techniques that demonstrated a positive impact mitigation potential in the SIMA subsea condensate and/or surface MGO/diesel have been assessed for their applicability and suitability as response options, taking into account the expected timing and resource limitations specific to WA-343-P and this EP. The response options further evaluated in Table 7-5 are as follows:

- Operational monitoring and evaluation
- Contain and recover
- Protect and deflect
- Shoreline clean-up
- Pre-contact wildlife response (hazing and translocation)
- Post-contact wildlife response.

The following response techniques have been excluded from this EP based on the outcome of the SIMAs for each scenario:

- In-situ burn
- Chemical dispersion (surface application).

The potential use of SSDI during a loss of well containment is described in Table 7-7.

A further evaluation of the oil spill response arrangements, timing and capability for the spill response strategies identified in the SIMAs for each scenario and considered to be applicable and suitable for this EP (Table 7-5) has been undertaken and is presented in Table 7-6. Table 7-6 presents further information regarding the environmental benefits and merit in improving the implementation of oil spill response controls i.e. implementing controls in a faster timeframe and cost benefit considerations. This evaluation supports the oil spill response arrangements in place and demonstrates that the arrangements in place are effective in reducing environmental risks to ALARP.

Common equipment, training needs and logistical support from vessel, helicopters etc. are required to implement the majority of spill response techniques. As such a summary of the common controls are described in Table 7-6.

Table 7-5: Evaluation of the applicability of spill response strategies identified in the SIMA

Oil spill response technique	Likelihood of success	Considered for implementation
Operational monitoring and evaluation	The SIMA evaluation found that operational monitoring and evaluation should always be implemented in the event of a level 2/3 spill. To implement this response strategy, the following capabilities are available: • oil spill trajectory modelling • aerial and vessel surveillance • oil spill tracker buoys • satellite surveillance capability. A detailed assessment of the logistical resources required to implement this response strategy are described in Table 7-6.	Yes
Contain and recover	The SIMA evaluation found that contain and recover was not appropriate against Group I/condensate spills; however, was potentially appropriate for Group II/diesel spills. Generally, oil needs to be >100 g/m^2 (O'Brien 2002) to feasibly corral oil with a boom and achieve any significant level of oil recovery with the skimmers. The initial, gravity-dominated release and spreading is generally complete within minutes to hours after a release (O'Brien 2002). In the context of the Browse Basin, with high sea surface and air temperatures in all seasons, the spreading of any diesel spill would be very rapid. INPEX currently do not maintain any offshore containment and recovery equipment (booms and skimmers) offshore in the Browse Basin area. However, INPEX do have access (via AMOSC) to a Level 2 stockpile of equipment in Broome, including offshore boom and skimmers. The practical deployment of offshore booms and skimmers from Broome to the permit area is expected to take approximately 24 hours using a PSV or small vessel (based on 6 hours loading in port and 24-28 hours steaming time to WA-343-P).	No

	Even if boom was stored on vessels within the permit area, it would take crews several hours to physically deploy lengths of offshore boom. A minimum of two vessels would be required in the permit area at the time of the slick to create a boom configuration that would attempt to recover oil. To achieve the logistical supply requirements of the drilling activity, it is not feasible to maintain two of the three supply vessels within WA-343-P at all times. In addition, in the early stages of a diesel spill, in locations where concentrations are expected to be >100 g/m^2, vessel access to the immediate spill area is likely to be restricted due to the presence of VOCs in excess of safe exposure thresholds, and potential for a flammable atmosphere. Given the very short time following a diesel spill in which the slick would have spread to <100 g/m^2, and the associated atmospheric safety risks, it would not be considered ALARP to store booms offshore, or commence the mobilisation of booms from Broome, to attempt offshore containment and recovery. Therefore, this response strategy is not considered an appropriate strategy for implementation.	
Protect and deflect	The SIMA evaluation found that protection and deflection was not appropriate against Group I/condensate spills; however, was potentially appropriate for Group II/diesel spills. Generally, oil needs to be >100 g/m^2 (O'Brien 2002) to feasibly deflect oil with a boom to achieve any significant level of oil deflection away from a sensitive location, or to achieve oil deflection into a collection area on a shoreline. As discussed in Table 8-7, surface oil concentrations of >10 g/m^2 (environmental impact threshold) were relatively limited to the vicinity of the release location, with the maximum distance travelled by a single spill trajectory (out of 300 simulations) predicted to be approximately 25 km. Therefore, there would be no situations where weathered oil slicks >100 g/m^2 would be arriving at remote shorelines (closest shoreline is at Browse Island 68 km away). Therefore, this response strategy is not considered an appropriate strategy for implementation.	No
Shoreline clean-up	The SIMA evaluation found that shoreline clean-up was potentially appropriate for both Group I/condensate, and Group II/diesel spills.	Yes

	The outcome of the spill modelling (Table 8-4) indicates that for a loss of well containment, 34 m^3 of condensate could accumulate on shorelines in the Camden Sound MP for the worst-case replicate. Based on grid cell size (1 km^2) used in the predictive modelling, this volume of oil represents the maximum volume of oil in the worst-case (deterministic) replicate across all of the shoreline at the receptor (Camden Sound MP) which in the case of this replicate equates to 42 grid cells being contacted. Therefore, the modelling outcome represents 34 m^3 spread across 42 km^2 of shoreline/intertidal habitat. Modelling predicted a worst-case concentration of 1,384 g/m^2 at this location, which although exceeding the impact threshold (Table 8-5), is not considered to reflect a uniform, widespread thickness of shoreline hydrocarbons across the entire area. Similarly, other locations with shoreline contact include Ashmore Reef with a worst-case of 26 m^3 accumulating across the 220 km^2 intertidal reef platform and vegetated islands of the reef and Cartier Island with a maximum worst-case accumulated volume of 9 m^3 across 10 km^2. The Group II/diesel spill modelling also predicted shoreline contact thresholds would be exceeded, however at lower worst-case concentrations when compared with the predicted shoreline contact concentrations for Group I/condensate spill scenario. At these concentrations and loadings, over such large intertidal areas, shoreline clean-up is unlikely to provide any significant environmental benefit compared to natural weathering. Therefore, this response strategy is considered unlikely to be successful. However, in the event of a spill, the IMT would consider shoreline clean-up as a response strategy based on the outcome of real-time operational monitoring and evaluation data. To implement this response strategy, the following capabilities are available to INPEX: • aircraft • vessels • shoreline clean-up equipment • shoreline clean-up personnel (trained and general labour) • waste management resources. A detailed assessment of the logistical resources required to implement this response strategy are described in Table 7-6.	

	It should also be noted that for WA/NT shorelines, the relevant Department of Transport would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore and Cartier, INPEX maybe be the control agency.	
Pre-contact wildlife response (hazing and translocation)	The SIMA evaluation found that shoreline clean-up was potentially appropriate for both Group I/condensate, and Group II/diesel spills. Wildlife hazing is most suitable when used near sensitive shoreline habitats against persistent oily slicks, such as heavy fuel oil or crude oil spills. It is generally not appropriate in an open water environment. In the case of a subsea condensate release or diesel spill, surface oil slicks are thin and not considered particularly adhesive, therefore reducing the likelihood and severity of impacts on wildlife (condensate slick over 10 g/m^2 impact threshold is limited to within 13 km of the release, and within 25 km from the vessel collision scenario). Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate. IPIECA (2014) advise that the difficulty of capturing wildlife safely and maintaining their health during relocation should not be underestimated, and that working with live or dead animals has health and safety issues including potential injuries (e.g. bites or scratches) or zoonotic diseases. Risks to wildlife are high during pre-emptive capture and the risks of oiling need to be weighed against the risk of injury, death etc. The translocation of turtles from beaches and islands would likely require the capture of large numbers of hatchlings at night, followed by translocation to a location far from the slick (to prevent surface oil impacts on released hatchlings). Attempting to capture large numbers of healthy seabirds would be very challenging and there is no practicable method to capture healthy seabirds at sea (DPaW 2014). Any seabirds captured and then released would likely fly back to the shoreline from which they originally were captured. Long term veterinary care (e.g. feeding etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the animals. Overall, there is a potential for harm of animals captured to occur; however, as a spill response strategy it may result in a positive impact. In the event of a Group I or II spill, the IMT would consider pre-contact wildlife response as a response strategy based on the outcome of real-time operational monitoring and evaluation data received, and whether indications were that a significant number of individuals of a protected species would be likely to benefit from the response strategy. To implement this response strategy, the following capabilities are available to INPEX:	Yes

	• aircraft • vessels • wildlife response equipment • wildlife response personnel (trained and general labour) • waste management resources. A detailed assessment of the logistical resources required to implement this response strategy are described in Table 7-6. It should also be noted that for WA/NT shorelines and wildlife response, the relevant Department of Transport would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore and Cartier, INPEX may be the control agency.	
Post-contact wildlife response	The SIMA evaluation found that shoreline clean-up was potentially appropriate for both Group I/condensate, and Group II/diesel spills. Capture, relocation, assessment, cleaning, rehabilitation of oiled wildlife does have the ability to increase the survival of individuals. The scale of oil impacts on wildlife is dependent on factors such as timing, location, oceanographic and weather patterns, and the movements of species that forage, feed, nest and inhabit that area (IPIECA 2014). Given the predicted weathering of any Group I or II spill, most wildlife exposure is expected to be to weathered hydrocarbons, with lower associated levels of toxicity (Stout et al. 2016). Group I and II hydrocarbons are relatively non-adhesive compared to crude oils, and generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline. They are also not likely to generate a thick surface barrier on a shoreline which would coat adult nesting turtles or turtle hatchlings as they transit to the ocean.	Yes

	Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they originally were captured and may be repeatedly affected. Therefore, long term veterinary care (rehabilitation, feeding, etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the seabirds. Once oiled, it is generally agreed that birds have a very low survival rate with many studies reporting the probability of dying near to 100%. The reported high success rates of seabird cleaning are typically associated with cleaning pelicans and penguins which are not present within the Browse Basin. IPIECA (2014) advise working with live or dead animals has health and safety issues including potential injuries (e.g. bites or scratches) or zoonotic diseases. In the event of a Group I or II spill, the IMT would consider post-contact wildlife response as a response strategy based on the outcome of the real-time operational monitoring and evaluation data received, and whether indications were that a significant number of individuals of a protected species would be likely to benefit from the response strategy. To implement this response strategy, the following capabilities are available to INPEX: • aircraft • vessels • wildlife response equipment • wildlife response personnel (trained and general labour) • waste management resources. A detailed assessment of the logistical resources required to implement this response strategy are described in Table 7-6. It should also be noted that for WA/NT shorelines and wildlife response, the relevant Department of Transport would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore and Cartier, INPEX may be the control agency. As described in Section 8.2, worst credible potential accumulated volumes of oil along shorelines were predicted as follows: • Lalang-Garram/Camden Sound Marine Park (34 m^3 in summer) • Ashmore Reef (26 m^3 in winter)	

	• Imperius Reef (13 m^3 in summer) • Browse Island (12 m^3 in summer) • Cartier Island (9 m^3 in summer) • Scott Reef South (4 m^3 in summer). Maximum accumulated volumes averaged over all replicate simulations (300 runs) were predicted at Browse Island (3 m^3 in summer) and Ashmore Reef (3 m^3 in winter). The minimum reported time for shoreline contact (at >1g/m^2 floating oil), based on all seasons was 96 hours (Ashmore Reef), 98 hours (Cartier Island) and 184 hours at Browse Island. All other shorelines were contacted after >200 hours. Based on the relatively small volumes of oil ashore Stochastic modelling indicates that both Ashmore Reef and Cartier Island could receive oil contact at the same time from a single spill event. Also, locations such as the Lalang-Garram/Camden Sound Marine Park and North Kimberley Marine Park may also have multiple islands/shorelines contacted simultaneously as part of a single spill event. A shoreline response for a single remote shoreline would typically involve a large accommodation support vessel, supported by tenders/landing barge, a crew change helicopter and potentially a light utility helicopter. If a second shoreline nearby was also contacted at the same time, such as Ashmore Reef and Cartier Island (60 km apart), an additional vessel may be required, however the helicopter assets would remain unchanged and could be shared between the response locations. Operational monitoring and evaluation assets (oil spill trajectory modelling, aerial surveillance, oil spill tracker buoys etc.) requirements would remain unchanged, regardless of the locations contacted.	

7.4 Oil spill response strategies

As identified in the SIMA not all response strategies are appropriate for every hydrocarbon spill, and as discussed in Table 7-5, not all response strategies are appropriate for the specific spill scenarios associated with the activity. Different types of hydrocarbon, spill locations and spill volumes require different response strategies, or combinations of techniques, to implement an effective response.

Based on the SIMA and subsequent evaluations (Table 7-5), INPEX has identified a set of primary and secondary response strategies to reduce the impacts and risks of hydrocarbon spills from the petroleum activity to ALARP. However, the deployment of response strategies has the potential to introduce further impacts and risks.

7.4.1 Primary response strategy

Operational monitoring and evaluation has been determined as the only appropriate primary (first strike) response measure for all hydrocarbon spills. This involves surveillance and reconnaissance, using vessels, aircraft, satellite imagery and satellite tracking buoys to monitor the size, trajectory, weathering and fate of the hydrocarbon spill.

The information obtained through the surveillance and reconnaissance program will inform spill modelling and the development of IAPs, which will include consideration of the use of secondary response strategies, as identified in the SIMA.

As stated in Table 7-3, source control will always be implemented in the event of a loss of well containment and is discussed further in Section 7.5.

7.4.2 Secondary response strategy

The following secondary response strategies have been determined as potentially applicable (depending on hydrocarbon type). An impact and risk evaluation for the implementation of these response strategies is presented in Table 7-6.

Table 7-6: Impact and risk evaluation – implementation of response strategies

Identify hazards and threats
Primary response strategy – monitoring and evaluation. Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. **Secondary response strategy – pre-contact wildlife response.** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. Poorly implemented wildlife response has the potential to cause stress or suffering to wildlife impacted by a spill. **Secondary response strategies –post-contact wildlife response.** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity.

The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. Capture, cleaning and rehabilitation of oiled wildlife has the potential to create additional stress to animals. The movement of equipment and personnel onto offshore islands has the potential to introduce terrestrial exotic pests, including rats. The movement of personnel and equipment onto offshore islands has the potential to disturb turtle nests and turtle-nesting activities. **Secondary response strategy – shoreline clean-up.** Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. The movement of equipment and personnel onto offshore islands has the potential to introduce terrestrial exotic pests, including rats. The movement of personnel and equipment onto offshore islands has the potential to disturb turtle nests and turtle-nesting activities. Incorrect management of hydrocarbon-contaminated wastes generated during shoreline clean-up has the potential to create additional contamination of the shoreline.	
Potential consequence: Primary response strategy – monitoring and evaluation	**Severity**
The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna including foraging BIAs). Monitoring and evaluation does not provide any material changes to the trajectory of the spill. Instead, it provides critical information on the fate, nature and weathering of the spill, as a result of exposure to natural biological and physical degradation processes. The strategy can be used to inform other response strategies and emergency response priorities. Since this strategy does not provide any material changes to the trajectory of the spill, the inherent impacts of the hydrocarbon on marine fauna in the trajectory of the spill will remain until natural degradation/weathering reduces the impacts of the spill.	Insignificant (F)

Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Ashmore Island, Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of the WA and NT coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F). Various conservation management plans identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during the implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 7-4.	
Potential consequence: Secondary response strategy – pre-contact wildlife response (wildlife hazing)	**Severity**
The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna including BIAs associated with turtle and marine avifauna nesting). Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators.. Therefore, EPBC-listed species, such as marine turtles and marine avifauna, may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Ashmore Island, Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of the WA and NT coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F).	Insignificant (F)

Various conservation management plans identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 7-4. A wildlife response strategy can increase the survival of wildlife potentially affected by a spill (particularly seabirds, marine mammals and reptiles in transit) by encouraging wildlife to move away from the location of the spill (IPIECA 2017b). There may be potential for increased stress to wildlife individuals subjected to hazing activities, or the potential to cause wildlife to move into the area affected by the spill from poorly implemented hazing activities (IPIECA 2017b). Therefore, any potential impacts would be only to individuals of a population, and as the activity is being undertaken to reduce impacts, the impact is considered Insignificant (F).	
Potential consequence: Secondary response strategy – pre-contact (translocation) and post-contact wildlife response	**Severity**
The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (turtles and marine avifauna). Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Ashmore Island, Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of the WA and NT coastlines, any temporary changes to water quality that may occur are expected to be short term and localised, and are therefore considered to be Insignificant (F).	Moderate (D)

Various conservation management plans identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 7-4. Pre-contact and post-contact wildlife response (capture, cleaning, relocation and rehabilitation of wildlife) can increase the survival rates of wildlife which may be, or has become, oiled at sea or onshore. There may be a potential for increased stress to some animals during capture, cleaning, relocation and/or rehabilitation (IPIECA 2017b). However, any potential impacts are considered to be of inconsequential ecological significance to protected species, as the capture, relocation cleaning, relocation and/or rehabilitation is conducted to increase survival rates of individuals (Insignificant F). The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009) identifies that exotic rodents (such as rats) have been a major cause of extinction and decline of island biodiversity. Introduction of rodents to any of the offshore islands in the EMBA could result in a medium-term impact on a population of protected species (Moderate D). Physical presence and movement of personnel across turtle-nesting beaches could potentially cause damage to buried turtle eggs, reducing turtle-nesting success. Artificial light is known to disorientate marine turtles, particularly hatchlings and female adults returning to the sea from nesting areas on the shore (Pendoley 2005). Incorrect management of personnel and equipment on turtle-nesting beaches could result in a minor impact on a small proportion of a turtle-nesting population (Minor E).	
Potential consequence: Secondary response strategy – shoreline clean-up	**Severity**
The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna) and marine fauna BIAs in the EMBA (turtles and marine avifauna nesting).	Moderate (D)

Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Ashmore Island, Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of the WA and NT coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F). Various conservation management plans identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F). The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 7-4. The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009) identifies that exotic rodents (such as rats) have been a major cause of extinction and decline of island biodiversity. Introduction of rodents to any of the offshore islands in the EMBA could result in a medium-term impact on a population of protected species (Moderate D). Physical presence and movement of personnel across turtle-nesting beaches could potentially cause damage to buried turtle eggs, reducing turtle-nesting success. Artificial light is known to disorientate marine turtles, particularly hatchlings and female adults returning to the sea from nesting areas on the shore (Pendoley 2005). Incorrect management of personnel and equipment on turtle-nesting beaches could result in a minor impact on a small proportion of a turtle-nesting population (Minor E). A shoreline clean-up response will generate a significant quantity of hydrocarbon-contaminated solid waste. Contaminated solids will include personal protective equipment (PPE), spill clean-up equipment (shovels, rakes, etc.) and the oil-contaminated sediments collected from shorelines (IPIECA 2015a). Inappropriate management of oil-contaminated waste could result in localised contamination of shoreline sediments and harm to individuals of protected species (Minor E).	
Identify the likelihood	

Likelihood	Hydrocarbon spills of a Level 2 or Level 3 nature that are likely to trigger response strategies, thereby introducing the impacts and risks from implementing response strategies, are evaluated in Table 7-3 and Table 7-4. The use of secondary response strategies may increase the likelihood of impact occurring in comparison to just employing source control and monitoring and evaluation techniques alone. However, based on the controls described, the likelihood of response activities resulting in the consequences described is considered Unlikely (4).
Residual risk	Based on a worst-case consequence of Moderate (D) and likelihood of Unlikely (4) the residual risk is Moderate (7).

Residual risk summary		
Consequence	Likelihood	Residual risk
Moderate (D)	Unlikely (4)	Moderate (7)

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility
Oil spill response logistics, personnel and equipment capability, will be maintained at acceptable levels through implementation of the environmental performance standards.	Operational monitoring and evaluation capability which can meet the mobilisation timeframes specified in Table 8-10, will be maintained including: • oil spill trajectory modelling • aerial surveillance • trained aerial observers • vessel surveillance • electronic surface tracking buoys • satellite imagery.	Records confirm operational monitoring and evaluation capability maintained including: oil spill trajectory modelling contract in place aircraft contacts / call-off agreements AMOSC contract vessel contracts / call-off agreements electronic surface tracking buoy locations (tracked via INPEX Oil Spill Preparedness and Response Register) satellite imagery provider contract.	IMT Leader/ INPEX Environmental Advisor
	Oil spill response capability for shoreline and oiled wildlife response, which can meet the mobilisation timeframes specified in Table 8-10, will be maintained including:	Records confirm oil spill response capability is maintained including: AMOSC contract	IMT Leader/ INPEX Environmental Advisor

	• access to AMOSC and OSRL equipment and personnel, including shoreline clean-up and oiled wildlife response personnel and equipment • access to small and large support vessel capability • access to light utility helicopter • access to additional support personnel through Environmental Service Providers general labour hire.	OSRL contract framework agreements.	
IMT will evaluate operational monitoring and evaluation data for the full duration of the spill event, to determine if additional response strategies are required.	The IMT will activate and evaluate real-time operational monitoring and evaluation data for any Level 2/3 spill event. The operational monitoring and evaluation data and the OPEP's Operational SIMA template will be used for the development of the Operational SIMA and IAP.	Records confirm real-time operational monitoring and evaluation data was received and evaluated by the IMT. Records confirm operational monitoring and evaluation data and the OPEP's Operational SIMA template were used for the development of the Operational SIMA and IAP.	IMT Leader
Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals	To monitor response strategy effectiveness, daily reports from field response activities will be provided to the IMT, in accordance with the OPEP. Effectiveness of the oil spill response will be monitored until: • the source of the spill has been stopped • the objectives of the IAPs have been met or • there are no further practicable steps that can be taken to respond to a spill.	Daily field activity reports, in accordance with the OPEP. Daily reports or other data confirms oil spill response termination criteria have been met.	IMT Leader/ INPEX Environmental Advisor
	Emergency response preparedness will be maintained by implementing Section 8.11.	Records confirm emergency response preparedness, is maintained.	INPEX Environmental Advisor

and marine avifauna (receptors) from a Level 2 or Level 3 spill (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.			
Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals and marine avifauna, and benthic communities which support them (receptors) from vessel discharges during oil spill response activities (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards.	All vessels involved in oil spill response activities will conduct sewage disposal activities in accordance with MARPOL 73/78, Annex IV. All vessels involved in oil spill response activities will conduct food scrap disposal activities in accordance with MARPOL 73/78, Annex V. No de-ballasting within marine parks during oil spill response activities.	Records of sewage discharge locations are maintained in a sewage disposal record book that complies with MARPOL 73/78, Annex IV. Records of food scrap discharges are maintained in a garbage record book that complies with MARPOL 73/78, Annex V. Records of de-ballasting.	Vessel Master
No inappropriate disposal of garbage.	All vessels involved in oil spill response activities will conduct garbage management in accordance with MARPOL 73/78, Annex V.	Records of garbage disposals are maintained in a garbage record book that complies with MARPOL 73/78, Annex V.	Vessel Master

No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision during oil spill response.	Vessels will be fitted with lights, signals, AIS transponders and navigation equipment as required by the Navigation Act 2012.	A premobilisation report confirms that required navigation equipment is fitted to all vessels to ensure compliance with the Navigation Act 2012.	INPEX Environmental Advisor
No secondary ocean or shoreline contamination due to inappropriate waste management during a shoreline clean-up response activity.	A contract will be maintained with a licenced waste management contractor, capability of receiving, treating and disposing of solid and liquid oily contaminated wastes.	Records confirm contract in place with a licenced waste management contractor.	INPEX Environmental Advisor
	In consultation with WA DoT/NT DIPL and AMOSC, a response waste management plan, including decontamination stations and waste storage, transport and disposal arrangements, will be prepared and implemented for any shoreline clean-up response activity. The plan will consider methods to eliminate, reduce and re-use materials to reduce the overall volume of waste generated.	Records demonstrate that a waste management plan was prepared and implemented, in consultation with WA DoT/NT DIPL and AMOSC, for any shoreline clean-up response activity.	IMT Leader
Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals and marine avifauna (receptors) from wildlife response activities (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards.	Permits will be obtained in consultation with DEE (Cwlth) before any wildlife hazing, post-contact wildlife response or shoreline clean-up activities take place in Commonwealth waters or on Commonwealth lands. Permits, including launching and landing aviation assets, will be obtained in consultation with DBCA/ NT PaWC (via WA DoT / NT DIPL) before any wildlife hazing, post-contact wildlife response or shoreline clean-up activities take place in WA/NT waters or lands.	Records demonstrate response activities with the potential to affect wildlife were conducted in consultation with, and under permits issued by, DEE (Cwlth), WA DBCA or NT PaWC. Records are kept of response activities demonstrating compliance with any controls defined in the permits.	INPEX Environmental Advisor

No introduction of terrestrial exotic pests to offshore islands.	Pre-flight visual inspections of helicopters conducted. Premobilisation visual inspections of vessels and equipment before mobilisation onto an offshore island and recorded on quarantine inspection checklists.	All aircraft technical logs confirm that pre-flight visual inspections have been conducted. Quarantine inspection checklists confirm vessel and equipment premobilisation inspections have been conducted.	INPEX Environmental Advisor
Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, (receptors) from a shoreline response (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards.	In the event of a shoreline response, an HSE plan will be prepared, in consultation with AMOSC and WA DBCA (via WA DoT) or NT PaWC (via NT DIPL) which addresses potential impacts to turtle nesting, including: personnel and equipment movement on turtle-nesting beaches light-spill (if night-time activities are required).	Records of correspondence with AMOSC and WA DoT / NT DIPL regarding turtle-nesting considerations. HSE plan documentation demonstrates controls regarding turtle nesting. Records demonstrate compliance with controls described in the HSE Plan.	INPEX Environmental Advisor

7.5 Source control arrangements and capability

Should a loss of well containment event occur during the drilling activity, a number of source control activities may be implemented depending on the specific circumstances of the loss of well containment.

In advance of commencing the drilling activities described in this EP, a relief well plan will be finalised, utilising specific well kill modelling results to complete the well design. The modelling considers a number of factors including well geometry, reservoir pressure, temperature, permeability and reservoir fluid properties. Depending on the loss of well containment scenario other source control activities may be required to assist in regaining control such as ROV based systems for seabed debris clearance, BOP intervention and/or well capping.

It should be noted that during the pre-drill site survey (Section 2.2) a number of relief well locations will also be surveyed as part of the relief well planning process.

Table 7-7 presents an evaluation of the applicability of various source control options.

Table 7-7: Evaluation of applicability of source control response options

Source control response technique	Likelihood of success	Considered for implementation
Site survey	Site survey involves the use a response vessel and ROV to conduct visual/sonar observations, to determine the condition of well and BOP and search for any debris, following the source control event. This information is required, to enable the source control team to conduct detailed planning for all source control activities.	Yes
Debris clearance	Debris clearance involves the use of response vessel(s) with cranes/lifting equipment and work-class ROVs, equipped with cutting tools, to cut and relocate/recover debris on the seabed, to enable other response strategies such as BOP intervention, capping stack deployment and mooring a relief well MODU to occur safety.	Yes
BOP intervention	BOP intervention involves the use of response vessels and work-class ROVs with BOP intervention tooling. The BOP intervention tooling will be used to attempt to close the shear-rams of the BOP to stop the flow from the well. BOP intervention can involve unlatching the BOP/LMRP to allow its removal for the installation of the capping stack.	Yes
Capping stack	A capping stack response involves the use of a heavy lift vessel (HLV) to lower and latch the capping stack on the blowing well, to stop the flow from the well.	Yes

Source control response technique	Likelihood of success	Considered for implementation
Capping stack – offset installation equipment	INPEX is aware of new technology developed by Saipem and marketed by Oil Spill Response Limited (OSRL) in the form of Offset Installation Equipment (OIE). The OIE is designed to deploy a capping stack on a blowing well where vertical access is not possible. It is essentially a mobile subsea crane which is used to perform debris clearance and then pick up a capping stack from a subsea parking stand and deploy it, though the discharge plume and on to a blowing well. INPEX do not believe that the proactive gaining of access to this equipment for the planned operations in WA-343-P is in line with ALARP principle. The OIE is an extremely complex spread of equipment and as outlined above, comes with attendant risks, any of which if realised, may preclude its deployment. Fortunately, the system has not been used to respond to an actual source control event but that makes it, as yet, unproven. Comparing this with a well-established source control method of intersection with a relief well and dynamic well kill, it is seen that the proactive gaining of access to OIE is not ALARP for operations in WA-343-P.	No
Relief well	A relief well can be drilled to intercept the original well bore close to the reservoir. Kill fluid is then pumped through the relief well into the original well-bore, to provide an overbalance pressure to the reservoir, and stop the flow of hydrocarbons from the well. To conduct the relief well, a MODU with support vessels is required. In addition, extra vessels with additional drilling fluid and pumping equipment may be required, for the well kill activity. Following the well kill, the MODU will use the relief well to isolate and abandon both wells.	Yes
Use of relief well injection spool	INPEX is aware of new technology developed by Trendsetter Engineering in the form of the Relief Well Injection Spool (RWIS). The RWIS is a spool piece with side outlets installed below the BOP of the relief well which facilitates the connection of more surface pumping resources. These additional resources can deliver greater kill fluid rates to the relief well which, in some cases, may reduce the number of relief wells.	No

Source control response technique	Likelihood of success	Considered for implementation
	INPEX has engaged with Trendsetter Engineering on the high-level feasibility of the deployment of this technology on a WA-343-P relief well. The RWIS is another complex spread of equipment and as outlined above, would only provide a minimal reduction in time to kill the well. Fortunately, the system has not been used to respond to an actual source control event but that makes it, as yet, unproven, and is therefore seen as not ALARP for operations in WA-343-P.	
Subsea dispersant injection	SSDI involves the use of an ROV, to inject dispersant directly into the hydrocarbon stream flowing from the damaged well. The outcome of SSDI is a significant increase of entrainment of oil in the water column. Modelling results (RPS 2019) indicates that under a worst-case blowout scenario, volatile organic carbon (VOC) concentrations (from oil evaporating into the atmosphere) are likely to exceed safe exposure thresholds within 1 km of the release location. The workforce onboard vessels conducting source control activities such as BOP intervention, debris clearance and capping stack installation could therefore be exposed to VOCs, and if gas monitoring indicated exposure had exceeded the VOC thresholds, the vessel would be required to cease the activity move out of the area. In effect, VOC exposure may impact the feasibility of debris clearance/capping stack installation and ultimately limit available source control options to drilling a relief well. Modelling results (RPS 2019) also concluded that SSDI would eliminate the risk of VOCs exceeding exposure thresholds. Therefore, the use of SSDI to significantly reduce the VOC risk to source control vessels/workers may contribute to the feasibility of capping stack deployment, instead of a well kill via relief well, which would take several more months to achieve.	Yes

Table 7-8: Impact and risk evaluation – source control

Identify hazards and threats
MODU and vessel activities Hazards and threats associated with general vessel and MODU drilling activities, when conducting source control activities, are the same as the hazards and threats associated with MODU and vessels conducting routine activities. This includes: • light emissions • atmospheric emissions • routine discharges to sea • waste management • noise and vibration • loss of containment (accidental release) • introduction of invasive marine species • interaction with marine fauna • seabed disturbance • physical presence – disruption to other marine users • vessel collision. The source control activity specific risks are discussed below. **Site survey** The activity of site survey using a vessel and ROV will not result in any additional impacts and/or risk to the marine environment compared to routine vessel/ROV activities. **Debris clearance** Depending on any damage sustained to subsea infrastructure, there is the potential that some debris may need to be removed from the well location in order to safely conduct other source control activities. Debris which is removed may either be recovered to surface, or temporarily stored on the seabed (wet-stored), until it is recovered at a later time. The area of additional seabed disturbed would be proportional to the size of debris which is wet-stored, and is likely to be small, and far less than the area of seabed disturbed due to routine anchoring of the MODU. The impacts and risks associated with seabed disturbance are described in Section 6.9. **BOP intervention** The activity of BOP intervention using a vessel and work-class ROV and a hot-stab will not result in any additional impacts and/or risk to the marine environment compared to routine vessel/ROV activities. **Capping stack deployment** The activity of capping stack deployment using vessels and work-class ROVs will not result in any additional impact and/or risk to the marine environment compared to routine vessel/ROV activities.

Relief well drilling

The activity of drilling a relief well is very similar in nature to the drilling of the original exploration well. There are no additional impacts or risks associated with drilling a relief well, compared to drilling the original exploration well.

Subsea Dispersant Injection

SSDI on condensate wells has traditionally not been considered environmentally acceptable, as under light wind conditions (<5 knots), a high proportion of condensate will evaporate into the atmosphere, removing the hydrocarbons from the marine environment. With increasing wind conditions, more hydrocarbons become entrained. By conducting SSDI, an even higher proportion of the condensate would become entrained in the water column, resulting in a potential increase in impacts associated with entrained hydrocarbons.

Combination of source control activities

During source control, there may be times when there is an increase in the number of vessels operating in the permit area, greater than during routine drilling activities. As a result, there is the potential for an increase in risk associated with vessel collisions. The impacts and risks associated with a vessel collision is described in Section 7 of this EP.

Potential consequence: Source control	**Severity**
The potential consequence associated with vessels and MODUs undertaking source control activities are the same as those described in Section 6 and 7 of this EP.	As per Section 6 and 7 of this EP.

Identify the likelihood	
Likelihood	The likelihood of a well control event that would trigger the activation of source control strategies, thereby introducing the potential impacts and risks from implementing source control activities, are evaluated in Table 7-3 of this EP. The likelihood of the impacts and risks of source control are the same as the likelihoods described in Section 6 and 7 of this EP.
Residual risk	The residual risk of source control activities is the same as the residual risk of all elements described in Section 6 and 7 of this EP.

Residual risk summary		
Consequence	Likelihood	Residual risk
As per Section 6 and 7 of this EP.	As per Section 6 and 7 of this EP.	As per Section 6 and 7 of this EP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria	Responsibility

Impacts and risks from vessel and MODU activities will be reduced to acceptable and ALARP levels, through the implementation of the environmental performance standard.	During source control activities, vessel and MODU activities will be conducted in accordance with the relevant environmental performance standards as described in Section 6 and 7 of this EP.	Records confirm that during source control activities, vessel and MODU activities were conducted in accordance with the relevant environmental performance standards as described in Section 6 and 7 of this EP.	INPEX Drilling Director
INPEX maintain source control preparedness at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	For the duration of the drilling activity, INPEX will maintain registers updated on a monthly basis, of the location and availability of support vessels, CSVs, HLVs and MODUs, including their capabilities and safety case status and jurisdiction.	Vessel and MODU registers.	INPEX Drilling Director
	For the duration of the drilling activity, INPEX will maintain an LLI register.	LLI register	INPEX Drilling Director
	For the duration of the drilling activity, INPEX will maintain contracts for suitable debris clearance equipment. Debris clearance equipment will be able to be mobilised to Broome within 5 days.	Records of contracts for debris clearance equipment.	INPEX Drilling Director
	For the duration of the drilling activity, INPEX will maintain contracts for suitable capping stack equipment. The capping stack equipment will be: • identified as fit for purpose, capable of being lowered and latched onto the selected BOP, utilising a single HLV • rated to achieve a well-kill, based on the expected pressures of the reservoir • primary stack available to be mobilised onto a HLV within 5 days • primary and secondary capping stack maintained in a suitable state of readiness.	Records of contracts for capping stack equipment.	INPEX Drilling Director

	For the duration of the drilling activity, INPEX will continue to subscribe to the APPEA MoU.	Record of APPEA MoU.	INPEX Drilling Director
	A Safety Case revision template will be developed. The Safety Case revision template will: • be finalised prior to spudding the well • reduce preparation time to revise existing accepted MODU/vessel safety cases for source control activities.	Safety Case revision template for source control activities.	INPEX Drilling Director
	Source control team will maintain preparedness through training and exercises will ensure the source control team: • understand the source control planning documents/procedures • understand their defined roles and responsibilities • validate communications with external source control service providers.	Records of training and exercises for the source control team.	Source Control Team Leader
	For the duration of the drilling activity, INPEX will maintain a contract with Wild-well, for the provision of personnel to: • provide technical expertise to the INPEX source control team • provide in-field supervision of source control activities.	Wild-well contract.	INPEX Drilling Director
	Prior to spudding; source control documentation will be approved and in place in accordance with the WOMP, including: • Drilling Browse Basin Emergency Response Plan • Source Control Emergency Response Plan • Blowout Contingency Plan – Browse Basin Wells • Well Control Modelling Service Report • Capping Stack Deployment and Installation Procedure.	Records confirm source control planning documentation was approved prior to spudding.	INPEX Drilling Director

	For the duration of the drilling activity, INPEX will maintain a contract for a SSDI spread, which can be mobilised to Broome within 10 days. The SSDI spread will contain a minimum of 500 m3 of dispersant.	Records of contract for SSDI spread.	INPEX Drilling Director
Impacts to the shallow water column through use of SSDI will be reduced to ALARP through the implementation of the Environmental Performance Standard.	SSDI will only be activated when: • Air quality monitoring and/or modelling determines there is a credible risk of atmospheric VOC concentrations exceeding safe exposure thresholds for source control activities; and • There is a requirement to conduct source control activities in the zone where atmospheric VOCs may present a hazard to the safety of workers, and Air quality monitoring and/or modelling of gas levels and lower explosive limits determines source control activities including SSDI could be safety conducted.	Records of: • Air quality monitoring and/or modelling demonstrating a credible risk of atmospheric VOC concentrations exceeding safe exposure thresholds for source control activities SSDI injection occurring concurrently with source control activities	Source Control Team Leader
INPEX will re-gain control of a well within 130 days of any source control event, through implementation of the environmental performance standards and the application of the environmental management implementation strategy.	In the event of a loss of well control, conduct a site survey of well-head infrastructure, to inform source control planning activities.	Records of site survey	Source Control Team Leader
	The source control team will utilise the source control planning documentation to develop and implement a source control plan. The source control plan will: • evaluate, define and schedule source control activities • utilise the asset registers to identify and safely mobilise suitable assets within the minimum timeframe possible • evaluate the potential to use the site survey vessel/ROV for BOP intervention • evaluate the potential to use the original MODU to drill top-hole sections for any relief wells.	Source control plan documentation	Source Control Team Leader

	In the event of relief well kill, INPEX will suspend all other drilling operations in the region, to release additional drilling personnel from the SE Asian region, to support the source control team.	Records from incident	INPEX Drilling Director
No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision during source control activities.	The source control team will develop a SIMOPs plan, to support the source control plan. The SIMOPs plan will specify: • permit area entry requirements, including DP checks • exclusion zones • minimum vessel separations • communications requirements and frequencies • SIMOPs planning meetings.	Records confirm SIMOPs plan developed and implemented.	Source Control Team Leader
No impacts to sensitive benthic primary producer habitats during temporary wet-storage of debris.	If debris clearance and wet-storage is required, the source control team will utilise the pre-drill site survey data to identify temporary wet storage areas which are not sensitive benthic habitats.	Records confirm any identified wet-storage areas do not contain sensitive benthic habitats.	INPEX Environmental Advisor

8 MONITORING ENVIRONMENTAL PERFORMANCE

The HSEQ-MS includes standards and procedures from other business areas for its completeness. It is based on the principle of a "plan, do, check, act" (PDCA) continual improvement cycle, and has been developed in accordance with the following Australian standards:

- AS/NZS 4801:2001, *Occupational health and safety management systems—Specification with guidance for use*
- AS/NZS ISO 14001:2004, *Environmental management systems—Requirements with guidance for use*.

It provides mandatory rules and processes for the systematic and consistent management of HSEQ risks, demonstration of compliance, and facilitation of continual improvement. In the context of this EP, the HSEQ-MS enables INPEX to ensure that:

- environmental risks of activities are identified and communicated
- organisational structures and resources are provided to ensure that control measures remain effective in reducing environmental risks to levels that are acceptable and ALARP
- performance outcomes and standards are being met
- continual improvement is achieved through application of lessons learned.

A summary of the elements associated with implementation of the EP and details on the arrangements for ongoing monitoring of environmental performance are provided in Table 8-1. The processes within the HSEQ-MS that specifically address how environmental performance is monitored and achieved are described in sections 8.1.

Table 8-1: HSEQ_MS Implementation

HSEQ-MS element	Description	Performance monitoring
Leadership and commitment	INPEX environmental performance is achieved through strong visible leadership, commitment and accountability at all levels of the organisation. Leadership includes defining performance targets and providing structures and resources to meet them.	The INPEX Environmental Policy solidifies this commitment and states the minimum expectations for environmental performance. The policy applies to all INPEX-controlled activities in Australia and related project locations, including WA-343-P. All personnel, including contractors, are required to comply with the policy. The policy is available on the INPEX intranet and displayed at all INPEX workplaces, including the MODU and all contractor vessels in the permit area. It will be communicated to personnel involved in the activities, including contractors, through inductions.
Capability and competence	INPEX appoints and maintains competent personnel to manage environmental risks and provide assurance that the INPEX Environmental Policy, objectives and performance expectations will be achieved. This applies to both individual competencies and the overall capability of the organisation.	INPEX conducts training needs analysis for each of the key roles in relation to the EP to define minimum training requirements. The analysis is used to develop training plans for individuals that are then used to document, schedule and record completion of specific HSEQ training. Inductions are provided to all personnel (including INPEX representatives, contractors, subcontractors and visitors) before they start work at or visit any of the vessels described in the EP. Inductions cover the health, safety and environment requirements under the INPEX HSEQ-MS, including information about the commitments contained in the EP.
Documentation, information and data	INPEX implements and maintains document and records management procedures and systems. These are in place to ensure that information required to support safe and reliable operation of the facility, and management of environmental risks, is identified, current, reliable and available to those who need it.	Documents and records are stored electronically in INPEX document management systems and databases. This EP and associated documentation are maintained within a database, with current versions also available via the controlled document repository.

HSEQ-MS element	Description	Performance monitoring
Risk Management	Robust and structured processes are applied to identify hazards and ensure that risks arising from the operation of the facility are systematically identified, assessed, evaluated and controlled on an ongoing basis.	The risks and impacts associated with the petroleum activity are detailed in Section 6 and Section 7. Additional risk assessments will be undertaken on an ongoing basis when triggered by any of the following circumstances: • when there is a proposed change to the activity, as identified by an INPEX management of change (MoC) request • when identified as necessary following the investigation of an event • when additional information about environmental impacts or risks becomes available (e.g. through better knowledge of the receptors present within the EMBA, new scientific information/papers, results of monitoring, other industry events or studies) • if there is a change in regulations, as necessary • during scheduled reviews of the documentation associated with this EP.
Operate and maintain	INPEX implements and maintains processes including the chemical assessment and approval process, to ensure that, while operating, records relevant to the implementation of the EP are maintained.	The INPEX HSEQ provides processes for the systematic and consistent management of HSEQ risks and demonstration of compliance during operations. Formal reviews of the effectiveness and appropriateness of the INPEX HSEQ-MS are performed by senior management on a periodic basis.
	Chemical assessment and approval	Chemicals discharged during the drilling activity will be selected to meet both technical and environmental criteria. The environmental criteria are specified in the INPEX Chemical Assessment and Approval Guideline as summarised below:

HSEQ-MS element	Description	Performance monitoring
		• The chemical product is listed in the OSPAR list of substances/preparations used and discharged offshore which are considered to PLONOR. This list is based on assessment of the intrinsic properties of a chemical product and in order for a product to be included on the list the OSPAR Commission must consider that it poses little or no risk to the environment. • The chemical product is GOLD or SILVER-rated under the OCNS chemical hazardous assessment and risk management (CHARM) model. The CHARM model calculates the ratio of predicted environmental concentration against no effect concentration. This is expressed as a hazard quotient (HQ), which is then used to rank the product. • The chemical product (if not CHARM-rated, e.g. inorganics, hydraulic fluids or pipeline chemicals) has an OCNS group rating of D or E. Non-CHARM products with a D or E grouping are either readily or inherently biodegradable. • The chemical product (if not OCNS registered) is assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria. The assessment process requires that chemical products requested for use on INPEX sites or facilities which would be released to the marine environment under normal operating conditions shall be reviewed by an INPEX environmental adviser. The INPEX pseudo ranking system, designed for those chemicals that are not OCNS registered, is a chemical assessment tool used to determine a chemical's inherent environmental hazard potential. This is determined by considering toxicity in conjunction with bioaccumulation and biodegradation potentials in line with the OCNS CHARM/non-CHARM criteria. Chemicals falling within the 'green' range are considered to present a low inherent hazard potential.

HSEQ-MS element	Description	Performance monitoring
Management of Change (MoC)	Where a change to management of an activity is proposed, internal notification will be communicated via an MoC request. The request will identify the proposed change(s) along with the underlying reasons, and highlight potential areas of risk or impact.	Changes to the EP will be managed in accordance with a business-wide standard, and related procedures and guidelines. Where a change to management of an activity is proposed, it will be logged. Internal notification will be communicated via a MoC request. The request will identify the proposed change(s) along with the underlying reasons and highlight potential areas of risk or impact.
Stakeholder engagement	Robust processes to ensure: • ongoing consultation with relevant stakeholders • communication with INPEX employees regarding legal and other requirements.	Any objections or claims received from stakeholders while the activity is ongoing will be considered and assessed using the same process and criteria described for the stakeholder consultation undertaken during the development of the EP. INPEX and its contractors adopt a number of methods to ensure that information relating to HSEQ risks and impacts are communicated to personnel, including: • daily toolbox meetings • MODU HSE meetings • use of noticeboards, intranet, HSE alerts and newsflashes e.g. environmental aspects and events • internal and external reporting.
Contractors and suppliers	Selection and management processes are in place to ensure that contractors working for, or on behalf of, INPEX are able and willing to meet the minimum business expectations of INPEX, including those related to HSEQ and risk management.	Contract compliance audits, and quality control and assurance checks are conducted throughout the life of the contract as appropriate to the scope of work and risks involved. Contractors are required to provide regular reports to communicate their HSEQ performance and compliance status and periodic checks and reviews are conducted by INPEX representatives.

HSEQ-MS element	Description	Performance monitoring
Security and emergency management	INPEX implements and maintains security and emergency management processes to ensure: • capabilities and arrangements are in place to respond to an emergency • employees are trained and capable • response arrangements are tested.	Specific functions identified within the incident management team (IMT) receive nationally accredited training in line with the Australian Quality Training Framework. In addition to this, certain identified functions, along with some key support members receive specific oil spill response training. This approach ensures that INPEX always has the capability to respond to an oil spill event. The MODU and each vessel ERT will maintain its own training in oil spill response, commensurate with the risks and responses required. There are ERPs for the MODU (Drilling Contractor ERP) and all contractor vessels that are implemented by the relevant facility/vessel emergency response team (ERT). INPEX and contractors nominate and train workplace personnel to form facility and vessel-based ERTs. These will be coordinated by the relevant person in charge (OIM or vessel master) to ensure that there is adequate emergency service cover on board at all times. INPEX oil spill response arrangements shall be tested by the IMT: • before the activity commences • when the arrangements for an activity are significantly amended • not later than 12 months following the most recent test. Notification and call-out drills, that test communications channels and the ability to contact key individuals, shall be conducted at least annually.
Incident investigation and lessons learnt	INPEX implements and maintains processes for ensuring environmental incidents are investigated and reported, and that corrective actions are implemented.	HSEQ performance data is monitored in accordance with the INPEX HSEQ Performance Measurement and Reporting Standard. This enables the status of conformance with HSEQ obligations and goals to be determined, and also ensures HSEQ risks are being effectively managed to support continuous improvement. HSEQ is regularly reviewed by senior management.

HSEQ-MS element	Description	Performance monitoring
Monitoring, auditing and reviewing	INPEX implements and maintains robust monitoring, auditing and reviewing processes to evaluate environmental performance and ensure continual improvement. Through a process of adaptive management, lessons from management outcomes will be used for continual improvement. Formal reviews of the effectiveness and appropriateness of the INPEX HSEQ-MS are performed by senior management on a periodic basis. Lessons learned from this process and iterative decision-making will then be used as feedback to improve future management.	An audit and inspection program will be developed and implemented in accordance with the INPEX business standard for auditing. The program will include: • self-assessment HSEQ audits against the HSEQ-MS • regular inspections of workplace equipment and activities • reviews to evaluate compliance with legislative and other requirements. Unscheduled audits may be initiated by INPEX in the event of an incident, non-compliance or for other valid reasons. Inspections will be undertaken to ensure that the environmental performance outcomes and standards documented in this EP can be achieved. Pre-mobilisation inspections will be conducted prior to site survey and drilling activities on relevant MODUs and vessels. During the activity, operational compliance against relevant EPO/EPSs will be assessed and maintained through the implementation of the INPEX Drilling Monthly Environmental Protection Checklist. Non-conformances and relevant findings during the inspections will be converted into actions that will be tracked within an action tracking database until closed. Through a process of adaptive management, lessons from management outcomes will be used for continual improvement. Formal reviews of the effectiveness and appropriateness of the INPEX HSEQ-MS are performed by senior management on a periodic basis. The things learned from this process and iterative decision-making will then be used as feedback to improve future management.

HSEQ-MS element	Description	Performance monitoring
		Together with the annual environmental performance report, an EP management review will be conducted post-activity completion.

8.1 Performance reporting to regulator

For the purposes of regulatory reporting to NOPSEMA, an incident is classified as either "Reportable" or "Recordable" based on the definitions contained in Regulation 4 of the OPGGS (E) Regulations 2009.

8.1.1 Reportable incidents

A "Reportable" incident is defined as "an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage." Environmental damage (or the potential to cause damage) includes social, economic and cultural features of the environment. For the purposes of this EP, such an incident is considered to have an environmental consequence level of Moderate (D) to Catastrophic (A) as defined in the INPEX Risk Matrix.

Based on the consequence assessments described in sections 7 and 8 of the EP Summary, incidents identified as having the potential to be "Reportable" (i.e. Moderate (D) or above on the INPEX Risk Matrix) include:

- the introduction of IMS
- a loss of well containment.

8.1.2 Recordable incidents

A "Recordable" incident is defined as "a breach of an environmental performance outcome or environmental performance standard … that is not a reportable incident." In terms of the activities within the scope of the EP, it is a breach of the performance standards and outcomes listed in the EP.

For the purposes of regulatory reporting to DEE, any significant impact to matters of national environmental significance (MNES), as classified using the INPEX Risk Matrix, will be reported to DEE. The Director of National Parks will be notified of any oil/gas pollution incidences within or likely to impact a marine park as soon as possible.

8.1.3 Annual performance reporting – external

In accordance with Regulation 14(2) of the OPGGS (E) Regulations 2009, INPEX will undertake a review of its compliance with the environmental performance outcomes and standards set out in this EP and will provide a written report of its findings for the reporting period to NOPSEMA on an annual basis, as agreed with NOPSEMA. The annual submission date for the environmental performance report will be 12 months after the start of the activity.

9 REFERENCES

ADB–see Asian Development Bank.

AFMA–see Australian Fisheries Management Authority

AIMS-see Australian Institute of Marine Science

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AMSA–see Australian Maritime Safety Authority

ANZECC/ARMCANZ–see Australian and New Zealand Environment and Conservation Council and Agriculture and Resources Management Council of Australia and New Zealand.

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