INPEX

Ichthys Project Offshore Facility (Operation)

Environment Plan

Environment plan summary

The WA-50-L environment plan summary has been prepared from material provided in this environment plan (EP). The summary consists of the following as required by Regulation 11(4) of the OPGGS (E) Regulations 2009:

EP summary and material requirement	Relevant section of EP containing EP summary material
The location of the activity	Sections 3.1 and 3.2
A description of the receiving environment	Section 4
A description of the activity	Section 3
Details of the environmental impacts and risks	Sections 7 and 8
The control measures for the activity	Sections 7 and 8
The arrangements for ongoing monitoring of the titleholders environmental performance	Sections 9.11, 9.12 and 9.13
Response arrangements in the oil pollution emergency plan	INPEX Browse Regional OPEP
Consultation already undertaken and plans for ongoing consultation	Sections 5 and 9.8.3
Details of the titleholders nominated liaison person for the activity	Section 1.7

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TABLE OF APPENDICES

Terms, abbreviations and acronyms

Term, abbreviation or acronym	Meaning
°C	degrees Celsius
ACCU	Australian Carbon Credit Units
AFMA	Australian Fisheries Management Authority (Cwlth)
AHO	Australian Hydrographic Office
AICS	Australian Inventory of Chemical Substances
AIM	asset integrity management
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
AMSA	Australian Maritime Safety Authority (Cwlth)
APASA	Asia-Pacific Applied Science Associates
APPEA	Australian Petroleum Production and Exploration Association
ARP	applied research program
AS/NZS	Australian/New Zealand Standard
ASV	accommodation support vessel
AUV	autonomous underwater vehicle
BIA	biologically important area
BCM	booster compression module
BFS	Biofouling Solutions Pty Ltd
BMS	INPEX's business management system containing all HSE requirements
BoM	Bureau of Meteorology
Bq/L	becquerels per litre

Term, abbreviation or acronym	Meaning
BROPEP	INPEX Browse Regional Oil Pollution Emergency Plan
BTEX	benzene, toluene, ethyl benzene, xylene
BWM	ballast water management
CAMBA	China-Australia Migratory Bird Agreement
CASA	Civil Aviation Safety Authority
CBP	chlorination by-product
CCS	carbon capture and storage
CCSWG	climate change strategy working group
CMMS	computerised maintenance management system
CMT	crisis management team
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent – a standard unit for measuring greenhouse gas emissions
COLREGs	International Regulations for Preventing Collisions at Sea 1972
CPF	central processing facility
CW	cooling water
Cwlth	Commonwealth
DAWR	Department of Agriculture and Water Resources (Cwlth) (now known as the Department of Agriculture, Water and the Environment)
dB	decibel
DBCA	Department of Biodiversity, Conservation and Attractions (WA)
DEE	Department of the Environment and Energy (Cwlth) (now known as the Department of Agriculture, Water and the Environment)
DAWE	Department of Agriculture, Water and the Environment (Cwlth) (formerly the DEE and Department of Agriculture)
DMIRS	Department of Mines, Industry Regulation and Safety WA (formerly Department of Mines and Petroleum)

Term, abbreviation or acronym	Meaning
DP	dynamically positioned
DPaW	Department of Parks and Wildlife (WA) now known as DBCA
DPIRD	Department of Primary Industries and Regional Development (WA)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EEP	energy efficiency program
EEZ	exclusive economic zone
EIAPP	Engine International Air Pollution Prevention
EIS	environmental impact statement
EMBA	environment that may be affected
ENVID	environmental impact identification
EP	environment plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)
ERC	emergency release coupling
ERT	emergency response team
ESD	ecological sustainable development
FGC	flash gas compression
FIS	filtered inhibited seawater
FLNG	floating liquified natural gas
FMP	flaring management plan
FPSO	floating production storage and offloading
FY	financial year
g/m^2	grams per square metre
g/m^3	grams per cubic metre
GT	gas turbine

Term, abbreviation or acronym	Meaning
GEC	gas export compressor
GEP	gas export pipeline
GERB	gas export riser base
GHG	greenhouse gas
GS	gathering system
GT	gross tonnes
ha	Hectare
HAZID	identification of operational risks and hazards
HFO	heavy fuel oil
HLV	heavy lift vessel
HP	high pressure
HSE	health, safety, environment and quality
HVAC	heating, ventilation and air conditioning
Hz	Hertz
IAP	incident action plan
IAPP	International Air Pollution Prevention
IBA	important bird area
IBC	intermediate bulk container
Ichthys Project	The Ichthys Project is considered to be a single facility comprising offshore and onshore plant and equipment.
IFC	International Finance Corporation
IGG	inert gas generator
IMM	inspection, maintenance and monitoring
IMO	International Maritime Organization
IMR	inspection maintenance and repair

Term, abbreviation or acronym	Meaning
IMS	invasive marine species
IMSMP	invasive marine species monitoring program
IMT	incident management team
INPEX	INPEX Ichthys Pty Ltd
INPEX Australia	Australian subsidiaries of INPEX Corporation including INPEX Ichthys Pty Ltd
INPEX Corporation	Parent company of INPEX
IOGP	International Association of Oil and Gas Producers
IOPP	International Oil Pollution Prevention
ISPPC	International Sewage Pollution Prevention Certificate
ISO	International Organization for Standardization
ISV	inlet surge vessels
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)
L	litre(s)
LAT	lowest astronomical tide
LDAR	leak detection and repair
LEMP	liquid effluent management plan
licence area	WA-50-L
LLR	lower limits of reporting
LNG	liquefied natural gas

Term, abbreviation or acronym	Meaning
LP	low pressure
m^2	square metres
m^3	cubic metres
m^3/d	cubic metres per day
m/s	metres per second
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973/1978
MBC	marine break coupling
MBES	multibeam echo sounders
MEG	monoethlyene glycol
MPG	main power generator
mg/L	milligrams per litre
MNES	Matters of National Environmental Significance
MNP	marine national park
MoC	management of change
MoU	memorandum of understanding
MP	marine park
MPPE	macro porous polymer extraction
MRU	mercury removal unit
MSI	Maritime Safety Information
NatPlan	National Plan for Maritime Environmental Emergencies
NDC	Nationally determined contribution
NEC	no effect concentration
NGER	National Greenhouse and Energy Reporting
nm	nautical miles

Term, abbreviation or acronym	Meaning
NMR	north marine region
NOM	natural organic material
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NORMS	naturally occurring radioactive materials
NOx	mono-nitrogen oxides
NPI	National Pollutant Inventory
NRSMPA	National representative system of marine protected areas
NT DIPL	Northern Territory Department of Infrastructure, Planning and Logistics
NT DITT	Northern Territory Department of Industry, Tourism and Trade
NWMR	north-west marine region
ODS(s)	ozone-depleting substance(s)
OGCI	Oil and Gas Climate Initiative
OGMP	Oil and Gas Methane Partnership
OGR	off-gas recovery
OIM	offshore installation manager
OIW	oil-in-water
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

Term, abbreviation or acronym	Meaning
OSTM	oil spill trajectory modelling
OSV	offshore support vessel
OWS	oil-water separator
PAH	polycyclic aromatic hydrocarbons
PDCA	plan, do check, act
PEZ	potential exposure zone
PLONOR	pose little or no risk (to the environment)
PLR	pig launcher receiver
PNEC	predicted no effect concentration
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
PSV	platform supply vessel
PSZ	petroleum safety zone
PTS	permanent threshold shift
PTW	permit to work
PW	produced water
QA/QC	quality assurance and quality control
Ramsar Convention	The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention)
RBI	risk based inspection

Term, abbreviation or acronym	**Meaning**
RCC	rescue coordination centre
RESDV	riser emergency shutdown valve
RO	reverse osmosis
ROKAMBA	Republic of Korea- Australia Migratory Bird Agreement
ROV	remotely operated (underwater) vehicle
RSS	riser support structure
SAR	seabed asset register
SDS	safety data sheet
SEEMP	Ship Energy Efficiency Management Plan
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 dioxide
sm^3	standard cubic metre (gas)
SMPEP	shipboard marine pollution emergency plan
SPS	subsea production system
SRU	sulfur removal units
SSD	species sensitivity distribution
SSIV	subsea isolation valve
SSS	side scan sonar
SSSV	subsurface safety valve
STP	sewage treatment plant
SWASP	State-wide array surveillance program

Term, abbreviation or acronym	Meaning
T	tonne
t/d	tonnes per day
TEG	triethylene glycol
THPS	tetrakis (hydroxymethyl) phosphonium sulfate
TOC	total organic carbon
TRH	total recoverable hydrocarbons
TSS	total suspended solids
TTS	temporary threshold shift
UNEP	United Nations Environment Programme
URF	umbilical risers and flowlines
VOC(s)	volatile organic compound(s)
VP	vice president
WA	Western Australia
WA-50-L	Production licence area within the Browse basin
WA DoT	Department of Transport (WA)
WA EPA	Western Australian Environmental Protection Authority
WAFIC	Western Australian Fishing Industry Council
WCSS	worst case spill scenario
WET	whole effluent toxicity
WGR	water-gas ratio
XT	christmas tree
XTV	christmas tree valve
μg/L	micrograms per litre
μPa	micropascal

1 INTRODUCTION

1.1 Background

In 2011, Commonwealth approval (EPBC 2008/4208) was obtained to develop the Ichthys Field in the Browse Basin, comprising of the development of two natural gas and condensate reservoirs, Brewster and Plover. The approval included, but was not limited to, the installation and operation of the offshore infrastructure for the 40-year field life. The Ichthys Field is in petroleum production licence WA-50-L in the Browse Basin about 220 kilometres off the north west coast of Western Australia and 820 kilometres south west of Darwin in water depths of 235 to 275 m (Figure 1-1). INPEX Ichthys Pty Ltd, on behalf of the Ichthys Upstream Unincorporated Joint Venture Participants, is recovering gas and condensate from these reservoirs and processing them offshore.

The Ichthys Field consists of two reservoirs: an upper reservoir in the Brewster Member and a lower reservoir in the Plover Formation. Continued development of the Ichthys Project, in accordance with the Commonwealth ministerial approval will see the introduction of hydrocarbons from the lower Plover Formation during the life of this EP.

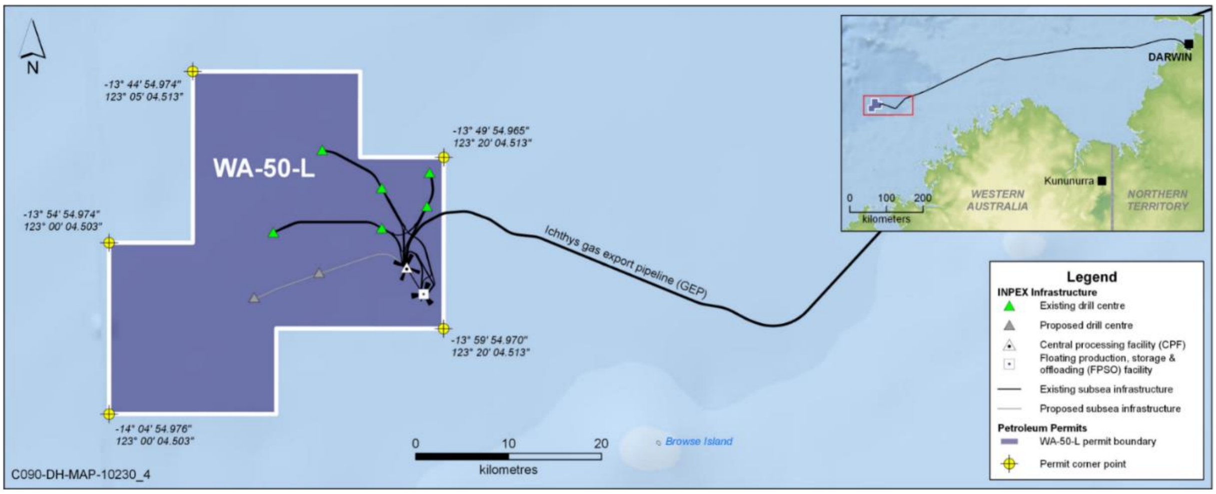


Figure 1-1: Location of INPEX Ichthys LNG Project

Hydrocarbon production involves gas from the Ichthys Field undergoing preliminary processing at the offshore central processing facility (CPF) to remove water and raw liquids, including the greater part of the condensate. This condensate is pumped to the interlinked floating production, storage, and offtake facility (FPSO) with hydrocarbon processing and monoethylene glycol (MEG) regeneration capabilities (Figure 1-2). The FPSO has a condensate storage capacity of more than 1,000,000 barrels (approx. 137,000 m^3) and transfers the condensate to tankers for export to overseas markets.

The gas and some condensate are transported along an 890 kilometre long subsea gas export pipeline (GEP) for further processing at Bladin Point in Darwin. Liquefied petroleum gases (LPG) and liquefied natural gas (LNG) are produced onshore from the export gas on behalf of the Ichthys Downstream Incorporated Joint Venture.

Figure 1-2: Ichthys offshore interlinked facility

1.2 Key milestones

Construction and installation of Ichthys Project subsea infrastructure and commencement of drilling for the first 20 development wells began in 2014. INPEX is preparing to expand capacity with further development of the Ichthys Field, as approved under the Ichthys LNG Project Commonwealth approval decision EPBC 4208/2008.

As described in Table 1-1, development drilling is currently ongoing along with umbilicals, risers and flowlines (URF) and subsea production systems (SPS) installation activities. These scopes are progressing to expand the hydrocarbon production capacity of the Ichthys LNG Project with new production wells and associated SPS connected to the existing offshore facility and operated under this EP.

A summary of key milestone activities to date is provided as follows:

- production well drilling commenced 2014 (first wells in Brewster Member)
- CPF and FPSO arrived in WA-50-L from South Korea with hook up in 2017
- commissioning and start-up of the CPF and FPSO commenced in 2017 lasting for approximately 12 months
- Brewster production wells flowed, and first offtake cargo occurred in 2018
- 'steady state' normal operations commenced in July 2019
- additional development drilling commenced in 2020 (further 12-15 wells in both the Brewster Member and Plover Formation)
- SPS expansion activities commenced in 2021 including the new (fourth) gathering system (GS4).

Three or four early Plover wells may be drilled within life of this EP to help characterise the reservoir properties further. The information gained from the early Plover wells will enable better understanding of the reservoir characteristics and optimise further Plover production well drilling locations ahead of Plover coming fully online later in field life.

Table 1-1: INPEX Ichthys LNG Project environment plans

Title	Activities	Indicative timing
Ichthys Development Drilling Campaign WA-50-L Environment Plan (0000-AD-PLN-60003) (Accepted)	• 12-15 well drilling program utilising semisubmersible drilling rigs • installation of well infrastructure and xmas trees (XTs) • well clean-up and completions • support activities, including equipment transfers, refuelling, crew transfers, and transfer of waste and general supplies to and from logistics support vessels • control and maintenance of well integrity.	Mar 2020 – Mar 2025
Umbilicals, Risers and Flowlines and Subsea Production Systems Installation Environment Plan (E075-AH-PLN-7000) (Accepted)	• construction and installation of URF infrastructure associated with the further development of the Ichthys LNG Project • survey activities • installation, mechanical completion, pre-commissioning and commissioning of URF infrastructure • connection of URF infrastructure and systems to the existing subsea infrastructure and offshore facility • pre-commissioning and commissioning of the well head Christmas trees at drill centres.	Jan 2021 – Jan 2026
Ichthys Project Gas Export Pipeline (Operation) Environment Plan (F075-AH-PLN-10001) (5-year EP revision in preparation F060-AH-PLN-70000)	• operation of the gas export pipeline from the gas export riser base to the boundary of Commonwealth waters adjacent to NT waters • inspection, maintenance and repair (IMR) of gas export pipeline infrastructure during the Operations stage • deployment of a pipeline repair system during a repair scenario • post-repair discharges of residual hydrocarbon, air, nitrogen gas, filtered inhibited seawater (FIS) or monoethylene glycol (MEG) to the environment.	Jan 2017 – Jan 2022

1.3 Scope

For the purposes of this EP, operation and works associated with these components include:

- operating the facility, including transferring condensate via an offtake hose to an offloading tanker (noting that the offloading tankers are not considered to be a facility under Schedule 3, Part 1, Clause 4 (6) of the Offshore Petroleum and Greenhouse Gas Storage Act 2006. Offloading tankers are not owned, chartered or operated by the titleholder and ownership of the condensate transfers at the inlet flange of the offloading tanker)
- IMR activities on the facility and installed subsea infrastructure
- installation and commissioning of a booster compression module
- operating vessels that for particular activities would be a facility as defined by Schedule 3, Part 1, Clause 4 of the Offshore Petroleum and Greenhouse Gas Storage Act 2006.

1.3.1 Petroleum activity

The Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations 2009) define a petroleum activity as the operations or works in an offshore area undertaken for the purpose of:

1. *exercising a right conferred on a petroleum titleholder under the Act by a petroleum title, or*
2. *discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act*.

Regulation 59C of the Offshore Petroleum Greenhouse Gas Storage (Regulatory Levies) Regulations 2004 further splits petroleum activities by type. Accordingly, the petroleum activities associated with this EP are described as follows:

Item 1 – ‘Operation of a facility that is used for the recovery or processing of petroleum’.

Item 9 – ‘Significant modification of a facility’.

In accordance with these regulations, infrastructure that is used during transfer or processing of hydrocarbon to, or between, the CPF and FPSO is considered to be a part of the processing facility. The interlinked, components of the hydrocarbon processing system described in this EP are:

- the subsea production system (SPS)
- the CPF – the Ichthys Explorer
- the FPSO – the Ichthys Venturer.

1.4 Out of scope

Any activities covered in the EPs listed in Table 1-1 are out of the scope of this EP and include the following:

- operation and maintenance of the GEP beyond the GERB
- tie-in of additional risers and flowlines, i.e. connecting new subsea infrastructure components to the CPF and FPSO
- well intervention and/or well workover activities
- the transport of condensate (activity is not under the titleholder’s control).

1.5 Objectives

The objectives of this EP are to:

- demonstrate that the environmental impacts and risks associated with the petroleum activity have been reduced to 'as low as reasonably practicable' (ALARP) and are of an acceptable level
- establish appropriate environmental performance outcomes, environmental performance standards and measurement criteria in relation to the petroleum activity
- define an appropriate implementation strategy and monitoring, recording and reporting arrangements, whereby compliance with this EP, the OPGGS (E) Regulations, and other relevant legislative requirements, can be demonstrated
- demonstrate that INPEX has carried out the consultations required by the OPGGS (E) Regulations
- demonstrate that the measures adopted by INPEX, arising from the consultation process, are appropriate
- demonstrate that the petroleum activity complies with the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and the OPGGS (E) Regulations.

1.6 Overview of activity description

Table 1-2: Overview of the activity description

Item	Description
Petroleum production licence area	WA-50-L
Basin	Browse
Gas field	Ichthys Field
Activity location	Wholly located within Commonwealth waters approximately 390 km north of Derby, Western Australia in the North West Marine Region (NWMR) of the Timor Sea.
Hydrocarbon type	Gas and condensate
Water depth	235–275 m at Lowest Astronomical Tide (LAT)
Interlinked facility	The CPF (*Ichthys Explorer*) is used to separate the reservoir fluid received from the gathering systems into liquid and gaseous phases, and export gas onshore for further processing. The CPF has accommodation facilities and utilities, with a capacity of 200 beds, to support a workforce. The FPSO (*Ichthys Venturer*) supports hydrocarbon processing systems and utilities by processing liquid hydrocarbons received from the CPF to produce a stabilised hydrocarbon condensate, which is then temporarily stored within the FPSO hull and, periodically, offloaded to tankers for export to market. The FPSO also has accommodation facilities utilities, with a capacity of 200 beds, to support a workforce.

Item	Description
	SPS infrastructure (e.g. XTs, manifolds, subsea control systems and umbilicals, risers and flowlines (URF), and the gas export riser base (GERB), which connect the wells to the CPF and FPSO).
Vessels	Platform supply vessels, accommodation support vessels, heavylift vessels (HLVs) – potentially also operating as a facility, offtake support vessels, installation vessels and other supply and support vessels required to support the operation and maintenance of the CPF, FPSO and subsea infrastructure, within the operational area.
Activities	Operations Conveyance of fluids, comprising gas, hydrocarbon condensate, MEG and produced water (PW) from the reservoirs by means of the subsea infrastructure to the CPF and FPSO. Regeneration of MEG by the FPSO used during processing so that it can be recycled back to the SPS and wells. Processing and storage of gas and condensate via the CPF and FPSO, including transfer of condensate via an offtake hose to an offloading tanker; and gas export up to the GEP. IMR activities on the CPF, FPSO and subsea infrastructure including deployment of the pig launcher receiver (PLR) attached at the GERB (excluding well intervention or well workover activities). Further development of the Ichthys Field with installation and commissioning of a booster compression module (BCM) on the CPF. Shutdown to undertake major maintenance, GEP pigging (deployment of PLR) and installation/commissioning of the BCM will require shutdowns of the CPF, FPSO and the full field during the life of this EP.
Duration	This EP revision will cover continuous operations 24 hours per day, for a period of up to five years from acceptance of this EP revision.

1.7 Titleholder details

INPEX Ichthys Pty Ltd is a joint titleholder of production licence WA-50-L but has been nominated as the single titleholder for the purposes of taking eligible voluntary actions under subsection 775B of the OPGGS Act, such as making submissions.

In accordance with Regulation 15(1) of the OPGGS (E) Regulations, details of the titleholder are described in Table 1-3. 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 1-3: Titleholder details

Name	INPEX Ichthys 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	46 150 217 253

In accordance with Regulation 15(2) of the OPGGS (E) Regulations, details of the titleholder's nominated liaison person are provided in Table 1-4.

Table 1-4: Titleholder nominated liaison person

Name	Jake Prout
Position	Environmental Operations Team Lead
Business address	Level 22, 100 St Georges Tce, Perth, WA 6000
Telephone number	+61 8 6213 6000
Email address	jake.prout@inpex.com.au

1.7.1 Notification arrangements

In the event that the titleholder, nominated liaison person or contact details for the nominated liaison person change, INPEX will notify the regulator in accordance with Regulation 15(3) of the OPGGS (E) Regulations.

1.8 Financial assurance

Financial assurance for the titleholder's liabilities for cleaning up, remediating and monitoring the impact of a petroleum release has been calculated using the Australian Petroleum Production and Exploration Association (APPEA) methodology for estimating levels of financial assurance (2018), based on the maximum credible spill scenarios.

Declarations of financial assurance will be provided in relation to title WA-50-L prior to acceptance of this EP by NOPSEMA.

2 ENVIRONMENTAL MANAGEMENT FRAMEWORK

2.1 Corporate framework

INPEX's Business Management System (BMS) is a comprehensive, integrated system that includes standards and procedures necessary for the management of HSE risks.

The INPEX Environmental Policy sets the direction and minimum expectations for environmental performance and is implemented through the standards and procedures of the BMS. This system and policy are further described in Section 9.1 in accordance with Regulation 16(a) of the OPGGS (E) Regulations.

2.2 Legislative framework

In accordance with Regulation 13(4) of the OPGGS (E) Regulations, the legislative framework relevant to the petroleum activity is listed in Table 2-1. A summary of applicable industry standards and guidelines is also presented in Table 2-2. Ongoing management of legislative and other requirements is described further in in Section 9.8.1.

Table 2-1: Summary of applicable legislation

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act; Cwlth) and Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations)	Provides for the protection and management of nationally and internationally important flora, fauna, ecological communities, and heritage places.	The OPGGS (E) Regulations were revised in February 2014 to include the requirement that matters protected under Part 3 of the EPBC Act are considered and any impacts are at acceptable levels. Part 8 of the EPBC Regulations outlines requirements for vessel when interacting with cetaceans. The EPBC Act provides for protection of 'matters of national environmental significance' including not only listed species but also heritage properties and Ramsar wetlands. There are exemptions covering provisions of Part 3 and 13 of the EPBC Act, for the undertaking of activities when responding to maritime environmental emergencies, in accordance with the National Plan (NatPlan). Australian Marine Parks (AMPs) are proclaimed under this Act and associated management plans are enacted under this legislation. In accordance with Regulation 9 of the OPGGS (E) Regulations, the activities described in this EP were approved by the Commonwealth Environment Minister under Part 9 of the EPBC Act (EPBC Approval Decision 2008/4208).	Relevant approval conditions within approval decision EPBC 2008/4208 have been addressed in this EP and are summarised in Appendix A. Section 4.3 – Australian marine parks Section 7.1.1 – Emissions to air Section 7.6.1 – Physical presence of vessels and Section 7.4.2 interaction with marine fauna. Section 8 – Emergency conditions. INPEX Browse Regional OPEP A demonstration of how this EP addresses the relevant conservation management documents related to EPBC listed species has been presented in Appendix B.
OPGGS (E) Regulations (Cwlth)	The OPGGS (E) Regulations under the OPGGS Act require a titleholder to have an accepted plan in place for a petroleum activity.	The OPGGS (E) Regulations require that the petroleum activity is undertaken in an ecologically sustainable manner, and in accordance with an accepted EP.	Throughout this EP. Implementation of the BMS

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Navigation Act 2012 (Cwlth)	The primary legislation that regulates ship and seafarer safety, shipboard aspects of protection of the marine environment, and employment conditions for Australian seafarers.	The *Navigation Act 2012* includes specific requirements for safe navigation, including systems, equipment and practices consistent with the International Convention for the Safety of Life at Sea (SOLAS) and the International Regulations for Preventing Collisions at Sea (COLREGS), as implemented as maritime law in Australia through a series of Marine Orders, including Marine Order –21 – Safety of navigation and emergency arrangements and Marine Order 30 – Prevention of collisions. The *Navigation Act 2012*, in conjunction with the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and through legislative Marine Orders, also requires vessels to have pollution prevention certificates (see below).	Section 7.6.1 – Physical presence – disruption to other marine users Section 8.2 - Vessel collision Implementation of the BMS.
OPGGS Act 2006 Section 572(2)(3)	The OPGGS Act provides the regulatory framework for petroleum exploration, production and greenhouse gas activities in Commonwealth waters.	Section 572(2) and (3) of the OPGGS Act requires titleholders to maintain all structures, equipment and property in a title area in good condition and repair, and to remove all structures, equipment and property when it is neither used nor to be used in connection with operations authorised by the title.	INPEX has plans in place to meet its regulatory obligation to maintain and remove property. Through implementation of the INPEX subsea infrastructure inspection process, INPEX will collect supporting information and data over the life of the facility to enable planning for eventual decommissioning. Section 3.5 (IMR) Implementation of the BMS

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (POTS Act; Cwlth)	The POTS Act provides for the prevention of pollution from vessels, including pollution by oil, noxious liquid substances, packaged harmful substances, sewage, garbage, and air pollution. In conjunction with Chapter 4 of the *Navigation Act 2012*, the POTS Act gives effect to relevant requirements of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL) in Australia.	The requirements of the POTS Act are implemented as maritime law in Australia through a series of Marine Orders and legislative instruments, made and administered by the Australian Maritime Safety Authority (AMSA). The requirements of each Marine Order made under the POTS Act and their relevance to the activity are outlined separately below.	Section 7 and Section 8 Implementation of the BMS
Marine Order 91 – Marine pollution prevention — oil	Marine Orders Part 91 implements Part II of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex I of MARPOL (oil pollution). The Marine Orders provide standards for the discharge of certain oily mixtures or oily residues and associated equipment and include duties to manage bunkering and transfers of oil between vessels; to maintain Oil Record Books and Shipboard Oil Pollution Emergency Plans (SOPEPs); and to report oil pollution.	Vessels ≥400 gross tonnes (GT) are required to maintain: • International Oil Pollution Prevention (IOPP) certificates to demonstrate that the vessel or facility and onboard equipment comply with the requirements of Annex I of MARPOL (as applicable to vessel size, type and class). • Oil Record Books to record activities, such as fuel/oil bunkering and discharges of oil, oily water, mixtures and residues. • SOPEPs outlining the procedures to be followed during an oil pollution incident. • Discharges must also comply with Annex I of MARPOL, and oil pollution incidents must also be reported to AMSA.	Section 7.1.3 – Routine discharges Section 7.7.1 – Accidental release Section 8 - Emergency Conditions INPEX Browse Regional OPEP Implementation of the BMS

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Marine Order 93 – Marine pollution prevention – noxious liquid substances	Marine Order 93 - Marine pollution prevention – noxious liquid substances (made under the *Navigation Act 2012* and the POTS Act and Annex II of MARPOL) specifies the requirements for the prevention of contaminating liquids and chemicals entering the marine environment. They set out the guidelines for developing a shipboard marine pollution emergency plan (SMPEP).	INPEX and vessel contractor will comply with the Marine Order 93: Marine Pollution Prevention– noxious liquid substances (as appropriate to vessel class) in relation to the discharge to sea of any noxious liquid substances. Marine vessels >150 GT will carry SMPEPs approved under MARPOL Annex II, Regulation 17 if the vessel is carrying noxious liquid substances in bulk. (noting that the vessels SOPEP and SMPEP may be combined into a single document).	Section 7.7.1 – Accidental release Implementation of the BMS
Marine Order 94 – Marine pollution prevention — packaged harmful substances	Marine Order 94 – Marine pollution prevention — packaged harmful substances, and the POTS Act relating to packaged harmful substances as defined by Annex III of MARPOL.	INPEX and vessel contractor will comply with the *Navigation Act 2012* – Marine Order 94: pollution prevention — packaged harmful substances (as appropriate to vessel class), through reporting the loss or discharge to sea of any harmful materials.	Section 7.2 – Waste management
Marine Order 95 – Marine pollution prevention — garbage	Marine Order 95 – Marine pollution prevention — garbage implements Part IIIC of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex V of MARPOL (garbage).	Vessels ≥100 GT, or vessels certified to carry 15 persons or more, are required to maintain a Garbage Management Plan. Vessels ≥400 GT are required to maintain a Garbage Record Book. The requirements will apply to vessels (as appropriate to their size, type and class) at all times.	Section 7.2 – Waste Management Implementation of the BMS

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
	The Marine Order provides for the discharge of certain types of garbage at sea, waste storage, waste incineration, and the comminution and discharge of food waste. They also set out requirements for garbage management and recording.		
Marine Order 96 – Marine pollution prevention — sewage	Marine Order 96 – Marine pollution prevention — sewage implements Part IIIB of the POTS Act, Chapter 4 of the Navigation Act 2012, and Annex IV of MARPOL (sewage). The Marine Order includes requirements for the treatment, storage and discharge of sewage and associated sewage systems, and for an International Sewage Pollution Prevention (ISPP) certificate to be maintained on board.	Vessels ≥400 GT are required to maintain International Sewage Pollution Prevention (ISPP) certificates to demonstrate that vessels and their onboard sewage systems comply with the requirements of Annex IV of MARPOL. Discharges of sewage must also comply with Annex I of MARPOL, and oil pollution incidents must also be reported to AMSA.	Section 7.1.3 – Routine discharges Implementation of the BMS
Marine Order 97 – Marine pollution prevention — air pollution	Marine Order 97 – Marine pollution prevention — air pollution implements Part IIID of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex VI of MARPOL (air pollution).	Vessels ≥400 GT are required to have International Air Pollution Prevention (IAPP) certificates and Engine International Air Pollution Prevention (EIAPP) certificates to demonstrate that the vessel or facility and onboard marine diesel engines comply with the requirements of Annex VI of MARPOL.	Section 7.1.1 – Emissions to air Implementation of the BMS

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
	The Marine Order sets requirements for marine diesel engines and associated emissions, waste incineration on board vessels, engine fuel quality, and equipment and systems containing ozone-depleting substances (ODS).	Low-sulphur fuel oil / marine diesel with 0.5% mass-for-mass (m/m) sulphur content is required to be used in engines after 31 December 2019. In accordance with Annex VI of MARPOL, the requirements do not apply to the following: • emissions resulting from the incineration of substances that are solely and directly the result of the exploitation and offshore processing of seabed mineral resources (i.e. hydrocarbons), including but not limited to flaring during well completion and testing operations and flaring arising from upset conditions • emissions associated solely and directly with the treatment, handling, or storage of seabed minerals (i.e. hydrocarbons) • emissions from marine diesel engines that are solely dedicated to the exploration, exploitation and associated offshore processing of seabed mineral resources (i.e. hydrocarbons). Vessels ≥400 GT are required to have an International Maritime Organization (IMO)-approved waste incinerator, as confirmed by the IAPP certificate. Vessels ≥400 GT with rechargeable systems containing ODS to maintain an ODS Record Book. Vessels ≥400 GT to have an International Energy Efficiency (IEE) certificate (as applicable to the vessel and engine size, type and class). Vessels ≥400 GT to have a Ship Energy Efficiency Management Plan (SEEMP) (as applicable to the vessel and engine size, type and class).	

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Biosecurity Act 2015 (Cwlth)	The Act and its supporting legislation are the primary legislative means for managing risk of pests and diseases entering into Australian territory and causing harm to animal, plant and human health, the environment and/or the economy.	Of specific relevance to this EP, the Act requires that ballast is managed within Australian seas. The *Biosecurity Act 2015* now defines Australian seas as: • for domestic and international vessels whose Flag State Administration is party to the BWM Convention - the waters (including the internal waters of Australia) that are within the outer limits of the exclusive economic zone (EEZ) of Australia (all waters within 200 nm); or • for all other international vessels – the Australian territorial seas (all waters within 12 nm).	Section 7.4.1 - Invasive marine species Implementation of the BMS
Biodiversity Conservation Act 2016 (WA) Animal Welfare Act 2002 (WA) Biodiversity Conservation regulations 2018	Ensures the protection of biodiversity and humane treatment of native fauna. Ensures appropriate treatment and management of wildlife in the event of a potential hydrocarbon spill and response activities.	Consult with WA Department of Biodiversity, Conservation and Attractions (DBCA) and obtain relevant permit(s) before a wildlife hazing and post contact wildlife response.	Section 8 – Emergency conditions INPEX Browse Regional OPEP
Fish Resources Management Act 1994 (WA)	The *Fish Resources Management Act* is administered by the WA Department of Primary Industry and Regional Development (DPIRD) that has powers to deal with incursions of marine pests.	INPEX will manage its operations in accordance with the Act and the associated Fish Resources Management Regulations (1995) with respect to managing potential invasive marine species (IMS) risks.	Section 7.4.1 - Invasive marine species Implementation of the BMS

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
Aquatic Resources Management Act 2016 (ARMA) WA	The ARMA will become the primary legislation used to manage fishing, aquaculture, pearling and aquatic resources in WA.	At the time of submission of this EP, only certain sections of the ARMA have taken effect, with most Sections not yet commenced. While this is the case, the *Fish Resources Management Act 1994* (WA) remains in effect until the transitional provisions for the ARMA are in operation. Once in operation the ARMA will provide new management methods in a flexible framework. This EP will be updated to reflect this once the ARMA comes into effect, expected within the duration of this EP.	
National Greenhouse and Energy Reporting Act 2007 National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015	The Act provides a single, national framework for the reporting and distribution of information related to greenhouse gas (GHG) emissions, GHG projects, energy production and energy consumption. The Act includes National Greenhouse and Energy Reporting (NGER) requirements and the Safeguard Mechanism requirements.	Reporting obligations are imposed upon corporations that meet emissions/energy thresholds. The Safeguard Mechanism is administered through the NGER scheme by the Clean Energy Regulator and is designed to minimise additional mandatory reporting requirements. As well as keeping their emissions below their baseline, safeguard facilities must adhere to the reporting and record keeping requirements of the NGER scheme. INPEX reports on the Ichthys Project as a whole and has committed to a baseline under the Safeguard Mechanism requirement.	Section 7.1.1 – Emissions to air Implementation of the BMS

Legislation	Description	Requirements	Demonstration of how requirements are met in EP
National Environment Protection (National Pollutant Inventory) Measure 1998 (established under the *National Environment Protection Council Act 1994*)	The National Pollutant Inventory (NPI) provides publicly available information on the types and amounts of toxic substances being emitted into the Australian environment. Ninety-three substances have been identified as important due to their possible effect on human health and the environment.	Australian, state and territory governments have agreed to legislation called National Environment Protection Measures (NEPMs), which help protect or manage particular aspects of the environment. Australian industries are required to monitor, measure and report their emissions under this legislation. INPEX reports relevant NPI substances to comply with the NPI NEPM.	Section 7.1.1 – Emissions to air Implementation of the BMS

Table 2-2: Summary of applicable industry standards, guidelines, conventions and agreements

Guideline	Description
Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018)	These guidelines provide a framework for water resource management and state specific water quality guidelines for environmental values, and the context within which they should be applied.
International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL)	This convention is designed to reduce pollution of the seas, including dumping, oil and exhaust pollution. MARPOL currently includes six technical annexes. Special areas with strict controls on operational discharges are included in most annexes.
International Convention on the Control of Harmful Anti-fouling Systems	This convention prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.
International Convention for the Safety of Life at Sea (SOLAS) 1974	In the event of an offshore emergency event that endangers the life of personnel, the International Convention for the Safety of Life at Sea (SOLAS) 1974 may take precedence over environmental management.
Bonn Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil and other harmful substances (Bonn Agreement)	The Bonn Agreement is the mechanism by which the North Sea states, and the European Union (the Contracting Parties), work together to help each other in combating pollution in the North Sea area from maritime disasters and chronic pollution from ships and offshore installations; and to carry out surveillance as an aid to detecting and combating pollution at sea. The Bonn Agreement Oil Appearance Code may be used during spill response activities.
The Australian Petroleum Production and Exploration Association *Code of Environmental Practice* (APPEA 2008)	Recognising the need to avoid or minimise and manage impacts to the environment, this code of environmental practice includes four basic recommendations to APPEA members undertaking activities: • Assess the risks to, and impacts on, the environment as an integral part of the planning process. • Reduce the impact of operations on the environment, public health and safety to as low as reasonably practicable (ALARP) and to an acceptable level by using the best available technology and management practices. • Consult with stakeholders regarding industry activities. • Develop and maintain a corporate culture of environmental awareness and commitment that supports the necessary management practices and technology, and their continuous improvement.

Guideline	Description
Australian Ballast Water Requirements, Version 8 (DAWE 2020)	Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015*.
National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2018)	A voluntary biofouling management guidance document developed under the National System for the Prevention and management of Marine Pest Incursions. Its purpose is to provide tools to operators to minimise the amount of biofouling accumulating on their vessels, infrastructure and submersible equipment and thereby to minimise the risk of spreading marine pests.
International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) (IMO 2009)	All vessels are required to manage their ballast water and sediments in accordance with the Convention and *Biosecurity Act 2015*. The convention came into force on 8 September 2017 and Australia's ballast water policy and legislation align with the convention.
Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (IMO 2012)	The guidelines provide a globally consistent approach to the management of biofouling. They aim to reduce the risk of translocation of marine pests from biofouling present on immersed areas of vessels. It was adopted by IMO marine environment committee in the form of Resolution MEPC.207 (62) in 2011.
National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020)	The guidelines provide best-practice industry standard for managing potential impacts of light pollution on marine fauna.
United Nations Framework Convention on Climate Change (1992)	The objective of the convention is to stabilise GHG concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. Australia ratified the convention in December 1992 and it came into force on 21 December 1993.
EPBC Act 1999 Policy Statement – Section 527E	Section 527E defines the 'impact' of an action (primary action) as an event or circumstance which is a direct consequence of the action; or an indirect consequence of the action, if the action is a substantial cause of the event or circumstance. Indirect consequences may also be referred to as indirect impacts and can be either upstream or downstream; they may include emissions or discharges that could result in harm to a matter of national environmental significance (MNES). The indirect consequence of an action must be a substantial cause of an event or circumstance for it to be considered an impact of the action.

Guideline	Description
Matters of National Environmental Significance - Significant Impact Guidelines 1.1 EPBC Act 1999	Under the EPBC Act an action will require approval from the minister if the action has, will have, or is likely to have, a significant impact on a MNES. A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.
Paris Agreement on Climate Change (2015)	The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 ^{o}C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 ^{o}C. The Paris Agreement provides the international framework and context around Australia's nationally determined contributions (NDC).
National disaster risk reduction framework	In 2019, the Australian Government agreed to a National Disaster Risk Reduction Framework outlining foundational actions to be taken across all sectors to address existing disaster risk and minimise the creation of new risk. The framework recognises global climate change as an underlying driver of disaster risk.

3 DESCRIPTION OF ACTIVITY

3.1 Overview

The Ichthys Field development, operated by INPEX, consists of a CPF and a FPSO with a number of satellite drill centres consisting of manifolds and subsea wells tied back to the CPF (Figure 3-1). A summary of Ichthys project infrastructure and coordinates is presented in Table 3-1 and Table 3-2. To provide further context from a spatial perspective, an indicative layout of Ichthys Project subsea infrastructure either currently installed or to be installed in WA-50-L, within the life of this EP is presented in Figure 3-2.

In addition to Ichthys Project infrastructure, historical exploration wells are also present within WA-50-L, a summary of these is provided in Table 3-3.

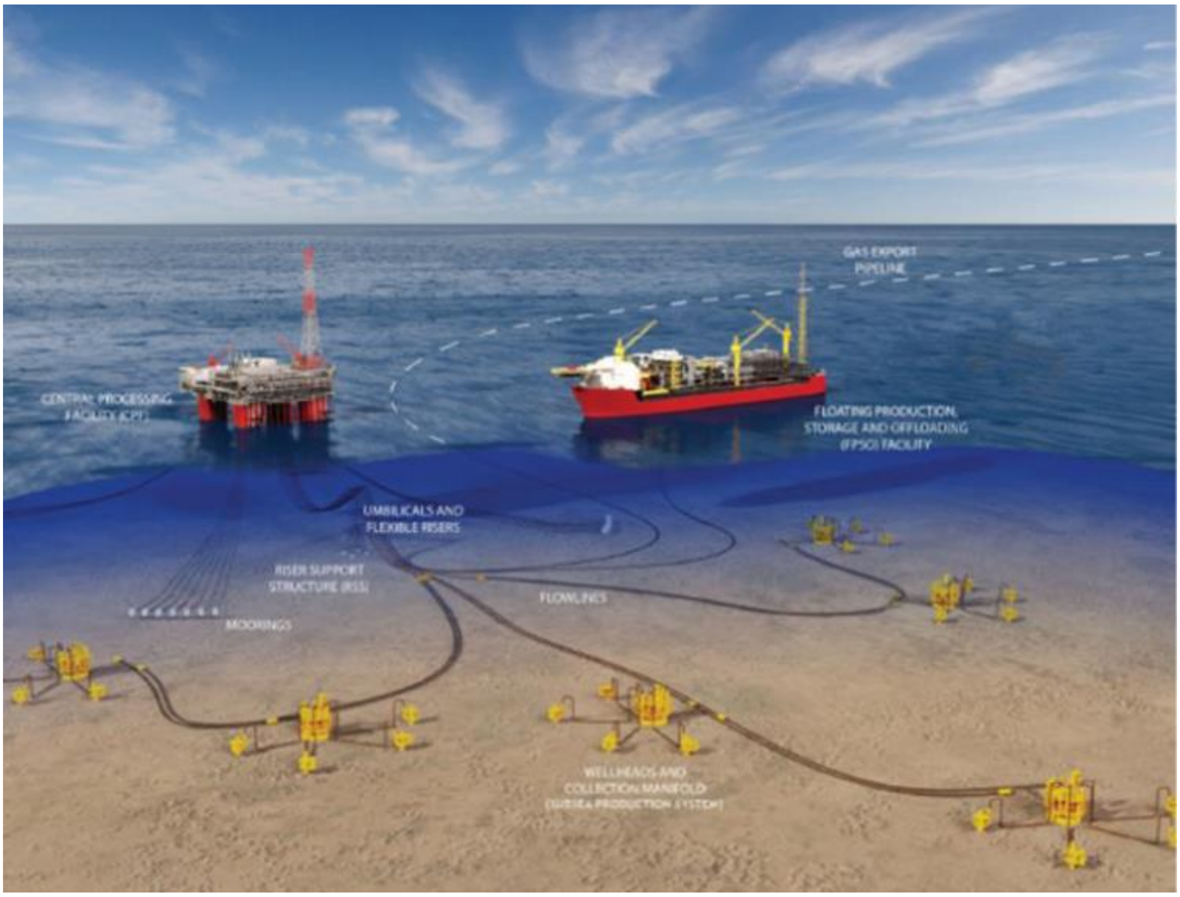


Figure 3-1: Ichthys field layout

Table 3-1: Ichthys Project infrastructure in WA-50-L

Infrastructure item	**Status**	**Latitude (South)**	**Longitude (East)**
CPF	Active	13° 56' 20.460''	123° 17' 52.048 ''
FPSO	Active	13° 57' 54.717''	123° 18' 53.239''
Riser support structure (RSS)	Active	13° 56' 14.717''	123° 17' 49.712''
Production riser base GS1	Active	13° 55' 56.812''	123° 17' 45.234''
Production riser base GS2	Active	13° 55' 57.036''	123° 17' 42.948''
Production riser base GS3	Active	13° 55' 59.228''	123° 17' 37.721''
Production riser base GS4	In development	-	-
GERB (modules 1, 2) GERB (module 3) Two 18-inch tie-in spools between GERB modules 1 & 2 and module 3 *	Active	13° 56' 04.423'' 13° 56' 01.335''	123° 17' 50.183'' 123° 17' 50.507''
42-inch GERB tie-in spool and support	Active	13° 56' 02.938''	123° 17' 48.990''
Two 18-inch production flowlines transport well fluids from production manifolds at each drill centre via the gathering system to a production riser base which feeds the well fluids to the CPF via 12-inch flexible production risers.	Active	The relative locations of these key pieces of Ichthys LNG infield subsea infrastructure are shown in Figure 3-2.	
Four 10-inch flexible export risers connect the CPF to the GERB	Active		
Two 12-inch CRM lines (flowlines and risers) for the transfer of well fluids from the CPF to FPSO	Active		
Two 8-inch flexible flash-fuel gas transfer lines (flowlines and risers) between the CPF and FPSO	Active		
8-inch and 6-inch MEG flowlines and risers from FPSO to the MEG distribution manifold to the drill centre manifolds	Active		
Power interconnector cable between the CPF and FPSO	Active		
Drill centres			
BDC-1A – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	Active	13° 51' 42.32''	123° 16' 22.23''

BDC-1B – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	Active	13° 50' 48.66''	123° 19' 13.67''
BDC-1C – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	Active	13° 52' 46.44''	123° 19' 04.33''
BDC-1D – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	In develop ment	-	-
BDC-2 – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	In develop ment	-	-
BDC-3 – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	In develop ment	-	-
BDC-4 – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	Active	13° 54' 17.84''	123° 09' 53.01''
BDC-5 – production manifold, umbilical, subsea distribution unit, flying leads, tie spools and well jumpers connecting to wellheads	Active	13° 49' 29.27''	123° 12' 47.85''

* Note – there is 6.9 km of GEP between the GERB and the boundary of WA-50-L, this section of the GEP is covered by the title, WA-22-PL and therefore is described in the GEP Operations EP.

Table 3-2: Ichthys Project production wells in WA-50-L

Drill centre	Well name	Status	Latitude (South)	Longitude (East)
BDC-1A	BDC 1A 01	Active	13° 51' 42.042"	123° 16' 23.354"
	BDC 1A 03	Active	13° 51' 42.620''	123° 16' 23.368"
	BDC 1A 04	Active	13° 51' 41.231"	123° 16' 22.559"
	BDC 1A 06	Active	13° 51' 41.234''	123° 16' 21.929''
BDC-1B	BDC 1B 01	Active	13° 50' 48.677"	123° 19' 12.538"
	BDC 1B 03	Active	13° 50' 48.099''	123° 19' 12.602"
	BDC 1B 04	Active	13° 50' 49.646"	123° 19' 13.055"
BDC-1C	BDC 1C 01	Active	13⁰ 52' 45.673"	123⁰ 19' 03.467"
	BDC 1C 02	Active	13⁰ 52' 46.181"	123⁰ 19' 03.196"
	BDC 1C 03	Active	13° 52' 45.360''	123° 19' 03.979''
	BDC 1C 06	Active	13° 52' 47.263''	123° 19' 03.518''
BDC-4	BDC 4 01	Active	13° 54' 16.778''	123° 09' 52.833''

Drill centre	Well name	Status	Latitude (South)	Longitude (East)
	BDC 4 02	Active	13° 54' 16.950''	123° 09' 52.372''
	BDC 4 03	Active	13° 54' 16.844''	123° 09' 53.407''
	BDC 4 04	Active	13° 54 17.393"	123° 09 51.971"
	BDC 4 06	Active	13° 54' 17.852''	123° 09' 51.599''
BDC-5	BDC 5 03	Active	13° 49' 28.634''	123° 12' 48.746''
	BDC 5 04	Active	13° 49' 28.359''	123° 12' 47.197''
	BDC 5 05	Active	13° 49' 29.203''	123° 12' 49.023''
	BDC 5 06	Active	13° 49' 28.762''	123° 12' 46.807''

This EP is the first 5-year EP revision for the operation of the Ichthys Project offshore facility and covers the next 5 years of the expected 40-year Ichthys field life. In addition to continuing production operations, the interlinked facility will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure over this time. During such periods of intense activity an accommodation support vessel (ASV) will be required to accommodate additional personnel. Progression of the development over the next 5 years through continuation of development drilling will also result in the introduction of Plover reservoir hydrocarbons.

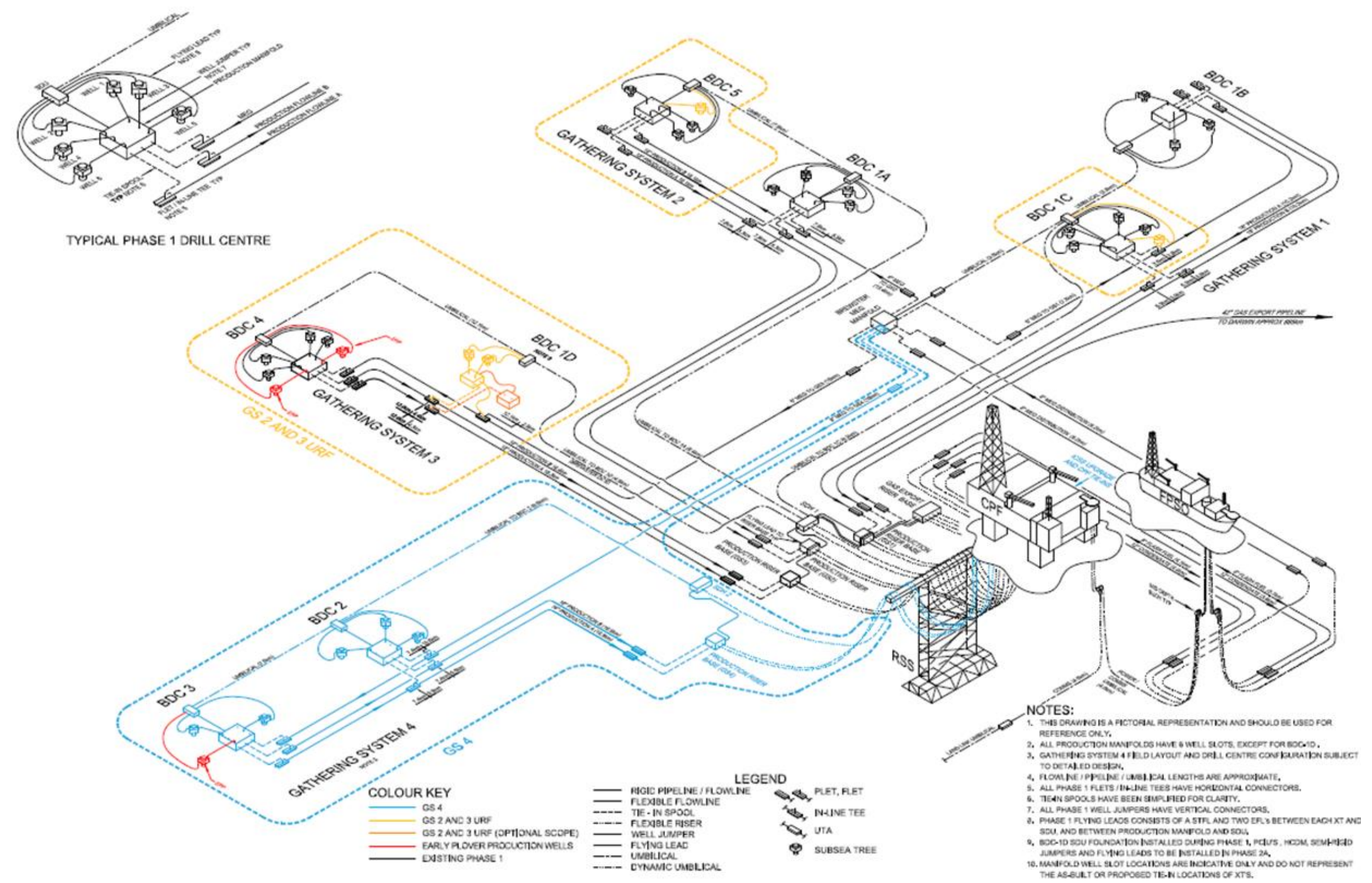


Figure 3-2: Indicative representation of Ichthys LNG infield subsea installation layout

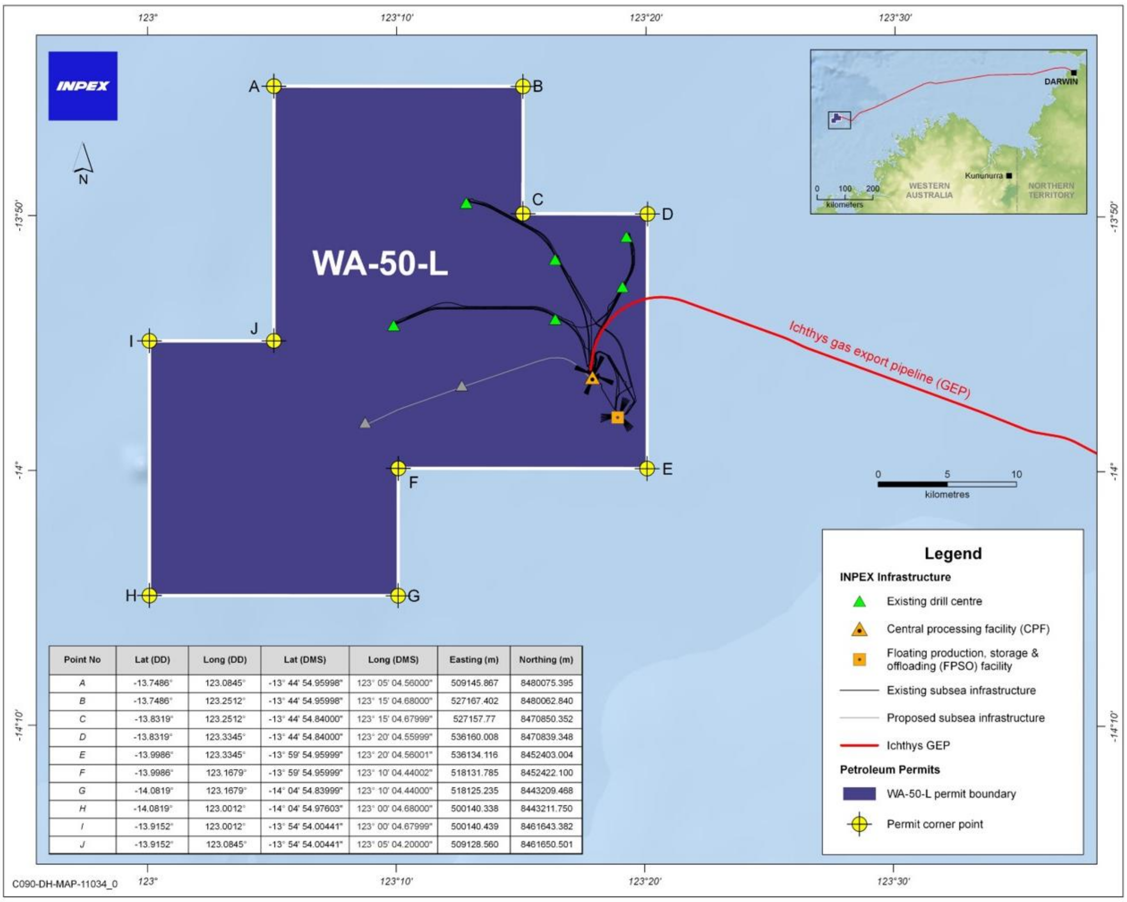
Within WA-50-L, previously part of WA-285-P, a number of exploration wells have been drilled between 1980 and 2008. With the exception of the wells listed in Table 3-3, all previous exploration wells in WA-50-L have been permanently plugged and abandoned with all subsea infrastructure (including wellheads) removed. The wells listed in Table 3-3 will be inspected as part of the scope of this EP, in accordance with WOMP requirements until such time that a separate decommissioning EP will be submitted to NOPSEMA (refer to Section 3.7).

Table 3-3: Exploration wells in WA-50-L

Exploration wells				
Well name	**Status**	**Wellhead**	**Latitude (South)**	**Longitude (East)**
Brewster - 1	Plugged & abandoned	Not recovered	13° 54' 41.370''	123° 15' 33.121''
Brewster -1A, -1A-ST	Suspended	In place	13° 54' 44.826''	123° 15' 33.455''
Gorgonichthys-1	Plugged & abandoned	Not recovered	13° 58' 36.480''	123° 07' 40.080''

3.2 Operational area

The activities covered by this EP will all be undertaken within the boundaries of petroleum production licence WA-50-L over a period of five years (Figure 3-3).



Point No	Lat (DD)	Long (DD)	Lat (DMS)	Long (DMS)	Easting (m)	Northing (m)
A	-13.7486°	123.0845°	-13° 44' 54.95998"	123° 05' 04.56000"	509145.867	8480075.395
B	-13.7486°	123.2512°	-13° 44' 54.95998"	123° 15' 04.68000"	527167.402	8480062.840
C	-13.8319°	123.2512°	-13° 44' 54.84000"	123° 15' 04.67999"	527157.77	8470850.352
D	-13.8319°	123.3345°	-13° 44' 54.84000"	123° 20' 04.55999"	536160.008	8470839.348
E	-13.9986°	123.3345°	-13° 59' 54.95999"	123° 20' 04.56001"	536134.116	8452403.004
F	-13.9986°	123.1679°	-13° 59' 54.95999"	123° 10' 04.44002"	518131.785	8452422.100
G	-14.0819°	123.1679°	-14° 04' 54.83999"	123° 10' 04.44000"	518125.235	8443209.468
H	-14.0819°	123.0012°	-14° 04' 54.97603"	123° 00' 04.68000"	500140.338	8443211.750
I	-13.9152°	123.0012°	-13° 54' 54.00441"	123° 00' 04.67999"	500140.439	8461643.382
J	-13.9152°	123.0845°	-13° 54' 54.00441"	123° 05' 04.20000"	509128.560	8461650.501

Figure 3-3: Operational area (WA-50-L)

3.3 Process description

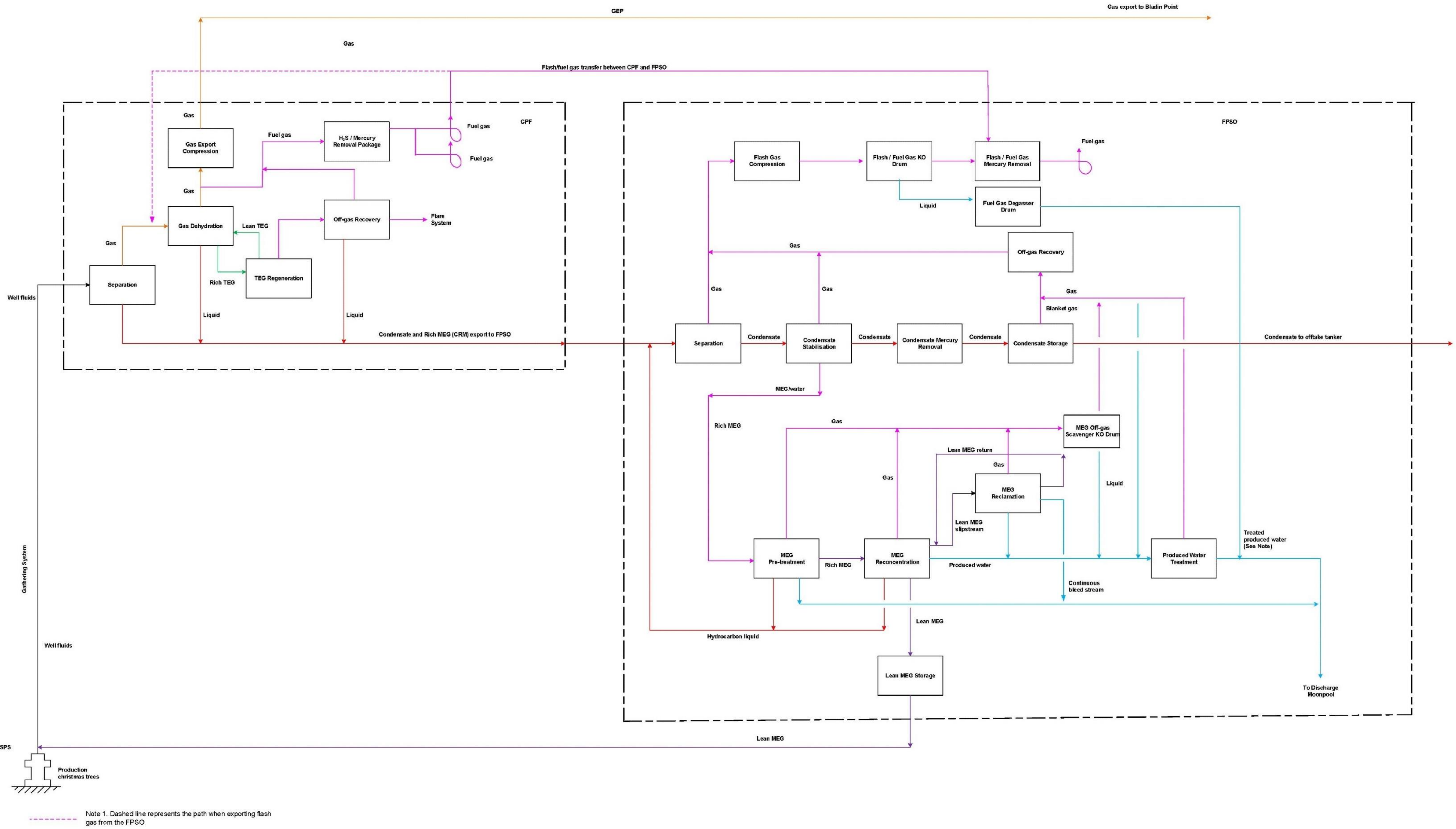
The process flow diagram presented in Figure 3-4 illustrates the principal hydrocarbon processing stages for the FPSO and CPF but, for reasons of clarity, does not show all of the supporting water and utility systems, although they are evaluated in this EP. The SPS, CPF and FPSO systems are described individually in sections 3.3.1, 3.3.2 and 3.3.3 of this EP; however, the following hydrocarbon process description is provided as an overview of production operations at the interlinked facility.

Well fluids comprising gas, condensate and PW are conveyed from the reservoirs by means of the SPS (Section 3.3.1). The well fluids, consisting of a liquid stream of condensate and rich MEG (delivered to the wellheads as lean MEG from the FPSO, as shown by the purple line in Figure 3-4) are received on the CPF in three parallel process trains of inlet surge vessels and production separators. The vessels enable the physical separation of bulk liquids (red line on Figure 3-4) from the gas (orange line in Figure 3-4). The bulk liquids, referred to as condensate and rich MEG (CRM), are transferred from the CPF to the FPSO. Water-saturated gas from the separators is then dehydrated through contact with triethylene glycol (TEG), upon which the gas is routed for gas export compression and exported to Bladin Point via the GEP.

Water is removed from the rich TEG to generate lean TEG which can then be recycled (the recovered water is sent, via the CRM, to the FPSO for treatment). The TEG regeneration process is thermally promoted and assisted by the use of stripping gas, and the resulting off-gas is diverted to the off-gas recovery system. The off-gas recovery system receives, compresses and cools the gas from hydrocarbon process vents on the CPF and the TEG regeneration system. The recovered gas streams are then routed to the fuel gas system (pink line on Figure 3-4) which provides power to various packages on the CPF, such as the gas export compressor and power generation packages.

Once transferred to the FPSO, the CRM is received in a slug catcher and split between two parallel processing trains enabling the incoming liquids to be split into three phases: condensate, flash gas and rich MEG. To promote the separation of the condensate, flash gas, and rich MEG, and to gradually reduce the liquids' pressure, the CRM is passed through the intermediate pressure (IP), the medium pressure (MP), and the first and second low pressure (LP) separators. Following initial separation in the IP and MP separators, the moisture content of the resulting condensate is further reduced by passing through the MP coalescer. The dewatered condensate is then stabilised in the first and second LP separators, by undergoing further heating and flashing, in order to reach the required specification. The condensate is then cooled and sent for mercury removal to meet export specification before storage and offtake by tanker.

The flash gas recovered in the IP, MP, and LP separators is comingled with the gas recovered from the FPSO off-gas recovery (OGR) system (pink line on Figure 3-4). The gas is then compressed, scrubbed of mercury, heated, and dosed with hydrogen sulfide (H_2S) scavenger to reduce its H_2S concentration. The spent scavenger is separated from the gas and routed to the PW system downstream of the MPPE unit, before the gas is sent to the FPSO fuel gas system for power generation. If excess gas is produced, it can be exported to the CPF. During re-starts, before sufficient flash gas is achieved, the gas will be flared.



Note - Degasser fluids are routed to the produced water (PW) buffer tank and then discharged via the moonpool covered under Temporary MOC 2000100004.

Figure 3-4: Process flow summary of HC processing system.

The rich MEG recovered from the separators is routed to the MEG regeneration system in order to generate lean MEG (i.e. removing water and hydrocarbon from the recovered MEG). The MEG regeneration system is comprised of the pre-treatment, reconcentration, and reclamation subsystems. In the pre-treatment subsystem, the volatile and dispersed hydrocarbons are removed, as well as low solubility salts (salts originating from the reservoirs). Following pre-treatment, the rich MEG is routed to the reconcentration subsystem to remove excess water by distillation. High solubility salts (also originating from the reservoirs) are then removed from the lean MEG in the reclamation subsystem. The generated lean MEG is stored on board the FPSO ready for reinjection back to the SPS (purple line on Figure 3-4). In each subsystem, the recovered gas is sent to the OGR system, the condensate recirculated into the process system, and the PW routed to the PW system. PW separated during the MEG regeneration process is treated before being discharged to sea.

Full details on the emissions, discharges and wastes associated with the operation of the offshore facility are identified in Table 3-7 which also includes supporting vessels and IMR activities.

3.3.1 Subsea production system

Operation of the subsea production system

The XTs, operated from the CPF, control and monitor the flow and condition of the reservoir fluids, and provide a means for the injection of chemicals necessary for production and asset protection. The XTs within each drill centre are connected to a subsea production manifold via well jumpers for the collection and commingling of reservoir fluids. Xmas tree valves (XTVs) are located within each XT, to isolate the production well from the production manifold.

The reservoir fluids are transferred from the subsea production manifolds to the production riser base through the 18-inch diameter production flowlines, which are laid along the surface of the seabed, then through the 12-inch diameter flexible production risers, which connect the flowlines to the CPF. The gas is separated from the reservoir fluids on the CPF and transferred to the gas export system. Four 10-inch flexible export risers connect the CPF to the GERB. Dehydrated hydrocarbons transfer through these risers to the GERB, and into the GEP, for export to the Ichthys LNG plant in Darwin. Subsea isolation valves (SSIVs) are located on the seabed at the base of each production and export riser, to isolate the production flowlines and GEP inventories from the risers.

Reservoir fluids transfer from the CPF to the FPSO via the two CRM lines, which consist of rigid flowlines on the seabed and flexible risers connected to the CPF and FPSO topsides. Two flexible flash-fuel gas (FFG) transfer lines are also connected for the transfer of flash gas and/or fuel gas between the CPF and the FPSO.

All CPF flexible risers are supported by the riser support structure, a 110-metre-high steel tower located on the seabed. FPSO risers are supported by mid-depth buoys. Riser emergency shutdown valves (RESDVs) are located on each riser at the CPF and FPSO, to isolate the riser inventory from the CPF and FPSO topside production systems.

In addition to the reservoir fluid gathering system, there is a network of utility pipelines and umbilicals, which transfer MEG and other production chemicals to the drill centres. There are also electrical and hydraulic controls lines used to operate the subsea production system.

Control of the subsea production system is via an open-loop (vent-to-sea) hydraulic system to provide the motive force to actuate subsea asset valves and chokes. Operation and maintenance of subsea open-loop valves will result in minor discharges of subsea control fluids, such as subsea hydraulic fluids and MEG.

3.3.2 Central processing facility

The CPF is a permanently moored, semisubmersible production unit which contains hydrocarbon processing systems and utilities on its topsides. It is permanently manned and has a maximum accommodation capacity of 200. The CPF is shown in Figure 3-5.

The CPF had multiple antifouling coatings applied while under construction. The antifoul coatings on the hull were International Intersmooth 365 with Intersmooth 100 topcoat. These biocidal antifouling coatings are Self-Polishing Copolymers (SPCs) and are present on approximately 95% of the external hull. International's Intersleek 970 (a fluoro-polymer Fouling Release Coating (FRC) was also used on niche areas such as draft marks, hull markings and boot tops.

Figure 3-5: The central processing facility (CPF)

The CPF is operated from the Central Control Room (CCR). The CPF CCR is continuously manned 24/7 and is the primary control point for:

- all CPF topsides and hull equipment
- all subsea equipment

- the GEP up to, but excluding, the beach valve(s) at the beach landing of the GEP
- the CPF–FPSO transfer lines from the CPF up to the connection to the FPSO turret.
- The CPF CCR has real-time, online visibility of the FPSO systems (and vice versa).

The purpose of the CPF is to separate the reservoir fluid received from the gathering system into its liquid and gaseous components. The separated liquid stream (condensate rich MEG (CRM)) is transferred to the FPSO for further treatment. The separated gas is dehydrated to the required water dewpoint, compressed, and transferred to the GEP by means of four 10-inch flexible gas export risers. The CPF has a range of systems to meet processing requirements. These systems consist of the following components:

- CPF gas systems
  - reception, separation, dehydration, gas export compression and liquid export
  - off-gas recovery system
  - fuel gas system
  - nitrogen system
  - flare system (LP/HP)
- CPF MEG storage and injection system
- TEG regeneration system
- CPF water systems
  - seawater cooling water
  - drainage and bilge
  - sewage effluent
  - ballast
- CPF utility systems
  - firewater and foam for fire-extinguishing
  - fresh/potable water production
  - power generation
  - chemical injection.

CPF gas systems

Reception, separation, dehydration, gas export compression and liquid export

Incoming well fluids are received in three parallel process trains of inlet surge vessels (ISVs) and production separators. The vessels promote the physical separation of the bulk liquids (water, MEG and condensate) from the gas and also remove any sand particles of >66 µm from the well fluids. Water-saturated gas from the separators is dehydrated by contact with lean triethylene glycol (TEG) in glycol dehydration columns. The purpose of the gas dehydration system is to dehydrate the process gas received from the production separators to meet the GEP water dewpoint specification. The dehydrated gas is compressed by gas-turbine-driven gas export compressors (GEC) and is then routed to the GEP. The rich TEG, containing water, hydrocarbons, and mercury, is sent for regeneration to produce lean TEG, which is then recycled. The regeneration process is thermally promoted and assisted by the use of stripping gas. The resulting off-gas is routed to the off-gas recovery (OGR) system.

Off-gas recovery

The OGR system collects, compresses and cools low-pressure hydrocarbon gases from around the production and storage systems on the CPF—gases which would otherwise be sent to flare—and routes them to the fuel gas system. This enables flaring on the CPF to be reduced with the process designed for no routine flaring, aside from the pilot flare, during normal operations. Two gas streams are recovered: the overhead gas from the TEG regeneration packages containing water vapour and hydrocarbon gas; and primary seal gas from the gas-turbine-driven gas export compressors (GEC). From the gas streams, any mercury present is condensed in the OGR compressor and liquid mercury is collected in the OGR mercury collector, which is periodically returned onshore for disposal or recycling.

When the OGR system is non-operational, off-gas is routed to the flare system. During normal operation, there are no emissions or discharges to the environment from the OGR system.

Fuel gas system

The fuel gas system provides fuel gas to different packages throughout the CPF; namely, the GEC packages, inlet compression packages, main power generation packages, the high-pressure/low-pressure (HP/LP) flare pilots, and the TEG regeneration packages. The fuel gas is a mixture of dehydrated process gas and gas from the OGR package and contains H_2S and elemental mercury. HP gas is passed through a mercury-removal unit (MRU) and two sulfur-removal units (SRUs) before distribution. The MRU consists of a bed of solid catalyst which reduces the mercury concentration in the gas to less than 50 ppb (wt). The SRU reduces the H_2S levels in the gas to around 0.1 ppm (v) and comprises two 100 per cent beds of solid catalyst. Spent solid catalysts from the MRU and SRUs are periodically replaced and returned onshore for disposal or recycling.

Nitrogen system

The nitrogen system generates 97 per cent pure nitrogen for the purging of vessels, equipment and piping throughout the CPF. It is also used as a purge gas within the LP/HP flare systems, a secondary seal gas within the compressors, and as a blanket gas within various tanks and drums (e.g. MEG and TEG storage tanks). Purged and displaced nitrogen is released to the atmosphere.

Flare system (LP/HP)

Situated in the north-west corner of the CPF, the flare stack is 150 m above the main deck with the flare tip at 213 m. The flare has been located to minimise the likelihood of a flaring event being blown towards the accommodation or helideck.

During normal operations, no routine flaring is expected, although the fuel gas-fired pilots will be continuously lit for safety reasons. The purging of flare headers on both LP and HP systems will be undertaken to prevent oxygen ingress, using nitrogen gas rather than fuel gas (which will only be used as a backup), in order to reduce emissions of combustion gases to the atmosphere.

Flaring is only expected to occur during maintenance, process upsets (including re-start following a shutdown or offline equipment/equipment trips), and emergencies, when it is required to protect the integrity of the facility and to prevent harm to personnel, environment and equipment. Guidelines on the expected volumes and duration limits for various unplanned flaring events, as well as the correction action and required approvals are detailed in the Flaring Management Plan and summarised in Section 9.6.3. Such events may include the following main flaring activities:

- pressure relief and emergency blowdown – to protect the integrity of the facility and prevent loss of containment.
- manual blowdown – to safely depressurise equipment before IMR or installation of new equipment.
- process upset – i.e. an unplanned event, such as gas exceeding the necessary dewpoint specification for export, requiring it to be flared to protect the integrity of the GEP or process upsets resulting from equipment trips.
- process upset during re-start of the facility following a shutdown –re-starts are expected to result in increased periods of flaring until normal operations recommence.

The LP flare system on the CPF collects, contains, and safely disposes of relief, depressurisation, and low-pressure operational loads from process equipment. Fluids released into the LP flare system are collected in the LP flare header and piped to the LP flare knock-out (KO) drum. Hydrocarbon gas is routed from the KO drum to the flare tip at the top of the flare stack, where it is disposed of by combustion. Any liquids collected within the KO drum are pumped to the closed-drains system.

The HP flare system on the CPF has been designed to manage and dispose of high-pressure operational loads from process equipment. The system receives hydrocarbon gas flows from pressure safety valves and blowdown valves located throughout the topside process areas. These flows are routed to the HP flare KO drum via the flare headers. Liquids collecting in the drum are pumped to the closed-drains system, and gas is routed to the flare tip at the top of the flare stack, where it is disposed of by combustion.

CPF MEG storage and injection system

The CPF MEG storage and injection system stores and delivers MEG to meet the needs of both the SPS and the CPF. Although MEG is provided to the SPS predominantly from the FPSO, it can also be supplied intermittently from the CPF for hydrate remediation during subsea and topsides start-up; pressure equalisation of riser emergency shutdown valves (ESDVs) and surface-controlled subsurface safety valves (SCSSVs); and pigging operations associated with riser change-outs. Fresh lean MEG (99.5% wt) is bunkered from a supply vessel, at a rate of up to 150 m^3/h, to the MEG storage tanks in the CPF hull. Two loading stations are provided, one on each side of the CPF, to accommodate varying weather conditions. The MEG loading hose is provided with a dry-break coupling. There are no planned discharges to the environment from the MEG storage and injection system.

TEG regeneration system

Water-saturated gas from the production separators is dehydrated by contact with lean triethylene glycol (TEG) in glycol dehydration columns. The TEG regeneration system removes water from the rich (water-laden) TEG received from the glycol dehydration column to produce lean TEG which is then recycled to the dehydration column. The regeneration process is thermally promoted by means of an electrical heating element and injected with stripping gas taken from the fuel gas system to ensure the regenerated (lean) TEG meets the required purity.

The TEG regeneration process results in the generation of 'off-gas', a mixture of water vapour, stripping gas, small quantities of benzene, toluene, ethylbenzene and xylene (BTEX), and mercury. The off-gas is mixed with the flash gases from the TEG flash drum and routed to the OGR system. TEG is bunkered from a supply vessel to the TEG storage and drain vessel. From there it is pumped to each regeneration package, as required. Two loading stations are provided, one on each side of the CPF, to accommodate varying weather conditions. The TEG hose is provided with a dry-break coupling. There are no planned emissions or discharges to the environment from the TEG regeneration system.

CPF water systems

Seawater cooling water

To provide the necessary cooling of process equipment on board the CPF, seawater is extracted at a depth of around 130 m below sea level by means of flexible hoses. The seawater is treated, i.e. filtered and dosed with a sodium hypochlorite (NaClO) solution from the biofouling control package to protect downstream equipment from biofouling and increased corrosion risk. The solution of NaClO is generated by decomposing seawater through an electrolyser to form NaClO and hydrogen gas. The hydrogen gas is stripped from the NaClO solution and mixed with air before being vented to the atmosphere. If the biofouling control package is non-operational, seawater can be treated by intermittently pumping diluted sodium hypochlorite solution (12.55 w/w) directly into the stream, generally for 15 minutes up to four times per day. Where possible, manual dosing coincides with ballast water movements to ensure that the product is distributed to all end user systems with the correct hypochlorite concentration. Free chlorine in the seawater system is routinely sampled from the seawater dump caisson and confirms that the free chlorine concentration is approximately 1 ppm or less

The seawater cooling water provides a feed of treated seawater for several systems on board the CPF, such as the mooring system, power generation equipment, and the heating, ventilation, and air conditioning (HVAC) equipment. In addition to cooling, it also provides a stream of treated seawater for use in other systems on board the CPF, such as the ballast system, the freshwater production system and the cooling medium system. The process equipment is cooled in a continuous flow, closed-loop system through the use of plate exchangers with no direct contact between the fluids. The CPF has been designed so that cooling water discharges do not exceed 45 °C. To confirm the design specification, water temperature monitoring in early field life recorded water temperature at discharge consistently ranged between 33-38 °C. After use as a cooling medium, the cooling water is returned to the sea via the seawater dump caisson at a depth of approximately 26 m. Infrequent overboard drainage of the seawater cooling system (return seawater) may be required for maintenance.

Cooling medium system

The cooling medium system is a closed loop, freshwater system which provides cooling to various process and utility users on the CPF. The cooling medium (inhibited seawater) is cooled against seawater in the seawater/cooling medium exchangers. There may be infrequent, ad-hoc drainage discharges from this system during maintenance.

Drainage (closed and open systems) and bilge

The closed drains system collects hydrocarbon drainage from process equipment where the release of the equipment contents could cause a risk to personnel, the environment, or the CPF. Recovered hydrocarbons are ultimately transferred to the FPSO along with the CRM.

The CPF has two decks (designated lower and main), both of which are plated, along with a number of intermediate grated decks. This means that the majority of rainwater falling on the CPF will be collected from the main deck, with only minimal flow onto the lower deck. Rain falling onto the main deck and the exposed part of the lower deck is collected in the equipment drip trays and deck drain boxes. Any hydrocarbon spilt is collected by the "first flush" of rain/deluge, flows from the trays and drain boxes into the drains headers, and is routed under gravity to the open drains system. To ensure adequate capacity following heavy rainfall events, drain boxes were modified to increase capacity and enable better drainage and avoid any overflow. The open drains system collects liquid spills, washdown and contaminated runoff on the CPF topsides, as well as operational and maintenance drainage of systems that either do not contain hydrocarbons or systems which have been flushed and/or purged and may contain residual hydrocarbons and routes them for treatment (de-oiling) while allowing noncontaminated rainwater to drain directly to sea.

De-oiling is by means of the open drains centrifuge package. The hydrocarbon liquid separated in the centrifuge package is routed to the closed drains drum for reprocessing. The treated water is discharged to sea via the open drains caisson, once it has met the required specification for oil-in-water (OIW). The open drains centrifuge package includes a filter downstream of the centrifuge and a recirculation system to further treat off-specification drainage.

The OIW concentration of the open-drain is measured via an inline OIW analyser downstream of the open-drains centrifuge package.

Open drains systems have the potential to become exposed to bacterial contamination. In the event that bacterial contamination is observed (e.g. smell), treatment with biocide may be required to reduce bacterial growth within the CPF open drains.

The bilge system provides the means of removing water from CPF hull compartments and machinery spaces that are normally dry, such as pump rooms, access shafts, access tunnels and voids. It is capable of managing small leaks and spillages of oil and water, and heavy leakage from pipes or equipment. Under normal operating conditions, bilge is pumped (via bilge well pumps) into the open drains centrifuge package for treatment before discharge. In case of an emergency (such as CPF columns flooding) the bilge content can be discharged directly overboard via dedicated emergency bilge pumps. Discharge from the bilge pumps occur through a purposely designed emergency bilge overboard opening on the CPF top deck approximately 23 m above the operating draft and 80 m to the side of the seawater dump caisson.

In addition, each CPF HVAC module, (one in each of the 4 x CPF caisson legs) discharges condensed water through a discharge pipe located on each caisson leg, directly into the ocean. Whilst this discharge is supposed to be condensed (pure) water only, due to corrosion of HVAC copper cooling coils, some copper has been detected in the discharge stream, due to unexpected, post-start-up corrosion of the HVAC copper cooling coils.

Sewage effluent, grey water and food waste

The sewage system receives domestic sewage from the toilets, showers, washbasins, kitchen and laundry facilities, which is collected in the macerator holding tank. The effluent is then pumped to the sewage macerators to reduce the solids particle size to less than 25 mm by means of maceration. The resulting effluent is then routed to sea via the sewage disposal caisson.

Grey water is collected in the grey water gravity collection system and drains naturally to the macerator holding tank. Black water is collected in a separate vacuum system but is also routed to the macerator holding tank. The tank also receives macerated food waste from the two waste disposal units located within the CPF galley, which is also discharged via the sewage disposal caisson at a depth of approximately 12 m.

The macerator holding tank has a capacity of 9 m^3 and is aerated by three sets of air diffusers mounted at the base of the tank. The blowers, which operate in a 2 × 100 per cent duty/standby configuration, continuously supply air to agitate the contents of the tank and prevent solids from settling.

Ballast system

The ballast system is designed, under normal conditions, to keep the CPF at operational draught and on an even keel by filling and emptying ballast tanks located within the pontoon. Ballast water is supplied with treated seawater from the seawater cooling system and return ballast is discharged to sea via the seawater dump caisson on an as-required basis. Discharged ballast water will contain residual NaClO however there will be no further dosing of ballast tanks with biocide.

CPF utility systems

Firewater/foam fire-extinguishing

Firewater is supplied by means of four electrically powered submersible firewater pumps. Each pump is equipped with a dedicated diesel-powered electrical generator and installed in a dedicated caisson. The foam fire extinguishing system supplies 3 per cent alcohol-resistant aqueous film-forming foam (AR-AFFF) and 3 per cent film-forming fluoroprotein (FFFP) foam mixed with water to deluge systems to protect equipment where the potential for a pool fire exists. Concentrated AR-AFFF is stored in a 35 m^3 tank on the main deck of the CPF which provides a minimum of 20 minutes supply. An additional 1 m^3 container of AR-AFFF is located at the helicopter-fuel skid and two 1 m^3 containers of FFFP foam are located in the helideck parking area. During an emergency event, or infrequently for maintenance testing, foam released on deck will be routed to the open-drains system for discharge to sea, with minor quantities of windblown foam.

Fresh/potable water

The purpose of the system is to produce, bunker, store, and distribute potable water for domestic consumption and general use on the CPF. During operations, fresh water will be produced by means of a reverse osmosis (RO) unit on board the CPF and the resulting saline reject-water stream will be sent to the seawater dump caisson for disposal to sea.

Power generation

Electrical power on the CPF is provided by means of three gas-turbine-driven generators, each rated at around 25 megawatts (MW). These main power generators (MPGs) are dual gas-fuel-fired with diesel backup. Fuel gas will always be used in preference to diesel; however, during periods when fuel gas is not available, liquid diesel fuel can be used until fuel gas is available again. Treated seawater is used directly to cool the MPGs.

The CPF and FPSO power generation systems are linked with a power interconnector cable. The cable allows the transfer of 25 MW of electrical power in either direction between the components of the facility so that the generation arrangement can be optimised in normal operations. This reduces the necessary margins on each component, improving overall efficiency. The CPF also has two, 2-MW diesel-powered emergency/black-start generation packages.

The resulting gaseous products of combustion from gas turbines and diesel packages are discharged to atmosphere via dedicated exhaust stacks.

Chemical injection

The chemical injection system on the CPF is used to store and deliver a range of chemicals required for the efficient operation of the CPF topsides process and the subsea XTs and flowlines. The following chemicals are provided for treatment of the CPF process systems and the chemical injection equipment is grouped together in packages on the CPF to suit skid dimensions and weight:

- corrosion inhibitor may be used in the TEG regeneration package.
- pH controller is used in the TEG regeneration package.
- antifoam is used to minimise the formation of foam and possible liquid carry-over in the process separators.
- TEG antifoam is used in the TEG regeneration package.
- scale inhibitor is used to prevent scale build-up in subsea flowlines and topsides process lines and equipment.
- demulsifier is used to break OIW emulsions to aid condensate/water separation.
- wax inhibitor is used to minimise wax build-up in the topsides process systems and liquid export transfer line to the FPSO. It is also used to minimise wax build-up in the subsea flowlines where it is injected downstream of the subsea choke valves.

Production chemicals injected into the process will partition into the hydrocarbon phase and/or the aqueous phases in the CRM liquids, and will be exported to the FPSO via the CRM line.

Chemicals of the required concentration are loaded to the chemical injection packages from tote tanks/ISO containers, and dosed to the systems that use/need them using duty/standby injection pumps. All permanent chemical storage and injection areas are bunded, with any spilt material routed to the closed-drains system.

3.3.3 Floating production storage and offloading

The floating production, storage and offtake (FPSO) facility is a purpose-built, permanently moored, mono-hulled, production and liquid storage unit which supports hydrocarbon processing systems and utilities over a number of deck levels on its topsides and has liquid storage tanks in its hull. It is also permanently manned and provides accommodation for 200 personnel.

The FPSO had multiple antifouling coatings applied while under construction. The antifoul coating on the external hull (approximately 98% of the exposed area) was International's Intersleek 970 (a fluoro-polymer FRC). The turret area (approximately 2% of exposed area) was coated with International Intersmooth 365 with Intersmooth 100 topcoat. These biocidal antifouling coatings are SPCs.

The FPSO CCR is continuously manned 24/7 and is the primary control point for:

- all FPSO topsides, turret and hull-located equipment, including condensate offloading facilities
- MEG supply for subsea operations (topsides supply header pressure control only).

The control system is designed so that the FPSO CCR has real-time, online visibility of the CPF systems (and vice versa). The FPSO will take executive action to manage events local to the FPSO. The FPSO and CPF are in constant live communication, and the CPF, which is in control of wells, will lead production-related decision and adjustments. The FPSO is shown in Figure 3-6.

The FPSO processes the liquid CRM received from the CPF to produce a stabilised hydrocarbon condensate (essentially light oil), Lean MEG, and treated PW for discharge. The condensate is stabilised through the removal of low molecular weight hydrocarbons (flash gas) and treated to meet condensate export specifications. It is then sent to storage within the FPSO hull from where it is periodically offloaded to shuttle tankers for export to market.

Figure 3-6: The floating production, storage and offtake (FPSO) facility

The recovered flash gas is compressed and used as fuel gas on the FPSO or, if in excess, returned to the CPF via two 8″ FFG transfer flexible flowlines/risers. The rich MEG stream is processed to remove hydrocarbons, PW and solids. Excess PW is then removed by distillation and the resulting lean MEG sent to storage for subsequent reinjection to the subsea wells in the SPS. The PW is treated to remove residual petroleum hydrocarbons and is then commingled and discharged to sea via the FPSO discharge moonpool.

The FPSO has a range of systems to meet processing requirements. These systems are described below and are generally considered to comprise:

- FPSO condensate and gas systems
    - reception and separation
    - condensate stabilisation and mercury removal
    - flash gas compression and mercury removal
    - off-gas recovery system
    - fuel gas system

  - blanket gas and inert gas systems
  - nitrogen system
  - atmospheric vents
  - flare system.
- FPSO MEG system
  - MEG pretreatment
  - MEG reconcentration
  - MEG reclamation.
- FPSO water systems
  - produced water
  - seawater cooling water
  - drainage, slops and bilge
  - sewage effluent
  - ballast.
- FPSO utility systems
  - firewater and foam for fire-extinguishing
  - fresh/potable water production
  - power generation
  - chemical injection.

FPSO condensate and gas systems

Reception and separation

The CRM transferred from the CPF to the FPSO is received in a slug catcher and is then split evenly between two parallel downstream trains of separators and coalescers. The separators promote the separation of the incoming fluids into three phases: rich MEG, hydrocarbon condensate, and flash gas. The rich MEG is routed to the MEG regeneration system, and the flash gas is sent to the flash gas compression system. The condensate is passed through electrostatic coalescers to remove the remaining rich MEG and ensure that the solids, water and salinity specifications for the condensate product are not exceeded. The condensate is then routed to the condensate stabilisation system.

Condensate stabilisation and mercury removal

The purpose of the condensate stabilisation system is to remove the light (i.e. low molecular weight) components from the condensate so that it meets the specification required for export. This is achieved by heating the condensate and passing it through separators. The separated gas is sent for flash gas compression, and the condensate is cooled and sent for mercury removal. The heating required for stabilisation is achieved by recovering waste heat in a closed loop system from the gas turbines that drive the main power generation system on board the FPSO; thereby, increasing the overall thermal efficiency of the process.

The condensate mercury removal system is designed to remove mercury by reaction/adsorption from the stabilised condensate so that its concentration meets the required specification for export. The condensate is then routed to the condensate storage tanks. Any MEG/water carry-over resulting from the stabilisation process is sent to the MEG regeneration system. Spent adsorbent and filters from the condensate mercury guard bed vessels are periodically replaced and returned onshore for disposal or recycling.

Flash gas compression and mercury removal

The flash gas compression (FGC) system receives the flash gas produced in the condensate separation and stabilisation systems and gas recycled via the off-gas recovery system (described below). The gases are compressed for use as fuel gas on the FPSO or, if in excess, returned to the CPF (during early field life, excess gas will be exported to the CPF via the flash/fuel gas transfer flowlines; however, in later field life, the FPSO can import gas from the CPF).

When the flash gas compression system is non-operational, flash gas is routed to the flare system. During normal operation, there are no emissions or discharges to the environment from the flash gas compression system.

The flash gas mercury removal system removes elemental mercury from the flash gas stream before it is used as fuel gas. This is achieved by passing the gas through the flash gas mercury guard bed vessels where the mercury is removed by reaction/adsorption before the gas is routed to the fuel gas system. Spent adsorbent and filters from the flash gas mercury guard bed vessels are periodically replaced and returned onshore for disposal or recycling. The first replacement of the mercury guard beds occurred in May 2021.

Off-gas recovery system

The FPSO OGR system collects continuous hydrocarbon process vents from around the FPSO and recycles the collected gases and liquids, returning the liquid components to the upstream condensate separation system and the gaseous components to the flash gas compression and fuel gas systems. This ensures that the process is designed for no routine flaring, aside from the pilot flare, during normal operations.

If the OGR system is non-operational during operations, low pressure process gases can be safely disposed of via the FPSO's atmospheric vent, and high-pressure process gas loads can be managed via the flare system (both systems are described further below). During normal operation, there are no emissions or discharges to the environment from the OGR system.

Fuel gas system

In early field life, the fuel gas generated on board the FPSO is a mixture of flash gas and gas from the OGR package. The gas is heated and dosed with H_2S scavenger to reduce its H_2S concentration. The spent scavenger is separated from the gas and sent to the PW system downstream of the MPPE unit. The gas is filtered, heated, and then distributed to users.

The fuel gas is provided continuously to the main power generation gas turbines, heating medium heaters and the HP flare pilot lights. Fuel gas is also supplied intermittently as an inert 'blanket' gas to maintain the tank blanketing header pressure in the FPSO hydrocarbon-containing tanks, and to the inert gas generators and other supporting or backup systems.

In certain circumstances, fuel gas will be imported from the CPF via the FFG transfer lines.

Blanket gas and inert gas systems

In order to maintain a nonexplosive atmosphere within the FPSO hydrocarbon containing tanks, fuel gas or nitrogen gas will be used as an inert ‘blanket’ gas to prevent oxygen ingress. However, when sufficient fuel gas or nitrogen gas is not available for use as a blanket gas in the tanks, inert gas can be provided from the inert gas generator. The inert gas is generated through the combustion of fuel gas, or diesel fuel as backup. The resulting gas from the combustion is scrubbed with seawater, which cools the gas and removes particulate combustion residues before distribution. The seawater used for this purpose is discharged to sea via the discharge moonpool.

Blanket fuel gas / inert gas displaced during the filling of the FPSO hydrocarbon containing tanks is collected and returned to the OGR system, which therefore results in a reduction of hydrocarbon gases released to the atmosphere with no continuous venting from tanks under normal operations.

Nitrogen system

The nitrogen system generates 97 per cent pure nitrogen for the purging of vessels, equipment and piping throughout the FPSO. It is also used as a purge gas within the flare system, secondary seal gas within the compressors, and as a blanket gas within various tanks and drums (e.g. MEG and oxygen scavenger storage tanks). Purged and displaced nitrogen is released to the atmosphere.

Atmospheric vents

The FPSO is provided with the following atmospheric vents for infrequent, unplanned, non-continuous emissions during process upsets:

- atmospheric vent
- H_2S vent
- inert gas vent
- tank maintenance vent.

The atmospheric vent is 83 m above the poop deck. It provides for infrequent gaseous emissions from pressure relief valves throughout the FPSO gas and condensate systems, and also provides a safe low-pressure disposal route for process and utility gases in the event that the OGR system is unavailable.

The H_2S vent provides for the venting of H_2S in a safe location in the rare event that the H_2S injection scavenger in the fuel gas system fails.

Inert gas resulting from overpressure protection of the inert gas distribution and hydrocarbon containing tank blanketing headers is collected and discharged to atmosphere at a safe location via the inert gas vent.

In the event that the hydrocarbon containing tanks are purged with inert gas, the inert gas is routed to the tank maintenance vent.

Flare system (HP)

A four-legged vertical flare tower supported by bulkheads in the hull is located on the FPSO topsides.

During normal operations, no routine flaring is expected, although the fuel-gas-fired pilot will be continuously lit for safety reasons. The purging of the flare header will be undertaken to prevent oxygen ingress using nitrogen gas, rather than fuel gas (which will only be used as a backup), in order to reduce emissions of combustion gases to the atmosphere.

Flaring is only expected to occur during maintenance, process upsets (including re-start following a shutdown) and emergencies, when flaring is required to protect the integrity of the facility and to prevent harm to personnel, the environment and equipment. Guidelines on the expected volumes and duration limits for various unplanned flaring events, as well as the correction action and required approvals are detailed in the Flaring Management Plan and summarised in Section 9.6.3. Such events may include the following main flaring activities:

- flaring to maintain fuel gas transfer line minimum turndown rate – to avoid slugging in transfer line to maintain integrity of the line
- flash gas compression system offline relating to a compressor train trip
- FPSO fuel gas system trip and flash gas route to CPF not available.

The HP flare system is designed to manage and dispose of high-pressure operational loads from process equipment on the FPSO. The flare system receives hydrocarbon gas flows from pressure safety valves and blowdown valves located throughout the topside process areas. These flows are routed to the HP flare knock-out drum via the flare headers. Liquids collecting in the drum are pumped to the closed drains system, and gas is routed to the HP flare tip at the top of the flare stack where it is disposed of by combustion. The flare tip is located 140 m above the FPSO poop deck. The HP flare tip is continuously monitored by means of an infrared camera.

There is no requirement for a LP flare system on the FPSO and any LP gases recovered are vented to atmosphere as described in the *Off-gas recovery* and the *Atmospheric vents* sections above.

FPSO MEG system and storage

The purpose of the MEG system is to treat rich MEG received from the FPSO's upstream processes in order to produce lean MEG for recycling to the SPS. The system comprises three subsystems:

- MEG pre-treatment. The purpose of this system is to remove hydrocarbons from the rich MEG feed, and precipitate low solubility (divalent) salts. Hydrocarbon liquids are removed by skimming and centrifugation. The divalent salts, originating from the reservoirs, are precipitated by the addition of sodium hydroxide (NaOH) and are routed to the FPSO discharge moonpool for disposal (intermittent discharge).
- MEG reconcentration. The rich MEG from pretreatment is distilled to remove excess water. The recovered water is sent to the PW system and the dewatered (lean) MEG is sent to storage in the lean MEG storage tank.
- MEG reclamation. This system is designed to remove high solubility (monovalent) salts from a slipstream of lean MEG taken from the reconcentration process. A closed loop heating medium system uses heat recovered from the power generation gas turbines and from gas-fired heaters to heat the slipstream under vacuum, causing the MEG and water to boil off. The remaining concentrate is dosed with sodium carbonate (Na_2CO_3) to precipitate the high solubility salts. These are removed by centrifugation, mixed with PW and sent to the PW system. The boiled off lean MEG (90% MEG, 10% water) is condensed and returned to the reconcentration process or sent to the subsea system, since it has already been dewatered. The lean MEG injection system uses variable speed injection pumps to deliver lean MEG from the

lean MEG storage tanks to the injection points on the subsea XTs. In order to control fluid viscosity in the system, and the accumulation of organic acids, a bleed stream can be withdrawn from the MEG system and routed to the FPSO discharge moonpool (intermittent discharge).

Citric acid is used for descaling within the MEG system and is periodically discharged in small volumes, once the strength of the acid has become depleted. The spent citric acid, along with the comingled bleed stream from the MEG reclamation system and the divalent salts from the MEG pretreatment system, comingles with the treated PW before being routed to the FPSO discharge moonpool.

FPSO water systems

The FPSO has been designed with inlet and discharge moonpools to enable seawater intake and liquid effluent discharge via flexible hoses. Operating the FPSO will give rise to several liquid effluent streams, all of which are commingled and discharged below the sea surface via a dedicated discharge moonpool (note there are two identical discharge moonpools as shown in Figure 3-7 but only one is used at any one time).

The design of the FPSO incorporates an internally located wide, open bottomed tank (moonpool) that is accessible, when empty, for maintenance purposes. The decision to locate the moonpools internally within the hull was to enable the FPSO to withstand weather conditions associated with a 1in10 000year cyclonic event, due to the absence of external appendages on the hull.

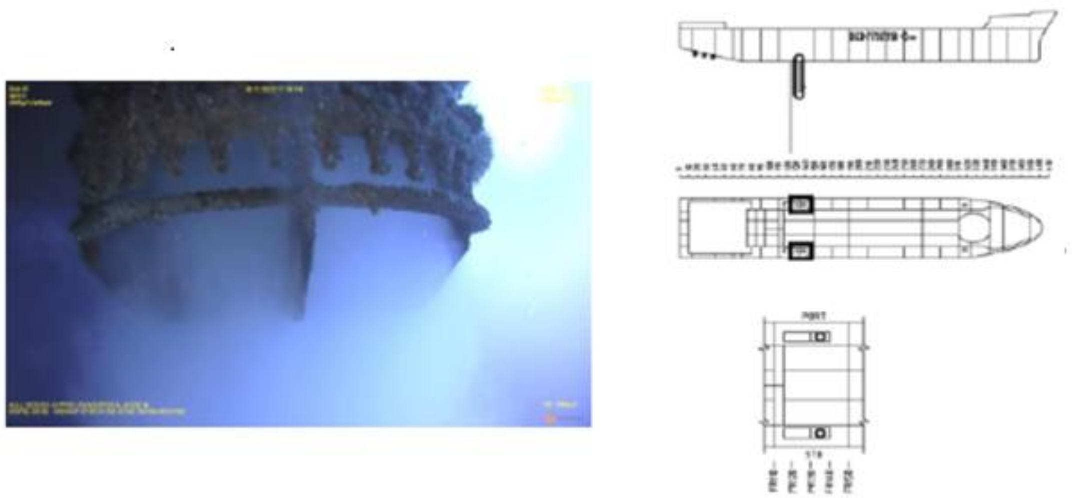


Figure 3-7: FPSO discharge moonpool

Produced water (PW)

PW is primarily composed of:

- condensed water vapour from processing
- formation waters from the reservoirs, i.e. produced formation water (PFW).

PW also contains hydrocarbons and trace levels of production chemicals. Before discharge into the marine environment, hydrocarbons are removed from the PW. Primary PW treatment is undertaken by means of a series of buffer tanks and skimming tanks to enable the gross (primary) separation of hydrocarbons from the PW. Following primary separation, the PW is pumped to a secondary treatment package to enable the further removal of hydrocarbons. If deemed necessary, the PW can be diverted to a settling tank for further separation before entering the secondary treatment package.

The secondary PW treatment is based on macro porous polymer extraction (MPPE) technology to treat the PW in order to remove both aromatic and aliphatic hydrocarbons. MPPE technology is an established technology based on liquid–liquid extraction where the extraction liquid is immobilised in a bed of macro porous polymer particles within the MPPE columns. The incoming PW is filtered and then pumped through the columns where hydrocarbons are absorbed into the MPPE particles and the resulting treated PW (containing residual hydrocarbons) is discharged to the sea via the discharge moonpool. The recovered hydrocarbons are sent to the recovered oil drum and are diverted back through the process to the condensate stabilisation system.

The use of MPPE for PW treatment is considered the best available technology and has been selected for use due to its proven effectiveness in the removal of aromatic and aliphatic hydrocarbons (including BTEX) as well as polycyclic aromatic hydrocarbons (PAHs). The treatment system is resistant to interference from other PW components, such as salts and surfactants, and requires minimal operator intervention.

The MPPE columns are frequently regenerated by stripping with low pressure steam. The recovered hydrocarbons from the stripping process are routed to the recovered oil drum and the condensed water stream is sent to a settling tank to enable the gross separation of hydrocarbons, before being routed to the MPPE for further treatment.

A strainer was permanently installed downstream of the MPPE package in 2021 to prevent the loss of any solids from the PW system. The performance of the strainer can be confirmed through pressure monitoring.

The OIW concentration of the PW is measured via an inline OIW analyser system downstream of the MEG system comingling points, and upstream of the drains system comingling point, before entering the discharge moonpool. When operating automatically the off-specification PW is routed back through the system for repeated treatment.

This method of hydrocarbon detection involves the use of Ichthys produced water as the calibrant. The FPSO has observed that OIW analyser readings can be disproportionally affected by either, other substances present in the discharge stream, or the unique characteristics of the Ichthys condensate itself. As such, alternative methods of detecting hydrocarbons are being investigated and temporary reliance on manual sampling alternatives are in place. These alternative methods can be used for calibration and verification of OIW concentrations.

Seawater cooling water

To provide the necessary cooling of process equipment on board the FPSO, seawater is extracted at a depth of around 110 m below sea level by means of flexible hoses located in the FPSO inlet moonpools. The seawater is treated (i.e. filtered and dosed) with a sodium hypochlorite (NaClO) solution from the biofouling control package to protect downstream equipment from biofouling. The solution of NaClO is generated by decomposing seawater through an electrolyser to form NaClO and hydrogen gas. The hydrogen gas is stripped from the NaClO solution and mixed with air before being vented to the atmosphere. If the biofouling control package is non-operational, seawater can be treated by pumping diluted sodium hypochlorite solution directly into the stream, generally for 15 minutes up to four times per day. Where possible, manual dosing coincides with ballast water movements to ensure that the product is distributed to all end user systems with the correct hypochlorite concentration. Sampling is conducted regularly to detect free chlorine in the seawater and throughout early field life the records indicated it is typically below 1 ppm.

The seawater cooling water provides a feed of treated seawater for several systems on board the FPSO, such as gas scrubbers, power generation equipment, and HVAC equipment. In addition to cooling, it also provides a stream of treated seawater for use in other systems on board the FPSO, such as the ballast system, the freshwater production system and the cooling medium system. The process equipment is cooled in a continuous flow, closed-loop system through the use of plate exchangers with no direct contact between the fluids. The FPSO has been designed so that cooling water discharges do not exceed 45 °C. Water temperature monitoring in early field life confirms that the water temperature at discharge consistently ranges between 33-38°C. The intake seawater is dosed with the NaClO solution to achieve the target dosing to prevent or reduce marine growth within the systems, pumps, and downstream piping and equipment without presenting an increased corrosion risk.

After use as a cooling medium, the cooling water is returned to the sea via the FPSO discharge moonpool at a depth of approximately 15–20 m. Infrequent overboard drainage of the seawater cooling system may be required for maintenance.

Cooling medium system

The cooling medium system is a closed loop system which provides cooling to various process and utility users around the FPSO. The cooling medium (inhibited seawater) is cooled against seawater in the seawater/cooling medium exchangers. There may be infrequent, ad-hoc drainage discharges from this system during maintenance.

Heating medium system

The heating medium system is a closed loop system which provides heat to the MEG system and other process users. Heat is recovered from the exhausts of the gas turbines which drive the main power generators. There may be infrequent, ad-hoc drainage discharges from this system during maintenance.

Drainage (closed and open systems), slops and bilge

The closed drains system collects hydrocarbon drainage from process equipment where the release of the equipment contents could cause a risk to personnel, the environment, or the FPSO. Hydrocarbons are collected in headers and routed to the closed drains drum from where they are recycled back through the hydrocarbon processing system. The closed-drains drum is provided with facilities to enable the offline removal of solids which may accumulate in the bottom of the drum. The solids are pumped as a slurry and returned to shore for treatment and disposal.

The open drains system is designed to collect liquid spills on the FPSO topsides captured in local bunds, drip pans or deck drain boxes, as well as operational and maintenance drainage of systems that either do not contain hydrocarbons or systems which have been flushed and/or purged and may contain residual hydrocarbons, and route them for treatment (de-oiling) while allowing noncontaminated rainwater to drain directly to sea. The collected liquids are routed via the open drain tanks to the slop tanks where basic gravity separation of oil from water occurs. Areas on the FPSO with the potential for spillage of significant quantities of hydrocarbon or hazardous liquids are fitted with either plated decks, local bunding (wall or curb) or drip pans. Plated areas of the FPSO are provided with deck drain boxes throughout. These features contain any spills and direct them to the open drains system. The drip trays and drain boxes each have a seal loop to the drains headers and a vertical 8″ overboard line. Typically, a spill will be retained in the trays/drain boxes until it is flushed into the drains system by rainwater. The open drains system has therefore been designed to treat this potentially contaminated "first flush". To ensure adequate capacity following heavy rainfall events, drain systems were modified to enable better drainage and avoid any overflow.

The slop tank system consists of three tanks structurally integrated in the FPSO hull. They perform three main functions, and in normal operations, each tank will be designated to fulfil one of the following functions:

- storage of fresh water for tank cleaning, where water is taken from, and returned to, the slop tank system
- collection, storage and treatment of drains and bilge water
- storage and treatment of slop water from tank cleaning and other cargo and process system flushing operations.

Oil is removed from the slop water by skimming and the water is then periodically pumped to the open-drains centrifuge package for further treatment and to enable the recovery of hydrocarbons. The recovered hydrocarbons are then recycled back through the hydrocarbon processing system. The OIW-treated water is discharged to sea via the discharge moonpool. Any drainage exceeding the OIW discharge specification is diverted to the slops tank system for further treatment. The OIW concentration of the open drains is measured via an inline OIW analyser.

Open drains systems have the potential to become exposed to bacterial contamination. In the event that bacterial contamination is observed (e.g. smell), treatment with biocide may be required to reduce bacterial growth within the FPSO open drains.

The bilge system provides the means of removing water from FPSO hull compartments and machinery spaces that are normally dry, such as pump rooms, cofferdams and voids. It is capable of managing small leaks and spillages of oil and water, and heavy leakage from pipes or equipment. Bilge is pumped into the open drains system from where, as described above, it is treated before disposal to the sea via the discharge moonpool.

Sewage effluent, grey water and food waste

The sewage system receives the domestic sewage from the toilets, showers, washbasins, kitchen and laundry facilities and is collected in either of two holding tanks. The effluent is then pumped to the sewage macerators to reduce the solids particle size to less than 25 mm by means of maceration. The resulting effluent, which also includes macerated food scraps and combined streams of grey water is then discharged via a dedicated hose that runs within the FPSO discharge moonpool but extends to a depth of approximately 30–35 m. The sewage discharge does not co-mingle with the other effluent streams within the FPSO discharge moonpool.

Ballast system

The purpose of the ballast system is to control the FPSO draught, list and trim, and to assist in controlling hull bending moments and shear force stresses. The system comprises multiple tanks arranged towards the outside of the hull to provide collision impact protection to cargo (condensate) tanks. Ballast filling is achieved using pumps installed in separate inlet moonpools and the pumps are dosed with NaClO to inhibit biofouling. Return ballast is discharged to sea via the FPSO discharge moonpool on an as required basis, depending on vessel stability, to maintain minimum draught requirements. Discharged ballast water will contain residual NaClO; however, there is no further dosing of ballast tanks with biocide.

FPSO utility systems

Firewater/foam fire-extinguishing

Firewater is supplied by means of four electrically powered submersible firewater pumps. Each pump is equipped with a dedicated diesel-powered electrical generator. The foam fire-extinguishing system supplies 3 per cent film-forming fluoroprotein (FFFP) foam mixed with water to deluge systems in order to protect equipment where the potential for a pool fire exists. FFFP concentrate is stored in a tank with a working capacity of 87.4 m^3 for a minimum of 20 minutes supply. Foam can be supplied to other areas e.g. the helideck via mobile foam carts. During an emergency event or (infrequent) maintenance testing, foam released on deck will be routed to the open drains system for discharge to sea, with minor quantities of windblown foam.

Fresh/potable water

The purpose of the freshwater system is to produce, bunker, store, and distribute potable water for domestic consumption and general use on the FPSO. During operations, fresh water will be produced by means of a reverse osmosis (RO) unit on board, and the resulting saline reject water stream is routed back to the seawater intake and is reused within the seawater cooling system.

Power generation

Electrical power on the FPSO is provided by means of three gas turbine-driven generators, each rated at around 25 MW. They are dual fuel gas fired with diesel backup. Fuel gas will always be used in preference to diesel; however, during periods when fuel gas is not available, liquid diesel fuel can be used until fuel gas is available again. In addition, there is a power interconnector cable which enables the transfer of 25 MW of electrical power in either direction between the CPF and the FPSO. The FPSO also has two, 2MW diesel-fired emergency generator packages.

The FPSO's MPG gas turbines are fitted with waste heat recovery units, with the recovered heat used in the closed loop heating system for condensate stabilisation and MEG reclamation. This will minimise combustion gas emissions per unit of heat generated.

The resulting gaseous products of combustion from turbines and diesel packages are discharged to atmosphere via dedicated exhaust stacks.

Chemical injection

On the FPSO, the chemical injection system is designed to store and deliver a range of chemicals to maintain system and process integrity. The following list of chemicals are provided for treatment of the FPSO process systems, and the chemical injection equipment is grouped together in packages on the FPSO to suit skid dimensions and weight:

- H_2S scavenger is injected with water to the fuel gas stream (flash gas and gas from OGR package) to reduce its H_2S concentration.
- demulsifier is used to break OIW emulsions to aid condensate/water (rich MEG) separation.
- scale inhibitor is used to prevent scale build-up in process lines and equipment but is not required unless a significant quantity of formation water is being produced.
- wax inhibitor is used to minimise wax build-up in the condensate rundown system. The chemical is injected in the condensate stabilisation process.
- antifoam is used to minimise the formation of foam and possible liquid carry-over in the process separators. The chemical is injected in the reception and separation process. A separate antifoam chemical is also dosed intermittently to the MEG regeneration package.
- sodium hydroxide (NaOH) is used in the MEG regeneration package.
- pH controller (HCl) is used in the MEG regeneration package for the neutralisation of excess alkalinity in the lean MEG product. It is also available for injection to the pretreatment of PW feed to the MPPE package, if required.
- citric acid is used for the offline descaling of equipment in the MEG regeneration package.
- oxygen scavenger is used in the MEG regeneration package and closed drain drum.
- sodium carbonate (Na_2CO_3) is used in the MEG reclamation package and as backup for NaOH.
- hydrochloric acid is used in the biofouling package for the cleaning of the electrolytic cells during maintenance periods.

Chemicals are delivered to the systems that use/need them using duty/standby injection pumps. Multi-head pumps are used for multiple injection locations. Two 100 per cent duty/standby positive displacement injection pumps are provided for each pump.

Sodium hydroxide (NaOH) and pH controller are bunkered due to the large storage volumes required. All other chemicals are loaded to the chemical injection systems from tote tanks. With the exception of citric acid, the chemicals are supplied premixed to the required concentrations. Sodium carbonate is pumped directly from tote tanks to the users without intermediate storage. The oxygen scavenger storage tank is nitrogen blanketed to minimise oxygen absorption by the chemical before its use. The demulsifier, wax inhibitor, and process antifoam storage tanks are also nitrogen blanketed to reduce the likelihood of a flammable atmosphere inside each tank. For the pH controller system, HCl vapour/fumes are directed to an HCl gas scrubber where they are scrubbed with treated seawater in order to remove and dispose of HCl vapour, which cannot be vented to atmosphere for health and safety reasons. The scrubbing water is discharged via the moonpool. All permanent chemical storage and injection areas are bunded, with any spilt material routed to the closed drains system.

Citric acid is not injected into the operating MEG regeneration package but is circulated through offline equipment requiring descaling. Concentrated citric acid is loaded from tote tanks to the citric acid storage tank. The citric acid is then diluted with freshwater and circulated from the tank, through the relevant components of the MEG regeneration package, and returned to the storage tank by the citric acid pumps. After several descaling operations, the strength of the citric acid in the tank is depleted and the spent tank contents are discharged via the moonpool.

3.4 Proposed key activities and schedule

In addition to the operation of the offshore facility described in Section 3.3, the following section provides a description of additional key activities scheduled for the next 5 years.

3.4.1 Proposed further development

Booster compression module

To account for future decline in pressure of the reservoirs over time, space and weight has been reserved for a BCM to be placed on the west side of the CPF main deck as shown in Figure 3-8. The BCM installation is currently scheduled for the 2024 – 2025 period.

The main objective of the BCM installation is to lower the arrival pressure of gas at the CPF, thereby:

- reducing well back-pressure and achieving Brewster reservoir production extension to meet onshore plant LNG demand profile
- maximising condensate production from the Brewster reservoir as well as increasing ultimate hydrocarbon recovery.

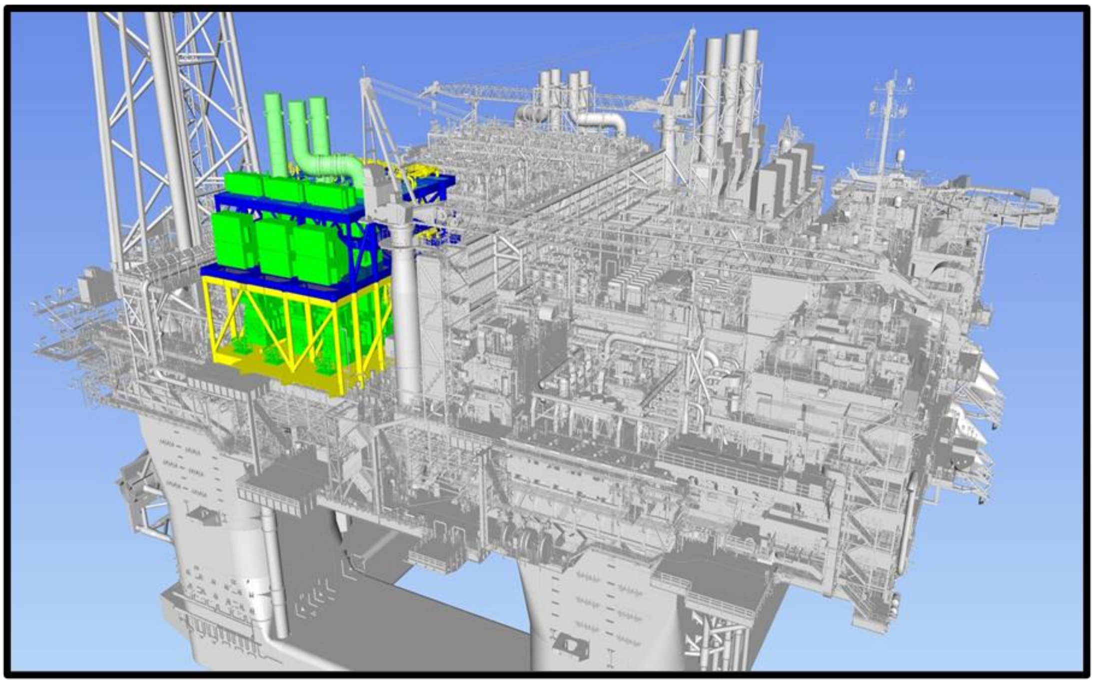


Figure 3-8: BCM location on the CPF main deck

The BCM is a compressor module with three compressor trains and includes utilities, suction scrubbers, heat exchangers, piping, instrumentation, telecoms and electrical equipment. It is split into lower and upper modules and the BCM may be installed as two horizontally split modules or as a single combined module. To facilitate the installation of the BCM other major scopes shall be implemented including:

- CPF deconstruction and BCM pre-installation works comprising of modifications to existing CPF systems, installation of tie-in valves and bumpers/guides.
- CPF post BCM installation works such as removal of bumpers/guides, module tie-in to CPF, installation of walkways etc, modification to CPF systems to low pressure (LP) operation including additional cooling system facilities.

- transportation and installation (T&I) – this scope covers the transportation of the BCM to the Ichthys Field. A heavy lift vessel (HLV) will be used to install the BCM. Prior to and during the BCM installation, CPF hydrocarbon production will be shut down[1] and gas systems depressurised from the riser emergency shutdown valves onwards. Only essential project personnel will be onboard the CPF during the installation along with sufficient operations resources to control shutdown activities along with operation of utilities and re-start of the production facilities upon completion of the heavy lift activities. The total lifting operation is expected to take less than 36 hours which is well within reliable suitable weather forecast to ensure a successful lifting operation.

3.4.2 Shutdowns

Proposed schedule

Regular maintenance of the systems and equipment on the offshore facility is undertaken on a day-to-day basis. However, during the life of this EP a number of major shutdowns are planned to undertake further inspections and maintenance and complete any repairs that cannot be completed during production operations. The major shutdowns may also be associated with expanding the capacity of the facility. A summary of planned major shutdowns with indicative timings is presented in Table 3-4.

Table 3-4: Planned major shutdowns

Planned shutdown	Indicative timings
CPF maintenance shutdown	2021, 2025
FPSO maintenance shutdown	2021, 2025
GEP pigging campaign	2022/23 with PLR recovery planned for 2024
Full field shutdown associated with major maintenance and further development	2022, 2024, 2025

Maintenance

During maintenance programs a number of tasks are scheduled to be completed in accordance with the work management system described in Section 9.6.7.

Maintenance tasks include preventative and corrective maintenance typically including testing, inspections and repair of the systems and equipment described in Section 3.3.

[1] Prior to BCM installation production wells will be shut-in and gas systems depressurised. The successful depressurisation of the CPF will be observed from the CCR by monitoring pressure transmitters. There are no discharges associated with the shutdown of the CPF prior to BCM installation but flaring during shutdown and blowdown of the topsides facilities will occur to protect the integrity of the facility and to prevent harm to personnel, environment and equipment. The depressurisation of the CPF will have no impact on the FPSO.

The planned maintenance shutdowns range in duration from two to six weeks and are expected to require additional personnel onboard the facility. No additional environmental impacts and risks associated with maintenance shutdowns have been identified other than those described in Section 7 and 8 of this EP.

Installation and commissioning

As part of the proposed further development of the Ichthys LNG Project (Section 3.4.1), the installation and commissioning of equipment will require shutdowns of the CPF and FPSO or the full field. During such shutdowns several tasks are scheduled to be completed such as tie-in of risers and umbilicals, installation and recovery of the PLR and installation/tie-in of the BCM.

The planned installation and commissioning shutdowns range in duration from two to six weeks and are expected to require additional personnel onboard the facility.

Re-start following shutdowns

Following a shutdown, once all maintenance and/or installation and commissioning activities have been completed, the facility will re-start. Re-starts following shutdowns are expected to result in process upset conditions; however, they will be limited in duration compared to the initial facility start-up completed during 2017 and 2018.

The duration of any process upsets is estimated to be in the region of several days and will include periods of increased flaring until normal operations recommence. Flaring is essential to protect the integrity of the facility and prevent harm to personnel, environment and equipment and will be managed in accordance with the flaring management plan described in Section 9.6.3.

3.5 Inspection maintenance repair

During the life of this EP, IMR activities may be required to ensure the safe and efficient operation of the infrastructure. Inspection activities, generally involving the use of a support vessel and remotely operated underwater vehicles (ROVs) include, but are not limited to, inspection of the CPF and FPSO hulls and subsea infrastructure. In addition, marine acoustic surveys (e.g. side-scan sonar (SSS) and multibeam echo sounders (MBES)) may also be undertaken. These inspections are typically conducted from a vessel or autonomous underwater vehicle (AUV) fitted with acoustic instruments. The exact frequency and nature of inspection activities is risk-based and, therefore, will depend on the specificities of individual systems/equipment. Inspections will be conducted in accordance with a risk-based inspection plan and the INPEX management of change process described in Section 9.6.6 of this EP. The inspection of exploration wells (Table 3-3) will be undertaken in accordance with the requirements specified in the WOMP.

Repair activities are expected to be infrequent, depending on the results of inspections. Indicative maintenance and repair activities that could potentially be undertaken include those presented in Table 3-5.

The exact nature of specific repair activities following, for example, failure of a subsea infrastructure component is unknown. In the event of a failure, an inspection will be undertaken to establish any maintenance or repair activities required. Potential maintenance and repair options available using any new sources of information will be assessed in accordance with Section 6 of this EP. Each maintenance or repair activity assessment will identify hazards and threats that may occur with respect to potential environmental impacts and risks. Where the assessment determines that the activity may result in a change that introduces a new or increased environmental impact or risk, INPEX will manage the changes in accordance with the management of change process described in Section 9.7 of this EP.

Table 3-5: Potential maintenance and repair activities in WA-50-L

Activity	Description
Pigging of GEP and SPS	Planned operational pigging of the GEP within WA-50-L is expected to occur up to twice within the life of this EP, where pigs will be launched from the GERB pig launcher and receiver (PLR) into the GEP. During operational pigging, MEG & small hydrocarbon discharges may occur at the GERB PLR. Pigging equipment will be provided on the CPF and FPSO to enable the operational pigging of the transfer flowlines and risers, if required. Pigging may also be used to support the decommissioning and commissioning activities for the repair or replacement subsea production infrastructure. During these pigging operations, trace amounts of hydrocarbon, FIS (contained within the replacement flowlines) and/ or MEG may be discharged to sea.
Seabed intervention activities	This may involve activities within the operational area (i.e. within 500 m of installed infrastructure) such as physical seabed intervention/excavation alongside infrastructure to adjust sand levels to gain access to or enable repairs of infrastructure including pipeline deburial. Excavation may involve activities such as jetting or mass-flow excavation. Seabed intervention activities may also include the installation of grout bags, concrete mattresses, rock placement, or other physical structures to stabilise and protect infrastructure on the seabed. The area of seabed disturbance is directly related to the nature of the repair or inspection being performed however, reasonably foreseeable activities such as ROV set downs may occur for a matter of hours and disturb an area approximately 2-4 m^2. Potential excavations may vary in length from a few meters to 100 m and may be in the order of 2 m to 4 m wide. Installation of other physical structures such as grout bags or mattresses may vary from <1 m^2 up to approximately 50 m^2.

Activity	Description
Marine growth / lime scale removal activities	This may involve the removal of marine growth and calcareous deposits on subsea infrastructure using mechanical techniques and/or chemical treatments using a vessel and ROV spread or high-pressure water jets on the topsides of the CPF/FPSO. Initially, physical removal with high pressure or cavitation jets may be used to remove as much marine growth or calcium deposits as possible. If physical removal is unsuccessful (i.e. due to access issues) weak acids such as vinegar or sulfamic acid may be used to remove residual marine growth / calcium deposits.
Riser replacement	Risers may be replaced as a result of damage, loss of integrity or when past the design life. A riser needing to be replaced will be isolated from the flowlines, and hydrocarbons will be displaced with MEG and/or treated seawater. The riser will then be depressurised and disconnected from the topsides and subsea facilities, then reeled onto an IMR vessel. Trace amounts of hydrocarbon may be discharged during disconnection. A replacement riser will then be installed from a reel on the IMR vessel. The new riser will be flooded with treated seawater and hydrotested, before being pigged, to displace the seawater, and commissioned in a condition ready for operation (e.g. filled with either nitrogen or MEG).
Flowline repair or replacement	In the event of significant damage to a MEG flowline, the contents of the flowline would be discharged to sea (release containing MEG and possible trace hydrocarbons). An IMR vessel would undertake the repair using a clamp or connector. External flowline coatings would first be removed, the damaged section would be either clamped or cut out and replaced with two connectors at each end of the damaged area and a new spool fitted in between. The flowline would then be hydrotested and commissioning prior to re-start. In the event of significant damage to an infield production flowline it is likely that the flowline would need to be replaced as the CRA cladding cannot be repaired in-situ and is highly susceptible to corrosion by seawater ingress. Therefore, the production flowline would be replaced to prevent future integrity issues. The method of flowline replacement is very much dependent on the nature of the damage and scenario surrounding the unplanned event. In this event, a new information assessment (Section 9.5) would be undertaken to ensure all impacts and risks associated with the repair were managed to ALARP and acceptable levels. As required, depending on the outcome of the new information assessment, an EP MOC may be prepared (9.6.6) or a revision to this EP may be submitted to NOPSEMA.

If maintenance or repairs are required, a support vessel may remain on site for approximately five to 60 days at a time, depending on the nature of the work required. Additional field time may, however, be required for any activity, depending on the specific circumstances. It is possible that performing some tasks (where a vessel is connected to the subsea facility) that it may be deemed as a 'Facility' under the OPGGS Act.

3.5.1 PLR

Operation of the GEP involves the transportation of dehydrated gas through the GEP to the Ichthys LNG plant in Darwin. The operation of the GEP, an entirely closed system with no planned discharges, is covered by the *Ichthys Project Gas Export Pipeline (Operation) Environment Plan* (F075-AH-PLN-10001).

The PLR was designed, fabricated and installed onto GERB module 3 as part of the original subsea production system under the original *Ichthys URF Installation Environment Plan.* During commissioning of the GEP, a dewatering pig-train was launched from an onshore-PLR in Darwin, with the pig-train arriving in the PLR at GERB module 3. The PLR at GERB module 3 was subsequently recovered to surface during the CPF and FPSO hook-up phase, and the PLR was transported to Darwin, where the dewatering pig-train was removed from the PLR for inspection.

As part of the routine/planned GEP inspection program, GEP internal wall inspections are required. The process commences with a GEP inspection pig/tool being inserted into the PLR in Darwin, and then the PLR is transported to the Ichthys Field. Using a vessel, the PLR is then re-installed onto GERB module 3 in WA-50-L (Figure 3-9) during a selected major shut-down. The duration of the PLR installation is expected to be approximately 7 days. Once the PLR is installed, as part of the facility re-start following the shutdown, CPF gas is used to drive the pig from the GERB along the length of the GEP. During transit through the GEP, the pigging tool records data which is subsequently used to assess the integrity of the internal wall of the GEP (Table 3-4). The pig will be received in the onshore-PLR at the Ichthys LNG onshore plant in Darwin. The PLR located on GERB module 3 will remain on the seabed, until the next major shutdown, when it can safely be recovered to surface and then returned to Darwin for storage. It will remain stored in Darwin until the next GEP internal inspection is required, where-upon the PLR will be re-loaded with a new inspection pig, and then re-installed at the GERB module 3. The deployment, operation and recovery of the PLR within WA-50-L is within the scope of this EP.

A GEP internal inspection/pigging campaign is currently scheduled for the 2022-23 period. The PLR will remain in-situ and will be recovered from the GERB module 3 during the scheduled 2024 shutdown.

Figure 3-9: Pig launcher receiver

3.6 Vessels

A range of vessels will be required to support the activity. Indicative vessel characteristics and their purposes are described in Table 3-6. During an emergency situation, vessels used may not be subjected to all premobilisation controls; however, controls relating to relevant environmental risks from vessel activities during an emergency condition are described in Section 8. Vessels will utilise different fuel types as detailed in Section 8 and will be equipped with on board systems to manage solid and liquid waste streams.

Vessel sharing arrangements with other nearby oil and gas operators (e.g. Shell Prelude FLNG) are in place. In such instances of vessel sharing, the IMS status of the vessel(s) are confirmed and shared between operators. Vessel sharing only occurs if the vessels are determined as having a low risk status.

The approximate durations described in Table 3-6 are indicative and subject to change, depending on operational requirements, potential delays caused by weather events and other factors.

Table 3-6: Vessels used in the petroleum activity

Vessel type	Number	Purpose
Accommodation support vessels (ASVs)	Two	During periods of intense activity such as major shutdowns, installation and commissioning activities, ASVs will link to the CPF or FPSO by means of gangways. ASVs will be held on station by means of dynamic positioning systems. ASVs can provide accommodation support in the order of 500 beds each, as well as helipads and storage/laydown areas. An example of a typical ASV is shown in Figure 3-10.
Platform supply vessels (PSVs)	Variable (2-3 on rotation)	PSVs primarily provide logistics support for materials between the main supply base in Darwin, the CPF and FPSO. They transport and transfer items, such as fuel, bulk chemicals, provisions and waste for return to the mainland. PSVs operate on a rotating basis and occasionally transfer cargo from the alternate supply base in Broome. Vessel routes typically remain outside of Australian territorial seas (i.e 12 nm), except where entering ports. The only other exception may be to temporarily seek shelter during adverse sea conditions such as in the event of a cyclone. Browse Island is located south east of the operational area. PSVs transiting from/to Darwin or Broome pass to the either the north or west of the island and the transit route does not pass within 25 km of the Island. When PSVs are in Port at a supply base they are typically alongside for less than 48 hours. During standby or in between transits, the PSVs may utilise temporary moorings located in Commonwealth waters. Nominally, PSVs within the operational area undertaking typical offloading/loading operations may be present every 3–4 days for 24–48 hours; however, subject to operational requirements, a PSV may remain in the operational area for up to two weeks continuously.

Vessel type	Number	Purpose
Offshore support vessel (OSV)	One	The primary role of the OSV is to assist and support offloading operations. It provides assistance with pilot transfer and during mooring/unmooring, hose-handling and static tow operations. The OSV may occasionally be called upon to perform IMR tasks e.g. asset inspection, subsea valve operations. OSV's are occasionally called upon to perform IMR tasks e.g. asset inspection, subsea valve operations. The OSV is present in the operational area, except for crew changes in Broome, approximately every four to five weeks, or for other reasons, such as maintenance or when on standby. During standby or in between transits, the OSV may utilise temporary moorings located in Commonwealth waters. Vessel routes ensure that during the transit, the vessels typically remain outside of Australian territorial seas, except where entering ports. The only other exception may be to temporarily seek shelter during adverse sea conditions such as in the event of a cyclone. Browse Island is located south east of the operational area. The OSV transiting from/to Broome passes to the west of the island and the transit route does not pass within 25 km of Browse Island. When in Broome Port performing a crew change and resupply, the vessel is expected to be alongside for less than 48 hours.
IMR support (including heavy-lift vessel) / ROV	Two	Foreseeable tasks for maintenance vessels include lifting and installation of pigging equipment to aid transfer of pigs through the GEP, between the GERB and the onshore LNG plant in Darwin. IMR vessels may also provide support during the tie-in of wells. A HLV will be used for the installation of the BCM. On occasion, these activities may involve a vessel to perform tasks that define the vessel as a facility under the OPGGS Act. These activities will typically be undertaken by dynamically positioned vessels supported using cranes and remotely operated underwater vehicles (ROVs). These vessels could be mobilised directly from foreign ports but are most likely to be mobilised and demobilised via Darwin or Broome Ports.
Small Logistics Support Vessel	As required (typically one)	Small logistics support vessels (hot-shot vessels) may be called upon, on an 'as required' basis, where specific equipment/items are urgently required at the offshore facility that are too heavy for transport via helicopter. Hot-shot vessels are typically small (e.g. 20-40 m in length), with a small crew of 3-4 personnel. These vessels will operate on MGO only, and typically mobilise from Broome, Darwin or Exmouth. The vessels will typically be loaded with the required item(s) in port, and steam directly from port to the CPF/FPSO, deliver the required item(s), and return to port. Hot-shot vessels are not planned to be routinely used, and may only be required a few times per year, if at all.

Vessel type	Number	Purpose
Offloading tankers	–	In accordance with Section 1.2 of this EP, an offloading tanker is not owned, chartered or operated by the titleholder. The information here is provided for context only, as it informs collision risk from a third party, while a tanker is within the operational area. Condensate offloading tankers arrive at the facility approximately every 5 to 10 days. They are piloted by an INPEX third-party contractor, who also acts as Loading Master during the hydrocarbon transfer. The transfer of condensate takes approximately 24 hours to complete. During the offloading process, the pilot directs the assisting OSV.

3.6.1 ASV

Accommodation support vessels (ASV) may be used to support major shutdown periods for maintenance and installation/commissioning activities described in Section 3.4.1 and Section 3.4.2. It is anticipated that an ASV would have the capacity to accommodate 250-500 people and will operate using DP systems (Figure 3-10).

Figure 3-10: Example accommodation support vessel

3.7 Decommissioning

As described in Section 3.1, this EP is the first 5-year EP revision for the operation of the Ichthys Project offshore facility and covers the next 5 years of the expected 40-year Ichthys field life. Within the life of this EP, further development is planned in WA-50-L including the drilling of additional production wells and installation and commissioning of associated equipment required for the development of the Ichthys Field (refer to Table 1-1). However, INPEX as the titleholder recognises the requirement for the maintenance and removal of structures, equipment and property brought into WA-50-L, as specified by Section 572 of the OPGGS Act (Maintenance and removal of property etc. by titleholder).

Maintenance and removal of infrastructure described in this EP (Table 3-1, Table 3-2 and Table 3-3) will be undertaken in accordance with the requirements of the OPGGS Act and the OPGGS (Resource Management and Administration) Regulations 2011 and NOPSEMA's Section 572 Maintenance and removal of property policy (NOPSEMA 2020a).

In preparation for the eventual decommissioning of Ichthys Project infrastructure, INPEX has developed a Decommissioning (Environmental) Standard (0000-AH-STD-60049) to define the business rules that will be implemented to eliminate or minimise any adverse environmental or social impacts from decommissioning activities. The impacts from decommissioning activities will be reduced to levels that are ALARP through robust and effective planning, management and monitoring practices.

The location of all property and equipment installed in WA-50-L on either a temporary or permanent basis is detailed and tracked in the INPEX seabed asset register (SAR). The SAR is an Excel spreadsheet combined with a computer-aided design (CAD) drawing that covers WA-50-L and includes all subsea equipment such as production riser bases, production manifolds, subsea distribution hubs/units, flowline end terminations, in-line tees, umbilicals, flowlines, risers, XT, well jumpers, electrical flying leads etc. Once any equipment is no longer required and is removed, the SAR is updated accordingly.

Inspection, maintenance and repair activities will be undertaken as described in Section 3.5, in order to ensure that all property and equipment is maintained in a state that ensures it can be removed safely at the end of its life. Inspections of the subsea production system through the subsea infrastructure inspection process are implemented in accordance with the Subsea Integrity Maintenance Management Plan (SIMMP) with the frequency specified in risk-based inspection schedules.

All subsea assets have associated inspection tasks which are implemented into SAP for routine actioning and tracking. All corrective maintenance activities are undertaken in accordance with the findings/anomalies from the routine inspection or identified failures which are captured in INPEX's subsea integrity and inspection management tool, COABIS. COABIS is the controlled source of information (codes and reference data) to maintain consistency for the capture and reporting of all subsea IMR activities and anomalies, any corrective actions are logged in SAP. The system is also used to catalogue and archive ROV and diver footage that has been recorded.

Exploration wells (Table 3-3) will be inspected in accordance with the requirements of the WOMP. At this stage in early field life, the only property or equipment in WA-50-L that is not in use relates to wellheads on the exploration wells. As part of the decommissioning planning process INPEX is gathering further information on the status of these wellheads to inform a decommissioning specific EP in relation to these wells. Factors that are being considered as part of an options assessment process include the current status of each wellhead, review of available data (inspection records and published studies) and feasibility of possible removal options. Once a greater understanding has been achieved, INPEX will submit a separate EP to cover this activity.

Further details on maintenance and inspection with respect to asset integrity management over the whole lifecycle of the asset is described in Section 9.6.7.

3.8 Summary of emissions, discharges and waste

A summary of the emissions, discharges, and wastes resulting from the operation of the offshore facility and supporting vessels, and from IMR activities is identified in Table 3-7.

Table 3-7: Emissions (E), discharges (D) and wastes (W) from the SPS, CPF, FPSO and supporting vessels

System	E, D, W	Description	
Subsea production system	D	Production xmas trees, manifolds, well jumpers, flowlines and risers	Open-loop subsea valve actuation results in the release of small amounts of subsea control fluids, such as MEG, to sea. Maintenance and repair of subsea infrastructure may also result in discharges of well fluids (gas and condensate), MEG or FIS to sea with trace hydrocarbons (e.g. during pigging, intrusive subsea intervention, MEG flowline repair or riser replacement) and the use of weak acids (vinegar, sulfamic acid) to remove residual marine growth / calcium deposits that are returned to the marine environment.
Reception and separation system Inlet surge vessels (ISVs) / sand treatment	W	CPF	Any sand in the well fluids should be removed in the CPF inlet surge vessels. Sand (solids) >66 µm in diameter will be collected by means of de-sanding through a three-phase separator and sent onshore for disposal.
		FPSO	Sand carryover from the CPF to the operators on the FPSO will be collected and disposed onshore.
Gas export compression	E	CPF	Combustion gas emissions from GEC gas turbine drivers are emitted to the atmosphere via an exhaust stack. The turbine drivers for the compressors are fired with fuel gas and the resultant emissions are direct emissions from the facility.
Booster compression	E	CPF	Combustion gas emissions from GEC gas turbine drivers are emitted to the atmosphere via an exhaust stack. The turbine drivers for the compressors are fired with fuel gas and the resultant emissions are direct emissions from the facility.
Off-gas recovery	W	CPF	Liquid mercury is collected in the CPF OGR mercury collector which is periodically returned to the mainland for disposal or recycling.

System	E, D, W	Description	
			No emissions, discharges or wastes arise directly from the FPSO OGR system. The primary energy source in this case is electricity – generated in the onboard main power generators.
Fuel gas	W	CPF	Spent solid catalysts from the MRU and SRUs are periodically replaced and returned to shore for disposal or recycling.
Nitrogen systems	E	CPF FPSO	Nitrogen gas used for purging, seal gas and blanket gas is displaced to the atmosphere. The energy source for the nitrogen system is electricity – generated in the onboard main power generators.
Flare (HP/LP)	E	CPF FPSO	Combustion gas emissions and fugitive emissions from flare pilots, and when flaring during re-starts, maintenance, process upsets and emergencies. During start-up of the new gathering system (GS4) the flowlines which are filled with nitrogen will be vented to atmosphere. Atmospheric emissions from the flare systems on the CPF and FPSO are considered to be direct emissions from the facility.
	E	CPF FPSO	Light emissions associated with flaring during re-starts, maintenance, process upsets and emergencies.
Condensate and flash gas mercury removal	W	FPSO	Spent adsorbent and filters from the condensate mercury guard bed vessels and flash gas mercury guard bed vessels are periodically replaced and returned to the mainland for disposal or recycling.
Inert gas system Inert gas generator (IGG)	D	FPSO	Seawater containing residual heat; and, potentially, combustion residues generated by gas scrubbing in the inert gas system, is discharged to sea via the FPSO discharge moonpool.
	E		Combustion emissions (fuel gas and diesel). These fuels are the primary energy source for the unit (it’s possible to use either fuel source) and the resulting emissions are direct GHG emissions.

System	E, D, W	Description	
Atmospheric vents	E	FPSO	Infrequent and unplanned process gas emissions are released via the atmospheric vent during upset conditions. Safe H_2S relief from the H_2S vent in the rare event that the H_2S injection scavenger in the fuel gas system is unavailable. Infrequent emissions of inert gases via the inert gas and tank maintenance vents during pressure relief or purging activities. Emissions from atmospheric vents are direct emissions for the purposes of atmospheric emissions reporting.
HVAC	D	CPF	HVAC condensed water discharges containing copper, discharged from each CPF column leg directly to marine environment.
Power generation	E	CPF FPSO	Combustion gas emissions from MPG gas turbine drivers and diesel-powered engines are emitted to the atmosphere via an exhaust stack. The dual fuel turbines on the main power generators are fired by either natural gas or diesel. Atmospheric emissions in this equipment are classified as direct emissions.
	E	CPF FPSO	Noise emissions from power generation (and other facility systems and topside activities).
	E	Vessels	Combustion gas emissions from diesel-powered engines are emitted to the atmosphere via an exhaust stack. Vessels are indirect emissions from the point of view of atmospheric emissions reporting as they are under the operational control of others in each case.
	E	Vessels	Noise emissions from vessel engines and propulsion systems.
Seawater cooling	D	CPF	Seawater containing residual heat and residual sodium hypochlorite is returned to sea via the seawater dump caisson. Infrequent maintenance on the seawater cooling system may require direct overboard drainage and/or limited continuous operation overboard. During such times the seawater cooling system will not be dosed with biocide and therefore any discharge will be return seawater with residual heat.

System	E, D, W	Description	
	D	FPSO	Seawater containing residual heat and residual sodium hypochlorite is returned to sea via the FPSO discharge moonpool. Infrequent maintenance on the seawater cooling system may require direct overboard drainage and/or limited continuous operation overboard. During such times the seawater cooling system will not be dosed with biocide and therefore any discharge will be return seawater with residual heat. The chlorinated seawater is filtered in the seawater coarse filter package which is designed to filter out any particles larger than 250 µm. The filter is periodically backwashed with filtered seawater to remove debris. The filtered backwash is discharged to sea via the discharge moonpools.
	D	Vessels	Seawater containing residual heat.
Open-drains system	D	CPF	Treated water is discharged to sea via the open-drains caisson.
	D	FPSO	Open-drains water and bilge is received in the slops tank system for treatment. Recovered hydrocarbons are recycled back through the process and treated water is discharged to sea via the FPSO discharge moonpool.
Closed-drains system	W	CPF FPSO	Hydrocarbon slurry from the CPF and FPSO closed drains is collected in the closed-drains drum on the FPSO and returned to shore for treatment and disposal.
Vessel deck drainage	D	Vessels	Vessel deck drainage water may be discharged to sea.
Bilge system	D	CPF	Bilge is pumped into the open-drains system for treatment to <15 ppm (v) OIW before discharge to sea via the open-drains caisson.
		FPSO	Bilge is pumped into the open-drains system for treatment to <15 ppm (v) OIW before discharge to sea via the FPSO discharge moonpool.
		Vessels	Treated contaminated bilge water with <15 ppm (v) OIW is discharged to sea.

System	E, D, W	Description	
PW treatment	D	FPSO	Treated PW (containing <30 mg/L OIW, inorganic salts, trace quantities of water-soluble production chemicals and dissolved organic compounds, such as H_2S) is commingled with other liquid waste streams, such as cooling water, and discharged to the sea via the FPSO discharge moonpool.
	W		MPPE media/columns for PW treatment are periodically replaced and collected and disposed of onshore.
MEG system and storage	E	FPSO	Combustion emissions from the gas-fired heaters are emitted to the atmosphere via an exhaust stack. These heaters, which heat the heating medium used as an energy source for MEG regeneration, use fuel gas directly and are direct atmospheric emissions from the facility.
	D		Low solubility divalent salts from MEG pre-treatment are comingled with the PW discharge stream and discharged to sea via the FPSO discharge moonpool. A continuous, low-volume bleed stream of high-viscosity liquid (salts and MEG) is comingled with the PW discharge stream and discharged to sea via the FPSO discharge moonpool. High-solubility salts from the MEG reconcentration system are mixed with PW and sent to the PW system before discharge to sea via the FPSO discharge moonpool. Periodic discharges of spent citric acid from descaling of the MEG system are discharged to sea with the PW discharge stream via the FPSO discharge moonpool.
Chemical injection systems	D	CPF FPSO	Trace quantities of water-soluble production chemicals and spent H_2S scavenger are sent to the PW treatment system and are then commingled with other liquid waste streams, including degasser fluids containing spent H_2S scavenger, and discharged to the sea via the FPSO discharge moonpool.
			HCl gas scrubbing water from the pH controller in the FPSO chemical injection system is commingled with other liquid waste streams, such as cooling water, and discharged to the sea via the FPSO discharge moonpool.

System	E, D, W	Description	
Sewage, grey water and macerated food waste effluent	D	CPF	Treated sewage effluent, grey water and macerated food waste are discharged to sea via the sewage disposal caisson.
		FPSO	Treated sewage effluent, grey water and macerated food waste are discharged to sea via a dedicated subsea hose routed through the discharge moonpool.
		Vessels ASV when attached	Treated effluent produced by vessel sewage treatment plants is discharged to sea. Sewage effluent from the ASVs will be macerated and treated using bio-treatment systems before discharge to sea.
Ballast system	D	CPF	Return ballast with residual sodium hypochlorite is discharged to sea via the seawater dump caisson.
		FPSO	Return ballast with residual sodium hypochlorite is discharged to sea via the FPSO discharge moonpool.
		Vessels	Return ballast from vessels is discharged to sea. The ASVs have UV treatment ballast water treatment plants. The OSV does not have a ballasting system; therefore, cannot uptake or discharge ballast water.
Firewater system	E	CPF FPSO	Combustion gas emissions from diesel-fired electrical generators used to drive the firewater pumps during emergencies. These are direct emissions from diesel combustion.
	D		Firewater/service water flushing on an infrequent basis will be discharged to sea.
Foam fire-extinguishing	D	CPF	Alcohol-resistant aqueous film-forming foam (AR-AFFF) and film-forming fluoroprotein (FFFP) foam is routed to the open-drains system and may be released to sea in the event of system deployment.

System	E, D, W	Description	
		FPSO	Film-forming fluoroprotein (FFFP) foam is routed to the open-drains system and may be released to sea in the event of system deployment.
		ASVs	The AFFF systems include AFFF foams released via deck drainage in the event of a fire. The foam has a shelf life of 10 years and will not be tested during the project.
Fresh/potable water	D	CPF	Saline reject-water stream will be discharged to sea via the seawater dump caisson.
		FPSO	Saline reject-water stream on the FPSO is routed back to the seawater intake and is therefore not discharged to sea.
		Vessels	Saline reject-water stream will be discharged to sea.
Waste incineration	E	Vessels	Combustion gas emissions from on board incineration of permitted wastes.
	W		Ash from incinerators will be stored as waste for disposal on the mainland.
Cooling / heating medium system (closed-loop)	D	CPF FPSO	Infrequent, ad-hoc maintenance and drainage discharges during maintenance events to maintain processing systems (e.g. flushing or replacing fluids in closed-loop systems). Depending on the volume to be discharged, small maintenance volumes will be diverted to the open drains for treatment (de-oiling) prior to discharge through open drains caisson (CPF) or discharge moonpool (FPSO). Larger volumes from closed-loop systems will be sampled to ensure OIW content is below 15ppm(v) prior to discharge overboard. During such times, lab testing will also be undertaken to ensure OIW content remains below 15 ppm(v) during discharge.
Marine acoustic surveys	E	Vessels/AUV	Noise emissions from SSS and MBES used for inspection purposes.

System	E, D, W	Description	
Sundries / miscellaneous	E	CPF FPSO Vessels	Combustion gas emissions from diesel-powered equipment engines (e.g. crane engines, temporary generators). These are direct emissions from the facilities, fueled by diesel.
	E		Light emissions from deck and navigation lights on facility topsides and vessels.
	W		Solid and liquid wastes from general maintenance operations, equipment replacement, etc., and domestic wastes are transported to the mainland for disposal.
	D		Marine growth (biofouling) on risers, thrusters and from topsides etc. will be removed periodically using high pressure washing with the removed residual marine growth discharged to sea.

3.8.1 Historical atmospheric emissions

Actual historical atmospheric emissions generated from fuel combustion and flaring on the offshore facility are presented in Table 3-8 and Table 3-9 respectively.

Table 3-8: Emissions from fuel combustion from the offshore facility (excluding support vessels) in FY 2019-20 and 2020-21

Emission	2019-20			2020-21		
	Annual emissions from fuel gas consumption	Annual emissions from diesel combustion	Total annual emissions from fuel combustion	Annual emissions from fuel gas consumption	Annual emissions from diesel combustion	Total annual emissions from fuel combustion
CO_2 (tCO_2-e)	454,769.1	34,039.2	488,808.3	432,600.3	36,637.0	469,237.3
CH_4 (tCO_2-e)	884.7	48.7	933.4	841.6	52.4	894.0
N_2O (tCO_2-e)	265.4	97.4	362.8	252.5	104.8	357.3
NO_x (kg)	874,355.1	257,683.5	1,132,038.6	824,419.6	315,766.6	1,140,186.2
SO_x (kg)	1,499.3	83.3	1,582.6	1,404.9	230.8	1,635.7

Table 3-9: Flared volumes from the offshore facility in FY 2019-20 and 2020-21

Emission	**Annual flared volume 2019-20 (tCO_2-e)**	**Annual flared volume 2020-21 (tCO_2-e)**
CO_2	1,428,577.97	551,433.54
CH_4	52,910.30	27,163.21
N_2O	15,873.09	5,310.10
Total GHG from flaring	1,497,361.35	583,906.85

Fugitive emissions comprise of non-combusted hydrocarbon gases generally released from minor leaks associated with valves, pipe connections and other equipment. Fugitive emissions from oil and gas extraction include emissions from venting, leaks, evaporation and storage losses. During 2019-2020 and 2020-2021, the offshore facility lost 108,215 and 40,439 tonnes of CO_2 equivalents respectively, through fugitive emissions noting that this figure does not include the flaring data as this is presented in Table 3-9.

3.8.2 Predicted future atmospheric emissions

Predicted future emissions from all facility point sources are presented in Figure 3-11 and Figure 3-12. These predictions cover the period 2021 to 2025 and have been estimated using internal processes and mirror those used for the Safeguard Mechanism calculated baseline. Predicted future emissions for the Ichthys Project as a whole for the field life are presented in Figure 3-13, organised by location rather than emissions source.

Figure 3-11: CPF forecast emissions FY 2021-2025

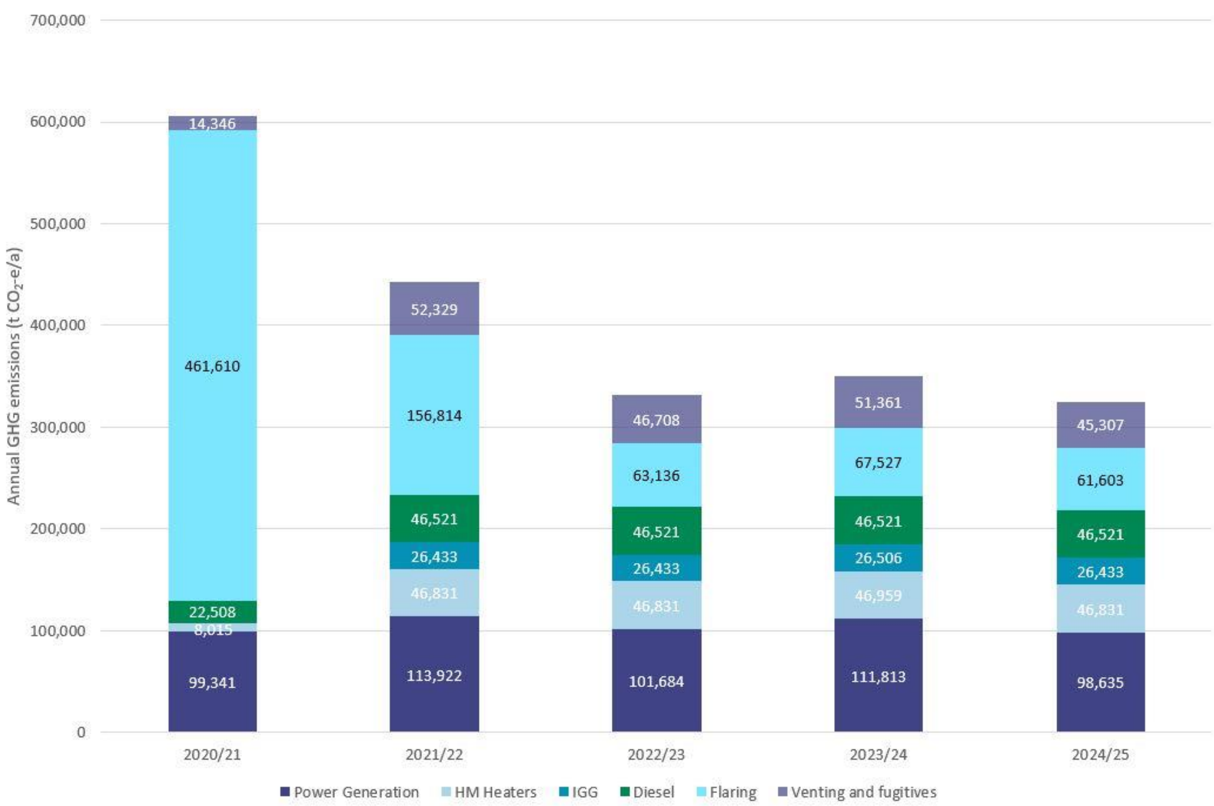


Figure 3-12: FPSO forecast emissions FY 2021 – 2025*

*note that IGG emissions were 0 in FY 2020/21.

Figure 3-13 shows actual emissions from the 2017/18 reporting year to the 2020/21 reporting year, then a forecast of emissions for the life of field (data also presented in Table 3-10. The life of field emissions forecast, previously published was that within the Environmental Impact Statement (EIS) for the Ichthys Project. The forecast in the EIS showed total cumulative emissions over the life of field of 278 Mt CO_2-e – of which 72 Mt were expected to come from the offshore facilities. The current estimate of forecast emissions, as displayed in Figure 3-13, estimates total cumulative emissions of 227 Mt CO_2-e; a reduction of 18%. Cumulative emissions over the life of field for offshore are now forecast to be 39 Mt CO_2-e.

The emissions forecast as part of the EIS was generated before the detailed design of the Ichthys project was finalised. Key unit operations were known, based on the known reservoir conditions, but the detail of individual equipment performance had not been finalised. The revised life-of-field forecast takes into account outcomes of detailed design and specific emissions reduction technologies incorporated in the design process and also incorporates actual performance of equipment. There is a process whereby the process models used to model production as part of medium- and long-term forecasts (a key input to the emissions forecast) are updated with reference to actual performance of equipment. This includes update of equipment performance models to reflect actual energy consumption.

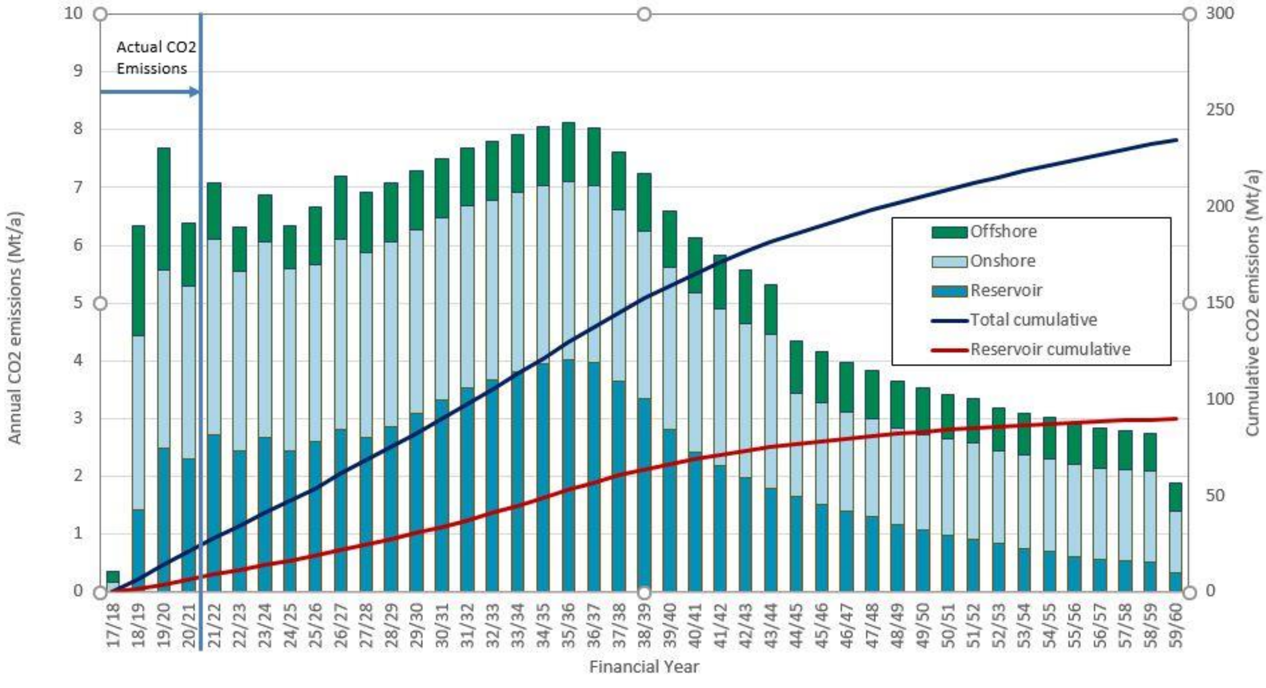


Figure 3-13: Forecast GHG emissions for the life of the Ichthys Project

Table 3-10: Tabulated forecast GHG emissions (CO_2 emissions Mt/a) for the life of the Ichthys Project

Financial year	Reservoir	Offshore	Onshore	Total CO_2 (Mt/a)
17/18	0.000000	0.173779	0.174668	0.348447
18/19	1.432363	1.880674	3.014631	6.327668
19/20	2.492072	2.096420	3.087522	7.676014

Financial year	Reservoir	Offshore	Onshore	Total CO_2 (Mt/a)
20/21	2.308113	1.097045	2.984496	6.389654
21/22	2.709720	0.956728	3.401354	7.067789
22/23	2.449763	0.758740	3.107687	6.316178
23/24	2.678172	0.811805	3.380084	6.870048
24/25	2.447947	0.753214	3.142814	6.343963
25/26	2.613017	0.998033	3.054033	6.665083
26/27	2.803026	1.097705	3.292989	7.193720
27/28	2.663894	1.046486	3.210039	6.920419
28/29	2.869700	1.029538	3.189632	7.088869
29/30	3.096402	1.023223	3.159858	7.279484
30/31	3.328006	1.019044	3.138509	7.485559
31/32	3.538792	1.018431	3.135318	7.692541
32/33	3.659194	1.013594	3.117616	7.790403
33/34	3.800375	1.011502	3.110148	7.922026
34/35	3.944196	1.008784	3.097853	8.050833
35/36	4.012747	1.014986	3.090501	8.118235
36/37	3.973428	1.006589	3.049679	8.029695
37/38	3.640906	0.997074	2.976643	7.614624
38/39	3.352943	0.996753	2.901022	7.250719
39/40	2.817929	0.980186	2.795873	6.593988
40/41	2.428627	0.960669	2.739340	6.128636
41/42	2.190719	0.941959	2.700086	5.832765
42/43	1.977111	0.909846	2.674850	5.561806
43/44	1.798440	0.851667	2.656081	5.306188
44/45	1.650895	0.890837	1.792259	4.333991
45/46	1.522361	0.872221	1.757533	4.152114
46/47	1.406429	0.854831	1.718674	3.979935
47/48	1.294618	0.839579	1.709803	3.844000
48/49	1.164525	0.810960	1.668253	3.643738
49/50	1.063897	0.796485	1.664140	3.524522
50/51	0.989690	0.782819	1.653704	3.426212
51/52	0.922877	0.770846	1.646655	3.340378
52/53	0.837964	0.742860	1.603670	3.184494
53/54	0.755721	0.730907	1.613723	3.100352
54/55	0.699640	0.716663	1.604304	3.020606

Financial year	Reservoir	Offshore	Onshore	Total CO_2 (Mt/a)
55/56	0.614143	0.695679	1.597530	2.907352
56/57	0.558997	0.679195	1.587276	2.825469
57/58	0.534467	0.672095	1.581349	2.787911
58/59	0.512487	0.664179	1.572232	2.748899
59/60	0.339153	0.482530	1.062967	1.884649

3.8.3 Emissions reduction technologies in design

Commonwealth approval (EPBC 2008/4208) was obtained to develop the Ichthys Field in the Browse Basin, comprising of the development of two natural gas and condensate reservoirs, Brewster and Plover. During the design process for the offshore facility, a number of specific decisions were made to decrease the overall emissions intensity of offshore operations as presented in Table 3-11. This additional consideration and implementation of emissions reduction technologies was completed within the context that reservoir CO_2 would increase because the Plover reservoir has a higher CO_2 content (17%) than Brewster (8%).

Table 3-11: Offshore facility emissions reduction technologies

System	Description
Interconnector power sharing cable	A power cable links the CPF and FPSO, allowing the power generating equipment across both assets to be optimized. This ability provides a greater level of energy efficiency, by allowing for sharing of the spinning reserve between the power generation facilities on the CPF and FPSO. Utilising this feature enables INPEX to minimise offshore fuel consumption (fuel gas and/or diesel) and its use is dependent on the reliability of all components of the power system, including the interconnector cable, power electronics and the MPG gas turbines on both the CPF and FPSO.
Flash gas compression	The flash gas compression system recovers flash gas and gas recycled via the VOC system. This gas is returned to the CPF for export into the GEP, and also provides a source of fuel gas on the FPSO; without this equipment, the flash gas would be flared and use of this system enables no routine flaring during normal operations. The FGC system on the FPSO accounts for 1,000,000 Sm^3/d of flaring reduction and offers the greatest potential for reducing flaring emissions. Therefore, the FGC has 100% redundancy to increase the reliability of the system. In Q3 2021, the FGC has had an average uptime of 90%. FGC system reliability improvement program initiatives have been completed on Train 2 and are planned to be completed for Train 1 during Q4 2021. Since the start of 2021 these actions have shown an increase in FGC system uptime. A reliability target of 95% has been set for the FGC system. The continued use of the FGC system at the projected uptime rates will result in minimal flaring during normal operations and will meet the flaring targets set in the FMP.
Vapour compression	The VOC system on the FPSO accounts for 25,000 Sm^3/d of flaring reduction on the FPSO.

System	Description
	Volatile gases from equipment such as condensate storage and other sources are recovered and recompressed into fuel gas. In Q2 2021, the system has had an average uptime of 94%. The initial focus of reliability improvement for flaring reduction has targeted FGC and OGR systems as these streams are considerable contributions to offshore flaring. Once reliability of those systems has improved the focus will move to the VOC system as part of continuous improvement. A reliability target of 95% has been set for the VOC system.
Off gas recovery compression - CPF	This unit on the CPF recovers flash gas from the liquid export vessels and recompresses it into the fuel gas system; this stream would otherwise be flared or vented. The OGR system on the CPF accounts for 100,000 Sm^3/d of flaring reduction on the CPF. Due to space and weight limitations on the CPF there is no redundancy for the OGR system. Corrective maintenance scopes have been undertaken to bring the OGR system online. Further work-scopes as part of the OGR Reliability Improvement Program will start in Q4 2021. Since the start of 2021, these actions have shown an increase in OGR system uptime and in Q3 2021 the OGR system has had an average uptime of 79%. A reliability target of 90% has been set for the OGR system. The continued use of the OGR system at the projected uptime rates will result in minimal flaring during normal operations and will meet the flaring targets set in the FMP. As the OGR system has no redundancy, during times of planned maintenance the system will be offline, and this is reflected in the reliability target.
Waste heat recovery	The FPSO's MPG gas turbines are fitted with waste-heat recovery units. The recovered heat is used in the closed-loop heating system for condensate stabilisation and MEG reclamation therefore minimising combustion gas emissions associated with generating heat.
Nitrogen system	The nitrogen generation system on the FPSO reduces reliance on the IGG burning fuel gas or diesel, for the generation of inert gas for purging / blanket gas.
Dry gas seals on compressors	All compressors have dry gas seals installed, which effectively eliminates fugitive emissions from compressor seals.
Instrument air driven pneumatic devices	All instrumentation in the facilities is driven by instrument air, not gas – ensuring that vented emissions from pneumatic devices is zero.

These initiatives have been incorporated into the final design and construction of the offshore facility described in Section 3.3.2 and Section 3.3.3. Although the initial commissioning and operation of some equipment took longer than expected after initial start-up of operations (primarily the flash gas compressor) all equipment is operational. The reliability targets set for the FGC, VOC and OGR systems shown in Table 3-11 exclude periods of planned maintenance and during shutdowns and re-starts.

The facilities were also designed to keep methane emissions to an absolute minimum. Of the nine core sources of methane emissions (Table 3-12) that are considered priority by the Oil and Gas Methane Partnership (OGMP) (a Climate and Clean Air Coalition initiative, led by the United Nations Environment Program), INPEX has put in place design details to deal with each.

Table 3-12: Core sources of methane emissions

Core source	Design features
Natural gas driven pneumatic controls and pumps	The CPF and FPSO do not have any natural gas driven pneumatic devices in the plant.
Fugitive equipment and process leaks	Where possible, non-routine vents are routed to the flare system. Reporting of fugitive emissions is done according to guidance from the American Petroleum Institute. Gas detectors are used to indicate loss of containment, which is investigated and repaired. A LDAR program is also in place.
Centrifugal compressors with wet (oil) seals	All centrifugal compressors have dry gas seals specified.
Reciprocating compressor rod seals and packing vents	The off-gas compressor is a four-stage reciprocating compressor with maintenance occurring as per original manufacturer requirements. In addition, packing vent gas is returned to the first stage of the compressor rather than being released to atmosphere.
Glycol dehydrators	Hydrocarbons from glycol dehydrators are recovered rather than vented.
Hydrocarbon liquid storage tanks	Stabilised hydrocarbons are stored, which minimises the evolution of vapours – these vapours are recovered into the fuel gas system.
Well venting for liquids unloading	The project does not currently employ practices to manually unload liquids from the wells and vent gas directly to atmosphere.
Well venting/flaring during completion for hydraulically fractured wells	The reservoir does not currently employ hydraulically fractured wells. Flowback from well completion activities is flared by drilling contractors – it is not vented.
Casinghead gas venting	This applies to oil wells specifically, and so are not relevant to the Ichthys gas wells.

It is noted that the OGMP have released OGMP 2.0 Reporting Framework, being version 2 of the framework for reporting and management of methane emissions. The updated framework requests that companies work towards achieving "gold standard" with respect to monitoring and reporting methane emissions from core sources within facilities.

INPEX currently monitors and measures methane emissions across the offshore facility from fugitive emissions, uncombusted methane in fuel and flare, and vents – calculating the methane intensity as a ratio of total methane to total gas sold. Using this metric, INPEX has a current methane emissions intensity of approximately 0.1%. This compares very favourably with the medium-term methane targets being set by large oil and gas companies – for example, the Oil and Gas Climate Initiative (OGCI) has set a target of 0.25% methane intensity by 2025. INPEX's corporate target is to maintain methane emissions at these low levels to 2030 and beyond.

The International Energy Agency (IEA) Methane Tracker provides very similar guidance to the OGMP and the OGCI methane management frameworks. The list of abatement technologies developed by the IEA mirrors those that are addressing the nine core sources identified by the OGMP (Table 3-12). As such, INPEX has design modifications in place already to minimise the incidence of fugitive emissions and strives to maintain overall methane intensity at world class low levels.

4 EXISTING ENVIRONMENT

4.1 Regional setting

Production licence area, WA-50-L is situated in the northern Browse Basin, approximately 390 km north of Derby, Western Australia (Figure 1-1). In the event of a worst-case unplanned oil spill, the area potentially exposed to hydrocarbons, hereafter referred to as the potential exposure zone (PEZ), covers a considerably larger area than the licence area where planned activities will occur.

The spatial extent of the PEZ was determined from stochastic spill modelling using the low hydrocarbon exposure thresholds described in NOPSEMA Bulletin #1 (NOPSEMA 2019a). This considered the worst-case credible hydrocarbon scenarios identified for the activity for surface hydrocarbons, shoreline accumulations of oil, and entrained oil and dissolved aromatic hydrocarbons in the water column (refer Section 7.7, Table 7-37). The PEZ has been used to identify relevant values and sensitivities that may be affected and has been used as the basis for the EPBC Act Protected Matters Database search (Appendix B). In addition, an EPBC Act Protected Matters search was undertaken for the operational area (WA-50-L) and is also presented in Appendix B.

The low thresholds that have been used to inform the extent of the PEZ are useful for oil spill response planning and scientific monitoring (water quality) purposes but may not be ecologically significant (NOPSEMA 2019a). Therefore, in addition to the PEZ, an environment that may be affected (EMBA) has also been established from stochastic spill modelling using hydrocarbon exposure thresholds identified as having the potential to cause impacts to ecological sensitive receptors such as fauna and habitats (refer Section 8, Table 8-2).

The resulting PEZ and EMBA from the oil spill modelling are the sum of overlaid stochastic modelling runs 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 PEZ or EMBA. The PEZ and EMBA are both geographically represented in the figures throughout this section of the EP and in Figure 8-1.

4.1.1 Australian waters

Australia's offshore waters have been divided into six marine regions to facilitate their management by the Australian Government under the EPBC Act. The production licence area is located entirely within the North-west Marine Region (NWMR). The PEZ intersects with the NWMR and the North Marine Region (NMR). The relevant key features of the NWMR and NMR in the context of WA-50-L and PEZ are further described in subsequent sections of this EP.

North-west Marine Region

The NWMR comprises Commonwealth waters, from the WA–NT border in the north, to Kalbarri in the south. The NWMR encompasses a number of regionally important marine communities and habitats which support a high biodiversity of marine life and feeding and breeding aggregations (DSEWPaC 2012a).

North Marine Region

The NMR comprises Commonwealth waters from the WA–NT border to West Cape York Peninsula. This region is highly influenced by tidal flows and less by ocean currents. The marine environment of the NMR is known for its high diversity of tropical species but relatively low endemism, in contrast to other bioregions (DSEWPaC 2012b).

4.1.2 External Australian Territories

In total there are seven Australian external territories; Ashmore and Cartier Islands, Australian Antarctic Territory, Christmas Island, Cocos (Keeling) Islands, Coral Sea Islands, Heard and McDonald Islands and Norfolk Island (Geoscience Australia 2021a). They represent remote offshore territories located in the Pacific, Indian and Southern oceans, and the Coral Sea (Geoscience Australia 2021a). External Australian territories located within the PEZ include Ashmore and Cartier Islands (described in sections 4.3.1 and 4.3.1), 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 2021b). 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 2021b). 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 2021b; DAWE 2021a). Hosnies Spring and the Dales Ramsar sites are located on Christmas Island (described in sections 4.6.4 and 4.6.7).

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 2021c). The territory is one of the remaining pristine tropical island groups in the Indian Ocean region with abundant wildlife, particularly seabirds. The Territory also has 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 2021c). The northern atoll consists of North Keeling Island and the marine area extending 1.5 km from the coastline. This area forms Australia's most remote Commonwealth National Park, the Pulu Keeling National Park, which is also a Ramsar site (described in Section 4.6.5). 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).

4.1.3 International waters

The PEZ 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 (described in Section 4.8.2).

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).

4.2 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). The north-western corner of WA-50-L overlaps one KEF, and a further 12 are located within the PEZ (Figure 4-1) follows:

WA-50-L:

- Continental slope demersal fish communities

PEZ:

- Ancient coastline at 125 m depth contour
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters
- Canyons linking the Argo Abyssal Plain with Scott Plateau
- Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula
- Carbonate bank and terrace system of the Sahul Shelf
- Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals
- Pinnacles of the Bonaparte Basin
- Seringapatam Reef and Commonwealth waters in the Scott Reef complex
- Carbonate bank and terrace system of the Van Diemen Rise
- Shelf break and slope of the Arafura Shelf
- Tributary canyons of the Arafura Depression
- Exmouth Plateau
- Glomar Shoals.

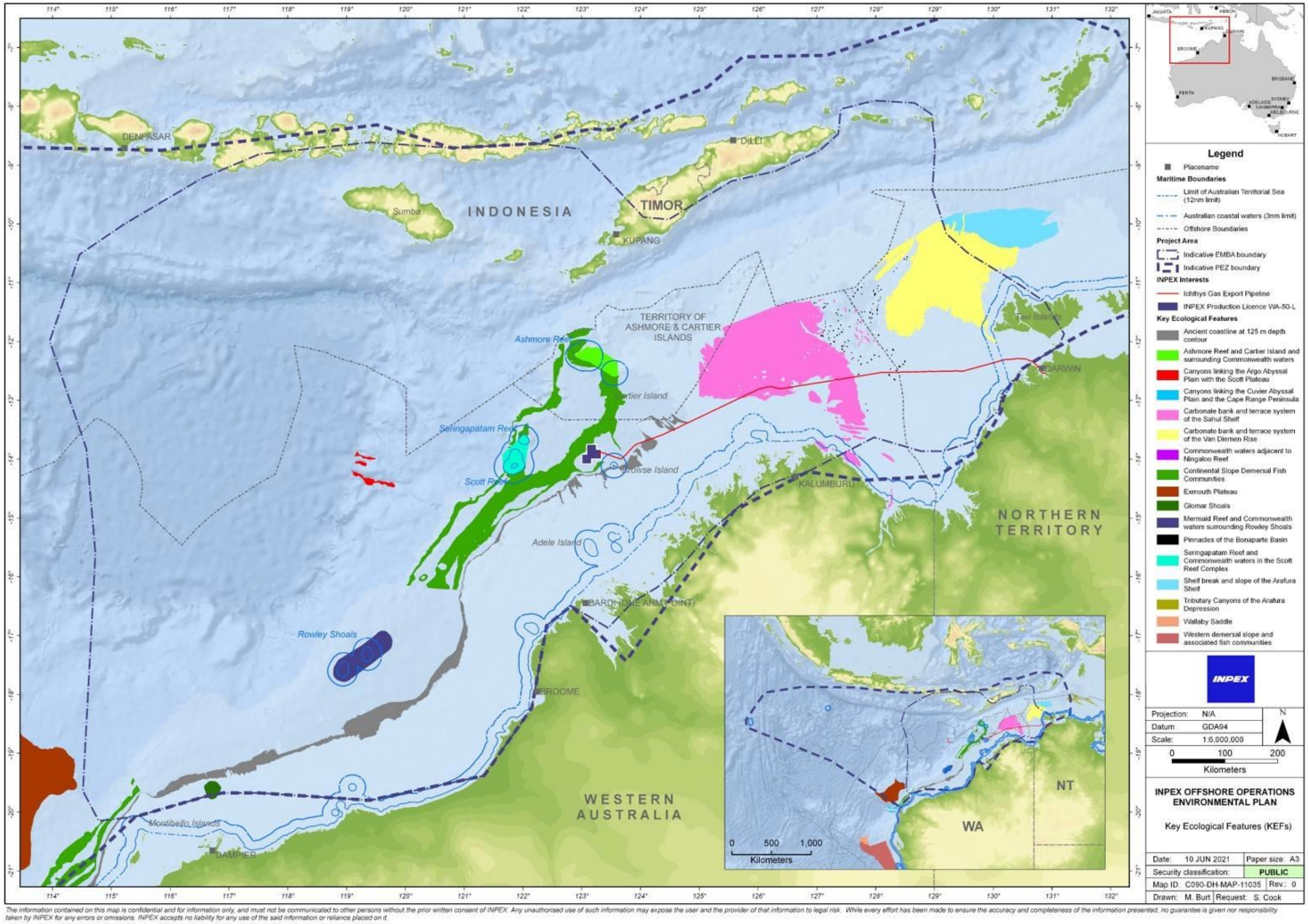


Figure 4-1: Key ecological features in north-west Australia (showing PEZ and EMBA)

4.2.1 Continental slope demersal fish communities

The north-western corner of WA-50-L overlaps a small portion of the continental slope demersal fish community KEF (Figure 4-1; Appendix B). 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) (DAWE 2021b). 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 (DAWE 2021b).

4.2.2 Ancient coastline at 125 m depth contour

The ancient coastline at 125 m depth contour KEF runs diagonally in a north-easterly direction, approximately 20 km south of WA-50-L, at its closest point (Figure 4-1). 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).

4.2.3 Ashmore Reef and Cartier Island and surrounding Commonwealth waters

The Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF is located approximately 132 km north of WA-50-L, at its closest point (Figure 4-1). 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).

Further details regarding this KEF are provided in Section 4.3 which describes Australian marine parks.

4.2.4 Canyons linking the Argo Abyssal Plain with the Scott Plateau

The canyons linking the Argo Abyssal Plain with the Scott Plateau KEF is located approximately 345 km west of WA-50-L, at its closest point (Figure 4-1). 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).

4.2.5 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 1,250 km south of WA-50-L, at its closest point (Figure 4-1). 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). Therefore, 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).

4.2.6 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 205 km north-east of WA-50-L, at its closest point (Figure 4-1). 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 km^2 and is separated from the next bank by narrow sinuous channels up to 150 m deep (DSEWPaC 2012a).

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.

4.2.7 Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals

The Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals KEF is located approximately 475 km south-west of WA-50-L, at its closest point (Figure 4-1). 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).

4.2.8 Pinnacles of the Bonaparte Basin

The Pinnacles of the Bonaparte Basin KEF is located approximately 455 km east of WA-50-L, at its closest point (Figure 4-1). 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 2012a & 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. Humpback whales and green 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.

4.2.9 Seringapatam Reef and Commonwealth waters in the Scott Reef complex

The Seringapatam Reef and Commonwealth waters in the Scott Reef Complex KEF is located approximately 100 km west of WA-50-L, at its closest point (Figure 4-1). 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).

4.2.10 Carbonate bank and terrace system of the Van Diemen Rise

The carbonate bank and terrace system of the Van Diemen Rise KEF is located approximately 580 km north-east from WA-50-L at its closest point (Figure 4-1), 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).

4.2.11 Shelf break and slope of the Arafura Shelf

The shelf break and slope of the Arafura Shelf KEF is located approximately 700 km north-east of WA-50-L, at its closest point (Figure 4-1). 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).

4.2.12 Tributary canyons of the Arafura Depression

The tributary canyons of the Arafura depression KEF is located approximately 1,150 km north-east of WA-50-L, at its closest point (Figure 4-1). 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).

4.2.13 Exmouth Plateau

The Exmouth Plateau KEF is located approximately 1,100 km south of WA-50-L, at its closest point (Figure 4-1). 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).

4.2.14 Glomar Shoals

The Glomar Shoals KEF is located approximately 950 km south of WA-50-L, at its closest point (Figure 4-1). 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).

4.3 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.

AMPs under the EPBC Act, and any zones within them, must be assigned to an IUCN Category (Environment Australia 2002). The IUCN categories that are present within the AMPs intersected by the PEZ, as shown in Table 4-1, include:

- IUCN Category Ia – Strict nature reserve – Protected area managed mainly for science
- IUCN Category II – National Park – Protected area managed mainly for ecosystem conservation and recreation
- IUCN Category IV – Habitat/species management area – Protected area managed mainly for conservation through management intervention
- IUCN Category VI – Managed resources protected areas – Protected area managed mainly for the sustainable use of natural ecosystems. Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

The Director of National Parks may make, amend and revoke prohibitions, restrictions and determinations under regulations 12.23, 12.23A, 12.26, 12.56 and 12.58 of the EPBC Regulations where it is considered necessary to:

- protect and conserve biodiversity and other natural, cultural and heritage values; or
- to ensure human safety or visitor amenity; or
- where it is otherwise necessary to give effect to the management plan.

At commencement of the North-west Marine Parks Network Management Plan (Director of National Parks 2018a) prohibitions made under regulation 12.23 of the EPBC Regulations are in place prohibiting entry to Ashmore Reef Marine Park, other than parts of West Lagoon and West Island, to protect the fragile habitats and biodiversity, and to Cartier Island Marine Park due to the presence of unexploded ordnance. These have been in place for many years.

All visitors to Ashmore Reef and Cartier Island (except recreational boat users accessing the Marine National Park Zone of Ashmore Reef) require approval from the Commonwealth Department of Agriculture, Water and the Environment. Undertaking other activities in these AMPs may also require approval from the Director of National Parks under Part 13 of the EPBC Act.

The Commonwealth Director of National Parks has issued a general approval under Section 359B of the EPBC Act allowing a range of activities to occur within these AMPs. The activities approved including 'mining operations' which, as defined under the EPBC Act, also includes all petroleum activities, including associated emergency response activities. No other approvals relating to this activity are required from the Director of National Parks.

Actions to respond to oil pollution incidents (including environmental monitoring and remediation) in AMPs, can be undertaken without an authorisation issued by the DNP, provided that the actions are undertaken in accordance with an EP that has been accepted by NOPSEMA. However, the DNP is to be notified of the pollution event or proposed spill response actions within AMPs prior to the activity being undertaken where practicable. WA-50-L does not overlap any AMPs (Figure 4-2; Appendix B). The AMPs and the IUCN categories that overlap the PEZ are outlined in Table 4-1 with a further description provided in subsequent sections.

Table 4-1: AMP and IUCN categories

AMP	Sanctuary Zone (IUCN Ia)	(Marine) National Park Zone (IUCN II)	Habitat Protection Zone (IUCN IV)	Recreational Zone (IUCN IV)	Multiple Use Zone (IUCN VI)	Special Purpose Zone (IUCN VI)	Special Purpose Zone (Trawl) (IUCN VI)
Arafura					X	X	
Argo-Rowley Terrace		X			X		X
Ashmore Reef	X			X			
Cartier Island	X						
Eighty Mile Beach					X		
Gascoyne					X		
Joseph Bonaparte Gulf					X	X	
Kimberley		X	X		X		
Mermaid Reef		X					

AMP	Sanctuary Zone (IUCN Ia)	(Marine) National Park Zone (IUCN II)	Habitat Protection Zone (IUCN IV)	Recreational Zone (IUCN IV)	Multiple Use Zone (IUCN VI)	Special Purpose Zone (IUCN VI)	Special Purpose Zone (Trawl) (IUCN VI)
Montebello					X		
Oceanic Shoals		X	X		X		X
Roebuck					X		

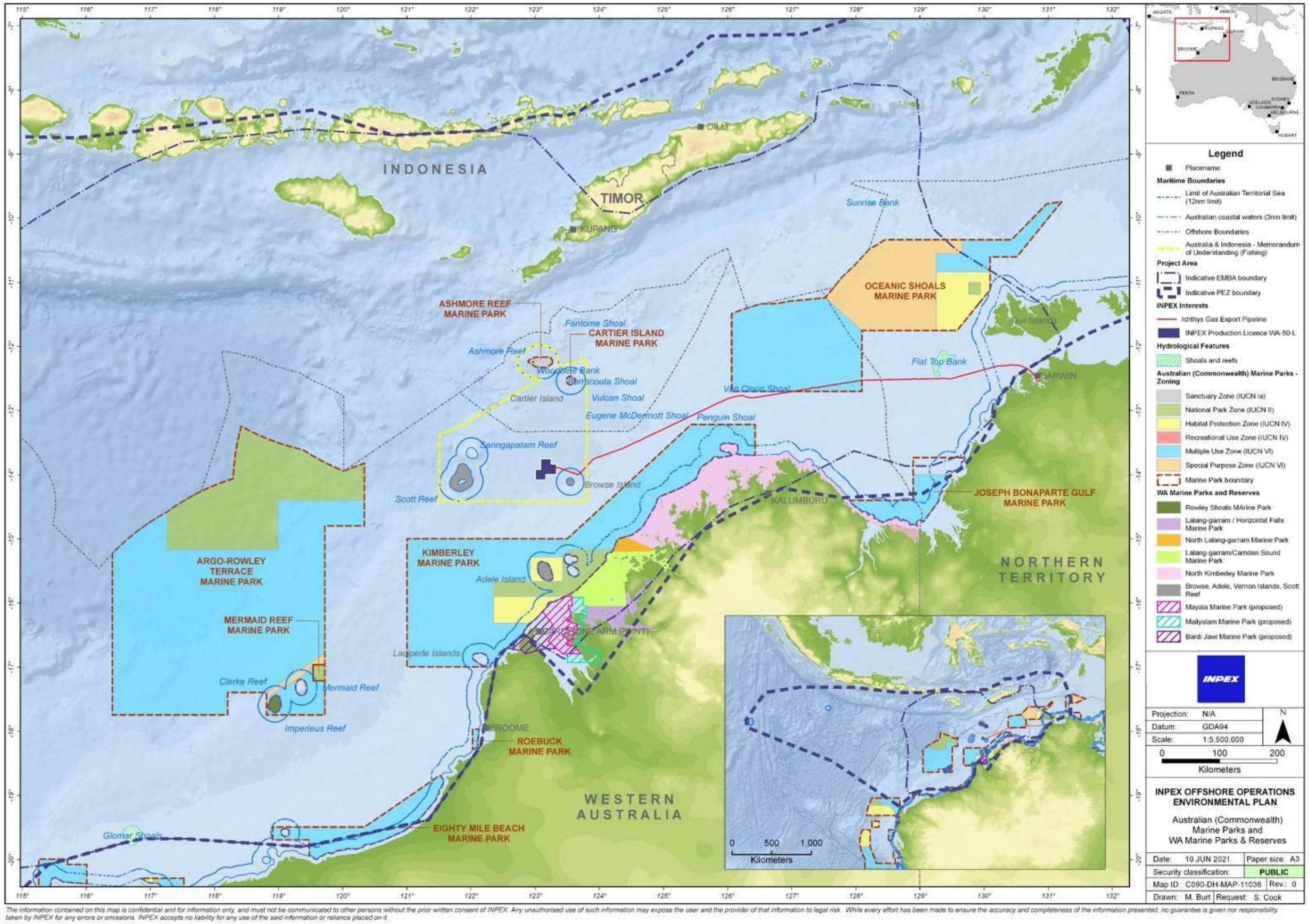


Figure 4-2: Australian and state marine parks, reserves, banks and shoals

4.3.1 Arafura MP

The Arafura Marine Park in the NMR is Australia's most northerly marine park (MP) and covers an area of approximately 23,000 km^2 (Parks Australia 2021k). The boundary of Arafura MP borders Australia's EEZ and is located approximately 1,000 km from WA-50-L. 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 2018b).

Marine life found in the MP includes Spanish mackerel, whale sharks, sawfishes as well as marine turtles and deep-sea sponges (Parks Australia 2021k).

4.3.2 Argo-Rowley Terrace MP

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 2021a). Its eastern boundary is approximately 300 km from WA-50-L.

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 2018a).

4.3.3 Ashmore Reef MP

Ashmore Reef MP is in the NWMR and is located 155 km north WA-50-L. 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 2021b) (Section 4.6.1).

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 2018a).

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 2021b; Director of National Parks 2018a).

4.3.4 Cartier Island MP

Cartier Island MP is located in the NWMR approximately 130 km north of WA-50-L and covers an area of 172 km^2 (Parks Australia 2021c). 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 2018a).

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 2021c). 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 4.2.3).

4.3.5 Eighty Mile Beach MP

The Eighty Mile Beach MP is located in the NWMR and is approximately 600 km from WA-50-L. The MP covers an area of approximately 11,000 km^2 (Parks Australia 2021d).

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 2018a). 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 2021d).

4.3.6 Gascoyne MP

The Gascoyne MP is located in the NWMR and is approximately 1,250 km from WA-50-L. The MP covers an area of approximately 82,000 km^2 (Parks Australia 2021e).

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 2018a). The MP therefore provides connectivity between the inshore waters of the Ningaloo MP and the deeper waters of the area (Parks Australia 2021e).

4.3.7 Joseph Bonaparte Gulf MP

The Joseph Bonaparte Gulf MP is located in the NMR, approximately 500 km from WA-50-L, 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 2021f).

Key conservation values of the reserve include (Parks Australia 2021f; Director of National Parks 2018b):

- 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).

4.3.8 Kimberley MP

The Kimberley MP is located approximately 100 km to the south and east of WA-50-L and occupies an area of approximately 74,500 km^2 (Parks Australia 2021g).

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 2018a). It is adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles (Parks Australia 2021g).

4.3.9 Mermaid Reef MP

The Mermaid Reef MP is located approximately 485 km south-west of WA-50-L 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 2021h). 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 2021h; Director of National Parks 2018a).

4.3.10 Montebello MP

The Montebello MP covers an area of approximately 3,400 km^2. It is located approximately 1,050 km from WA-50-L 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 2021i). 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 4.2).

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 2018a). 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 2018a).

4.3.11 Oceanic Shoals MP

WA-50-L is located approximately 325 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 2021j). The Oceanic Shoals MP is the largest marine park in the NMR and also overlaps the NWMR.

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 2018b).

4.3.12 Roebuck MP

The Roebuck MP is located in the NWMR approximately 445 km from WA-50-L and is approximately 300 km^2 in size (Parks Australia 2021l).

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 2021l).

4.4 State and Territory reserves and MPs

There are no State or Territory MPs/reserves located within WA-50-L (Appendix B). However, the EPBC Act Protected Matters search identified a total of 36 State and Territory reserves within the PEZ as listed below. Unnamed locations were identified using the Collaborative Australian Protected Areas Database (CAPAD 2020):

- Adele Island (WA)
- Balanggarra (WA)
- Bardi Jawi (WA)
- Bedout Island (WA)
- Browse Island (WA)
- Channel Point (NT)
- Coulomb Point (WA)
- Dambimangari (WA)
- Garig Gunak Barlu (NT)
- Jinmamkur (WA)
- Jinmamkur Kulja (WA)
- Karajarri (WA)
- Lacepede Islands (WA)
- Lawley River (WA)
- Lesueur Island (WA)
- Low Rocks (WA)
- Marri-Jabin (Thamurrurr – Stage 1) (NT)
- Mitchell River (WA)
- Niiwalarra Islands (WA)
- Prince Regent (WA)
- Swan Island (WA)
- Tanner Island (WA)

- Unnamed WA28968 identified as Caffarelli Island
- Unnamed WA37168 identified as Lacepede Islands
- Unnamed WA41775 identified as Browse Island
- Unnamed WA44669 identified as Tanner Island
- Unnamed WA44672 identified as Bedout Island
- Unnamed WA44673 identified as Adele Island
- Unnamed WA44677 identified as Lesueur Island
- Unnamed WA51162 identified as site on mainland WA north of Broome
- Unnamed WA51932 identified as site on mainland WA near Roebuck Bay
- Unnamed WA52354 identified as site on mainland WA north of Broome
- Unnamed WA53015 identified as site on mainland WA at Eighty-mile Beach
- Uunguu
- Yampi
- Yawuru.

Of these reserves, six are Indigenous Protected Areas (IPAs); Balanggarra IPA, Bardi Jawi IPA, Dambimangari IPA, Karajarri IPA, Uunguu IPA and the Yawuru IPA. The most relevant value and sensitivity within the IPAs is traditional fishing, which is practised within these reserves, and is further discussed in Section 4.11.3 .

Further research and investigation of the Collaborative Australian Protected Areas Database (CAPAD 2020) for the State/Territory reserves and MPs listed in Appendix B was undertaken. Where sites were considered not relevant to the PEZ they are not discussed further in this EP. This is primarily as there are no 'marine' values or sensitivities which could be impacted by an oil spill, unlike locations where significant turtle and seabird nesting rookeries may be present, and/or associated BIAs have been declared.

The EPBC Act Protected Matters search report (Appendix B) did not identify the following additional MPs/reserves listed below. However, these are considered to be relevant, and therefore they have been described in this EP:

Scott Reef Nature Reserve

Lalang-garram / Camden Sound MP

North Kimberley MP

North Lalang-garram MP.

For completeness, three new proposed marine parks in the Buccaneer Archipelago have also been included. The relevant State reserves within the PEZ are described below and displayed on Figure 4-2. Should any new State or Territory MP/reserve management plans come into effect, the impacts of these changes will be assessed in accordance with Section 9.8.1 and Section 9.7 of this EP.

4.4.1 Adele Island Nature Reserve

Adele Island is a declared nature reserve to protect seabird breeding colonies, and is located approximately 170 km south from WA-50-L.

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).

4.4.2 Bedout Island

Bedout Island is a Class 'A' nature reserve off the Pilbara coast of WA. Located approximately 780 km from WA-50-L and 95 km north-east of Port Headland. The island covers an area of approximately 0.4 km^2 and was designated in 1975 (UNEP-WCMC 2021a). 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 2021a).

4.4.3 Browse Island Nature Reserve

Browse Island is the nearest landform to WA-50-L (33 km away) 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 (No. 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.

Browse Island features diverse coral reef fauna with numerous patch reefs and hard coral cover in shallow depths surrounding the Island (Heyward et al. 2019). Benthic cover transitions to hard and soft coral communities at deeper (40-60m) depths around the island before transitioning into filter feeding communities. Browse Island also supports a highly diverse assemblage of tropical reef fish with 385 species identified (Heyward et al. 2019). In contrast to the subtidal habitat surround the island, the intertidal areas (e.g. reef platform/flat) has low species richness of flora and fauna (Olsen et al. 2018). Interestingly, seagrass is completely absent at Browse Island. Rocky shore habitat on the island is represented only by exposed beach rock, and there are no intertidal sand flats.

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 important nesting areas for green turtles from November to March under the Recovery Plan for Marine Turtles in Australia (DEE 2017a). 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 DAWE 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.

4.4.4 Lacepede Islands

The Lacepede Islands are a Class 'C' nature reserve, located 320 km south of WA-50-L, 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 (2010a) 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) and confirmed as an important rookery based on track counts (Waples et al. 2019). The Recovery Plan has provided a 60 km internesting buffer around the Lacepede Islands for flatback turtle nesting occurring from October to March, with a peak in December and January. A 20 km internesting buffer has also been provided for green turtle nesting, occurring from November to March each year.

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 2021b). 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 2021b).

4.4.5 Yawuru Nagulagun/Roebuck Bay MP

The Roebuck Bay MP includes an internationally significant wetland for migratory shorebirds in Australia (described in Section 4.6.6) and provides habitats to a range of marine fauna as described in Section 4.3.12. Within the park, 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).

4.4.6 Scott Reef Nature Reserve

Sandy Island is a C class nature reserve (under WA legislation) for the purpose of conservation (No. 42749), declared to Low Water Mark (LWM). It has an approximate area of 117 km^2. This encompasses much of the South Scott lagoon, and the south-western reef flat of North Scott Reef. The remainder of the South Scott Reef lagoon and North Scott Reef are Commonwealth waters and Commonwealth jurisdiction applies. The Scott Reef Nature Reserve values and sensitivities are described in Section 4.2.9.

Scott Reef (including a 20 km buffer) has been classified as habitat critical to the survival of marine turtles in the Recovery Plan for Marine Turtles (DEE 2017a).

4.4.7 Lalang-garram/Camden Sound MP

The Lalang-garram / Camden Sound MP is located in the Buccaneer Archipelago of the Kimberly coast, approximately 175 km from WA-50-L. The MP covers an area of approximately 7,050 km^2 (DPaW 2013a). The MP 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 MP 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 MP 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 MP, 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 MP, which are subject to the JAMBA, CAMBA and ROKAMBA migratory bird agreements and are listed as migratory species under the EPBC Act (Appendix B). 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).

4.4.8 North Kimberley MP

The North Kimberley MP is located approximately 175 km from WA-50-L. This park extends all the way from the northern boundary of the Camden Sound MP to the Northern Territory border (DPaW 2016a). The MP is the second largest marine park in Australia spanning approximately 18,540 km^2. 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).

High densities of dugongs have been recorded in areas of the MP with extensive seagrass habitat (Waples et al. 2019). The MP also supports populations of Manta rays (*Manta* spp.) 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).

4.4.9 North Lalang-garram MP

The North Lalang-garram MP, located approximately 155 km from WA-50-L, 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 MP, and its southern boundary adjoins the Lalang-garram/Camden Sound MP. 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 2016b).

4.4.10 Proposed Mayala MP

The proposed Mayala MP is located approximately 220 km from WA-50-L and will cover an area of approximately 3,150 km^2. It is located in the Buccaneer Archipelago within the Kimberley region of WA, approximately 200 km north east of Broome and it is proposed that the MP will be reserved as a 'Class A' MP providing the highest level of protection (DBCA 2020a).

The proposed MP will be bordered to the west by the proposed Bardi Jawi MP and bordered to the east by the proposed Maiyalam MP described in Section 4.4.11 and Section 4.4.12. The proposed MP comprises an extensive network of hundreds of islands. No terrestrial areas are included within the proposed MP but intertidal areas to the high-water mark are included (DBCA 2020a).

The area covered by the proposed MP is home to a diverse range of marine life. Fringing reefs have formed around the many islands of the Buccaneer Archipelago, withstanding a tidal range in excess of 11 m (Richards et al. 2017). Mangrove-lined creeks, seagrass meadows and macroalgae communities create important nursery areas for fish, and turtles are regularly seen foraging and nesting in the area. From June to November each year humpback whales (*Megaptera novaeangliae*) migrate to Mayala Sea Country and beyond to give birth to their young, and dugongs visit the proposed marine park from May to July.

The proposed marine park supports commercial activities such as pearling, aquaculture and commercial fishing. Customary hunting of turtles, dugongs and saltwater crocodiles is permitted by Mayala people in the proposed MP.

The proposed MP contains many places of cultural and spiritual importance such as the Port of Yampi Sound; and the establishment of the proposed marine park will contribute to the conservation and enhancement of the outstanding cultural, ecological, recreational and commercial values in the area (DBCA 2020a).

4.4.11 Proposed Bardi Jawi MP

The proposed Bardi Jawi MP is situated in the west Kimberley region of WA surrounding the northern part of the Dampier Peninsula and the western islands of the Buccaneer Archipelago. Located approximately 240 km from WA-50-L, the proposed MP covers an area of 2,040 km^2. It is proposed that the MP will be reserved as a 'Class A' MP providing the highest level of protection (DBCA 2020b).

The proposed MP extends around the tip of the Dampier Peninsula from Pender Bay on the western side of the Dampier Peninsula to Cunningham Point on the eastern side of the Peninsula. The eastern boundary of the proposed MP borders the proposed Mayala MP and the western boundary extends out to the seaward limit of WA State waters (three nautical miles from the territorial baseline) and includes intertidal areas to the high-water mark. The southern boundary of the proposed MP is situated approximately 160 km north of Broome (DBCA 2020b).

Similar to the adjacent proposed Mayala MP (Section 4.4.10) the proposed Bardi Jawi MP supports a diverse array of plants and animals. Fringing reefs have formed around the many islands of the Buccaneer Archipelago with large tides and complex currents created between the islands. Important nursery habitat is provided through many areas of mangroves, seagrasses and macroalgae communities. Sunday Island located within the proposed marine park is recognised as having particularly extensive and diverse seagrass meadows with eight species being recorded in the raised lagoons of the islands (Kendrick et al. 2017). The high rates of growth and consumption of the seagrass and macroalgae in the lagoons, indicate they are important habitats for marine herbivores such as green turtles and rabbitfish (*Siganus lineatus*).

The warm tropical waters of the proposed MP also provide optimal conditions for commercial activities such as pearling, aquaculture and commercial fishing.

The proposed MP also contains many places of cultural and spiritual importance to Bardi and Jawi people. The majority of significant cultural sites and places occur on land, but many have sea-related aspects (DBCA 2020b).

4.4.12 Proposed Maiyalam MP

The proposed Maiyalam MP is situated in the west Kimberley region of WA in the Buccaneer Archipelago. The eastern boundary of the proposed marine park borders the proposed Mayala MP (Section 4.4.10) and it is proposed that the creek systems of Yampi Sound which are currently in the Port of Yampi Sound will be included into the proposed MP (DBCA 2020c)

Located approximately 220 km from WA-50-L, the proposed park covers an area of 470 km^2 and following gazettal of the proposed Maiyalam MP, it is intended that the Lalang-garram/Camden Sound MP, North Kimberley MP, North Lalang-garram MP and the Maiyalam MP will be amalgamated to form the Lalang-gaddam MP (DBCA 2020c). The existing MPs are currently gazetted as Class A MPs and it is intended that the proposed Maiyalam MP will also be gazetted as a Class A reserve.

As described previously, the Kimberley region where the proposed MP is located experiences one of the largest tidal ranges in Australia. The large tides result in extensive intertidal areas with diverse ecosystems such as coral reefs, mangroves and mudflat communities. The subtidal habitats and communities of the MP include diverse filter-feeding communities of sponges and hard and soft corals. The intertidal and subtidal habitats of the marine parks provide critical foraging and nursery areas for a wide range of threatened, protected and culturally important species such as dugong, turtles, estuarine crocodiles, cetaceans and migratory sea birds (Mustoe & Edmunds 2008).

4.5 International marine parks

4.5.1 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 2021; UNEP-WCMC 2021b). It was established in 2009 and has an IUCN Category II status (UNEP-WCMC 2021b). 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).

4.6 Wetlands of conservational significance

4.6.1 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 PEZ and is approximately 155 km from WA-50-L (Figure 4-8).

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 4.3.3.

4.6.2 Coburg 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 km^2. It is approximately 1,000 km from WA-50-L. 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 (DAWE 2021q).

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 (DAWE 2021q).

4.6.3 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 km^2. Eighty Mile Beach is characterised by extensive mudflats supporting an abundance of macroinvertebrates which provide food for large numbers of shorebirds (DAWE 2021r).

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.

4.6.4 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 km^2. Christmas Island is approximately 1,950 km from WA-50-L.

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 (DAWE 2021d).

The site is an example of a specific type of wetland unique to Christmas Island and perhaps unique worldwide. Hosnies Spring is isolated and relatively inaccessible so there is minimal human impact on the area (DAWE 2021d).

4.6.5 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-50-L.

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 (DAWE 2021e).

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 (DAWE 2021e).

Current use of the Ramsar site includes scientific research, and tourism activities such as scuba diving, snorkelling and surfing.

4.6.6 Roebuck bay

The Roebuck Bay Ramsar site is located at Roebuck Bay near Broome in northern WA totalling 341 km^2. Roebuck Bay has a large tidal range which exposes around 160 km^2 of mudflat, covering most of the Ramsar site and is one of only a dozen intertidal flats worldwide where benthic food sources are sufficient to support internationally significant numbers of waders (DAWE 2021s).

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 (DAWE 2021s). 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 (DAWE 2021s). 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 (DAWE 2021s).

4.6.7 The Dales

The Dales Ramsar site is located in the Australian External Territory of Christmas Island and covers an area of approximately 5.8 km^2 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 (DAWE 2021f). 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 (DAWE 2021f). 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 (DAWE 2021f).

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 (DAWE 2021f).

4.6.8 Mermaid Reef

Although not a Ramsar site, Mermaid Reef is identified as a Nationally Important Wetland in the EPBC Act Protected Matters search of the PEZ (Appendix B). The intertidal and subtidal reef system and associated ecological values and sensitivities are described above in Section 4.3.9. It is considered that marine avifauna which roost on the islands within Clerke and Imperieuse Reef may forage at Mermaid Reef.

4.6.9 Finniss Floodplain and Fog Bay Systems

The Finniss Floodplain and Fog Bay System is an example of a beach-fringed curved bay with continuous intertidal mudflats (DAWE 2021c). 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 (DAWE 2021c). There are extensive paperbark swamps and small areas of samphire near the estuaries and the south-west part of the bay. This 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 2021c).

4.6.10 Yampi Sound Training Area

Identified as a Nationally Important Wetland (Appendix B), Yampi Sound Training Area is located 140 km north of Derby in the Kimberley Region of WA. The area covers approximately 5,660 km^2 and contains coastal habitats such as mangroves and low-lying coastal flood plains (DAWE 2021g). Several bird species have been recorded in the area including the Little Tern (*Sternula albifrons*) (DAWE 2021g).

4.6.11 Big Springs

Located on the mud flats on the eastern shore of King Sound in the West Kimberley, Big Springs is a Nationally Important Wetland (DAWE 2021t). The site comprises a single large mound spring along with further scattered clusters of outlying, densely vegetated spring islands. The total area of the Big Springs site is approximately 0.8 km^2. The wetland is a complex system of freshwater seepages and mound sprigs that support rainforest, surrounded by saline tidal flats devoid of vegetation (DAWE 2021t). Freshwater crocodiles and many bird species have been recorded however, no threatened flora or fauna have been documented at the site.

4.6.12 Bunda Bunda Mound Springs

Identified as a Nationally Important Wetland (Appendix B), the Bunda-Bunda Mound Springs comprises of one large (approximately 0.2 km^2) and one small mound area (approximately 0.02 km^2) located approximately 300 m from the shoreline on tidal mudflats in Carnot Bay on the Kimberley coastline (DAWE 2021u). Bunda-Bunda supports a range of flora and fauna on raised peaty swamps, approximately 2 – 3 m above the surrounding tidal flats, that resemble islands (DAWE 2021u). They provide freshwater for birds during summer and the surrounding area is used for pastoral cattle grazing (DAWE 2021u).

4.6.13 Mitchell River System

Situated in the Shire of Wyndham in the North Kimberley, the Mitchell River System Nationally Important Wetland comprises the entire Mitchell River drainage system including waterfalls, tidal creeks and flats (DAWE 2021v). Mangroves present within the site support bats, possums and mangrove forest birds and at least 10 species of freshwater fish occur including the Mitchell Gudgeon (*Kimberleyeleotris hutchinsi*), a species endemic to the Kimberley and only found in the Mitchell River system (DAWE 2021v).

4.6.14 Prince Regent River System

The Prince Regent River System comprising of estuary and river catchment in the Prince Regent Nature Reserve is identified as a Nationally Important Wetland (Appendix B) located in the North Kimberley region of WA. The site comprises of large areas of mangrove and provides important habitat for waterbird species, forest bird species typically confined to mangroves and one of the largest populations of saltwater crocodiles in WA (DAWE 2021w).

4.6.15 Willie Creek Wetlands

Identified as a Nationally Important Wetland, the Willie Creek Wetlands are situated on the tidal flats of Willie Creek estuary in the Shire of Broome and cover an area approximately 0.2 km^2 (DAWE 2021x). The site consists of two spring-fed and tidally inundated wetlands, Nimalaica swamp and a crescent-shaped lake fringed by bare mudflats. Bird and fish breeding habitats support a range of species including migratory seabirds such as the Broad-billed Sandpiper (*Limicola falcinellus)* and barramundi that are reported to grow to maturity in the freshwater streams then move downstream to breed in the estuaries (DAWE 2021x).

4.7 Threatened Ecological Communities

An ecological community is a naturally occurring group of plants, animals and other organisms that interact within a unique habitat. Ecological communities are listed as threatened if the community is presumed to be totally destroyed or at risk or becoming totally destroyed. There is one threatened Ecological Community found adjacent to the waters of the PEZ, the monsoon vine thickets on the coastal sand dunes of Dampier Peninsula (Appendix B).

Monsoon vine thicket occurs as semi-deciduous and evergreen vine thicket communities on and behind landward slopes of coastal sand dunes on the Dampier Peninsula in the Kimberley Region. This community is closely associated with coastal dunes elsewhere on the Dampier Peninsula and is listed as Endangered under the EPBC Act (DAWE, 2021h).

Although present within the EPBC Act Protected Matters Database (including a 1 km buffer) as presented in Appendix B, upon further consideration the threatened ecological community is not considered relevant to the PEZ and is therefore not discussed further in this EP. This is primarily because there are no 'marine' values or sensitivities which could be impacted by an oil spill. This is supported by the description of the community in the Approved Conservation Advice (DSEWPaC 2013) which states that most patches of the ecological community occupy the leeward slopes and swales and sometimes the exposed crests. Some patches may extend landward into the red-soil pindan plains.

4.8 Physical environment

4.8.1 Climate

Air temperature

Air temperatures recorded at Browse Island, the closest Bureau of Meteorology (BOM) climatological station to WA-50-L, shows a maximum temperature of 33.3 °C and a minimum of 21.6 °C (BOM 2021). 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).

Winds

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 winter season is characterised by steady north-east to south-east winds of 5 metres per second (m/s) to 12 m/s, driven by south-east trade winds. The prevailing south-east winds bring predominantly fine conditions throughout the north of Australia. The summer season is the period of the predominant north-west monsoon. It is characterised by north-west to south-west winds of 5 m/s for periods of five to 10 days with surges in airflow of 8 m/s to 12 m/s for periods of one to three days.

During the summer season, the weather in the north is largely determined by the position of the monsoon trough, which can be in either an active or an inactive phase. The active phase is usually associated with broad areas of cloud and rain, with sustained moderate to fresh north-westerly winds on the north side of the trough. Widespread heavy rainfall can result if the trough is close to, or over, land. An inactive phase occurs when the monsoon trough is temporarily weakened or retreats north of Australia. It is characterised by light winds, isolated showers, and thunderstorm activity, sometimes with gusty squall lines.

Tropical cyclones can also develop off the coast in the northern wet season, usually forming within an active monsoon trough. Heavy rain and strong winds, sometimes of destructive strength, can be experienced along the coast within several hundred km of the centre of the cyclone. The Browse Basin is prone to tropical cyclones, mostly during the tropical wet season from December to March (INPEX 2010). Under extreme cyclone conditions, winds can reach 83 m/s.

Rainfall

The region has a pronounced monsoon season between December and March, which brings heavy rainfall. Heaviest rainfall is typically associated with tropical cyclones.

Troughton Island located on the Kimberley coastline is the closest location to WA-50-L with a historical rainfall record. Historical rainfall data shows the highest maximum (269.8 mm) and mean (>100 mm) monthly rainfalls occur from December to March (BOM 2021). Rainfall intensity at the Ichthys Field is expected to range from approximately 215 mm/h to 460 mm/h over a 5-minute interval (based on 1-year and 200-year average recurrence intervals) (AMEC Ltd. 2011).

Air quality

There is currently no air quality data recorded within the vicinity of WA-50-L. However, given the distance from land, air quality is expected to be relatively high. Potential sources of air pollution associated with anthropogenic influences are expected to be emissions generated by shipping, and oil and gas activities, and therefore considered to be localised in relation to the regional setting.

4.8.2 Oceanography

Currents

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 (Figure 4-3). 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).

Offshore regions with water depths exceeding 100-200 m tend to experience significant large-scale drift currents. These drift currents tend to be stronger than tidal currents and are the dominant driver of the long term (> several days) transport of effluent plumes. Drift currents in the location of the INPEX *Ichthys Venturer* FPSO within WA-50-L are expected to be directed towards the south-west during summer and winter. During the transitional period, drift currents will be variable, predominantly switching between the south-west and north-east directions. Typical drift current speeds range from zero to 0.3 m/s throughout the year (APASA 2015). Tidal current data, also from the FPSO location, indicate that tidal currents are likely to be directed along a north-west to south-east axis throughout the year. Typical tidal current speeds are in the range of 0.2–0.6 m/s (APASA 2015). Wind shear at the surface also generates local-scale currents.

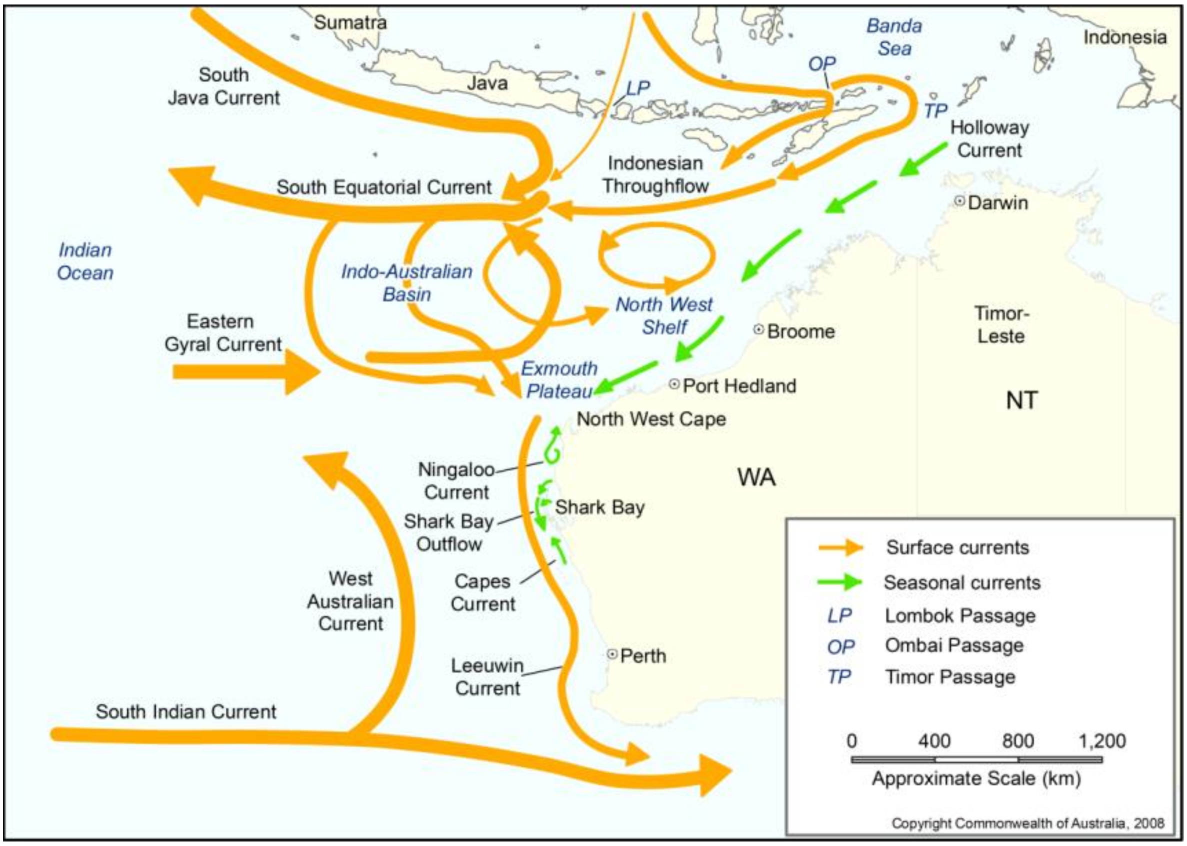


Figure 4-3: Surface currents for WA waters

Tides

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 WA-50-L is about 2.7 m above lowest astronomical tide (LAT) with a spring tidal range of about 5.0 m.

Waves

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 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.

4.8.3 Bathymetry and seabed habitats

Water depths within WA-50-L ranges from 235 m to 275 m at LAT. Studies using sub-bottom profiling, multibeam echo-sounder and sidescan sonar have been undertaken by INPEX at the Ichthys Field 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 NSW 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 Ichthys Field, 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 suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities.

4.8.4 Water quality

Offshore surface waters are typically oligotrophic. This has been confirmed by studies recording low nitrate concentrations and low phytoplankton abundance. In general, the region experiences an influx of comparatively nutrient-rich waters at depth in summer and a variety of processes, such as tidal currents, internal waves and cyclone mixing, are known to carry these nutrients into the bottom waters of the shelf (Hallegraeff 1995).

Inshore coastal waters tend to be more turbid than offshore open ocean waters due to suspension of sediments by wave action and sediment laden runoff from the land. Higher total suspended solids (TSS) concentrations tend to occur during spring tide conditions due to stronger tidal currents and meteorological perturbations, such as periods of strong winds.

Water quality has been measured by INPEX during numerous surveys in order to describe the natural water quality conditions in the Ichthys Field and in surrounding areas including WA-50-L. An overview of the water quality studies undertaken are as follows:

- Water quality sampling was conducted at 27 offshore locations near the Ichthys Field, Echuca Shoal and their surrounds between March 2005 to June 2007 as a part of the INPEX Ichthys EIS studies.
- Near-seabed temperature and salinity profiles were obtained along the proposed pipeline route from the Ichthys Field to Darwin Harbour during geophysical and geotechnical surveys conducted between August and October 2008.

- ARP studies between INPEX and Shell in the Browse Basin included 66 water quality profiles and more than 1,300 water samples collected from 56 locations around the Ichthys Field in May 2015. Sampling locations were based on a gradient design away from a central point in the Ichthys Field and also included increased sampling around Browse Island, Echuca and Heywood shoals. Samples were analysed for metals and hydrocarbons (Ross et al. 2017). In addition, ad hoc water quality samples have also been collected from sampling locations during other ARP field surveys to increase the dataset and knowledge.
- Water quality monitoring in the receiving environment was undertaken in 2019, as part of the Liquid Effluent Management Plan (Section 9.6.2), to detect changes in water quality attributable to liquid discharges from the CPF and FPSO. Samples were collected from 31 locations based on the modelled mixing zones for the CPF and FPSO and included fixed sampling locations and sampling sites along the prevailing currents (Jacobs 2019).

The results of these studies, as relevant to this EP, are summarised in Table 4-2.

Water quality in the Indonesian waters of the PEZ is unknown. However, the Asian Development Bank (2014) reported that approximately 40% of domestic sewage in Indonesia is discharged directly or indirectly via rivers and into the sea without proper treatment. The high organic and nutrient content of untreated sewage can lead to eutrophication or excessive nutrient enrichment, which triggers the growth of phytoplankton in the form of harmful algal blooms, or red tides, in many places in Indonesia.

Table 4-2: Summary of water quality parameters in the vicinity of WA-50-L

Parameter	Description
Surface-water temperature	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). Offshore waters in the region are typified by thermal stratification, with the start of the thermocline generally around 60 m below sea surface (but ranging from 30-80 m) (Ross et al 2017). Temperature decays rapidly through the water column to 14 °C at approximately 200 m and then decays more slowly to a minimum of circa 8 °C recorded at the deepest sites (Ross et al. 2017).
Salinity	Salinity was spatially and temporally consistent at 34 to 35 parts per thousand (ppt) across all sampling sites and can reasonably be expected to be similar within the wider area, given the distance from major freshwater discharges (INPEX 2010). Sampling undertaken in 2019, found the vertical salinity profiles of various sites sampled within and around the CPF and FPSO were similar and did not change markedly from surface to bottom. Generally, salinity was approximately 34.4 ppt at the surface and then increased slightly at the seabed 34.5 ppt (Jacobs 2019).

Parameter	Description
Dissolved oxygen	Dissolved oxygen concentrations in the Ichthys Field mirrored water temperatures, with concentrations varying considerably between the surface and subsurface layers. The surface mixed layer was generally well oxygenated throughout; however, below the thermocline (starting at approximately 60 m through to 200 m water depth), the concentration of dissolved oxygen decreased consistently with depth (RPS 2007; Ross et al. 2017; Jacobs 2019). Dissolved oxygen concentrations were recorded at constant levels of 6.0 to 6.5 ppm at or above the thermocline in both summer and winter. In the cooler waters below the thermocline, dissolved oxygen decreased with increasing depth, with levels as low as 4.5 to 5.0 ppm recorded at a depth of 93 m and 3 ppm at a depth of 250 m (INPEX 2010). This indicates that the strong thermal stratification at the offshore locations results in limited oxygen replenishment of subsurface waters due to the lack of regular mixing between water layers (RPS 2007).
pH	The average pH of waters was measured at approximately 8.4 (RPS 2007), which is slightly higher (more alkaline) than normally encountered in the marine environment and is above the default criteria given in the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZG 2018). Sampling undertaken in 2019 reported, the pH of the surface water for sites within and around the CPF and FPSO ranged from 8.12 to 8.20 (Jacobs 2019). Further, the shape of the profiles for pH and dissolved oxygen were similar, with a decrease in pH occurring near the top of the thermocline, due to oxidation of organic matter.
Turbidity and light attenuation	Turbidity is generally higher in the shallow waters of the continental shelf and towards the base of many of the deeper water column profiles. Sampling undertaken in 2019, found turbidity was very low throughout the majority of the water column at each site sampled. At approximately 20–50 m above the seabed the turbidity was slightly elevated and increased with depth (Jacobs 2019). This has been attributed to the action of currents passing over the seabed causing some turbulence and resuspension of sediments. The re-suspension of materials from the seafloor includes organic material, which could comprise a pathway for hydrocarbon materials to become incorporated into sediments. Light attenuation coefficients calculated from photosynthetically active radiation (PAR) measurements ranged from 0.026 to 0.043 in October and December 2006, and 0.048 to 1.09 in June 2007. These were observed to be consistent with reported "typical" levels for the region (RPS 2007).
Petroleum hydrocarbons	Baseline sampling has indicated low levels of naturally occurring hydrocarbons released by organic matter decay or higher trophic level organisms. Shallow water sites showed a constant hydrocarbon concentration through the profile. Deep water sites showed a low and constant concentration above the thermocline, with a peak of 0.2-0.25 µg/L at the thermocline before slowly diminishing (Ross et al. 2017).
Radionuclides	Water-column sampling for radionuclides in the Ichthys Field area indicated concentrations of radium-226 ranging from below lower limits of reporting (LLR) to 0.034 (±0.012) becquerels per litre (Bq/L) and concentrations of radium-228 ranging from below LLR to 0.167 (±0.128) Bq/L. With the exception of one mid-depth sample, all samples returned gross alpha-particle and gross beta-particle radiation levels below the Australian Drinking Water Guidelines (ADWG) screening criterion of 0.5 Bq/L provided by the National Health and Medical Research Council (NHMRC) and the Natural Resource Management Ministerial Council (NRMMC).

Parameter	Description
Metals	Total metal concentrations in the offshore waters sampled were below the 99% species protection level for marine waters with the exception of zinc and cobalt at one site each. The reason for these two slightly elevated readings is unknown (INPEX 2010). Ultra-trace-level analysis methods were used to assess metal concentrations in surface waters because ANZG (2018) guideline trigger values at the 99% species protection level are lower than the limits of standard laboratory methods. Mercury was the only metal not detected above the LLR, while cobalt was marginally above the LLR at only one site. Concentrations of arsenic, nickel, chromium and zinc were consistent across all sites, but the concentrations of cadmium, copper and lead showed greater variability (INPEX 2010). Sampling undertaken in 2019, found copper concentrations above 99% species protection levels were recorded at various sites including sites up to 10 km from the FPSO (Jacobs 2019). There were no exceedances of the copper guideline value for sites closest to the discharge for either fixed or mobile sites and all sites with exceedances were different distances and directions from the discharge. Chromium was detected in water samples collected from both fixed and mobile sites the edge of the CPF and FPSO mixing zones or beyond. All chromium concentrations were below the laboratory limits of reporting (LOR) (Jacobs 2019).

4.8.5 Sediment quality

Similar to water quality, marine sediments have been sampled during numerous surveys in order to characterise the marine sediments in the Ichthys Field and surrounding areas. Overviews of the studies are listed below, with the results as relevant to this EP summarised in Table 4-3:

- Sampling and characterisation of marine sediments in the Ichthys development area was conducted at 10 sites in September 2005 and May 2007. This included five sites within 20 km of the Ichthys Venturer FPSO location and another five sites between 36 km and 134 km away. A further 10 sites were also sampled for particle size distribution (PSD) between 24 km and 66 km of the FPSO location in WA-50-L.
- Seabed sediment sampling along the proposed pipeline route from the Ichthys Field to Darwin Harbour was conducted at approximately 10 km intervals during geophysical and geotechnical surveys between August and October 2008.
- ARP studies included 133 sediment samples at 56 locations collected around the Ichthys Field in May 2015. Sampling locations were based on a gradient design away from a central point in the Ichthys Field and also included increased sampling around Browse Island, Echuca and Heywood shoals. Samples were analysed for metals and hydrocarbons (Ross et al. 2017). In addition, ad hoc sediment samples have also been collected from sampling locations during other ARP field surveys to increase the dataset and knowledge.
- Sediment quality monitoring in the receiving environment was undertaken in 2019, as part of the Liquid Effluent Management Plan (Section 9.6.2), to detect changes in surficial sediment quality attributable to liquid discharges from the CPF and FPSO. Sediment samples were collected from 18 fixed sampling locations based on a gradient design radiating out from the FPSO to approximately 10 km as the FPSO represents a point source discharge.

Table 4-3: Summary of sediment quality parameters in the vicinity of WA-50-L

Parameter	Description
Particle size distribution (PSD)	The seabed in offshore locations on the continental shelf is known to consist of generally flat, relatively featureless plains characterised by soft sandy-silt marine sediments that are easily resuspended. Similarly, the substrate of the Scott Reef – Rowley Shoals Platform, in water depths of 200–600 m, is considered to be a depositional area with predominantly fine and muddy sediments (INPEX 2010). The PSD of sediment at sites located within the Ichthys Field was primarily sand, with some silts.
Petroleum hydrocarbons	Concentrations of BTEX and PAH compounds in sediments in the vicinity of the sampling sites were very low (Ross et al. 2017, RPS 2007). The components of the more prevalent alkane compounds found indicated that the concentrations observed were likely to have originated from biogenic sources (Ross et al. 2017). Sampling undertaken in 2019 at fixed and mobile sites around the FPSO (out to 10 km) found all hydrocarbons, BTEX and speciated phenols were below the laboratory limits of reporting and guideline values (Jacobs 2019).
Radionuclides	Naturally occurring radioactive materials (NORMs) for the majority of results were below or close to LLR. Radium-226 was detected at one site but all other samples were below LLR for each radium isotope. The concentration of uranium and thorium was consistent across all sites (RPS 2007). Sampling undertaken in 2019 found NORMs were below background concentrations at all sampling sites (fixed and mobile) (Jacobs 2019).
Metals	Concentrations of all metals were consistent across the sampling sites and well below the interim sediment quality guidelines (ISQG) low screening level (ANZG 2018), with the majority also below their respective LLR (RPS 2007). Organometallics (i.e. tributyltin (TBT)) were below ANZG (2018) guidelines and lower than the LLR at all sampling locations. Sampling undertaken in 2019 at fixed sampling sites at the FPSO, found all metals/metalloids were below the guideline values indicating no significant change to sediment quality has occurred as a result of the FPSO discharges (Jacobs 2019).

4.8.6 Underwater noise

The Centre for Marine Science and Technology (CMST) at Curtin University undertook a study on behalf of INPEX from September 2006 to August 2008 to assess ambient biological and anthropogenic sea noise sources in the Browse Basin. Ambient noise in the Ichthys Field was measured using a sea noise logger deployed at a depth of 240 m on the seabed 45 km north-west of Browse Island. The monitoring revealed an average ambient noise level of 90 dB re 1 µPa under low sea states, with inputs of low frequency energy from the Indian Ocean (INPEX 2010).

Biological noise sources recorded in the Ichthys Field included regular fish choruses (one at >1 kHz and another at around 200 Hz) and several whale calls from humpback whales, pygmy blue whales, minke whales and other unidentified species. Results from this survey are considered to be indicative of typical underwater noise levels and frequencies within the NWMR and NWR bioregion as a whole.

4.9 Biological environment

4.9.1 Planktonic communities

Plankton communities comprise phytoplankton and zooplankton, including fish eggs and larvae. Phytoplankton and zooplankton are a source of primary and secondary productivity, and key food sources for other organisms in the oceans (Brewer et al. 2007). Eggs and larvae may be dispersed throughout the water column and throughout the region, playing an important role in species recruitment.

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 2010). Annual variability of phytoplankton productivity in waters surrounding Indonesia is heavily influenced by the El Niño-Southern Oscillation climate pattern (NASA 2010). 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 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 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).

4.9.2 Benthic communities

Banks and shoals

A number of banks, shoals and reefs exist within the Browse Basin (Figure 4-2). The closest to WA-50-L are Echuca and Heywood shoals that are located approximately 79 km and 96 km away respectively. Browse Island is the nearest intertidal habitat which is located 33 km away from WA-50-L (INPEX 2010).

Other representative banks and shoals within the PEZ, with approximate distances from WA-50-L include:

- Vulcan Shoals (173 km)
- Eugene McDermott Shoals (175 km)
- Barracouta Shoals (179 km)
- Woodbine Bank (180 km)
- Fantome Shoals (266 km)
- Penguin Shoal (277 km)
- Gale Bank (350 km)
- Van Cloon Shoals (383 km)
- Rowley Shoals (500 km)
- Sunrise Bank (600 km)
- Flat Top Bank (670 km)
- Glomar Shoals (900 km).

The shoals and banks within the PEZ 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.

A detailed study on Echuca and Heywood Shoals, the two closest submerged shoals to WA-50-L, was undertaken as part of the Shell/INPEX ARP comprising of annual field surveys conducted from 2014 to 2016 (Heyward et al. 2018). The focus of the study was the shoal benthic habitats and associated fish communities predominantly on the plateau areas, present as horizontal or gently sloping seabed in depths of 15 m to 30 m. The outcome of the study by Heyward et al. (2018) reported that Echuca Shoal's oval shaped and slightly shallower 11 km^2 plateau had less unconsolidated substrate, such as sand or rubble, than Heywood Shoal's plateau of approximately 31 km^2. The benthic habitats and fish communities were similar, with many species in common. All epibenthic organisms on both shoals appeared normal and healthy throughout the study. Fish abundance and diversity was high but varied over time and between the shoals in a consistent manner. Species richness, abundance and fish community structure were influenced mainly by depth and the abundance of epibenthos, especially hard coral (Heyward et al. 2018). These results are comparable with other shoals throughout the region.

The submerged shoals within the PEZ 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. The shoals and banks of the area may therefore act as 'stepping stones' for enhanced biological connectivity between the reef systems of the region. Shoal and bank habitats are thought to provide additional regional habitat for marine fauna, including sharks and sea snakes (AIMS 2012).

The community structure of the banks and shoals is likely to be influenced by a number of processes, including disturbance resulting from storms and cyclones, and localised recruitment due to the limited larval dispersal of some invertebrate species (AIMS 2012). It is unknown how interconnected the individual banks and shoals are in regard to larval recruitment. The majority lie in the path of a south-westerly flowing current originating in the Indonesian Throughflow. However, seasonal reversals of current flow suggest larval recruitment can be supplied from outside this process. Seasonal current patterns, local effects within ocean currents (e.g. reversal of current direction against prevailing winds) and species lifecycle characteristics are all likely to exert an influence over the larval recruitment (and hence biodiversity) of the banks and shoals (INPEX 2010).

Coral reefs

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 PEZ include:

- Ashmore Reef
- Cartier Island
- Seringapatam Reef
- Scott Reef
- Hibernia Reef
- Rowley Shoals
- Mermaid 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). The Rowley Shoals and Scott Reef support very high coral species diversity, as discussed in sections 4.2 and 4.3. 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-50-L) are discussed in Section 4.4.3.

Fringing coral reefs around Christmas Island are relatively simple with 88 coral species previously identified which are identified to support and over 600 fish species (Director of National Parks 2012; Hobbs et al. 2014). The Cocos (Keeling) Islands also have a wide variety of corals species (Geoscience Australia 2021c).

Indonesia has the largest coral reef area in Southeast Asia and estimates of the extent of these coral reefs vary, but they likely total about 51,000 km² (ABD 2014). More than 590 species of corals have been identified in Indonesian waters. The Lesser Sunda Ecoregion which intersects the PEZ is considered important for coral endemism, particularly the areas of Bali-Lombok, Komodo and East Flores. Fringing coral reefs tend to be less developed on the southern, more exposed shorelines (Wilson et al. 2011). Coral species composition is influenced by regional and local scale seasonal upwellings that typically occur from April to May each year on the southern side of the Indonesian islands (DeVantier et al 2008).

Observations throughout the world indicate that coral spawning on most reefs extends over a few months during the spawning period, typically between late spring and autumn (Stoddart & Gilmour 2005, cited in INPEX 2010). Spawning of corals in the Northern Territory Aquarium has been observed around the full moon period in October and November (TWP 2006, cited in INPEX 2010). In northern Queensland, captive corals have been observed to spawn at the same time as those in the adjacent waters. Coral spawning has been observed at Scott Reef during summer/autumn (March/April; main spawning event) and spring (October/November) (Gilmour et al. 2009). This has been confirmed by AIMS research at Scott Reef, which estimates that 60–75% of community reproductive output occurs in autumn, 15–25% in spring, and 5–15% in summer, with comparatively little reproductive output during winter (Gilmour et al. 2013). Research into coral larval dispersal (Gilmour et al. 2009, 2010, 2011; Underwood et al. 2009, 2017; Cook et al. 2017; Waples et al. 2019) has indicated that dispersal and recruitment is predominately local and limited to within a few kilometres to a few tens of kilometres from natal reef patches.

Seagrass

There is no seagrass within WA-50-L due to water depth (approximately 250 m) and lack of suitable habitat.

Seagrasses occur in the PEZ with the closest seagrasses to the licence area located at Ashmore Reef, approximately 156 km north of WA-50-L, 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). Other important seagrass habitats include the Lacepede Islands, Scott Reef and Cartier Island. Coastal shallow-water seagrass habitats are generally rare in the region, accounting for only 11.5 km or 0.2% of the total Australia coastline surveyed by Duke et al. (2010). The regionally dominant genera in Australia are *Halophila* and *Halodule*.

The Cocos (Keeling) Islands have an extensive lagoon with more than 26 km^2 of shallow seagrass meadows that include *Thalassia* spp. and *Thalassodendron* spp. (Hobbs et al. 2007). Due to a lack of lagoonal habitats, no seagrass habitats have been recorded at Christmas Island (Hobbs et al. 2014).

Seagrass habitats are widely distributed across the Lesser Sunda Ecoregion and within Indonesian waters the lower intertidal and upper subtidal zones are considered important areas for the growth of seagrass (Hutumo & Moosa, 2005). Pioneering vegetation in the intertidal zone is dominated by *Halophila ovalis* and *Halodule pinifolia* while *Thalassodendron ciliatum* dominate the lower subtidal zones (Hutumo & Moosa, 2005). Data from the United Nations Environment Program (UNEP) World Conservation Monitoring Centre has identified the south-west and west Lombok, Savu and the south coast of Timor-Leste as potential areas of importance for seagrass (DeVantier et al. 2008).

4.9.3 Shoreline habitats

There are no islands within WA-50-L, with the closest intertidal habitat located at Browse Island (33 km south-east of the licence area). However, within the PEZ there are numerous small islands along the Australian and Indonesian coastlines.

In the offshore waters of the PEZ 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 4.3, 4.4, 4.5 and 4.6.

Sandy beaches

Sandy beaches are the dominant shoreline habitat on the offshore islands within the PEZ and provide significant habitat for turtles and seabird nesting above the high tide line. Sandy beaches are present within the PEZ at the sandy cays of Ashmore Reef, Cartier Island, Browse Island, Scott Reef and along the coastlines of the Tiwi Islands as described in sections 4.3 and 4.4. The southern coastlines of the Lesser Sunda Ecoregion of Indonesia and Timor-Leste islands are known to contain sandy beaches consisting of soft black sand, formed by volcanic activity. Within this region, a number of important sites for turtle nesting beaches have been identified (Huffard et al. 2012).

Generally, sands are highly mobile and therefore do no support a high level of biodiversity. Fauna within sandy beach habitats usually consists of polychaete worms, crustaceans and bivalves that provide a valuable food source for resident and migratory sea and shorebirds (DEC/MPRA 2005). Natural processes tend to supply fresh sediments and larval stock (food source) with each tidal influx.

Mangroves

Mangrove communities make up a common shoreline habitat along the northern WA coastlines with extensive mangrove communities along the Australian and Indonesian coastline within the PEZ. They commonly occur in sheltered coastal areas in tropical and sub-tropical latitudes. Mangroves play an important role in connecting the terrestrial and marine environments and reducing coastal erosion. They also play an important ecosystem role in nutrient cycling and carbon fixing (NOAA 2010).

More than a quarter of the world’s species of mangroves can be found along the Kimberley coast, covering an area of approximately 1,400 km^2. During 2009, shoreline ecological aerial and ground surveys were conducted from Darwin in the NT to Broome in WA in response to the Montara oil spill (Duke et al. 2010). Approximately 5,100 km of shoreline was surveyed, analysed and mapped to quantitatively characterise coastal ecological features. Mangroves were found to grow along 63% of the surveyed shoreline and salt marshes occurred over 24% of the shoreline.

No mangroves are present on Christmas Island with the exception of a stand of estuarine mangrove species, identified approximately 37 m above sea level at the Hosnies Spring wetland (Ramsar site, Section 4.6.4) (Director of National Parks 2012).

Within Indonesia, 41 species of mangroves, occupying some 32,000 km^2 have been recorded (ABD 2014). The Timor-Leste coastline also features mangrove communities surrounding entrances to rivers, primarily situated on the southern coast.

4.9.4 Marine fauna

Species of conservational significance

Species of conservation significance within WA-50-L and the PEZ were identified through searches of the EPBC Act Protected Matters Database (including a 1 km buffer) both of which are presented in Appendix B.

The search identified 39 “listed threatened” and 86 “listed migratory” species of marine fauna that could potentially use or pass through the PEZ. In addition, 167 “listed marine” species were identified, of which 32 were “whales and other cetaceans” that may occur at, or immediately adjacent to, the area.

Table 4-4 presents the marine species that are “listed threatened” species or “listed migratory species” that may potentially occur in the broader PEZ, which also captures those species present in the WA-50-L search report. Note that true terrestrial species have not been listed in Table 4-4.

Table 4-4: Listed threatened and/or migratory species under the EPBC Act potentially occurring within the PEZ

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
Sousa chinensis/ Sousa sahulensis	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

Species	Common name	Conservation status	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
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
Carcharhinus longimanus	Oceanic whitetip 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

Species	Common name	Conservation status	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
Limonsa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	Critically Endangered	Migratory
Macronectes giganteus	Southern giant petrel	Endangered	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
Anous stolidus	Common noddy	N/A	Migratory
Apus pacificus	Forktailed swift	N/A	Migratory
Ardenna carneipes	Flesh-footed Shearwater	N/A	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

Species	Common name	Conservation status	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
Charadrius dubius	Little Ringed Plover	N/A	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 haliaetus	Osprey	N/A	Migratory
Philomachus pugnax	Ruff (Reeve)	N/A	Migratory
Pluvialis fulva	Pacific Golden Plover	N/A	Migratory

Species	Common name	Conservation status	Migratory
Pluvialis squatarola	Grey Plover	N/A	Migratory
Thalasseus bergii	Greater Crested Tern	N/A	Migratory
Tringa brevipes	Grey-tailed Tattler	N/A	Migratory
Tringa incana	Wandering 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

Conservation management plans

In addition to species being identified as threatened or migratory and MNES, depending on the threat classification, the DAWE has established management policies, guidelines, plans and other materials for threatened fauna, threatened flora (other than conservation-dependent species) and threatened ecological communities listed under the EPBC Act.

In particular, the objectives of DAWE recovery plans and conservation advice, seek to support the long-term recovery of various species outlining research and management measures that must be undertaken to stop the decline of, and support the recovery of a species, including the management of threatening processes.

Species identified during the EPBC Act Protected Matters searches that have a conservation advice or a recovery plan in place, as well as any particular relevant actions to assist their recovery and conservation, including threat abatement plans, are summarised in Appendix B.2.

Biologically important areas

The DAWE 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.

Table 4-5 provides an overview of the EPBC-listed species, identified by the EPBC Act Protected Matters search, that are associated with a BIA in the PEZ. The locations of relevant BIAs for EPBC-listed species are shown in Figure 4-4 to Figure 4-8.

Note, there are no BIAs that intersect WA-50-L, with the closest BIAs being a green turtle internesting buffer at Browse Island and the whale shark foraging BIA located approximately 15 km south-east of WA-50-L at its closest point.

Table 4-5: BIAs intersecting the PEZ

Species	Migration route	Foraging	Internesting	Resting/ breeding	Aggregation/ calving	Pupping/ nursing
Humpback whale	x				x	
Pygmy blue whale	x					
Dugong		x				
Coastal dolphins: Indo-Pacific humpback dolphin, bottlenose dolphin and Australian snubfin dolphin		x		x	x	
Whale shark		x				
Largetooth/freshwater, dwarf and green sawfish		x				x
Avifauna		x		x		
Flatback turtle		x	x			
Green turtle		x	x			
Hawksbill turtle		x	x			
Loggerhead turtle		x				
Olive ridley turtle		x				

Marine mammals

Noise logging surveys were undertaken by INPEX to determine the critical areas of use and to establish a baseline of abundance for cetaceans within the Kimberley region. Noise loggers were set on the sea floor at two sites: in the Browse Basin 45 km north west of Browse Island (in 240 m of water) and at an inshore site near the Maret Islands (in 45 m of water) between September 2006 and August 2008. The loggers detected anthropogenic noise signals from vessel activities and seismic surveys, as well as signals from pygmy blue whales, humpback whales, Antarctic and dwarf minke whales, a signal which is believed to be from Bryde's whales, and several unknown great whale signals, plus a plethora of fish signal types and choruses (McCauley 2009). Further desktop analysis of available marine megafauna survey and satellite tracking data was undertaken as part of the Shell/INPEX ARP focussing on the Kimberley region (Ferreira et al. 2018).

There are no identified BIAs for marine mammals within WA-50-L. However, a number of marine mammal BIAs overlap the PEZ as outlined in Table 4-5 and shown in Figure 4-4 and Figure 4-5. Marine mammals associated with a BIA in the PEZ are described in more detail within this subsection.

Humpback whale

There are two humpback whale (*Megaptera novaeangliae*) BIAs located within the PEZ; a migratory corridor and a breeding and calving area, as shown in Figure 4-4. During their annual northern and southern migrations, transitory humpback whales will pass through the PEZ generally between June and October, with peak ingress during July. The population increases up to mid-August when whales begin to depart on their southern migration. Peak egress occurs around September and the final groups of whales tend to have departed by late October (Jenner et al. 2001; Thums et al. 2018).

The migratory habitat for the humpback whale around mainland Australia is primarily coastal waters less than 200 m in depth and generally within 20 km of the coast (Jenner et al. 2001). Breeding and calving generally occurs between the Lacepede Islands and Camden Sound. Camden Sound is considered the northern most limit and is considered an important calving and breeding area (Jenner et al. 2001). A study as part of the Kimberley Marine Research Project (Thums et al. 2018) analysed three decades of satellite, aerial, boat-based sightings and determined that abundance was greatest in nearshore waters in water depths of approximately 35 m. However, whales (including cows and calves) may also occur in lower abundance elsewhere within and further offshore from the BIAs, with whales having been recorded in offshore locations such as Browse Island and Scott Reef (e.g. McCauley 2009). Isolated observations of humpback whales and their calves have been noted within the Ichthys Field. The closest BIA to WA-50-L relates to calving and resting and is located approximately 120 km south-east of the licence area.

Various sightings and individual humpback whale stranding's have been recorded at many Indonesian shorelines including Bali, Flores and East Nusa Tengarra (Mustika et al. 2009).

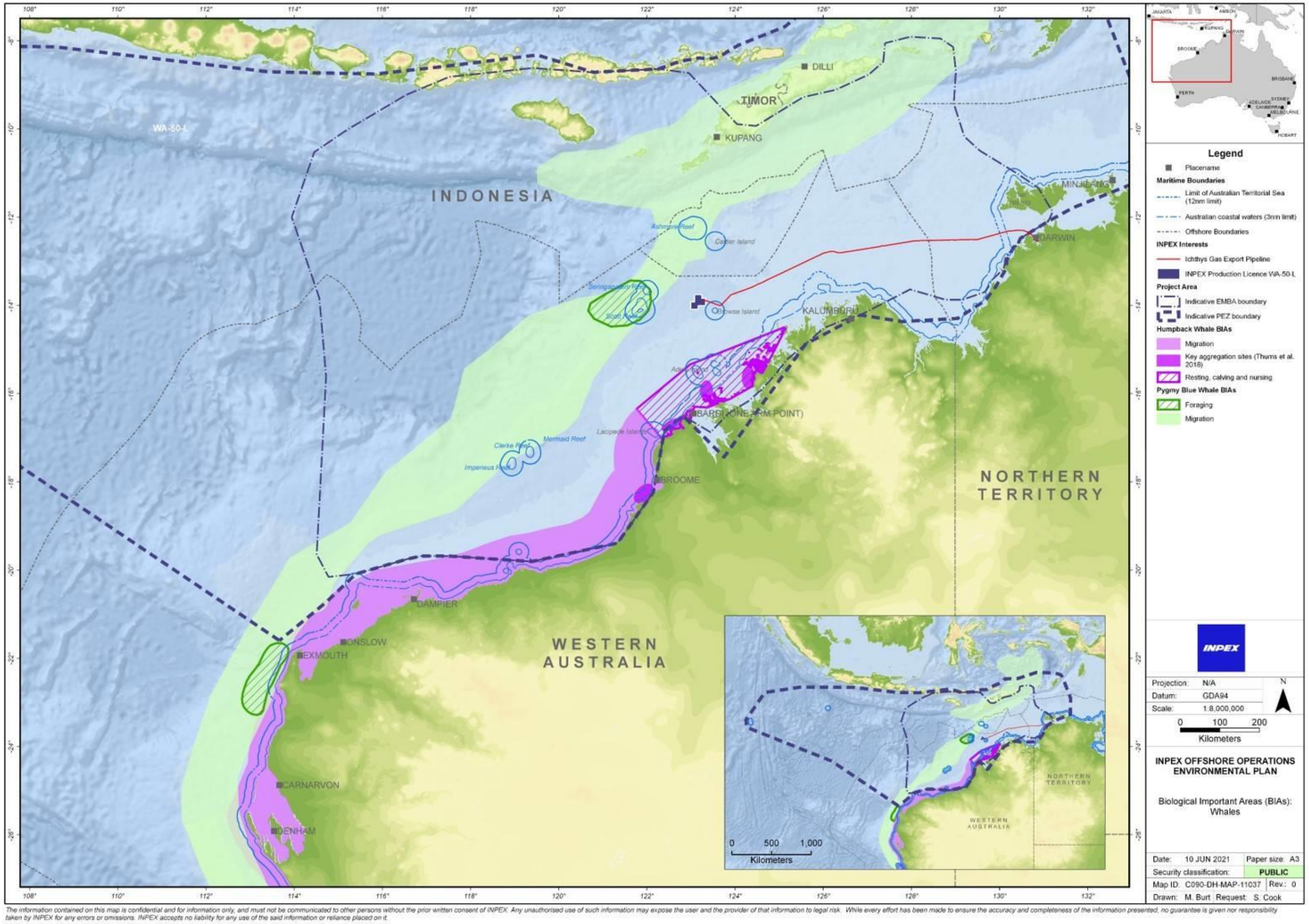


Figure 4-4: Biologically important areas associated with whales

Blue whale

There are two recognised subspecies of blue whale in the southern hemisphere, which are both recorded in Australian waters. They are the southern (or 'true') blue whale (*Balaenoptera musculus intermedia*) and the 'pygmy' blue whale (*Balaenoptera musculus brevicauda*) (DoE 2015). In general, southern blue whales occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S (i.e. not in the Antarctic) (DoE 2015). On this basis, any blue whales present within the licence area/PEZ would be expected to be pygmy blue whales.

The 2015 Conservation Management Plan for the Blue Whale (DoE 2015) outlines the distribution of blue whales in Australian waters, and associated BIAs (i.e. migratory corridor and foraging areas). The closest BIA present within the PEZ, is a migratory corridor, located approximately 60 km north west of WA-50-L at its closest point, and a foraging BIA at Scott Reef, approximately 98 km west of WA-50-L (Figure 4-4).

Pygmy blue whale migration is thought to follow deep oceanic routes. More recently, the migration route has been defined as along the shelf edge at depths between 500 m to 1,000 m (DoE 2015). Observations suggest most pygmy blue whales pass along the shelf edge out to water depths of 1,000 m but centred near the 500 m depth contour (McCauley & Jenner 2010). Satellite tagging (2009–2011) confirmed that the general distribution of pygmy blue whales was offshore in water depths >200 m and commonly >1,000 m (Double et al. 2014). Blue whales have been found across the Savu and Timor Seas and within the waters of the Savu Sea MNP. Pygmy blue whales have been confirmed to use this region as a corridor when migrating from WA to their potential breeding grounds in Indonesian waters (Double et al. 2014).

Blue whale population structure, distribution and migration are poorly understood. However, a comparison of blue whale songs was used to monitor different acoustic populations of blue whales in the Indian Ocean, noting that song variation may be as a result of reproductive isolation and that pygmy blue whale populations described in the study are distinguishable only acoustically with no morphological differences (Leroy et al. 2021). The study suggests that there is a previously unknown pygmy blue whale acoustic population, the Chagos blue whale that migrates between the waters of the central Indian Ocean around the Chagos Archipelago and the Kimberley region in the north of WA (Leroy et al. 2021). This demonstrates that multiple acoustic populations of pygmy blue whales could be migrating over large distances within the deep waters of the PEZ.

Dugongs

Within the PEZ, there is a dugong foraging BIA at Ashmore Reef and another along the Dampier Peninsula, near Broome (Figure 4-5) which correlates with seagrass habitats (refer Section 4.9.2).

Dugongs are considered Specially Protected under Schedule 4 of the *Biodiversity Conservation Act 2018* (WA) and are listed as migratory species under the EPBC Act. A significant proportion of the world's dugong population occurs in the coastal waters of the west-Pilbara nearshore, as well as Ningaloo Reef and Exmouth Gulf (Marsh et al. 2011). Dugongs generally inhabit shallow waters (around 10 m depth) and are commonly found in mangrove channels of inshore islands and shallow areas near the seagrass habitats on which they feed (DAWE 2021i).

The shallow seagrass habitat at the Cocos (Keeling) Islands appears suitable for dugongs, and the Islands were once part of the dugong's historical range; however, in 1970, it was reported that dugongs no longer occur at the Islands (Hobbs et al. 2007). Since 1970, there have only been three confirmed sightings (in 1989, 1998 and 2007) of dugongs at the Cocos (Keeling) Islands (Hobbs et al. 2007).

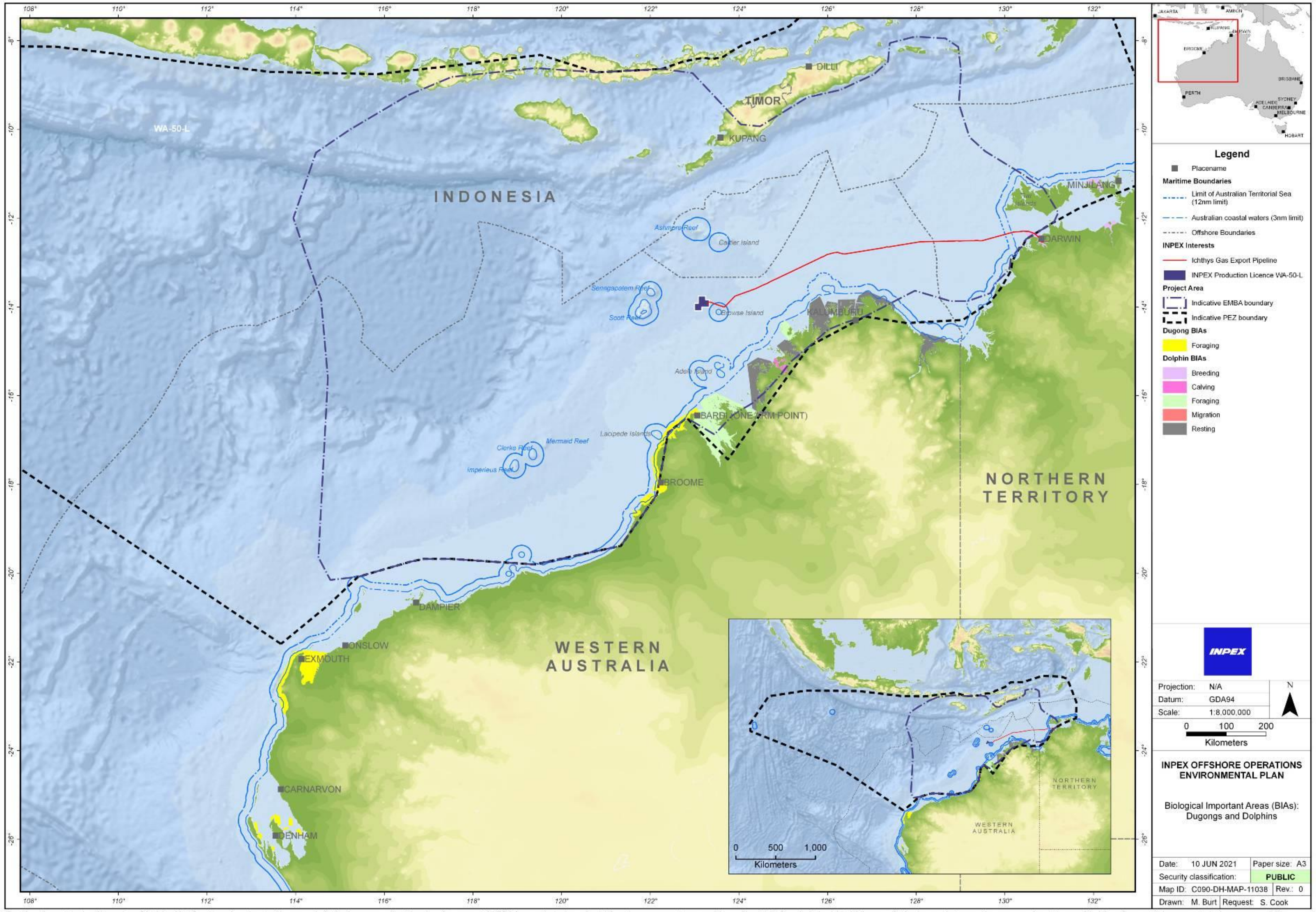


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Figure 4-5: Biologically important areas associated with dugongs and dolphins

Dolphins

Coastal dolphin BIAs for breeding, resting, calving and foraging are located within the PEZ, as shown in Figure 4-5. There are three species of coastal dolphin to which these BIAs relate as discussed below. A recent study of snubfin and humpback dolphins in the Kimberley region (Waples et al. 2019) confirmed these species of dolphins are present at low densities and occur as relatively small populations across the Kimberley.

Indo-Pacific bottlenose dolphin

The Indo-Pacific spotted bottle nose dolphin (*Tursiops aduncus*) is generally considered to be a warm water subspecies of the common bottlenose dolphin (*Tursiops truncatus*) and may occur within WA-50-L and the PEZ. The Indo-Pacific spotted dolphin appears to occupy inshore waters, often in depths of less than 10 m (Bannister et al. 1996). It is known to occur from Shark Bay, north to the western edge of the Gulf of Carpentaria and is regarded as a migratory species under the EPBC Act (DAWE 2021j).

Australian snubfin dolphin

The Australian snubfin dolphin (*Orcaella heinsohni*) may occur within the PEZ. All available data on the distribution and habitat preferences of Australian snubfin dolphin (*Orcaella heinsohni*) indicate that they mainly occur in the shallow coastal and estuarine waters of the NT and north WA (Beasley et al. 2002). There are no data to estimate any past or potential future declines in the area of occupancy for snubfin dolphins in Australia; however, incidental catches in gillnets (albeit at unknown levels), in addition to habitat degradation, may lead to a reduction of area of occupancy over the next three generations for Australian snubfin dolphins. (DAWE 2021k).

Indo-pacific humpback dolphin

The Indo-Pacific humpback dolphin (*Sousa sahulensis/Sousa chinensis*) may occur in the PEZ with its presence reported along the northern coastline of Australia down to Exmouth on the WA coastline. The total population size of the Indo-Pacific humpback dolphin in Australian waters is unknown. Given that the required shallow habitat preferred by this species occurs continuously throughout its recorded range, the distribution of the Indo-Pacific Humpback Dolphin is considered to represent one continuous location (DEE 2021l).

Marine reptiles

Turtles

The EPBC Act Protected Matters search of both WA-50-L and the PEZ identified six species of marine turtle which may occur: the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*), flatback turtle (*Natator depressus*), hawksbill turtle (*Eretmochelys imbricate*) and olive ridley turtle (*Lepidochelys olivacea*). While there are no known BIAs for marine turtles within WA-50-L, there are a range of BIAs and critical habitats for turtle breeding, foraging and internesting within the PEZ (Figure 4-6).

Nesting rookeries within the PEZ include Browse Island, Ashmore Reef, Cartier Island, Cassini Island, Scott Reef, Tiwi Islands and the Lacepede Islands as identified in the Recovery Plan for Marine Turtles in Australia (DEE 2017a). Peak nesting periods for all turtle species within these areas are generally between November and April. Further, 20 km internesting buffers associated with green turtles have been identified for Browse Island, Scott Reef (Sandy Islet), Adele Island, Melville Island (Tiwi islands) and Cassini Island between November and March. Similarly, a 60 km internesting buffer for flatback turtles has been identified at Cassini Island between May and July (DEE 2017a).

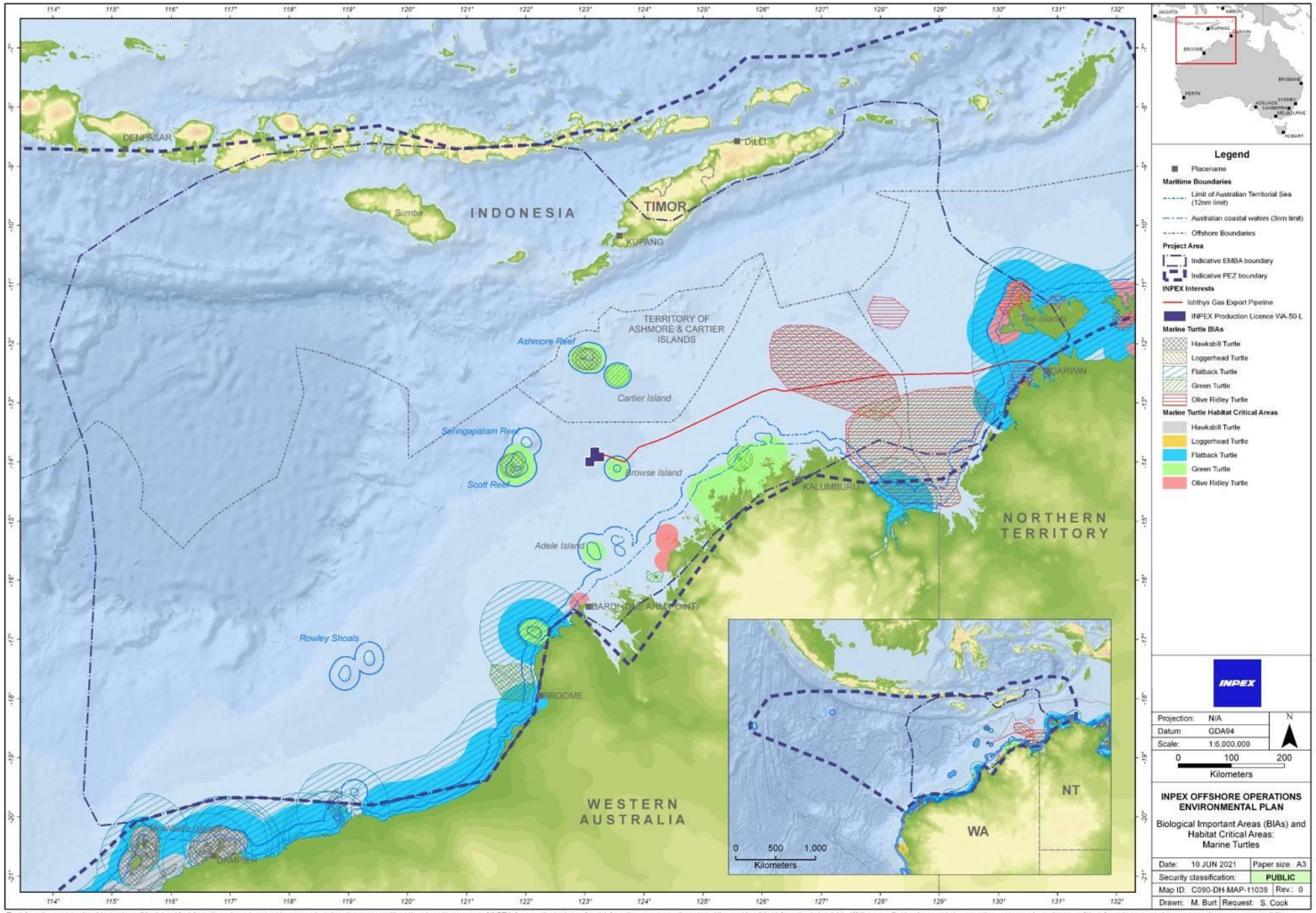

Figure 4-6: Biologically important areas associated with marine turtles

At Scott Reef there is an internesting BIA (20 km buffer) for hawksbill turtles where internesting occurs in October – February each year, and peaks in December and January (DEE 2017a). At the Tiwi islands, a year-round internesting buffer for flatback (60 km) and olive ridley (20 km) turtles have been identified (DEE 2017a) with peak nesting occurring between June – September and April - June respectively. Foraging BIAs for these species occurs at the Joseph Bonaparte Depression and Joseph Bonaparte Gulf, which overlap the PEZ and EMBA (Figure 4-6).

Satellite tagging of nesting female loggerhead turtles from the Ningaloo/Pilbara coast of Western Australia have shown dispersal north-west as far as Indonesia and southern Borneo, north-east as far as the Tiwi Islands and south as far as the Great Australian Bight (Waayers et al. 2015; Whiting et al. 2008). Flatback turtles are known to forage across the Australian continental shelf as far north as Indonesia and Papua New Guinea (DEE 2017a). There is limited tag recovery data for olive ridley turtles, but satellite tracking data indicates that they appear to remain on the Australian continental shelf (Waayers et al. 2015).

Turtles are not expected to be present in high numbers in WA-50-L. However, individual green turtles may occasionally be present associated within the internesting buffer at Browse Island, and other marine turtle species are likely to be present in the waters of the PEZ as it encompasses several locations that support turtle foraging, nesting and internesting behaviours.

Sea snakes

The EPBC Act Protected Matters search identified 26 sea snake species which may occur within the PEZ, 13 of which may also occur within WA-50-L. There are no reported BIAs for sea snakes. Scott Reef is considered a region of high sea snake endemism and a decline in sea snake abundance has been reported within the Ashmore Reef MP (Udyawer 2020). Most of the knowledge of sea snakes in Australian waters comes from trawler bycatch (Udyawer et al. 2020; Milton et al. 2009; Ward 1996). These studies indicate that sea snakes in northern regions of Australia tend to breed in shallow embayment's and estuaries which are only represented in the PEZ. Therefore, these species may be seen in the open waters of WA-50-L, but their presence is unlikely to be common.

Crocodiles

The salt-water or estuarine crocodile (*Crocodylus porosus*) has a tropical distribution that extends across the northern coastline of Australia, where it can be found in coastal waters, estuaries, freshwater lakes, inland swamps and marshes, as well as far out to sea (Webb et al. 1987). There are no reported BIAs for crocodiles. Due to the species preference for estuaries and swamps and coastal waters they are unlikely to occur in the open waters of WA-50-L and are more likely to be observed in the PEZ where these preferred habitats occur. This was confirmed in the EPBC Act Protected Matters searches (Appendix B).

Fishes and sharks

While there are no BIAs for fishes and sharks within WA-50-L, in the PEZ a BIA exists for whale sharks (foraging area) that largely follows the 125 m ancient coastline KEF and at its closest point is approximately 15 km south-east of WA-50-L as shown in Figure 4-7. There are also BIAs for sawfish (green, dwarf and freshwater) located to the south-west and north-east of Broome on the WA coastline.

Although not specifically identified as BIAs, several of the KEFs within the PEZ, as described in Section 4.2 also known to provide important habitat for diverse fish assemblages.

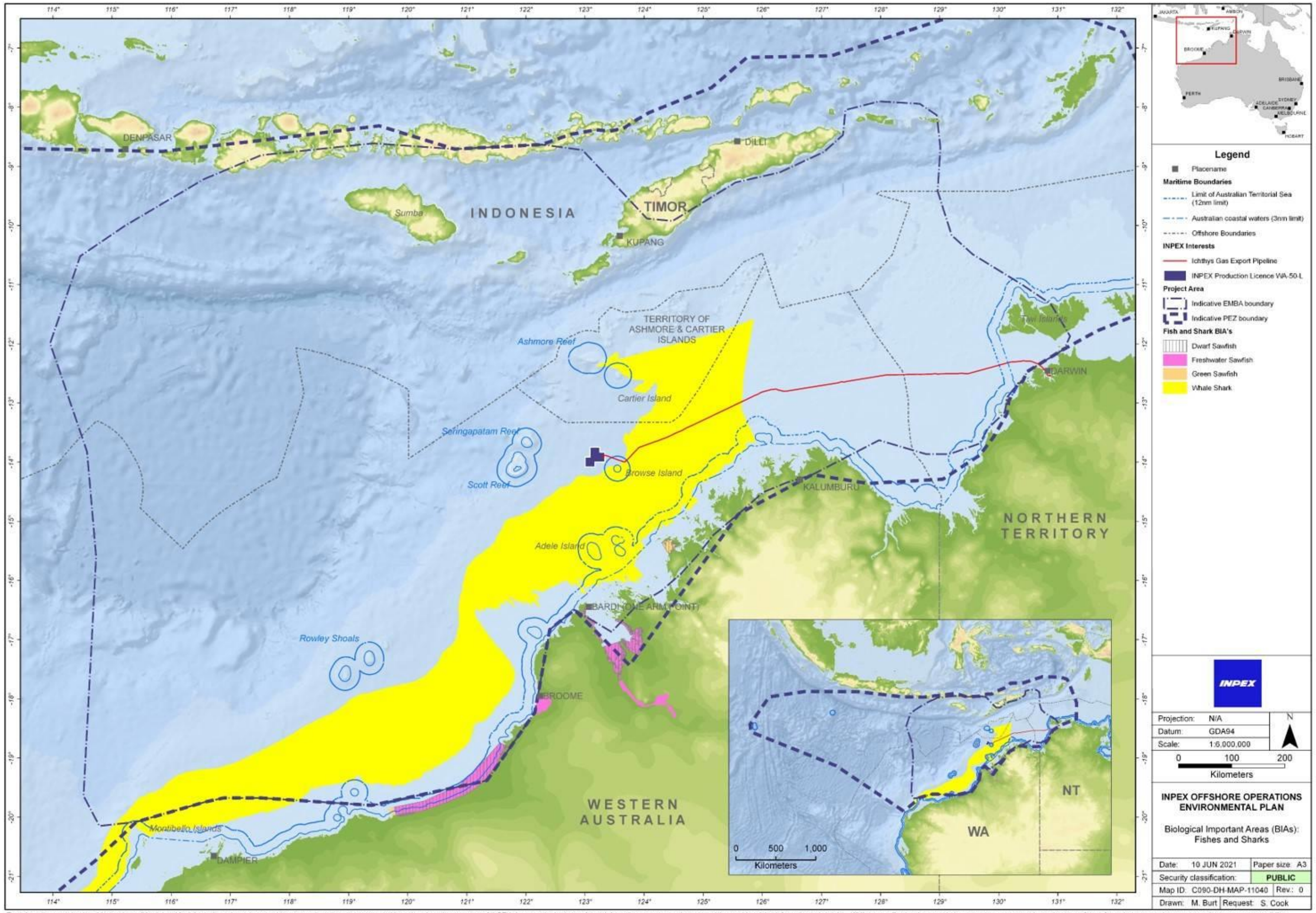

Figure 4-7: Biologically important areas associated with fishes and sharks

Whale shark

The whale shark is a solitary planktivorous species that spends the greater part of its foraging time at water depths above 100 m, often near the surface (Brunnschweiler & Sims 2011; Wilson et al. 2006). However, whale sharks are also known to engage in mesopelagic and even bathypelagic diving when in bathymetrically unconstrained habitats (Brunnschweiler et al. 2009; Wilson et al. 2006).

Whale sharks appear to prefer different locations at different times of year, and despite a reasonable understanding of the various whale shark aggregation locations and timings, little is known about the large-scale transoceanic movements in response to seasonal abundance of planktonic prey species (Eckert & Stewart 2001).

It is however understood that whale sharks can travel over vast distances between aggregation sites. One whale shark tagged in the Seychelles was relocated after 42 days having travelled 3,000 km to south of Sri Lanka and then located again 4 months later, a further 5,000 km away in the waters of Thailand (Hsu et al. 2007). Therefore, it is possible that whale sharks may transit through the PEZ in both Australian and International waters.

Whale sharks are widely distributed in tropical Australian waters. Within WA, whale sharks aggregate seasonally (March–June) to feed in coastal waters off Ningaloo Reef (Wilson et al. 2006). Taylor (1996) and Rowat & Gore (2007) examined whale shark movements at Ningaloo Reef and observed that the sharks swim parallel to the reef but found no clear evidence of a north-south migration.

Whilst Ningaloo is the nearest aggregation to the WA-50-L, it is located over 1,300 km to the south. Research on the migration patterns of whale sharks in the western Indian Ocean, indicates that a small number of the WA (Ningaloo) population migrate through the wider vicinity of the Browse Basin region (McKinnon et al. 2002; Wilson et al. 2006; Jenner et al. 2008; Meekan & Radford 2010). Whale sharks from Ningaloo Reef fitted with satellite trackers were observed to travel either north-east towards Timor Leste, or north-west towards the Indonesia islands of Sumatra and Java, with some individuals passing through the broad vicinity of Scott Reef (McKinnon et al. 2002, Wilson et al. 2006, Meekan & Radford 2010; Sleeman et al. 2010). Aerial (Jenner & Jenner 2009a; RPS Environment and Planning Pty Ltd 2010, 2011) and vessel (Jenner et al. 2008; Jenner & Jenner 2009b) surveys conducted in 2008 and 2009, involving over 1,000 hours of observer effort, recorded one whale shark in 2008 and two whale sharks in 2010 in the Browse Basin (Jenner et al. 2008 and RPS Environment and Planning Pty Ltd 2011 respectively).

Within the PEZ, the whale shark BIA largely follows the ancient coastline at 125 m depth contour KEF and at its closest point is located approximately 15 km south-east of WA-50-L. However, based on the levels of whale shark abundance observed in the studies listed above, the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration.

Sawfish

Four species of sawfish (largetooth/freshwater/northern, narrow, dwarf and green sawfish) were identified in the EPBC Act Protected Matters search of the PEZ (Table 4-4). Only the narrow sawfish and green sawfish were identified in the EPBC Act Protected Matters search of the operational area (WA-50-L). While sawfish are identified as potentially occurring in WA-50-L and the PEZ, due to their ecology (generally estuarine rather than open-ocean species) it is expected that they will only be present in high numbers on the periphery of the PEZ where the BIAs are located (Figure 4-7).

As described in Section 4.3, environments found in the PEZ provide protection for shallow shelf habitats that are important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish. The range of sawfish species overlaps with popular recreational fishing locations in some parts of the NMR (DSEWPaC 2012b) and adjacent areas. Observations of dead discarded sawfish species from recreational fishing highlights that mortality may occur as a direct result of capture and discarding (DSEWPaC 2012b).

Pipefish and seahorses

The EPBC Act Protected Matters search identified 30 species of the family Syngnathidae which may occur within WA-50-L and a further 22 species that may also potentially be present within the PEZ. Syngnathidae is a group of bony fishes that includes seahorses, pipefishes, pipehorses and sea dragons. Seahorses and pipefishes are a diverse group and occupy a wide range of habitats. However, the species identified in the EPBC Act Protected Matters searches (Appendix B) generally display a preference for shallow water habitats such as seagrass and macroalgal beds, coral reefs, mangroves and sponge gardens that can be found in the shallower areas of the PEZ (Foster & Vincent 2004; Lourie et al. 1999; Scales 2010). In WA-50-L, water depths are approximately 250 m and preclude the presence of seagrass and hard bottom substrates, which can potentially support coral and macroalgae sponge garden communities. Therefore, pipefish and seahorses are only expected to occur in areas where suitable habitats are present, predominantly outside of WA-50-L in the broader PEZ.

Sharks and rays

Six shark species (including whale shark described above) and one ray species were identified as having the potential to occur in WA-50-L (Appendix B). Two additional shark species and one additional ray species were identified as having the potential to occur within the PEZ (Table 4-4; Appendix B).

It is considered possible that larger pelagic sharks such as the great white, oceanic whitetip, whale and mako sharks may transit through the licence area. The likelihood of these species occurring in WA-50-L is expected to be very low as the licence area is not considered to provide habitat that is of breeding or feeding importance. As such, these species are unlikely to be common or resident within WA-50-L.

Movements of tagged grey nurse sharks on the west coast of Australia indicated a preference for water depths 20-160 m and broad use of the continental shelf (McCauley 2004). The majority of recorded great white shark movements in Australian waters are reported to occur between the coast and the 100 m depth contour (DAWE 2021m). The critically endangered, speartooth shark inhabits tidal rivers and estuaries in the NT and Queensland and is therefore not likely to be present in the waters surrounding WA-50-L (DAWE 2021n).

Listed manta rays have been observed within the PEZ, but for the same reasons as the large pelagic sharks, are unlikely to be common or resident within WA-50-L.

Marine avifauna

WA-50-L is located within what is known as the East Asian–Australasian (EAA) Flyway an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters (Figure 4-8). 'Flyway' is the term used to describe a geographic region that supports a group of populations of migratory waterbirds throughout their annual cycle. There are 54 species of migratory shorebirds that are known to specifically follow migration paths within the EAA Flyway (Bamford et al. 2008). Migratory shorebird species are mostly present in Australia during the non-breeding period, from as early as August to as late as April/May each year. After arrival in Australia at the end of long migrations, they disperse throughout the country to a wide variety of habitats including coastal wetlands, mudflats, reefs and sandy beaches (DEE 2017b).

There are no BIAs for marine avifauna within WA-50-L. However, the PEZ overlaps a large number of BIAs for a number of different marine avifauna species (Figure 4-8). The closest BIAs for marine avifauna relate to foraging around Adele Island, Ashmore Reef and Cartier Island, and Scott Reef. Several nationally important wetlands and Ramsar sites are also present within the PEZ (refer Section 4.6), these sites provide important habitat for marine avifauna.

Vessel-based surveys conducted around the Ichthys gas field, Browse Island and to the west as far as Scott Reef were conducted by the Centre for Whale Research (CWR) in 2008 (Jenner et al. 2008). Seabirds observed included frigatebirds, boobies, terns, noddies, tropicbirds, petrels, shearwaters and gulls, with the brown booby the most common species recorded. Of the species recorded during the vessel-based surveys, a number are migratory species listed under the EPBC Act, including the streaked shearwater, brown booby, masked booby, lesser frigatebird, bridled tern, lesser crested tern and little tern. These migratory species can be expected to be encountered in low numbers as they are likely to transit through the operational area and the PEZ. In addition to seabirds, the search of the EPBC Act Protected Matters database identified 32 species of migratory wetland bird species potentially present within the PEZ (six of which may also occur within WA-50-L). These species may migrate through the operational area/PEZ to wetland habitats on the mainland and/or larger coastal islands (DEE 2017b). It is considered unlikely that WA-50-L would provide any significant resources to support these species.

Observations of coastal seabirds in Timor-Leste were recorded from surveys undertaken between 2005-2010 (Trainor 2011). The surveys confirmed the presence of several species included in Table 4-4 such as *Calidris tenuirostris* (Great Knot) and *Limosa Lapponica baueri* (Bar-tailed Godwit).

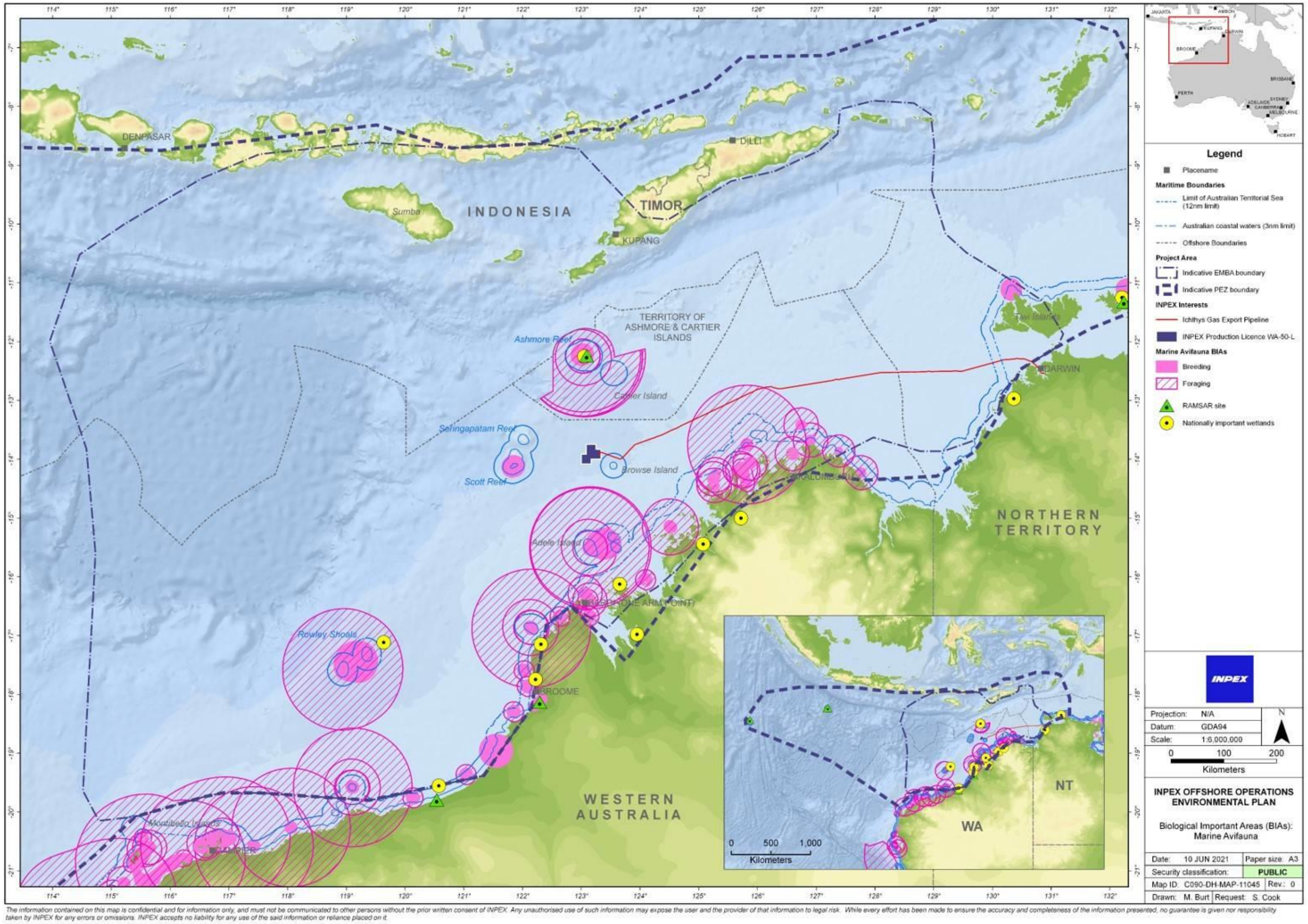

Figure 4-8: Biologically important areas associated with marine avifauna

4.10 Marine pests

Marine pests, or invasive marine species (IMS), are defined as non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment; or have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia's marine environment (DAWR 2018). There are 60 known non-native marine species that have become established in WA waters. Most are temperate species, with only six that are exclusively tropical. The greatest number of introduced species is found in the south-west corner of the State (DoF 2016).

Not all marine species introduced into a new area become pests as not all of them will survive or may not manage to reproduce and establish a viable population. Many introduced marine species that establish self-sustaining populations cause no detectable harm. However, others have the potential to cause significant long-term economic, ecological and health consequences for the marine environment (DoF 2016).

Marine pests pose a major threat to the environment, economy and social amenity by disrupting ecological processes both directly (through predation or competition with native plants and animals) or indirectly (through habitat alteration). Once established, marine pests can rarely be eradicated, and their impacts are often long lasting (DAWR 2018).

Shallow water, coastal marine environments are most 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). The main supply bases supporting the offshore facility in WA-50-L are Darwin Harbour and Broome Port, described in Section 4.11.5 including a summary of their IMS status.

Within WA waters the marine pest, *Didemnum perlucidum* (white colonial sea squirt) is widely established in many ports, marinas and other locations (Smale & Childs 2012; Dias et al. 2016; DPIRD 2021). *D. perlucidum* has been recorded in natural and artificial marine environments in WA from Busselton to Broome and the NT in Darwin and surrounding coastal waters (Muñoz & McDonald 2014.) First identified in WA in 2010, further monitoring confirmed the presence of separate populations along approximately 2,800 km of WA coastline. This ascidian can survive temperatures between 15 and 30 °C and has been recorded at depths of up to 8 m, however, it is commonly found in the upper 1–3 m of the water column (Muñoz & McDonald 2014).

Eradication of this pest has not been possible and the DPIRD manages *Didemnum perlucidum* only at the Montebello Islands where it is known to not have become established.

4.11 Socioeconomic environment

4.11.1 World heritage areas

No world heritage areas were identified as overlapping WA-50-L or the PEZ.

4.11.2 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 (DAWE 2021o). The West Kimberley is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands.

4.11.3 Fishing

Commercially significant fish stocks, considered to be key indicator species, that may be present in WA-50-L are shown in Table 4-6, including spawning and aggregation times.

Table 4-6: Commercially significant fish species

Key commercial fish species	Spawning/aggregation times
Goldband snapper	Goldband snapper typically occur in 50—200 m water depths, and often concentrated in depths from 80—150 m. They spawn throughout their range (rather than aggregating at specific locations) during November to May (extended peak spawning period).
Spanish mackerel	Spanish mackerel occur in continental shelf waters and congregate in coastal waters around reefs, shoals and headlands to feed and spawn, occurring typically in water depths from 1—50 m. They form spawning schools around inshore reefs with peak spawning period of September to January.
Rankin cod	Rankin cod typically occur in water depths of 10—150 m. They spawn throughout their range (rather than aggregating at specific locations) during June to December and March (peak spawning period August to October.
Red emperor	Red emperor typically occurs in 10—180 m water depths, and are often concentrated in depths from 60—120 m. They spawn throughout their range (rather than aggregating at specific locations) during September to June (with bimodal peaks from September to November and January to March).
Blue spotted emperor	Blue spotted emperor typically occurs in water depths of 5—110 m. They spawn throughout their range (rather than aggregating at specific locations) during July to March (extended peak spawning period).

Commercial fisheries – Australian waters and external Australian territories

Within the PEZ, five Commonwealth-managed fisheries have the potential to operate with three of these also overlapping WA-50-L, as summarised in Table 4-7.

In addition to the Commonwealth-managed fisheries, 38 State/Territory-managed commercial fisheries have the potential to operate within the PEZ. Of these, five fishery boundaries overlap with WA-50-L (Table 4-8). Fisheries highlighted in bold have potential fishing grounds that overlap with WA-50-L, it does not indicate that they are currently active within the licence area; however, there is a potential that they may be active in the future.

Table 4-7: Commonwealth-managed commercial fisheries (AFMA-managed)

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
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 2021a). 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-50-L, with reportedly low negligible trawl-fishing in the Ichthys Field; however, catch data is confidential for this fishery (AFMA 2021a).
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 PEZ 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 2021c).
Western Skipjack Tuna Fishery	The Western Skipjack Tuna Fishery covers the waters surrounding 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 2021d).
Southern Bluefin Tuna Fishery	The Southern Bluefin Tuna Fishery covers Australian waters 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. 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 South Australia (AFMA 2021e) and therefore does not overlap the PEZ or WA-50-L. No catch is taken from the NWS.

Commercial fishery (BOLD denotes overlap with WA-50-L)	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 Cape York in Queensland to Cape Londonderry in WA and is predominantly active in the shallower waters of the PEZ. To manage the fishery, there are 2 fishing seasons (April—June and August—November). There are currently 52 boats with fishing rights in the fishery (maximum number vessels at one time) and bottom trawl fishing gear is used in this fishery (AFMA 2021f). The fishery does not overlap WA-50-L.

Table 4-8: State/Territory-managed commercial fisheries (WA DPIRD/NT DITT)

Commercial fishery (BOLD denotes overlap with WA-50-L)	Fishery summary
Northern Demersal Scalefish Managed Fishery (WA) Area 2 (Area 1 & 2 overlaps PEZ but not WA-50-L)	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 PEZ. There are currently 11 licences in Area 2 and the value of the fishery is estimated at $5-10 million (Gaughan & Santoro 2021).
Mackerel Managed Fishery (WA) Area 1 (Area 2 overlaps PEZ but not WA-50-L)	The Mackerel Managed Fishery uses near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands (WAFIC 2021a). The fishery targets Spanish mackerel (*Scomberomorus commerson*) and lands over 80% of the annual large pelagic catch in WA. There are currently 48 licences in the fishery with 14 active in the Kimberley area (Area 1) (Gaughan & Santoro 2021).
North Coast Shark Fishery (Cwlth/WA) Northern Zone (Southern Zone overlaps PEZ but not WA-50-L)	The northern shark fisheries comprise the state-managed WA North Coast Shark Fishery in the Pilbara and western Kimberley (closed since 1998), and the Joint Authority Northern Shark Fishery in the eastern Kimberley. Target species of the northern shark fisheries included the sandbar, hammerhead, blacktip and lemon sharks (AFMA 2021g). The Joint Authority Northern Shark Fishery has not been active since 2008/2009 to enable recovery of shark species (AFMA 2021g).
Pearl Oyster Managed Fishery (WA) Zone 3 (Zones 1 and 2 overlap PEZ but not WA-50-L)	The WA Pearl Oyster Managed Fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. It is a quota-based, dive fishery operating in the shallow coastal waters along the NWS (WAFIC 2021b). The main fishing grounds (Zone 2) are off Eighty Mile Beach (Gaughan & Santoro 2021). In 2019, the catch was taken in Zone 2 only with no fishing in Zones 1 or 3. The number of wild-caught pearl oysters was 611,816 harvested over 14,022 dive hours (Gaughan & Santoro 2021).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
West Coast Deep Sea Crustacean Fishery (WA)	The West Coast Deep Sea Crustacean Fishery operates using baited pots in a long-line formation in the shelf edge waters > 150 m depth (Gaughan & Santoro 2021). The catch in 2019 was 153.2 tonnes dominated by crystal (snow) crabs with the majority sold live to Asian markets (Gaughan & Santoro 2021).
Trochus Fishery (WA)	The Trochus Fishery is a small fishery based on a single target species (*Trochus niloticus*) harvested by hand from King Sound and the Buccaneer Archipelago. The fishery is operated by the Bardi Jawi and Mayala Aboriginal communities (Gaughan & Santoro 2021). 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 with the product sold locally and overseas (WAFIC 2021c).
Kimberley Prawn Managed Fishery (WA)	The Kimberley Prawn Managed Fishery predominantly target banana prawns (*Penaeus merguiensis*) and catch also includes tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*). The fishery operates from the north eastern boundary of the Exmouth Gulf Prawn Fishery to Cape Londonderry, in the PEZ (WAFIC 2021d). In 2019 the total prawn landings were 100 tonnes the lowest catch on record (Gaughan & Santoro 2021).
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. Approximately 200 different species of Specimen Shell are collected generally by hand in shallow coastal waters (Gaughan & Santoro 2021). The fishery currently has 31 licences with a maximum of 4 divers allowed in the water per licence at any one time. Total catch in 2019 was 7,232 shells. While the fishery covers the entire WA coastline, there is some concentration of effort in areas adjacent to population centres in the PEZ such as Broome.
South West Coast Salmon Managed Fishery (WA)	South West Coast Salmon Managed Fishery targets Western Australian salmon (*Arripis truttaceus*) and in 2019 the total catch was 147.8 tonnes using beach seine nets (Gaughan & Santoro 2021). 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.
North Coast Crab Fishery (Including Kimberley 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 Crab Managed Fishery) and mud crabs in the Kimberley (the Kimberley Crab Managed Fishery). Catch rates in 2019 were 19.3 tonnes for blue swimmer crabs and 7.4 tonnes for mud crabs (Gaughan & Santoro 2021).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Marine Aquarium Fish Fishery (WA)	This Marine Aquarium Fish Fishery is typically more active in coastal waters south of Broome with higher levels of effort around the Capes region, Perth, Geraldton, Exmouth, Dampier and Broome (Gaughan & Santoro 2021). The fishery resource includes more than 1,500 species of marine aquarium fishes under the *Marine Aquarium Fish Managed Fishery Management Plan 2018.* Operators are also permitted to take coral, live rock, algae, seagrass and invertebrates. Ten out of twelve licences were active in 2019 with a total catch of 69,446 fishes, predominantly the Scribbled Angelfish (*Chaetodontoplus duboulayi*) (Gaughan & Santoro 2021).
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. There was only one active licence in 2019 with a total catch of < 60,000 crabs (Gaughan & Santoro 2021).
Broome Prawn Managed Fishery (WA)	In 2019, extremely low fishing effort occurred in the Broome Prawn Managed Fishery as only one boat undertook trial fishing to investigate whether catch rates were sufficient for commercial fishing. This resulted in negligible landings of western king prawns (*Penaeus latisulcatus*) (Gaughan & Santoro 2021).
Abalone Managed Fishery (WA) Northern Zone/Area 8 overlaps PEZ	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 2021e). The fishery operates in shallow coastal waters coinciding with abalone distributions (Gaughan & Santoro 2021). Although the area of the fishery overlaps WA-50-L, no fishing effort occurs in the licence area given the water depth, water temperature and lack of suitable habitat.
Nickol Bay Prawn Managed Fishery (WA)	The Nickol Bay Prawn Managed Fishery operates along the western part of the NWS and predominantly target banana prawns (*Penaeus merguiensis*) (WAFIC 2021d). Total catch in 2019 was 254 tonnes of which 216 tonnes were banana prawns (Gaughan & Santoro 2021).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Pilbara Trap Managed Fishery and Pilbara Fish Trawl Interim Managed Fishery (WA)	The main species landed by the Pilbara Trap Managed Fishery and Pilbara Fish Trawl Interim Managed Fishery are blue spotted emperor, red emperor and rankin cod. Of the total commercial catches of demersal scalefish in the Pilbara in 2019 (2,980 tonnes), 72% (2,152 tonnes) were landed by the trawl sector and 23% (680 tonnes) taken by the trap sector with the remaining 5% (148 tonnes) taken by the line sector – see below Pilbara Line Fishery (Gaughan & Santoro 2021).
Pilbara Line Fishery (WA)	The Pilbara Line Fishery uses a drop line fishing method. The fishery is made up of 9 fishing boat licences allowing them to fish for any nominated 5-month block period during the year (WAFIC 2021f). The indicator species blue spotted emperor, red emperor, rankin cod and ruby snapper are used to assess stock status. In 2019, 148 tonnes were landed. (Gaughan & Santoro 2021).
Kimberley Gillnet and Barramundi Fishery (WA)	The Kimberley Gillnet and Barramundi Fishery extends 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 (Gaughan & Santoro 2021). The fishery targets barramundi and is limited to four licences. Fishing is now prohibited between the southern boundary to north of Willie Creek and in King Sound. Barramundi catch in 2019 was 47 tonnes comprising 64% of the fishery total catch with the remainder comprising of Threadfin, Tripletail, Black Jewfish and sharks (Gaughan & Santoro 2021).
Onslow Prawn Managed Fishery (WA)	The Onslow Prawn Fishery predominantly targets banana prawns (*Penaeus merguiensis*) but also catches tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*) (WAFIC 2021d). Area 3 of the fishery slightly overlaps the PEZ; however, areas trawled in 2019 do not overlap the PEZ with total landings in 2019 less than 50 tonnes undertaken by one boat over 28 days of fishing effort (Gaughan & Santoro 2021).
Timor Reef Fishery (NT)	The Timor Reef Fishery primarily targets the higher-valued gold-band snapper (*Pristipomoides multidens*) and other Pristipomoides species. Significant quantities of red snappers (*Lutjanus malabaricus, L. erythropterus*), red emperors (*L. sefcae*) and cods (Family Serranidae) are also harvested. In 2018, 382 tonnes of gold-band snapper and 391 tonnes of red snapper were landed (AFMA 2021g). The fishery operates from north-east of Darwin to the WA/NT border and to the outer limit of the Australian Fishing Zone (NTSC 2021a).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Demersal (multigear) Fishery (NT)	The Demersal Fishery targets mainly red snappers (*Lutjanus malabaricus, L. erythropterus*) and gold-band snappers (*Pristipomoides spp.).* Drop lines, traps and trawl are the main gear types used in the fishery and catch data recorded 2526 tonnes of red snapper landed in 2018 (AFMA 2021g). The fishery extends 15 nm from the low water mark to the outer boundary of the Australian Fishing Zone (NTSC 2021b).
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. The area covered by the fishery covers some parts of the PEZ; 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 2021c).
Bait Net Fishery (NT)	Commercial fishers within the Bait Net Fishery are allowed to take all fish for use as bait except barramundi, threadfin salmon, Spanish mackerel or mud crab. Commercial fishing for bait is allowed from the high-water mark to the 3 nm seaward of the low water mark but excluding Darwin Harbour and Shoal Bay. The fishery is currently restricted to two licences which are both allocated (NTG 2021a).
Coastal Net Fishery (NT)	The Coastal Net Fishery targets a range of species, particularly mullet, blue threadfin (*Eleutheronema tetradactylum*), shark and queenfish (*Scomberoides commersonnianus*). 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 (NTG 2021b).
Coastal Line Fishery (NT)	The Northern Territory's Coastal Line Fishery mainly targets black jewfish (*Protonibea diacanthus*) and golden snapper (*Lutjanus johnii*).The fishery extends along the NT coast between the high-water mark and15 nm out from the low water mark (NTG 2021c). 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 (NTG 2021c)
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 PEZ. The main species targeted is the sandfish (*Holothuria scabra*), commonly found in coastal areas with soft sediments and seagrass beds (NTSC 2021d).

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Aquaculture (NT)	The two major aquaculture activities include Pearl Oyster (*Pinctada maxima*) culture and Barramundi farming (*Lates calcarifer*). Other products include sea cucumber (trepang), giant clams and freshwater plants. Sea cucumber 'ranching' occurs on Goulburn Island and Groote Eylandt, with hatchery-produced juveniles used to restocked suitable areas at sea (NTSC 2021e).
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 2021f).
Jigging Fishery (NT)	The Jigging Fishery is currently closed.
Mollusc Fishery (NT)	The Mollusc Fishery operates in intertidal waters from the high-water mark out to the low water mark. Molluscs are collected by hand and only shellfish can be taken with no collection of pearl oysters or cephalopods allowed. There is only one commercial licence allocated by the NT Government (NTG) (NTG 2021d).
Mud Crab Fishery (NT)	The Mud Crab Fishery targets mud crabs. The fishery operates in NT tidal waters year-round but most activity stops during the wet season (NTSC 2021g). As of 2016, 49 licences were active across 35 operators, with most working from a single dinghy (NTSC 2021g).
Offshore Net and Line Fishery (NT)	The Offshore Net and Line Fishery targets blacktip sharks (*Carcharhinus tilstoni*, *C. limbatus* and *C. sorrah*) and grey mackerel (*Scomberomorus semifasciatus*) (AFMA 2021g). 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 (NTG 2021e). The 2018 landings comprised of 42 and 499 tonnes of blacktip sharks and grey mackerel respectively (AFMA 2021g).
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 (NTG 2021f). There are currently 5 licences in the fishery.

Commercial fishery **(BOLD denotes overlap with WA-50-L)**	**Fishery summary**
Spanish Mackerel 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 and most Spanish mackerel are caught off the western and eastern mainland coasts and near islands including Bathurst Island in the PEZ (NTG 2021g).
Small Pelagic Developmental Fishery (NT)	The Small Pelagic Developmental Fishery targets Blacktip sharks (*Carcharhinus tilstoni*, *C. limbatus* and *C. sorrah*). There are currently three active licences with a commercial catch of 0.1 tonnes reported in 2017 (NTG 2019).
Fishing Tour Operator Fishery (NT)	Commercial fishing tour operators (FTOs) are managed by the NTG 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 caught primarily using hook and line (NTG 2019).
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 WA 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 2021). The angelfish are collected using hand or scoop net or seine net of specific dimensions. There is only one licence issued for the fishery and catch data is not reportable due to confidentiality provisions (Gaughan & Santoro 2021).
Christmas Island Line Fishery	The Christmas Island Line Fishery operates within the 0-12 nm zone around Christmas Island and is managed by WA DPIRD on behalf of the Commonwealth government. The fishery primarily targets pelagic species, mainly wahoo (*Acanthocybium solandri*) and yellowfin tuna (*Thunnus albacares*) however demersal fishing activities are also undertaken for mainly deepwater snappers (Gaughan & Santoro 2021). 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 2021).

Commercial fisheries – International waters

Within the international waters of the PEZ, 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).

As described in Section 4.5.1 approximately 65% of the East Nusa Tenggara regional fisheries production comes from the Savu Sea (Perdanahardja & Lionata 2017) where unsustainable fisheries practices are known to pose a threat to marine fauna in the region.

Recreational fishing

There is no evidence that recreational fishing occurs within WA-50-L due to the distance from land and a lack of features of interest. A wide range of recreational activities do occur within the NWMR and NMR. Recreational fishing activities peak in winter and are concentrated in coastal waters along the Kimberley and NT 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 PEZ, such as the Tiwi Islands and Flat Top Bank, all of which are readily accessible from Darwin. Some of the recreationally important species of the coastal areas include barramundi, mangrove jack, jewfish and bream.

Fishing methods typically involve rod and line gear and approximately three quarters of fish caught by fishing tour operators are released (NTG 2019). While the survivorship of released Barramundi is high, the same is not true for reef-associated species, such golden snapper and black jewfish. Both species are susceptible to pressure-induced injuries (barotrauma), with the rate of injury and post-release mortality proportional to capture depth. Concerns regarding the impacts of barotrauma on reef fishes (and other factors) have led to the development of new management controls on the harvest of these species (NTG 2019).

Offshore islands, coral reef systems and continental shelf waters are increasingly targeted by fishing-based charter vessels (Gaughan & Santoro 2021). 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, Tiwi Islands and Flat Top Bank. Generally, there is little recreational fishing that occurs within WA-50-L 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, snorkelling, and diving. Recreational and artisanal fishing are undertaken around the Cocos (Keeling) and Christmas Islands targeting both finfish and invertebrate species (Gaughan & Santoro 2021). Christmas Island recreational boat fishers troll for pelagic species including wahoo, dog tooth tuna, yellowfin tuna and mahi mahi (dolphin fish) (DoF 2007). Recreational boat fishers target the near-shore waters around the Island by trolling using surface lures for giant trevally. Shore-based fishing is also popular with fishers mostly targeting rainbow runner and giant trevally off the rocks. Free diving for rock lobster is also a popular fishing activity on the limited fringing reefs around Christmas Island (DoF 2007).

Traditional fishing

Australian traditional 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 (DAWE 2021p). The EPBC Act Protected Matters Search (Appendix B; NIAA 2021) 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)
- Uunguu IPA (600 km north-east of Derby on the far north-west coast of the Kimberley)
- Yawuru IPA (located in Roebuck Bay).

These IPAs are all expected to have traditional 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 Bathurst Island have been actively involved in managing their own sea turtle stocks in consultation with the NT Government. 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).

Indigenous harvest of traditional marine resources (e.g. turtles, whale sharks and dugong) adjacent to the NWMR is a pressure of potential concern for the carbonate bank and terrace system of the Sahul Shelf, the pinnacles of the Bonaparte Basin, and the Commonwealth waters surrounding Ashmore Reef and Cartier Island (DSEWPaC 2012a).

Indonesian traditional 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 (Figure 4-2).

The MoU requires fishers to use traditional sail-powered fishing vessels and non-motorised equipment, and prohibits them from taking protected species, such as turtles, dugongs and clams. Fishers target a range of animals, including trepang, trochus, reef fish and sharks. Indonesian fishing effort is high at Scott Reef and also takes place at Browse Island.

Although WA-50-L falls within the MoU Box, due to the nature of traditional fishing activities, the actual fishing effort generally only occurs in the shallow subtidal/intertidal habitats of the reefs and islands within the PEZ.

Traditional Indonesian fishing effort is intense at Seringapatam Reef and Commonwealth waters in the Scott Reef complex. Depending on the intensity of effort and composition of catch, the extraction of living resources from these KEFs may affect trophic structures and ecological functioning (DSEWPaC 2012a).

Other traditional activities

As described in Section 4.4, several State and Territory reserves and marine parks contain places of cultural and spiritual importance. The establishment of such places within the reserves and marine parks will contribute to the conservation and protection of these important sites. The majority of these cultural heritage values occur on land (above the high-water mark) and are therefore considered not to be directly impacted by the petroleum activity described in this EP; however, some do have sea-related aspects.

4.11.4 Aquaculture

There are no aquaculture operations in WA-50-L. Aquaculture development in the region 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 (Gaughan & Santoro 2021). The wild shell collection occurs in shallow coastal waters (WAFIC 2021b). 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.

Developing marine aquaculture initiatives in the Kimberley region include farming barramundi in the Kimberley Aquaculture Development Zone located in Cone Bay, situated approximately 200 km north-east of Broome, and comprising an area of 2,000 hectares that was declared in 2014 (Gaughan & Santoro 2021). Another focus is the Broome Tropical Aquaculture Park where a commercial pearl oyster hatchery is located along with the Kimberley Training Institute aquaculture facility (Gaughan & Santoro 2021). Located on the Dampier Peninsula at One Arm Point is the Ardyaloon Hatchery established to address the declining stocks of the *Trochus niloticus* shell and seek to create a commercially sustainable industry harvesting the shell.

An analysis by WorldFish has indicated that aquaculture will overtake capture fisheries as the major source of fish in Indonesia before 2030 (Phillips et al. 2015). By volume, Indonesian aquatic production is dominated by seaweeds due to the simple farming techniques required, low requirements of capital and material inputs, and short production cycles. However, by value, domestically consumed species such tilapia and milkfish, together with export-orientated commodities such as shrimp and tuna, are of greater importance (Phillips et al. 2015).

4.11.5 Shipping and ports

Vessel tracking data from AMSA‘s Craft Tracking System (CTS) for April 2021 is presented in Figure 4-9. CTS collects vessel traffic data from a variety of sources, including terrestrial and satellite shipborne Automatic Identification System (AIS) data sources. Figure 4-9 highlights the presence of commonly used transit routes in the vicinity of the licence area used by supply vessels routinely supporting offshore developments in the Browse Basin including INPEX’s Ichthys offshore facility within WA-50-L itself, and the nearby Shell Prelude FLNG facility. The major shipping lanes linking WA to Indonesia are situated over 180 km to the west of WA-50-L.

The closest ports to WA-50-L are Derby, Broome and Wyndham. These are small ports, exporting nickel, lead, zinc and cattle, and importing products to support their local communities. The Port of Broome provides supply facilities for the petroleum industry operating in the Browse Basin.

By comparison, the ports along the north-west and north coast, such as Onslow, Dampier, Cape Lambert, Port Hedland, and Darwin handle much larger tonnages of iron ore, and petroleum exports, with shipping routes throughout the region.

As described in Table 3-6 the main supply bases supporting offshore operations are Darwin and Broome. As all vessels, including Project vessels, have the potential to act as vectors for marine pests to these ports, a brief description of the current and historical IMS status of these ports is provided below.

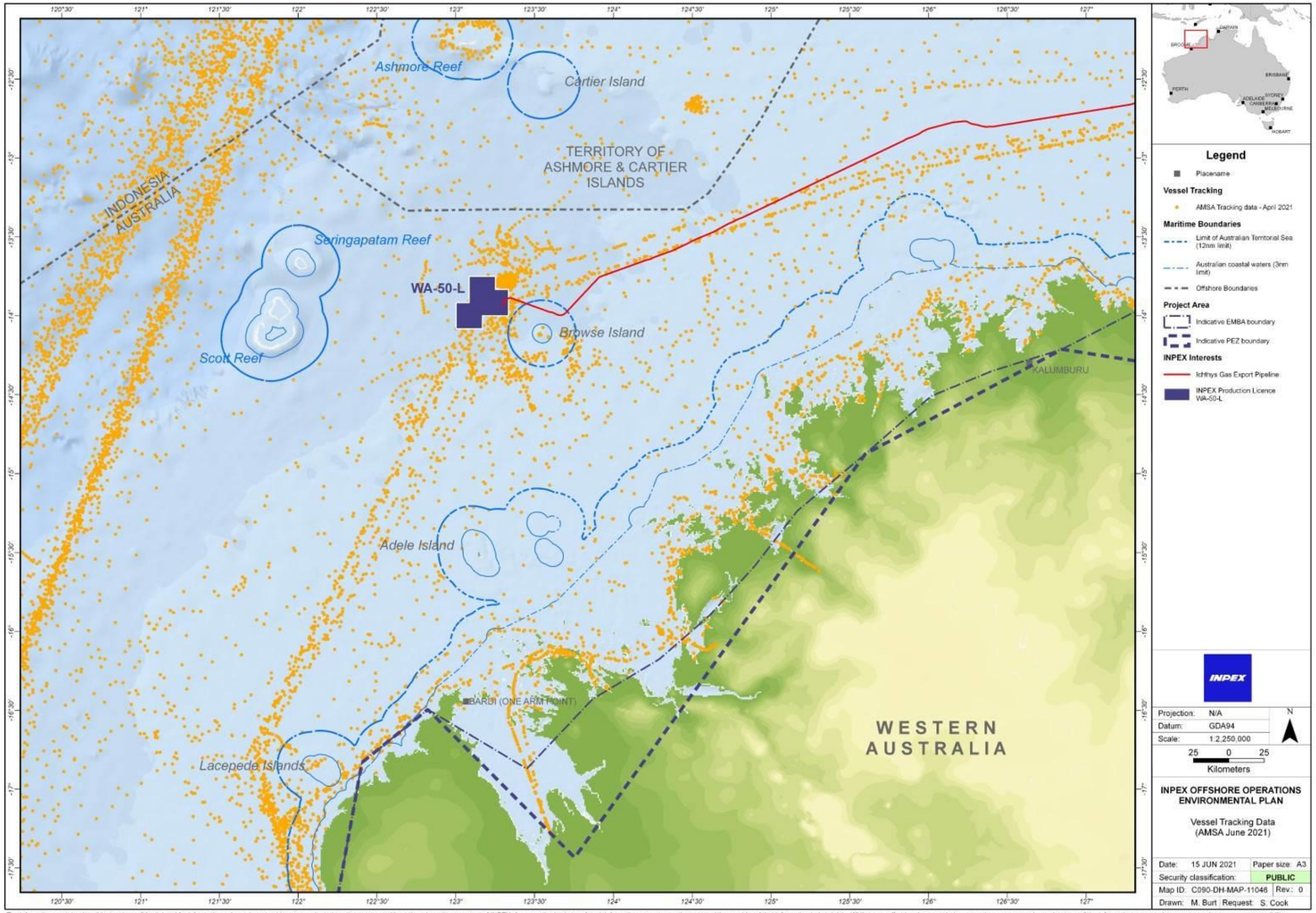

Figure 4-9: Vessel tracking data in the Browse Basin (April 2021)

Darwin Port

Darwin Port is located in Darwin Harbour in the NT. Darwin Harbour is a large ria (drowned river valley) system with an area of approximately 500 km^2. Darwin Harbour has a complex assemblage of marine habitats and there are large differences in the extent, diversity and significance of the associated biological communities. Rocky intertidal areas are found where headlands protrude into the Harbour. Extensive mangrove communities dominate in the bays and other protected areas throughout the intertidal zone. Seaward of the mangroves, a range of intertidal and subtidal habitats occur supporting seagrass, coral and macroalgae communities (INPEX 2010).

Darwin Port is a major service centre for the mining and energy sectors. Darwin Port operations consist of marine traffic of non-commercial vessels (e.g. recreational anglers) and trading vessels, including commercial ships carrying cargo and passengers, rig tenders, tankers and bulk-cargo vessels.

A number of targeted marine pest monitoring programs have been executed in Darwin Harbour since 2010 (Cardno 2015, Golder Associates 2010), and through the course of these programs the following marine pest species have been detected however none of these are listed as noxious species by the NT Government: *Magallana gigas* (presence of one shell valve) and *Caulerpa racemosa var. lamourouxii* (Golder Associates 2010) *Amphibalanus amphitrite* (barnacle), *Bugula neritina* (bryozoan) and the ascidians *Botryllus schlosseri, Botrylloides leachi* and *Didemnum perlucidum* (Cardno 2015). While *M. gigas* was detected during a survey, as this was based on the presence of one shell valve, Golders Associates (2010) determined it was likely to be a discarded shell from oysters imported and purchased for human consumption and therefore its presence did not confirm this species had established in Darwin Harbour. *Caulerpa racemosa var. lamourouxii* is common in tropical and warm temperate seas and has previously been recorded in warmer waters in Australia including Darwin Harbour (Golders Associates 2010).

In addition to monitoring program outcomes, in 1999 an outbreak of black stripped mussels was recorded in three Darwin Harbour marinas. Following, a national response to the outbreak this species was successfully eradicated from invaded locations (Ferguson 2000).

In summary, numerous marine pest monitoring studies have been undertaken at Darwin Port with species of marine pests identified. Therefore, Darwin Port is considered to be an operationally active environment rather than a pristine environment.

Broome Port

Broome Port is the largest deepwater port in the Kimberly region of WA and is managed by the Kimberley Ports Authority. The port facilities comprise a single 650 m jetty from the shore to deep-water, with almost 600 m of berth space, which is designated into 12 berths. Aside from the main jetty, there are approximately 160 moorings in the port (Bridgwood and McDonald 2014).

The port supports Broome's pearling fleet as well as offshore oil and gas exploration supply vessels, oil tankers, livestock carriers, breakbulk or general cargo vessels, fishing vessels, charter boats, cruise liners, private vessels and Navy and Customs patrol vessels. The port is the main fuel and container hub port for the Kimberley region, and in recent years its principal exports have been livestock and offshore drilling rig equipment and materials (Kimberley Ports Authority 2020).

Broome Port waters are dominated by the tidal regime of the region, with spring tidal range in excess of 9.5 m. Substrates within the port are predominantly soft mud tidal flats but some rocky substrates occur around the headlands in the area. Large expanses of substrate are exposed at low tide. Submerged artificial substrates include the steel jetty piles as well as the boat moorings, although most of these are intertidal. Areas of mangroves exist within and nearby to the port, particularly in Dampier Creek to the north-east of the port, and in Willie Creek directly to the north (Bridgwood and McDonald 2014).

At Broome Port, the presence of invasive marine pests is monitored through the WA DPIRD's State-wide Array Surveillance Program (SWASP) (Kimberley Ports Authority 2020). The SWASP program involves the deployment of passive settlement arrays to monitor for growth and shoreline searches to identify potential IMS with surveillance occurring in ports every 6 months. Over 8 years, participation in SWASP has grown from 3 to 11 ports, spanning over 11,000 km, from the tropical north to temperate south of WA (McDonald et al. 2019). The programme has proven to be highly effective as a means of fostering stakeholder involvement and, importantly for invasive marine pest surveillance. The growth and success of SWASP has continued primarily because of the commitment and farsightedness of the ports involved.

Adverse impacts from marine pests may not occur until decades after the initial introduction and establishment, and previous incursions of marine pests reported at Broome Port include black-striped mussel (*Mytilopsis sallei*) on illegal Indonesian fishing boats (McDonald 2008) and the colonial sea squirt (*Didemnum perlucidum*) first reported in WA waters in 2010 (DPIRD 2021).

In comparison to Darwin Port, less information is available with respect to marine pests that may be present in Broome Port. However, from the information presented it can be concluded that species of marine pests have been identified in Broome Port and therefore it is not considered as a pristine environment.

4.11.6 Oil and gas industry

The existing INPEX offshore facility (subsea and on the surface) is present within WA-50-L consisting of an interlinked facility comprising SPS, CPF (*Ichthys Explorer*) and FPSO (*Ichthys Venturer*).

The next closest operational production facility to WA-50-L, is the Shell Prelude FLNG facility located approximately 17 km to the north-east.

4.12 Summary of values and sensitivities

4.12.1 WA-50-L

Table 4-9: Particular values and sensitivities potentially within WA-50-L (Appendix B)

Value and sensitivity	Description
Receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage).	Fisheries (traditional and commercial).

<table>
<tr><th colspan="2">Value and sensitivity</th><th>Description</th></tr>
<tr><td colspan="2">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.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Regionally important areas of high diversity (such as shoals and banks).</td><td>WA-50-L overlaps the continental slope demersal fish communities KEF.</td></tr>
<tr><td colspan="2">World heritage values of a declared World Heritage property within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">National heritage values of a National Heritage place within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Ecological character of a declared Ramsar wetland within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act.</td><td rowspan="2">A number of threatened species or migratory species have been identified as having the potential to transit through WA-50-L.
These have been categorised as marine fauna:
• marine mammals
• marine reptiles
• fishes and sharks
• marine avifauna.
Also refer to Appendix B (EPBC Act Protected Matters Report – WA-50-L).</td></tr>
<tr><td colspan="2">Presence of a listed migratory species within the meaning of the EPBC Act.</td></tr>
<tr><td rowspan="2">Any values and sensitivities that exist in, or in relation to, part or all of:</td><td>a Commonwealth marine area within the meaning of the EPBC Act.</td><td>Productivity and diversity associated with planktonic communities and benthic communities.</td></tr>
<tr><td>Commonwealth land within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">BIAs associated with EPBC-listed species.</td><td>There are no known BIAs associated with listed threatened species or migratory species within WA-50-L.</td></tr>
</table>

4.12.2 PEZ

Table 4-10: Particular values and sensitivities potentially within the PEZ (Appendix B)

Value and sensitivity	Description
Receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage).	Fisheries (commercial, traditional and recreational).
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.	Benthic primary producer habitats are described in Section 4.9.2 and include the Commonwealth and state marine reserves and KEFs listed below.
Regionally important areas of high diversity (such as shoals and banks).	KEFs: • Continental slope demersal fish communities • Ancient coastline at 125 m depth contour • Ashmore Reef and Cartier Island and surrounding Commonwealth waters • Canyons linking the Argo Abyssal Plain with Scott Plateau • Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula • Carbonate bank and terrace system of the Sahul Shelf • Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals • Pinnacles of the Bonaparte Basin • Seringapatam Reef and Commonwealth waters in the Scott Reef complex • Carbonate bank and terrace system of the Van Diemen Rise • Shelf break and slope of the Arafura Shelf • Tributary canyons of the Arafura Depression • Exmouth Plateau • Glomar Shoals. Benthic habitats: Various banks and shoals, and coral reefs (Section 4.9.2) Seagrasses (Ashmore Reef Buccaneer Archipelago, dugong foraging BIA north of Broome and along the Indonesian coastline) Shoreline habitats:

<table>
<tr><th colspan="2">Value and sensitivity</th><th>Description</th></tr>
<tr><td colspan="2"></td><td>Islands, mangroves and sandy beaches (Section 4.9.3).</td></tr>
<tr><td colspan="2">World heritage values of a declared World Heritage property within the meaning of the EPBC Act.</td><td>None identified within this area.</td></tr>
<tr><td colspan="2">National heritage values of a National Heritage place within the meaning of the EPBC Act.</td><td>The West Kimberley is identified as natural National Heritage Places (Section 4.11.2).</td></tr>
<tr><td colspan="2">Ecological character of a declared Ramsar wetland within the meaning of the EPBC Act.</td><td>Seven Ramsar sites (Section 4.6):
• Ashmore Reef National Nature Reserve
• Coburg Peninsula
• Eighty Mile Beach
• Hosnies Spring
• Pulu Keeling National Park
• Roebuck Bay
• The Dales.</td></tr>
<tr><td colspan="2">Presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act.</td><td rowspan="2">A number of threatened species or migratory species have been identified as having the potential to transit through the PEZ.
These have been categorised as marine fauna (Section 4.9.4):
• marine mammals
• marine reptiles
• fishes and sharks
• marine avifauna.
Also refer to Appendix B (EPBC Act Protected Matters Report - PEZ).</td></tr>
<tr><td colspan="2">Presence of a listed migratory species within the meaning of the EPBC Act.</td></tr>
<tr><td rowspan="2">Any values and sensitivities that exist in, or in relation to, part or all of:</td><td>a Commonwealth marine area within the meaning of the EPBC Act.</td><td>Productivity and diversity associated with planktonic communities and benthic communities.</td></tr>
<tr><td>Commonwealth land within the meaning of the EPBC Act.</td><td>Commonwealth land identified includes Christmas Island National Park and Pulu Keeling National Park (Section 4.1.2) and Yampi Sound Training Area (Section 4.6.10.
Quail Island Bombing Range, Mt Goodwin Radar Site and Norforce Depot – Derby were also identified (Appendix B); however, these are not marine sensitivities and therefore are not discussed further.</td></tr>
<tr><td colspan="2">BIAs associated with EPBC-listed species.</td><td>A large number of BIAs are present within the PEZ including:
Marine mammals
• humpback whale migration route and aggregation/calving areas</td></tr>
</table>

Value and sensitivity	Description
	• pygmy blue whale foraging and migration route • dugong foraging at Ashmore Reef and near Broome • coastal dolphins breeding, calving and foraging areas. Marine reptiles Turtle nesting, internesting and adjacent foraging areas including Browse Island, Ashmore Reef, Cartier Island, Lacepede Islands, Sandy Islet (Scott Reef), Joseph Bonaparte Gulf and Tiwi Islands. Fish and sharks • whale shark foraging area • green sawfish BIA • KEFs associated with increased species diversity and abundance (i.e. continental slope demersal fish communities and the ancient coastline at 125 m depth contour). Marine avifauna • a number of resting and breeding areas associated with shoreline habitats (e.g. Adele Island, Ashmore Reef, Browse Island, Cartier Island, Sandy Islet (Scott Reef), Lacepede Islands and nearshore waters and islands of the WA and NT coastline) including nationally important wetlands (Section 4.6) • a large number of offshore foraging areas that are adjacent to these shoreline habitats.

5 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 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.

INPEX acknowledges the importance of consultation to ensure that persons who may be affected by a petroleum activity ('relevant persons') are informed about the activity and have the opportunity to advise INPEX of any functions, interests or activities that could be impacted by the petroleum activity.

INPEX's awareness of the functions, interests or activities of relevant persons supports the development of management plans that consider and address any environmental, social or economic objections or claims about the petroleum activity.

INPEX's process for stakeholder engagement (consultation) in the development and implementation of an EP and relevant management plans is shown in Figure 5-1 further described in this section.

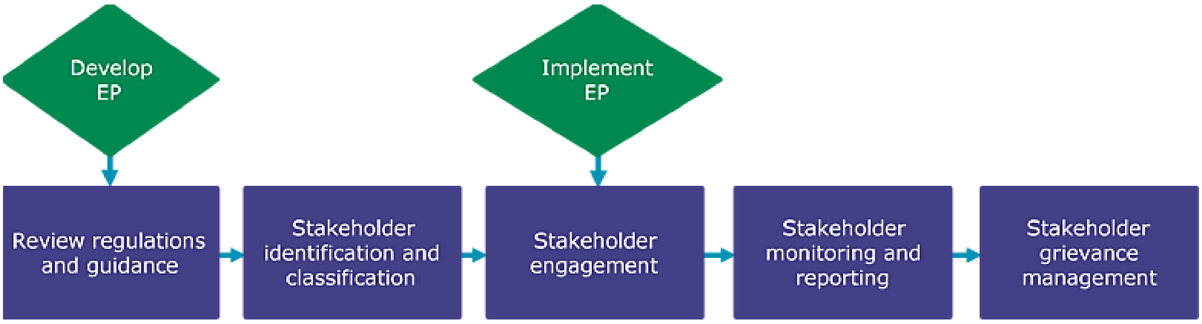

Figure 5-1: Process for stakeholder engagement (consultation) for development and implementation of an EP

5.1 Regulatory requirements and guidelines

Since 2013 and prior to operations commencing, INPEX has undertaken extensive and ongoing stakeholder consultation for several EPs throughout the development, construction, start-up and early operations phases of the Ichthys LNG Project. For the development of this 5-year EP revision, INPEX reviewed the following documents to prepare for further stakeholder consultation on the petroleum activity:

- Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations
- NOPSEMA policies, guidance and information papers related to environment plan development, including:
  - PL1347 – Environment plan assessment policy – 19 May 2020
  - GL1721 - Environment plan decision making – 10 June 2021
  - GL1887 – Consultation with Commonwealth agencies with responsibilities in the marine area – 3 July 2020
  - GN1344 - Environment plan content requirements - 11 September 2020
  - GN1488 - Oil pollution risk management - Rev 2 - February 2021
  - GN1785 – Petroleum activities and Australian marine parks - 3 June 2020

  - IP1764 – Considerations for a five-year environment plan revision – 14 January 2021
  - IP1411 - Consultation requirements under the OPGGS Environment Regulations 2009 - Rev 2 - 2014
  - A696998 – Bulletin #2 Clarifying statutory requirements and good practice consultation – Rev 0 – November 2019
- Guidance issued by relevant stakeholders (as known or provided to INPEX), including:
  - Australian Government Guidance: Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area
  - Australian Fisheries Management Authority (AFMA): Petroleum industry consultation with the commercial fishing industry
  - WA Department of Primary Industry and Regional Development (WA DPIRD): Guidance statement for oil and gas industry consultation with the Department of Fisheries
  - WA Department of Transport (WA DoT): Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and consultation arrangements.
- INPEX stakeholder engagement procedures and guidelines.

INPEX acknowledges its responsibility under the various legislative instruments and other guidance to ensure that relevant persons are appropriately identified and consulted in the development of its EPs and in the conduct of its offshore activities.

5.2 Stakeholder identification and classification

With an understanding of the general requirements and expectations for consultation, INPEX conducted stakeholder identification and classification activities.

As an initial exercise, stakeholders previously identified as relevant to the petroleum activity were reviewed and assessed to ensure their continued relevance. Additionally, any new 'relevant persons' were identified and classified, to determine a suitable engagement priority and method. Key INPEX personnel undertook discussions to outline the requirement for engagement, established the context of the continuing petroleum activity, and identified relevant persons in accordance with Regulation 11A(1) of the OPPGS (E) Regulations and NOPSEMA's additional clarifications of Regulation 11A(1) as provided in Issues Paper IP1411 (NOPSEMA 2014), IP1764 (NOPSEMA 2021a) and Bulletin #2 A696998 (NOPSEMA 2019b).

INPEX treats stakeholder identification (and subsequent activities) as an iterative process whereby the company may become aware of relevant persons both during the process of consultation and also after the development and submission of an EP. INPEX acknowledges that relevant persons may be identified during an EP assessment period and also during the petroleum activity.

5.2.1 Definition of 'relevant persons'/relevant stakeholders

In identifying relevant persons to be consulted on the petroleum activity, INPEX prescribes to the definition provided under Subregulation 11A(1) of the OPGGS (E) Regulations, being:

a. each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant

b. *each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant*

c. *the Department of the responsible State Minister, or the responsible Northern Territory Minister*

d. *a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan*

e. *any other person or organisation that the titleholder considers relevant.*

5.2.2 Relevant activity

In determining who is a relevant stakeholder, it was necessary for INPEX to determine what constitutes a relevant activity, and for which activities a stakeholder should be engaged.

Petroleum activity (planned activity)

The OPGGS (E) Regulations require that consultation be undertaken to ensure that persons who may be affected by a petroleum activity are given the opportunity to inform the titleholder how they may be affected and to allow the titleholder to assess and address any objections or claims about that activity in the preparation of environment submissions.

Regulation 4 of the OPGGS (E) Regulations defines a petroleum activity as "any operations or works in an offshore area carried out for the purpose of:

a. *exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or*

b. *discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act."*

When identifying relevant persons, INPEX considers which stakeholders perform a function in relation to – or have a function, activity or interest that may be impacted by – the planned, physical petroleum activity.

The planned activity for this EP, to be undertaken in Commonwealth waters, is the operation of the interlinked facility used for the recovery or processing of petroleum and any other petroleum-related operations or works carried out under an instrument, authority or consent granted or issued under the OPGGS Act. Therefore, in determining who is a relevant person for engagement on the petroleum activity, INPEX sought to identify and engage with stakeholders whose functions, interests or activities could be affected by the activity.

Unplanned event/activity (emergency conditions)

INPEX undertakes a more targeted approach to consultation with stakeholders in relation to unplanned – and highly improbable – emergency conditions, e.g. a loss of containment of hydrocarbons during the petroleum activity.

Stakeholders who may perform a function in INPEX's planning for, or management of an unplanned activity, and whose information is integral to the development of those management plans, are engaged during the development of the EP revision and INPEX *Browse Regional OPEP.*

Stakeholders whose functions, interests or activities otherwise overlap the PEZ for the unplanned activity are not engaged during the development of those plans but may be engaged in the event of an unplanned emergency condition.

This approach has been adopted to reduce consultation fatigue for stakeholders who will not be impacted by the (physical) petroleum activity.

INPEX will engage contrary to this approach where a stakeholder has expressed a significant (high to very high) level of concern about loss of containment events and wishes to understand more about the potential impact and planned response activities.

INPEX maintains an extended stakeholder list which includes stakeholders who may have a function, activity or interest that falls within for the PEZ, but for the purpose of the development of these plans, engages with stakeholders as outlined in Table 5-1.

Table 5-1: Classification and method of engagement with stakeholders in relation to an unplanned oil spill event and oil spill response

Stakeholder category	Method of engagement	Stakeholders
Government departments, agencies or organisations with functions or roles directly relevant to emergency and oil spill preparedness and response	Involve/consult regarding the petroleum activity and potential unplanned emergency conditions during the preparation of the EP and INPEX *Browse OPEP.*	Australian Maritime Safety Authority (AMSA) WA Department of Transport (DoT) WA Department of Primary Industries and Regional Development (WA DPIRD) WA Department of Biodiversity, Conservation and Attractions (DBCA) NT Department of Infrastructure, Planning and Logistics (NT DIPL) Australian Marine Oil Spill Centre (AMOSC)
Stakeholders where land access is required to be agreed prior to the activity commencing	Involve/consult regarding the petroleum activity and potential unplanned emergency conditions during the preparation of the EP and INPEX *Browse Regional OPEP.*	Landowners Native title holders Aboriginal and Torres Strait Islander communities
Stakeholders whose level of interest (or expectation) in relation to a potential oil spills and oil spill response for the planned activity is high or very high.	Inform regarding the petroleum activity and potential unplanned emergency conditions during the preparation of the EP and INPEX *Browse Regional OPEP.*	As determined during stakeholder identification and classification process (Section 5.2)
Stakeholders whose level of interest (or expectation) in relation to a potential oil spills and oil spill response for the planned activity is low or medium.	To be informed only in the event of an unplanned emergency condition (i.e. oil spill) that has the potential to affect their functions, activities or interests.	As determined during stakeholder identification and classification process (Section 5.2)

5.2.3 Commercial fishery stakeholder identification and classification

In addition to the process outlined above for planned activities and unplanned events, identification of relevant commercial fishing stakeholders distinguishes between:

- fisheries that overlap the planned petroleum activity; and
- fisheries that overlap the PEZ but not the location of the planned petroleum activity.

INPEX used a variety of resources (e.g. data files and fishery reports) to identify and classify stakeholders according to these criteria.

With the view to minimise stakeholder fatigue, INPEX restricted engagement activities to licence holders in fisheries that overlap the area (location) of the planned petroleum activity. INPEX also considered if and where licence holders are active (or potentially active) within a fishery to assess whether that licence holder should be engaged.

In summary, identification of and engagement with commercial fishing stakeholders was conducted as follows:

- Government authorities (AFMA, DAWE, WA DPIRD and NT DITT) were engaged regarding the petroleum activity and engagement with commercial fishing stakeholders. Materials made available by government authorities, e.g. WA FishCube (fishing effort) data files and fishing reports, were used in fisheries determinations.
- Fishing industry associations that represent fisheries with licence areas that overlap the petroleum activity (e.g. WAFIC, Commonwealth Fisheries Association, etc.) were consulted regarding the petroleum activity and engagement with their members.
- Licence holders in commercial fisheries were engaged/not engaged according to the following criteria:
  - Active or potentially active licence holders in commercial fisheries whose activities overlap or are very close to the planned petroleum activity <u>were considered to be relevant stakeholders</u> and were accordingly engaged during the development of this 5-year EP revision.
  - Licence holders in commercial fisheries that overlap or are close to the planned petroleum activity, but whose activities or interests are not expected to be affected by the planned petroleum activity <u>are not considered to be relevant stakeholders</u>. Such licence holders were not engaged during the development of this 5-year EP revision, but the industry associations representing these fisheries were informed. An example would be where the licence holder fishes in a distant part of that fishery, e.g. off the southern coast of Australia.
  - Licence holders in commercial fisheries that overlap the broader PEZ but not the area of the planned petroleum activity <u>are not considered affected parties/relevant stakeholders</u> and were therefore not informed during the development of this 5-year EP revision.

Licence holders that are not considered to be relevant to the planned petroleum activity are included in the expanded list of stakeholders who would be informed in the event of an unplanned emergency condition.

Table 5-2 presents the commercial fisheries classified according to their relevance to the planned petroleum activity or an unplanned emergency condition. No commercial fishery has been active within WA-50-L within the last 4 years, though it is noted that the Northern Demersal Scalefish Fishery (WA) and the North West Slope Trawl Fishery (Cwth) fish in adjacent waters and so licence holders of these two fisheries were determined to be relevant stakeholders. No other commercial fisheries fish in or close to the planned petroleum activity.

Table 5-2: Classification of commercial fishery licence holders

Fishery	Relevance and process of engagement
Commercial fisheries overlapping or close to the planned petroleum activity area and with licence holder activities or interests that may be affected by the planned petroleum activity.	
Northern Demersal Scalefish Managed Fishery – Area 2 (WA)	Relevant. Licence holders directly consulted.
North West Slope Trawl Fishery (Cwlth)	
Commercial fisheries overlapping the planned petroleum activity area, but licence holder activities or interests are not expected to be affected by the planned petroleum activity.	
Mackerel Managed Fishery – Area 1 (WA)	Not affected. Licence holders not consulted during the development of this 5-year EP revision; however, representative industry associations were informed, and each fishery's interests considered in the development of the EP. Licence holders to be informed in the event of an unplanned emergency condition.
North Coast Shark Fishery (Northern Zone) (WA)	
Pearl Oyster Managed Fishery - Zone 3 (WA)	
Western Tuna and Billfish Fishery (Cwlth)	
Southern Bluefin Tuna Fishery (Cwlth)	
Western Skipjack Tuna Fishery (Cwlth)	
West Coast Deep Sea Crustacean Managed Fishery (WA)	
Commercial fisheries overlapping the PEZ but not the planned petroleum activity area.	
Northern Prawn Fishery (Cwlth)	Not affected. Licence holders not consulted during the development of this EP 5-year revision, but each fishery's interests considered in the development of the EP. Licence holders to be informed in the event of an unplanned emergency condition.
Broome Prawn Managed Fishery (WA)	
Kimberley Prawn Managed Fishery (WA)	
Nickol Bay Prawn Managed Fishery (WA)	
Pilbara Trap Managed Fishery (WA)	
Pilbara Fish Trawl Interim Managed Fishery (WA)	
Pilbara Line Fishery (WA)	
Pilbara Crab Managed Fishery (WA)	
Specimen Shell Managed Fishery (WA)	
Abalone Managed Fishery – Area 8 (WA)	
Hermit Crab Fishery (WA)	
Kimberley Crab Managed Fishery (WA)	
Kimberley Gillnet and Barramundi Fishery (WA)	

Mackerel Managed Fishery – Area 2 (WA)	
Marine Aquarium Fish Managed Fishery (WA)	
Northern Demersal Scalefish Managed Fishery – Area 1 (WA)	
Onslow Prawn Managed Fishery (WA)	
Pearl Oyster Managed Fishery – Zones 1 and 2 (WA)	
Trochus Fishery (WA)	
Joint Authority Northern Shark Fishery (Cwlth/WA)	
South West Coast Salmon Managed Fishery (WA)	
Timor Reef Fishery (NT)	
Demersal (multigear) Fishery (NT)	
Barramundi Fishery (NT)	
Bait Net Fishery (NT)	
Coastal Net Fishery (NT)	
Coastal Line Fishery (NT)	
Trepang Fishery (NT)	
Aquaculture (NT)	
Aquarium Fishery (NT)	
Mollusc Fishery (NT)	
Mud Crab Fishery (NT)	
Offshore Net and Line Fishery (NT)	
Pearl Oyster Fishery (NT)	
Spanish Mackerel Fishery (NT)	

5.2.4 Stakeholder classification

Stakeholders were then classified based on their level of interest in/potential impact by, and influence over, the petroleum activity. The purpose of this activity was to determine a 'priority' for consultation that was appropriate to the classification. Priority levels are shown in Table 5-3.

Table 5-3: Engagement classification

Priority	Interest/potential impact level and/or Influence level	Stakeholder classification (engagement priority)
Level 1	(Both) High to very high	Collaborate/empower: partner with stakeholder on each aspect of the decision; allow stakeholder (regulatory or approvals bodies) to make the final decision.
Level 2	(Either) High to very high	Consult/involve: ensure stakeholder concerns and expectations are consistently understood and considered, and obtain feedback from stakeholders on analysis, alternatives and/or decisions.
Level 3	(Both) Low to medium	Inform: provide balanced, objective, timely and consistent information to stakeholder.

Stakeholders who are relevant only in the event of unplanned emergency conditions were classified separately based on their role or function in relation to unplanned emergency conditions or based on their level of interest and influence in unplanned emergency conditions.

5.3 Stakeholder engagement

Following the stakeholder identification and classification exercise, an engagement plan was developed to register identified stakeholders and the following information:

- the activity/ies (planned and unplanned) for which they have been identified as relevant
- the activities on which they should be engaged
- the function, activity or interest that may be affected by the relevant activity
- their assigned classification (priority for engagement)
- the proposed manner of engagement (i.e. modes, timing, and by whom).

Those INPEX personnel responsible for engagement were provided with a copy of the plan and instructions on how to carry out the necessary engagement.

INPEX prepared a consultation information sheet to provide relevant stakeholders with important details of the petroleum activity. The information sheet 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) may provide more information relevant to the functions, activities or interests of the stakeholder receiving the information sheet. Additional information was also sent to stakeholders in subsequent communications, as requested by the stakeholder and/or as the information became available.

5.4 Stakeholder monitoring and reporting

Using the stakeholder engagement plan as a guide, INPEX retains a record of all communications sent and received as part of the stakeholder engagement activity. This includes email correspondence, telephone call logs, letters and minutes of meetings.

All queries and feedback from stakeholders were logged, and where applicable, 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.

5.4.1 Relevant matters, objections and claims

During stakeholder consultation, each meeting, phone call or piece of correspondence received from a stakeholder was assessed by INPEX for relevant information or for objections, claims or concerns raised regarding the activity. The INPEX assessment of relevance and assessment of merit considered four broad categories:

- objection, claim or concern has merit – The objection, claim or concern raised is relevant to both the planned petroleum activity and the stakeholder’s functions, activities or interests. The matter has merit if there is a reasonable/scientific basis for related effects or impacts to occur and/or there is reasonable basis for the matter to be addressed in the EP.
- objection, claim, or concern does not have merit – The objection, claim or concern raised may be relevant to the planned petroleum activity or the stakeholder’s functions, activities or interests, however, the matter raised has no credible or scientific basis.
- relevant matter – The matter raised does not fit the criteria descriptions for objections, claims or concerns with/without merit. However, the matter raised is relevant to the planned petroleum activity, comprises a request to INPEX for further relevant information, or provides information to INPEX that is relevant to the petroleum activity or the EP.
- not a relevant matter – Correspondence does not relate to the planned petroleum activity or the stakeholder’s functions; interests or activities being affected by the petroleum activity. Non-relevant matters may also be generic in nature with no specific issues raised (e.g. salutations, acknowledgements, meeting arrangements, etc.).

A summary of all stakeholder consultation undertaken, and the full assessment of relevance and merit are provided in Appendix C. The actual records of correspondence are provided in a ‘Sensitive Matters Report’ that is submitted to the Regulator separately to this EP.

An overview of feedback received from stakeholders that resulted in material inputs to the EP is provided in Table 5-4.

Table 5-4: Summary of material inputs to the EP from stakeholder consultation

Stakeholder	**Summary of material stakeholder feedback**	**Summary of INPEX action**
Petroleum activity engagement		
Australian Maritime Safety Authority (AMSA) – Nautical Advice	AMSA raised no concerns with proposed activities and requested: INPEX continue to provide timely Maritime safety information Vessel lighting was managed in accordance with COLREG requirements.	The JRCC and AHO were notified when the activity commenced in 2017. INPEX will notify AHO and JRCC if there are any changes to the intended operations (refer to Section 9.8.3). Vessel navigational lighting is managed in accordance with the *Navigation Act* and associated Marine Orders, which align with COLREGS requirements (refer to Table 7-6, Table 7-36 and Table 8-7).
Department of Agriculture, Water and Environment (DAWE) – Fisheries	DAWE-Fisheries raised no concerns with proposed activities and requested that they (and other stakeholders i.e. AFMA and fishing industry representatives) were updated on any future developments associated with Project.	INPEX will notify DAWE-Fisheries, AFMA and fishing industry representatives of any future developments associated with the Project, as required (Refer to Section 9.8.3).
Department of Biodiversity Conservation and Attractions (DBCA) - Environmental Management Branch (WA)	DBCA requested INPEX to provide further detail in relation to the following topics: Baseline Data Light pollution Notification process for oiled wildlife response	INPEX provided a summary of INPEX's capability in relation to the topics raised and described how the topics are addressed within the EP and other business management documents. Specifically: • Existing environment for the region is described in Section 4 • INPEX has considered the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds during its assessment of impacts and identification of controls (refer to Table 7-5 and Table 7-6). • Requirement to notify DBCA in relation to oiled wildlife response is included in oil spill response documents.
Department of Mines, Industry Regulation and Safety (DMIRS) – WA	The stakeholder raised no concerns with the proposed activity and requested that they were informed of any relevant updates.	INPEX will notify DMIRS of any future developments associated with the Project, as required (refer to Section 9.8.3).

Stakeholder	Summary of material stakeholder feedback	Summary of INPEX action
Director of National Parks	The stakeholder raised no concerns with the proposed activity and requested the following: • Ensure the EP identifies how INPEX will manage all impacts and risks on AMPs so these are consistent with associated AMP management plans • Notification of oil/gas pollution incidents that occur within or are likely to impact on an AMP.	INPEX has described all relevant AMPs and associated objectives and values of these in Section 4. No AMPs overlap the planned petroleum activity. Where unplanned activities have the potential to impact on AMPs these have been considered in Section 7 and Section 8 of the EP. Requested notification to DNP of oil/gas pollution incidents, which have the potential to impact on AMPs, has been included in the BROPEP.
AMOSC	The stakeholder raised no concerns with the proposed activity and requested the following: • Update on drilling programs/schedules	INPEX will update AMOSC on drilling programs/schedules that extend beyond 2023 (refer to Section 9.8.3).
Specific activity/aspect engagement – Domestic vessel biosecurity risk assessment		
WA DPIRD and NT DITT (Aquatic Biosecurity)	DPIRD and DITT accepted the information INPEX provided on existing best practice IMS controls. DPIRD and DITT asked for INPEX to consider utilising "vessel check". It was confirmed that vessels assigned either a 'Low' or 'medium' risk (within vessel check) are acceptable. In addition, both stakeholder representatives, noted that actual marine pest biofouling risk posed by a vessel does not change if the vessels are travelling between Broome – Darwin – and offshore production facilities. This is because there have not been marine pests of concern detected at any of these locations, as such vessel movements between these locations is a low risk.	INPEX provided evidence that opportunistic IMS survey reports from the last 4 years had not identified any IMS of concern and that the PSVs and OSV had no indication they are acting as significant vectors for *D. perlucidum.* INPEX provided a draft modification to the Domestic vessel risk assessment process (i.e. remove assessment for short term vessels arriving domestically) for discussion; and provided a draft amendment to the IMS monitoring program (i.e. to replace the routine annual review by a specialist with a 5 yearly review cycle). INPEX also described existing 'best practice' controls for managing biofouling being implemented and sought confirmation that if 'Vessel check' assessments were requested to be provided to INPEX, to inform an assessment, it would be acceptable if the vessel (within vessel check) returned either' 'medium' or 'low' risk ranking.

Stakeholder	Summary of material stakeholder feedback	Summary of INPEX action
		INPEX has retained the existing best practice biofouling management controls, updated the domestic biofouling risk assessment process, amended the IMS monitoring program and where vessel check data is available for contracted vessels INPEX will accept 'low' or 'medium' risk reports as evidence the vessel pose a low biofouling risk.
Specific activity/aspect engagement – MARPOL requirements Offshore Facility		
AMSA – Ship registration and operations branch	AMSA and DNV confirmed that INPEX should obtain a "Statement of compliance" (rather than seek certification) to demonstrate equivalence to MARPOL. The advice was to seek equivalence using Form 288, to demonstrate compliance with the Protection of the Sea Act (implemented via MARPOL Marine Orders).	INPEX sought confirmation from AMSA and DNV on the requirement or otherwise for certification in relation to compliance with the Protection of the Sea Act 1983. INPEX submitted the Form 288 demonstration of Equivalence forms to DNV and AMSA in July 2021. These applications are under review at the time of submission of the EP. It has been agreed that after these forms have been signed off, INPEXs ongoing demonstration of compliance can be achieved via a "Statement of compliance" issued by a third-party inspection body (e.g. DNV).
Specific activity/aspect engagement – BROPEP		
Australian Maritime Safety Authority (AMSA) -Marine Environment Pollution Response (Cwth) Department of Transport (WA DoT) – Marine Safety NT Department of Environment, Parks and Water Security (EPaWS) - Marine Pollution WA DBCA DAWE	Stakeholders were engaged to explain the shift from single OPEPs to Regional OPEP concepts. Jurisdictional authority and control agency responsibilities were verified and expectations between INPEX and government agencies in regard to spill response notification, first strike actions, and spill response capabilities and arrangements were verified.	INPEX has incorporated stakeholder feedback throughout the BROPEP and the supporting documents.

5.5 Stakeholder grievance management

A grievance is a complex stakeholder objection or claim ('relevant matter') which has progressed beyond management through the Stakeholder Monitoring and Reporting process.

In line with grievance management as described in the INPEX Community Grievance Management Procedure, a relevant matter that cannot be resolved with the concerned stakeholder (grievant) by the applicable contact person (supported by area experts where required) will be referred to the INPEX Community Relations Working Group (CRWG) for advice and resolution before a response is made to the grievant.

If the resolution proposed by the INPEX CRWG is unacceptable to the grievant, a third-party mediator may become involved to facilitate a resolution between the parties.

In relation to engagement activities for this 5-year EP revision, all stakeholder enquiries were either dealt with as outlined above or are ongoing due to the iterative process of engagement being applied.

No grievances have been recorded in relation to the engagement process nor to the offshore activities undertaken by INPEX in the last 5 years.

5.6 Ongoing consultation

Ongoing consultation activities ensure that INPEX develops and maintains a current and comprehensive view of stakeholder functions, interests and activities, and provide a forum for enquiries, objections or claims by relevant persons during the conduct of a petroleum activity.

Ongoing consultation for the petroleum activity is outlined in the implementation strategy (Section 9.8.3).

6 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHODOLOGY

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 have been identified. In the preparation of this 5-year EP revision for a long-term activity, additional considerations have also been incorporated into the impact and risk assessment methodology, in accordance with NOPSEMA's Information Paper (NOPSEMA 2021a) and other guidance (NOPSEMA 2020b, 2020c). A summary of the outcomes from this process are included in Section 7 *Impact and Risk Assessment* and Section 8 *Impact and Risk Assessment – Emergency Conditions* of this EP.

As this is a 5-year EP revision, several additional sources of information and data have been reviewed and used during the preparation of the EP. These sources have been assessed/reviewed to ensure that knowledge accrued by INPEX, over the last five years of activities, has been used as the basis for ensuring that appropriate and effective controls are in place to manage the activities covered by this EP. Assessed/reviewed sources of information and data included:

- outcomes of quarterly risk reviews undertaken during recent years of operation
- outcomes of audits and inspections undertaken during recent years of operation
- new information assessments/Management of Change (MoCs) updates
- annual and monthly performance reporting undertaken during recent years of operation
- incident reports, investigations and lessons learned during recent years of operation
- environmental monitoring data gathered during recent years of operation.

Several HAZID (environmental hazard identification) workshops were also undertaken for this EP revision. These workshops involved the review and update of the original HAZID, which considered changes to the activity description and any accrued information and data (refer above). The workshops involved small, targeted focus groups including environmental, engineering, compliance, health, safety, and emergency response personnel. Each workshop focussed on a specific topic e.g. IMR activities, planned shutdown and maintenance, etc.

The HAZID workshops were 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 (and evaluation of interaction to determine an impact pathway)
3. the identification of potential consequences (severity)
4. the identification of existing design safeguards and control measures
5. the proposed 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.

6.1 Establishment of context

The first stage in the process involved a review of legislative requirements including government policies and guidelines (Section 2 *Environmental management framework*). A review of the scope and activities to be covered by the EP for the next 5 years was then undertaken (Section 3 *Description of activity*). This was achieved through a series of meetings and discussions with relevant HSE, project teams, operations, engineering and emergency response personnel. Lessons learned from previous years of operational activities and planned scopes of work for future development of the Ichthys development and IMR activities were also considered.

A review of the existing environment, and confirmation and identification of the particular values and sensitivities was also undertaken. This included a revised and updated EPBC Act Protected Matters report (Appendix B) and the incorporation of information and data collected by INPEX (and other published literature sources) during environmental monitoring undertaken in recent years in the Browse Basin.

The outcome of these exercises is presented in Section 2 *Environmental management framework*, Section 3 *Description of activity* and Section 4 *Existing environment*, of this EP.

6.2 Identification of aspects, hazards and threats

The aspects associated with the petroleum activities covered by this EP revision were grouped to align with the INPEX BMS environment standards. An aspect is defined as

“An element or characteristic of an activity, product, or service that interacts or can interact with the environment” (ISO 14001 2015).

A summary of the aspects identified are as follows:

- emissions and discharges
- waste management
- noise and vibration
- biodiversity and conservation protection
- land disturbance (or seabed disturbance)
- social and cultural heritage protection
- loss of containment.

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. If there is no credible exposure of the value or sensitivity, there is no risk of harm or damage. Subsequently, there is no potential for impact (or consequence).

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.

Outcomes from previous and existing risk assessments were reviewed against the revised activity description (Section 3) and existing environment description (Section 4) to ensure all hazards and threats were captured in this EP revision.

6.3 Identify potential consequence

In Section 7 Impact and risk assessment and Section 8 Emergency conditions, for each aspect, the greatest consequence (or potential impact) of an activity, is evaluated with no additional safeguards or control measures in place for the activities as described in Section 3. This allows the assessment to be made on the maximum foreseeable exposure of identified values and sensitivities to the hazard from the activities, taking into account the extent and duration of potential exposure. The consequence is defined using the INPEX risk matrix (Figure 6-1).

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 for environmental impact and impacts to cultural and social heritage.

6.4 Identify existing controls

Control measures associated with the existing design are then identified to prevent or mitigate the threat and/or its consequence(s). These controls may relate to the implementation strategy and have relevant environmental performance outcomes and standards presented in Section 9.

INPEX

Risk Matrix

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

LIKELIHOOD TABLE

	6	5	4	3	2	1
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 (USD)	Health & Safety	Environment	Reputation	Cultural & Social Heritage	Legal
A	>$1B	>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	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	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	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	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	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 6-1: INPEX risk matrix

6.5 Propose additional safeguards (ALARP evaluation)

Where existing safeguards or controls have been judged during the evaluation as inadequate to manage the identified hazards (on the basis that the criteria for acceptability is not met as defined in Section 6.8), 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 6-2. 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.

The level of performance of existing controls currently being implemented was also reviewed in a series of meetings and discussions with relevant HSE, project teams, operations, engineering and emergency response personnel. The objective of these discussions was to ensure that current controls are effective and to identify any new additional controls that may now be available, where they may not have been during previous years of operation. The outcomes of these discussions are documented in ALARP review/new information assessment logs and a summary is present in the relevant sections of this EP revision (sections 7 & 8 and INPEX *Browse Regional OPEP*).

Most 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
Least Preferred	**Procedures & Administration**		Management systems and work instructions used to prevent or mitigate environmental exposure to hazards

Figure 6-2: ALARP options preferences

6.6 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 6-1.

6.7 Assess residual risk

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

6.8 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* (NOPSEMA 2019b), 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) as shown in Table 6-1.

Table 6-1: 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 (Figure 9-2) INPEX *HSE Hazard and Risk Management Standard* and the INPEX BMS (Section 9.1) 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 Ichthys Project. Scientific knowledge is available to support this and processes are in place to ensure that INPEX remains up-to-date with scientific publications (Section 9.13).
(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. Energy efficiency and emissions reduction technologies have been developed and incorporated into the design of the Ichthys Project.

Principles of ESD	Demonstration
(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 petroleum 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
- the predicted level of impact 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.

6.9 Definition of performance outcomes, standards and measurement criteria

As defined in Regulation 4 of the OPGGS (E) Regulations 2009, INPEX has used environmental performance outcomes, performance standards to address potential environmental impacts and risks identified during the risk assessment.

Environmental performance outcomes, standards, and measurement criteria that relate to the management of the identified environmental impacts and risks are defined as follows:

- Environmental performance outcome means a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.
- Environmental performance standard means a statement of the performance required of a control measure.
- Measurement criteria are used to determine whether each environmental performance outcome and environmental performance standard has been met.

7 IMPACT AND RISK ASSESSMENT

7.1 Emissions and discharges

7.1.1 Emissions to air

Greenhouse gas emissions

Offshore GHG emissions and climate change

The physical impacts of climate change are likely to be felt in Australia in coming years. The CSIRO (2020) estimates the following impacts will be felt in Northern Australia:

- Continued substantial increases in projected mean, maximum and minimum temperatures in line with our understanding of the effect of further increases in greenhouse gas concentrations (very high confidence).
- Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells (very high confidence).
- Future increase in the intensity of extreme rainfall events (high confidence).
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (very high confidence).

The nature of climate change, being a global issue with very complex global impacts, is such that it is difficult to directly link Ichthys' offshore GHG emissions with specific environmental impacts resulting from climate change. Although climate change impacts to features of the Australian environment cannot be directly linked to the Ichthys Project, it is certainly the case that the accumulation of GHG in the atmosphere from all global emissions sources continue to contribute to climate change. Impacts arising from Ichthys' offshore GHG emissions associated with the 'primary action' approved under EPBC Act approval (EPBC 2008/4208) are not considered to constitute a substantial cause of climate change (indirect impact).

As a responsible corporate citizen, INPEX recognises the need to decarbonise and has corporate targets to promote decarbonisation throughout the INPEX group of companies. An overview of the corporate framework is provided in Section 9.6.3.

Ichthys operations

While the Ichthys Project is considered a single facility for the purposes of NGER reporting and the Safeguard Mechanism; in practice, it is made up of the CPF, FPSO and the onshore LNG plant – with the 889 km GEP connecting them and the necessary subsea infrastructure providing the feed gas from the reservoir. During steady-state operation, GHG emissions are generated in each part of the facility; however, most emissions are generated in the onshore LNG plant – which includes the acid gas removal process, where reservoir CO_2 is separated. Onshore emissions are regulated by the NT EPA and is licensed under the *Waste Management and Pollution Control Act* and therefore are not within the scope of this EP. In total, 14% of the overall emissions for the Ichthys facility occur offshore, with the remainder occurring onshore (Figure 7-1). This figure represents expected emissions during steady state operations and formed the basis of the baseline application under the Safeguard Mechanism.

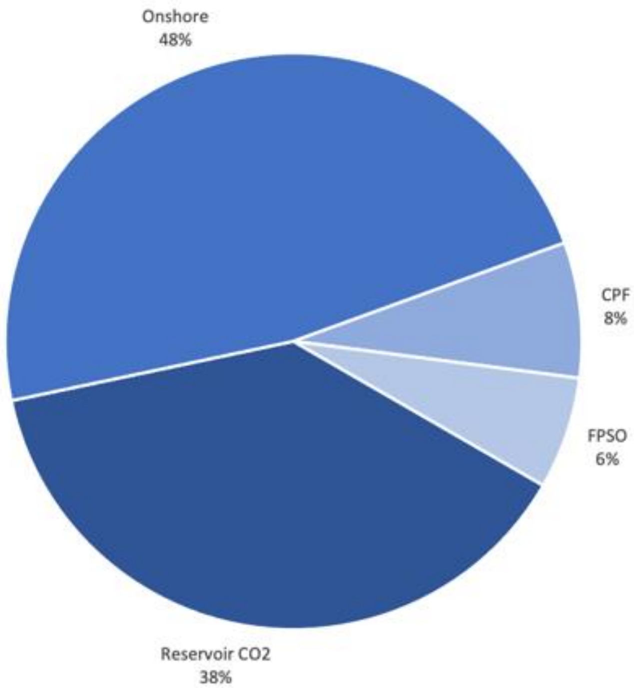


Figure 7-1: Ichthys Project atmospheric emissions by area

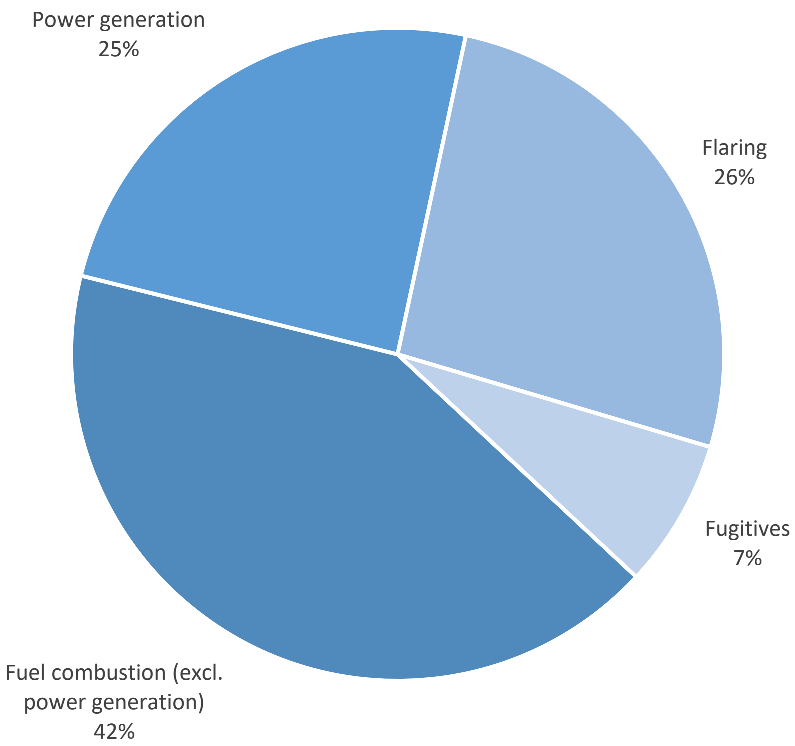


Figure 7-2: Offshore emissions by emissions source

Indirect emissions from offshore facilities

The offshore facility produces condensate that is exported directly from the FPSO and gas that is transported via the GEP to INPEX's onshore LNG plant at Bladin Point – where it is further processed to LNG, propane, butane and onshore condensate. These onshore and offshore products are largely exported overseas for use by Ichthys customers. The downstream value chain for the offshore facility encompasses both the downstream processing by INPEX, the transport of products to market and the use of those products by Ichthys customers. From an emissions point of view, the downstream processing of gas from the offshore components (CPF and FPSO) is still an INPEX Scope 1 emissions source that occurs at Bladin Point. Emissions from transport and use of products – either offshore condensate or onshore products – is a Scope 3 emissions source for INPEX. These definitions are consistent with the application of the corporate reporting standards under the GHG Protocol[2].

INPEX's Scope 1 emissions at Bladin Point are the subject of ongoing analysis and identification of emissions reduction opportunities. Notably, INPEX is continuing to investigate the potential for carbon capture and storage at the onshore facility – building on the more than $US10M that has already been spent developing this opportunity. If implemented, carbon capture and storage would represent a material emissions reduction for INPEX and contribute significantly to INPEX achieving its corporate emissions reduction goals including net zero emissions by 2050.

With regard to Scope 3 emissions, the majority of emissions are attributable to the 'Use of Products' category. All other Scope 3 emissions sources are immaterial in comparison to the use of products. Of these emissions, most can be attributed to LNG use by Ichthys' customers located globally. All LNG is exported from Australia and consumed in other countries such as Japan, Taiwan and South Korea. LNG/natural gas is the lowest emissions intensity fossil fuel. Natural gas plays two key roles in the energy mix, by displacing higher emissions intensity energy sources such as coal and by enabling firming of renewable energy through provision of a low-cost dispatchable backup to renewables.

The overwhelming majority of product from the Ichthys facility is sold under contract with LNG buyers across Asia – with a large portion being shipped to Japan, where it contributes to overall energy security for the country and provides a stable energy source for the production of electricity and heat. More than just displacing high emissions energy sources, LNG from Ichthys provides security to these long-term contracts.

There are many views of the future of fossil fuels as part of long-term energy mixes with regard to decarbonisation scenarios, including those prepared by the IEA – such as the Net Zero Emissions pathway. This scenario in particular shows that there is demand for natural gas in the future. The Net Zero Emissions pathway also shows that natural gas will provide more energy globally that either coal or oil in 2050. A significant proportion of future natural gas demand is predicted to be utilised in the production of clean hydrogen – a market that INPEX is exploring in detail and forms part of the future strategy for the company. Furthermore, demand for natural gas in this pathway does not peak until around 2030. Taking all of this into account (displacement of higher emissions energy, long-term contracts, energy security and overall natural gas demand), these emissions from downstream combustion of INPEX products are considered to be acceptable and overall offer a net benefit compared to alternatives.

Figure 7-3 shows a forecast for the next 5 years of the future emissions across INPEX's complete value chain.

[2] The GHG Protocol Corporate Accounting and Reporting Standard and the Corporate Value Chain (Scope 3) Standard by the World Resources Institute and the World Business Council for Sustainable Development

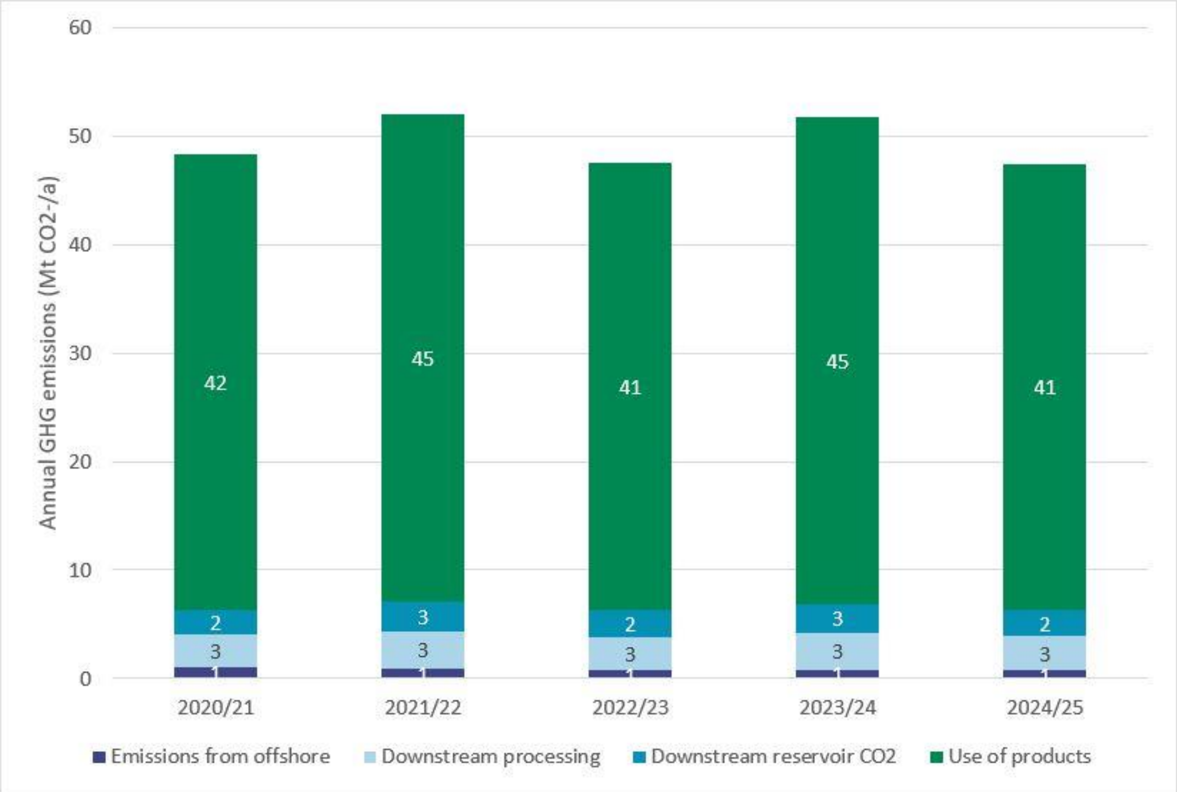


Figure 7-3: Predicted future emissions across INPEX's value chain

Decarbonisation of the global economy and the impact on INPEX's value chain is an area of focus within the INPEX Corporation climate strategy and is the subject of study by the climate change working group. Forecast energy mix scenarios and decarbonisation pathways from groups such as the International Energy Agency continue to show demand for natural gas products into the future – including in the Net Zero Emissions pathway in the 2021 World Energy Outlook – and LNG does play a role in the broader energy transition. The value chain emissions from the Ichthys offshore facilities form part of this energy transition and enable global decarbonisation. INPEX continually reviews scenarios of future demand as part of scenario analysis that sits within the climate change risk assessment process. Details of the scenarios used and the way in which future demand is included within broader business strategy are documented on INPEX's corporate website.

Indirect consequences

Section 527E of the EPBC Act refers to the 'indirect consequences' of an action – with an action in this case being the processing of reservoir fluids into products from the offshore facilities. Under the definitions provided in the Policy Statement supporting this Section of the Act, an indirect consequence of the action occurs if there is a secondary action that creates an impact provided some key conditions are met. Namely:

- The primary action facilitates the secondary action to a major extent; and
- The secondary action is within the contemplation of the person taking the primary action or is a reasonably foreseeable consequence of the primary action; and
- The event or circumstance is within the contemplation of the person taking the primary action or is a reasonably foreseeable consequence of the secondary action.

With consideration that the operation of the offshore facilities is the primary action, the secondary actions will constitute the following, with the potential consequences relating to GHG emissions listed.

Table 7-1 - Secondary actions and indirect consequences

Secondary action	Potential consequences
Downstream processing of field condensate	Field condensate produced by the FPSO is loaded onto tankers and further processed to refined hydrocarbons – this downstream processing generates GHG emissions
Use of refined hydrocarbons	The sale of refined hydrocarbons by the downstream refining and consumption by end users also generates GHG emissions
Downstream processing of natural gas	Downstream processing of natural gas from the CPF occurs in INPEX facilities at Bladin Point, which it is separated and liquefied to LNG, LPG and plant condensate – causing GHG emissions to be generated at the onshore facility
Shipping of products from Bladin Point	Products from the LNG facility are shipped to customers generating GHG emissions from the transportation of products
Use of products from Bladin Point	The products from the LNG facility are sold to customers where they are combusted – causing additional GHG emissions

With reference to the conditions that would link these indirect consequences to the primary action, it can be argued that the primary action facilitates the secondary action to a major extent as the secondary action requires the primary action to provide the feed for any downstream activities. Combustion of products form part of this downstream value chain also. Both the secondary actions of downstream processing/combustion of products and the consequence of those secondary actions being GHG emissions from these activities are recognised as being reasonably foreseeable.

For the purposes of the consideration of secondary actions, the emissions at Bladin Point are under INPEX Operational Control and subject to the net zero commitment at a corporate level. As such, achievement of net zero emissions in this facility by 2050 (a commitment that is aligned with the overall goals of the Paris Agreement) will mean that the ultimate impact in the long-term will be zero.

Table 7-2 defines the control measures, environmental performance outcomes and standards and measurement criteria relating to offshore GHG emissions associated with the petroleum activity in WA-50-L.

Table 7-2: Impact and risk evaluation – greenhouse gas emissions

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">As described in Table 3-7, Table 3-8 and Table 3-9, there are several sources of GHG emissions from the offshore facility in WA-50-L. The accumulation of GHG in the atmosphere will result in increased temperatures and will have an adverse effect on ecosystems and threaten biodiversity (CSIRO 2017, IPCC 2021).
As defined by the National Greenhouse and Energy Reporting Regulations 2008, GHG emissions can be considered either direct or indirect. Direct emissions relevant to the activity include Scope 1 emissions that are associated with the offshore combustion of hydrocarbon fuels, transportation and venting of fugitive emissions. Indirect emissions, known as Scope 3 emissions, associated with the petroleum activity are predominantly associated with third party consumption of Ichthys products in customer markets. Emissions at the onshore LNG facility at Bladin Point, whilst being secondary impacts from the offshore activities (Table 7-1), are Scope 1 emissions from the point of view of INPEX GHG reporting.
Climate change impacts, due to the accumulation of GHG in the atmosphere occur at a global scale and cannot be attributed to any single source of emissions or specific facility. Therefore, impacts (direct or indirect consequences) arising from Ichthys Project offshore GHG emissions associated with the ‘primary action’ approved under EPBC Act approval (EPBC 2008/4208) are not considered to constitute a material or substantial cause of climate change (Commonwealth of Australia 2013).</td></tr>
<tr><td>Potential consequence</td><td>Severity</td></tr>
<tr><td>Climate change poses severe challenges for natural ecosystems and many of Australia’s most species-rich areas are highly vulnerable to climate change as a result of increasing global GHG emissions (Dunlop et al. 2012). Human-induced global warming has already caused multiple observed changes in the climate system including increases in both land and ocean temperatures and an increase in the frequency and duration of heatwaves both on land and in the marine environment (Hoegh-Guldberg et al. 2018).
The particular values and sensitivities of the Australian environment identified as having the potential to be impacted by climate change are:
• Terrestrial and wetland ecosystems
• Marine ecosystems
• Physical environment including oceanography (circulation/currents), water quality and temperature
• Biological environment including planktonic communities, benthic communities, shoreline habitats and marine fauna
• Socioeconomic environment including fisheries and aquaculture.
Terrestrial and wetland ecosystems
Climate change related impacts to terrestrial flora and fauna are likely to be highly species-dependent and spatially variable and may include threats such as degradation of habitat and landscapes through vegetation clearing, introduced pest animals and weeds, highly modified and overcommitted water resources, changed fire regimes, widespread use of fertiliser and other chemicals, urbanisation, mining and, for some species, over-harvesting. Changes to biodiversity as a result of climate change are already evident, including</td><td>Insignificant (F)</td></tr>
</table>

shifts in genetic composition, changed migration patterns of some birds and altered lifecycles of some species and reduced reproduction rates in others (Steffen et al. 2009). Extreme weather events such as droughts, floods, storms and fire can affect population dynamics, species boundaries, morphology, reproduction, behaviour, community structure and composition and ecosystem processes. Changes in the frequency and intensity of extreme weather events may have larger impacts on many species and communities than increases in temperature and changes in rainfall patterns (Steffen et al. 2009). Hoegh-Guldberg et al. (2018) concludes that constraining global warming to 1.5ºC rather than 2ºC has strong benefits for terrestrial wetland ecosystems. Species range losses, increased extinction risks, changes in phenology together with projected increases in extreme weather events all contribute to the disruption of ecosystem functioning and loss of services provided by these ecosystems to humans such as avoidance of desertification, flood control, water and air purification, pollination, nutrient cycling, some sources of food, and recreation. Marine ecosystems The distribution and productivity of marine ecosystems is heavily influenced by the timing and location of ocean currents. Climate change may suppress upwelling in some areas and increase it in others, leading to shifts in location and extent of productivity zones. Many marine organisms are highly sensitive to changes in temperature, leading to effects on growth rates, survival, dispersal, reproduction and susceptibility to disease. Increasing temperatures may reduce larval development time, potentially reducing dispersal distances and warm-water assemblages may replace cool-water communities. As CO_2 is absorbed by oceans, the pH lowers leading to ocean acidification. This in turn increases the solubility of calcium carbonate, a key component of skeletal material in marine organisms such as corals. Increases in water temperature at the sea surface may impact on planktonic communities and lead to coral bleaching. Coral mortality following bleaching events can affect vast areas and coupled with increasing acidification, the ability of tropical coral reefs to provide habitat for fish and invertebrates will be undermined. Coral reefs are likely to degrade over the next 20 years, presenting fundamental challenges for those who derive food, income or coastal protection from coral reefs (Hoegh-Guldberg et al. 2017). Climate change is likely to have a substantial impact on mangrove ecosystems through processes including sea level rise, changing ocean currents, increased storm events, increased temperature, changes in precipitation and increased CO_2 (Ward et al. 2016; Hoegh-Guldberg et al. 2018). Higher temperatures and evaporation rates, and extended droughts could lead to die-offs in northern Australia and a change in mangrove distribution and abundance (Duke et al. 2017). Climate variability and change may cause distribution and migratory timing changes and decreased health of individuals in marine fauna populations. Climate change can lead to ocean temperature increases, changes in ocean heat transfer resulting in changes to circulation patterns (e.g. upwellings), ocean acidification and melting of Antarctic sea ice. This may impact krill availability, the major food source for blue whales (DoE 2015). It is predicted that cetaceans limited to warmer areas such as pygmy blue whales will experience a southward shift in distribution as ocean temperature increases. There is evidence of these changes already occurring in	

other marine mammal species, but such changes are difficult to detect for whales due to the complexity of ecological systems and the lack of long-term records (DoE 2015). Climate change is likely to have impacts on marine turtles across their entire range and at all life stages. Climate change is expected to cause changes in dispersal patterns, food webs, species range, primary sex ratios, habitat availability, reproductive success and survivorship. Impacts will differ based on the ability of a stock to adapt to changes in suitable nesting beaches and food availability (DEE 2017a). Predicted increases in sand temperature may result in changed sex ratios or decreased hatching success. Changes to water temperature may affect ocean circulation and dispersal patterns, timing of breeding, as well as result in coral bleaching and seagrass die off, which may affect turtle foraging. Sea level rise presents a risk of nests flooding which may complicate hatchling success. The magnitude of sea level rise is expected to be greater at more southerly latitudes, particularly for WA. For seabirds in the Australian region, climatic and oceanographic variation and change has been associated with changes in distribution, success and timing of breeding, chick growth and survival of adults and immature birds, across many foraging guilds and regions. Sea level rise is also likely to reduce existing breeding habitat, particularly for burrow and surface nesting species on low-lying islands (Chambers et al. 2009). Socioeconomic impacts resulting from climate change include impacts on the functions, interests or activities of other users which rely on these ecological values, including commercial and recreational fisheries and aquaculture. There may also be impacts to cultural heritage sites and places of spiritual importance in coastal locations due to sea level rises. In summary, terrestrial, wetland and marine ecosystems are susceptible to climate change impacts associated with global GHG emissions. Impacts are likely to be highly variable; however, it is predicted temperatures will increase across Australia, rainfall patterns will change significantly and extreme events such as droughts, floods and fires will become more common (Hoegh-Guldberg et al. 2018). The nature of climate change, being a global issue with very complex global impacts, is such that it is difficult to directly link Ichthys' offshore GHG emissions with specific environmental impacts resulting from climate change, and impacts cannot be attributed to any one specific project. Additionally, the use of Ichthys gas will play a role in the overall reduction in net global GHG emissions by displacing emissions associated with more carbon intensive fossil fuels that might otherwise be used. With no direct link between Ichthys' offshore GHG emissions and climate change impacts, the contribution is considered to be Insignificant (F) in the context of existing global GHG concentrations.	
Identify existing controls	

• Installation of the emission reduction technologies on the offshore facility described in Table 3-11.
• Implement the following aspects of the Air emissions management program in accordance with Section 9.6.3 specifically:
  ○ Corporate GHG governance and targets (Table 9-14, Table 9-15 and Table 9-17)
  ○ Key emissions reduction equipment reliability management (Table 9-18)
  ○ Flaring Management Plan (Table 9-20)
  ○ Offsets (Table 9-21)
  ○ Leak detection and repair program (Table 9-22)	

◦ Energy efficiency program (Table 9-23) • Scheduled inspections and maintenance of the flare systems (flare tip integrity and ignition systems) undertaken as described in Section 9.6.7 and Table 9-27.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Remove the ability to flare	No	Flaring is required during maintenance, process upsets (including re-start following a shutdown or offline equipment/equipment trips), and emergencies, when it is required to protect the integrity of the facility and to prevent harm to personnel, environment and equipment.
	No routine flaring during normal operations (excluding during maintenance, process upsets (including re-start following a shutdown or offline equipment/equipment trips), and emergencies).	Yes	Through the implementation of the controls described in Table 3-11 (and in this table), during normal operations there will be no routine flaring offshore. The Ichthys Project has been designed to produce LNG and LPG for export. Therefore, there is commercial incentive to avoid flaring where practicable. Any gas flared represents lost revenue and is only undertaken as a safety requirement to protect people and the assets and is not used as a disposal mechanism as it may be for other offshore production operations such as oil field developments. The elimination of routine flaring by 2030 in INPEX operated projects is one of the GHG emissions reduction targets set by INPEX Corporation, which covers INPEX Australia and the Ichthys Project.
	Reduce daily production output to reduce flaring	No	When producing under normal operating conditions no flaring occurs. Reducing production rates would not result in a reduction of flaring because the facility has been designed to capture, compress and utilise gas from the process. Flaring is not used as a disposal mechanism as it may be for other offshore production operations such as oil field developments.
	Reinject surplus gas instead of flaring	No	As described above, the Ichthys Project is an LNG project therefore there is no surplus gas, as gas is the final product for export. The injection and disposal of gas via dedicated wells into a suitable geological formation is only relevant to oil field developments. Reinjection is therefore not a practicable option.

	Eliminate the use of fossil fuels for power generation on the offshore facility	No	Renewable sources of energy such as solar, wind or wave power are not considered to be reliable, proven technologies in offshore environments such as WA-50-L which is a cyclone zone. Additional space and weight restrictions on the CPF and FPSO for transformers and batteries etc make this an unpractical control with significant technical challenges.
Substitution	Implementation of offshore carbon capture and storage (CCS) options	No	CCS would be difficult to implement offshore as the equipment required to remove CO_2 from the natural gas stream or from combustion streams and then compress and transport to a suitable storage location is too large for the existing facility. It has been deemed more cost effective to investigate the use of CCS at the onshore facilities – a project that will reduce overall project emissions significantly. As shown in Figure 7-1, 48% of emissions for the Ichthys Project occur onshore, with only 14% occurring offshore. To date, INPEX has spent over $US10M on investigations and has constructed the onshore LNG Plant to enable it to be CCS-ready through completion of preliminary process design, provision of tie-ins, allowance for utilities, reserved plot space for CCS plant and equipment and reserved space in the pipeline corridor for CO_2 transport. If implemented, CCS at the onshore plant has the potential to materially reduce emissions for the overall facility. Although these emissions reductions do not occur offshore, the current work to progress this project does demonstrate INPEX's commitment to emissions reduction overall. 38% of emissions are currently estimated to be reservoir CO_2 emissions.
	Replace gas turbines on GEC systems	No	Combustion gases are emitted from the GEC and booster compression gas turbines. Ichthys' offshore gas turbines are all aero-derivative. On the CPF, these are open cycle (MPG turbines and the GEC turbines). The MPG gas turbines on the FPSO have waste heat recovery units. To achieve a higher efficiency of generation than closed-cycle aero-gas turbine would require a radical change to the design and rely on immature and less reliable technology (e.g. methane fuel cells). The current design is ALARP.
Engineering	Waste heat recovery units - CPF	No	The heat balance on the CPF does not require waste heat recovery. A retrofit to install a waste heat recovery unit on the CPF that has no clear use for the recovered energy, and with limited space and weight available is impracticable.

	Optimisation and monitoring of flare tip performance - FPSO	Yes	During a maintenance shutdown in Q2 2021, the flare tip on the FPSO was changed out to overcome vibration issues that occurred while flaring at low gas rates. This has an additional benefit in relation to light emissions from flaring as through replacement of the flare tip, flaring can occur at lower gas flow rates therefore reducing the intensity of light associated with the flare.
	Flare flame out monitoring/auto ignition controls	Yes	Flare booms have been designed to minimise the risk of flame out by having an auto-ignition sensor. The pilot ignition system is a high integrity system with automated backup from a ballistic system if required.
Procedures and administration	Methane emissions management through leak detection and repair (LDAR) including: • inspection – minimum once annually for each component on the CPF and FPSO. • leak classification using a tiered system, based on thresholds of flammable gas or flammable liquid mass. • leak response and investigation including risk assessments of weeps and seeps, corrective work orders, monitoring records and action plans.	Yes	Through the design of the offshore facility, the potential for fugitive emissions has been reduced for example by dry gas seals on compressors to minimise the escape of fugitive emissions (Table 3-12). Having a LDAR program in place allows INPEX to continually improve and reduce methane emissions and operate more efficiently. This contributes towards INPEX achieving its corporate emissions reduction goals including net zero emissions by 2050. Due to the size and complexity of equipment, and length of time required to survey the components, surveys can only be completed in a staggered manner and may be completed at separate times on the CPF and the FPSO. A frequency of once per year, per component has been selected because of the nature and scale of the facilities and the considerable man hours required to complete a full survey. Outputs from the LDAR program also provide inputs into the emissions estimation methods. The 2021 update to the National Greenhouse and Energy Reporting (Measurement) Determination allows for, but does not mandate, the use of higher order emissions estimation methods for fugitive and leak emissions estimation. This includes using the results of the LDAR program to estimate fugitive emissions if INPEX chooses to report using Method 3 emissions estimation for the offshore facilities. This decision must be made in conjunction with consideration of the other areas of the Ichthys Project facility, including the onshore LNG plant, as offshore and onshore are reported as a single facility under the NGER Scheme and choosing Method 3 for one fugitive emissions source results in Method 3 being used for all fugitive emissions sources.

			Therefore, implementation of the LDAR program allows continual improvement in emissions reduction to occur over the life of the activity. An EPO and EPS related to the LDAR program are presented in Section 9.6.3 and Table 9-22.
	Procedure to monitor flaring durations/rates during each re-start	Yes	This procedure is currently implemented onshore where re-starts are typically consistent, and performance is comparable. For the offshore facility the specific scenario for each re-start is generally different. However, this control will be implemented offshore in 2022 to gain information and compare flaring performance. Additionally, an increased understanding of the duration and rates of flaring events will also enable durations and rates (light intensity) to be minimised and subsequently reduce light emissions.
	Minimise flaring during shutdowns/re-starts through scheduling of maintenance activities	Yes	Through scheduling of maintenance shutdowns and coordination of tasks, the number of required re-starts that will result in necessary flaring are optimised to reduce loss of production and the associated generation of GHG emissions and light emissions. Through the implementation of this control, flaring is managed to ALARP, which contributes towards INPEX achieving its corporate emissions reduction goals including net zero emissions by 2050.
	Implement reliability targets for key emissions reduction equipment – FGC, OGR and VOC system • 95% for the FGC system • 90% for the OGR system • 95% for the VOC system. To remain within set targets, any trip of the FGC, OGR or the VOC will trigger a root cause analysis (RCA) investigation to be undertaken. The outcome of which will determine probable causes and a development of correction actions to be addressed. The intent of the RCA is to capture and address learnings to mitigate future trips that result in reliability issues.	Yes	The ability to meet direct emissions targets is dependent on the reliability of key emissions reduction equipment. The monthly flaring targets detailed in the FMP factor in the reliability targets for key equipment and systems related to flaring (FGC, OGR and VOC systems). As described in Table 3-11, reliability targets are defined for the FGC, OGR and VOC systems which are key, to ensure monthly and annual direct emissions targets are achieved. To set targets of 100% is unreasonable because the facility needs to plan for maintenance and repairs that require blowdown of the facility when flaring must be conducted for protection of people and the asset. As the OGR system has no redundancy, during times of planned maintenance the system will be offline, and this is reflected in the reliability target of 90%. As the FGC system (and VOC system which feeds into the FGC system) has 100% redundancy a reliability target of 95% is considered ALARP. The reliability targets are tracked by the reliability team on a monthly basis and are designed to ensure that they are reasonable and help achieve the environmental outcome of reducing overall emissions. If the actual

			reliability falls below the above targets, a reliability improvement plan is established for that piece of equipment. The initial focus of reliability improvement for flaring reduction has targeted FGC and OGR systems as these streams are considerable contributions to offshore flaring. Once reliability of those systems has improved the focus will move to the VOC system as part of continuous improvement. The implementation of reliability targets for key emissions reduction equipment contributes towards INPEX achieving its corporate emissions reduction goals including net zero emissions by 2050. An EPO and EPS related to reliability targets are presented in Section 9.6.3 and Table 9-18.
	Implement reliability targets for other emissions reduction equipment – interconnector power cable, waste heat recovery, nitrogen system	No	The installation of other emissions reduction equipment/design features described in Table 3-11, although considered to be best practice as they contribute to energy efficiency and an overall reduction in GHG emissions do not offer the same magnitude of potential emissions reduction as the key systems (FGC, OGR and VOC systems). Therefore, the administrative burden of monitoring performance and reliability for these individual systems is considered to be grossly disproportionate to the environmental benefit gained.
	Implement reliability improvement plans, when key emission reduction equipment falls below reliability targets, that: • define the problem definition and scope. • define the risk assessment and probabilistic failure likelihood. • assess potential root causes and create a corrective plan. • assign a reliability improvement owner who is fully accountable for delivering on actions with regular meetings to discuss each item and	Yes	The facility was built between 2014 and 2017 with a design life of 40 years. The performance of mechanical equipment reliability can vary over time. Therefore, reliability improvement plans are developed for problematic systems and equipment, that have demonstrated poor reliability. The implementation of reliability improvement plans contributes towards INPEX achieving its corporate emissions reduction goals including net zero emissions by 2050. An EPO and EPS related to reliability targets are presented in Section 9.6.3 and Table 9-18.

	ensure work is on track to rectify issues.		
	Implement monthly targets to report on direct GHG emissions.	Yes	Direct emissions such as flaring, fuel gas consumption and the use of diesel is forecast and tracked on a monthly basis with performance reported as part of overall GHG emissions for the Ichthys Project. Such data is not discretionary and is a function of the production rate. These direct emissions form part of the indicative GHG emissions forecast (Table 9-16). An EPO and EPS related to direct GHG emissions targets is presented in Section 9.6.3 and Table 9-17.
Identify the likelihood			
Likelihood	Although climate change impacts to features of the Australian environment cannot be directly linked to the Ichthys Project, it is certainly the case that the accumulation of GHG in the atmosphere from all global emissions sources continue to contribute to climate change. In the context of existing global GHG concentrations and with the control measures described above in place, the potential for climate change impacts to be directly attributable to Ichthys' offshore GHG emissions are considered Remote (6).		
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Remote (6) the residual risk is Low (10).		
Residual risk summary			
Consequence	Likelihood	Residual risk	
Insignificant (F)	Remote (6)	Low (10)	
Assess residual risk acceptability			
Legislative requirements Commonwealth approval (EPBC 2008/4208) was obtained to develop the Ichthys Field in the Browse Basin, comprising of the development of two natural gas and condensate reservoirs, Brewster and Plover, with approval granted for up to 50 wells across 12 – 15 drill centres. Emissions, energy consumption and energy production data will be reported annually to the Clean Energy Regulator in accordance with NGER requirements. INPEX will comply with the requirements of the NGER (Safeguard Mechanism) Rule which applies to all facilities with Scope 1 emissions of more than 100,000 tonnes of CO_2-e per year. NPI emissions data will be reported annually to the NT EPA in accordance with NPI NEPM requirements. The Paris Agreement provides the international framework and context around Australia's NDC (26-28% below 2005 levels by 2030) and the long-term aspirational goal of net zero emissions by 2050. INPEX has a corporate target of net zero emissions by 2050 and a 2030 target to decrease emissions intensity across the group by 30%. Ichthys, as the key contributor to INPEX emissions in the group is required to align with these targets. The long-term targets for INPEX are Paris aligned insofar as net zero emissions by 2050 is the decarbonisation pathway consistent with achievement of well below 2 °C temperature rise by 2100.			

In relation to the principles of ESD, specifically inter-generational equity (the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations), GHG emissions associated with Ichthys offshore operations are considered to be acceptable. This is in respect to the use of LNG in preference to more carbon intensive fossil fuels such as coal and may therefore contribute to a reduction in global GHG emissions (Commonwealth of Australia 2017). INPEX recognises the need to decarbonise as a responsible corporate citizen and consistent with the precautionary principle, a defining principle of ESD, the lack of full scientific certainty has not been used as a reason to postpone the implementation of control measures described in this EP, to prevent environmental damage with regards to the threat of serious or irreversible environmental degradation resulting from GHG emissions.

IFC Environment, Health and Safety Guidelines for Offshore Oil and Gas Development refer to the World Bank's Global Gas Flaring Reduction partnership – under which sits the Zero Routine Flaring targets. These specifically target flaring of associated gas during oil production and, as such, INPEX's operations are not in scope for the World Bank program. There is a clear commercial driver to reducing flaring for INPEX as any gas flared is gas that cannot subsequently be sold. However, the IFC guidelines do provide some generic guidance with respect to flaring that have been applied to INPEX's operations. INPEX's facilities have been designed and constructed with a view to achieving zero routine flaring. Since the start of operation, changes have been executed to key equipment (the FGC and OGR systems) to enable the achievement of zero routine flaring on an operational basis. This is in alignment with the IFC guidelines, along with other examples such as: the use of efficient flare tips and optimization of the size and number of burning nozzles; maximising flare combustion efficiency by controlling and optimizing flare fuel, air and stream flow rates to ensure the correct flow of assist stream to flare stream; minimising flaring from purges and pilots through measures including installation of purge gas reduction devices, vapor recovery units, inert purge gas, and installation of conservation pilots; minimising risk of pilot blowout by ensuring sufficient exit velocity and providing wind guards; use of a reliable pilot ignition system; metering of flare gas; and minimising liquid carryover and entrainment in the gas flare stream with a suitable liquid separation system. Therefore, the installation and operation of the flare systems on both the CPF and FPSO are in line with expectations under the IFC guidance and in line with industry standards.

Stakeholder consultation

No specific stakeholder concerns have been raised regarding potential impacts and risks associated with GHG emissions from the operation of the offshore facility in WA-50-L.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). Many of the recovery plans or conservation advices identify climate change as an emerging threat to protected species with research priorities and actions identified to obtain a greater understanding of the impacts of climate change. Other actions are predominantly focussed on Australia's international commitments regarding NDC, to reduce GHG emissions.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of emissions and no other additional controls have been identified that can reasonably be implemented.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards

<table>
<tr><td colspan="3">• the activity takes into account stakeholder feedback
• the activity is managed in a manner that is consistent with the intent of conservation management documents
• the activity does not compromise the relevant principles of ESD
• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.</td></tr>
<tr><th>Environmental performance outcome</th><th>Environmental performance standards</th><th>Measurement criteria</th></tr>
<tr><td rowspan="7">Undertake the petroleum activity in a manner such that GHG emissions are constantly monitored and managed, ensuring that appropriate actions to minimise and reduce emissions in line with 2030 and 2050 company emissions reduction targets and annual emissions targets are implemented where they are deemed to be practicable.</td><td>Use of emissions reduction technologies and equipment specifically:
• interconnector power cable
• waste heat recovery units on FPSO
• nitrogen system on FPSO</td><td>Records demonstrate use of
• interconnector power cable
• waste heat recovery units
• nitrogen system</td></tr>
<tr><td>No routine flaring during normal operations*
*excluding during maintenance, process upsets (including re-start following a shutdown or offline equipment/equipment trips), and emergencies.</td><td>Records of flaring</td></tr>
<tr><td>Continued monitoring of flare tip performance</td><td>Maintenance records</td></tr>
<tr><td>Use of flare flame out monitoring and auto ignition controls</td><td>Records of flaring</td></tr>
<tr><td>Implementation of offshore flaring performance procedure following re-start.</td><td>Records of flaring performance procedure</td></tr>
<tr><td>Scheduling of maintenance tasks to minimise the required number of re-starts and associated flaring</td><td>Shutdown plans and schedule</td></tr>
<tr><td colspan="2">Refer Table 9-15 (monitoring and reporting) and Table 9-17 (GHG emissions targets)</td></tr>
</table>

Atmospheric emissions – offshore facility

The offshore facility will produce atmospheric emissions when operating. The primary source of combustion emissions from the facility (CPF and FPSO) during normal operations will be from the exhaust stacks for the power generation gas-turbine-driven generators, CPF gas export compression generators and the FPSO's gas-fired generators. These stacks are elevated above the upper deck levels to allow for rapid dispersion in the offshore location. Other routine combustion emissions from the facility will occur from the continuously lit HP/LP flare pilot lights on the CPF and FPSO, and other diesel-powered sundry equipment and electrical generators (e.g. crane engines).

The main constituents of such combustion emissions include nitrogen oxides (NO_X), carbon dioxide (CO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and some volatile organic compounds (VOCs) and particulate matter. Trace amounts of hydrogen sulfide (H_2S) and elemental mercury may also occur from the combustion of fuel gas, although removal of H_2S and mercury in the CPF and FPSO fuel gas systems will have reduced concentrations in the exhaust emissions to low levels (~0.1 ppm(v) H_2S, and <50 ppb(wt) elemental mercury).

Atmospheric emissions will also be generated by flaring on the CPF/FPSO. The offshore facility has been designed with no routine flaring as an overarching design philosophy. Routine flaring is defined as flaring during normal operations and not flaring as a result of emergency situations or upset conditions on the CPF and FPSO or for shutdown and re-start processes. Flaring volumes from the CPF and FPSO will vary depending on a number of factors, and annual flaring volumes are forecast based on known work activities such as planned maintenance programs and forecast reliability of equipment and systems. Historical atmospheric emissions generated from fuel combustion and flaring on the offshore facility are presented in Table 3-8 and Table 3-9 respectively.

Table 7-3 and Table 7-4 define the control measures, environmental performance outcomes and standards and measurement criteria relating to atmospheric emissions from the offshore facility and vessels associated with the petroleum activity in WA-50-L respectively.

Table 7-3: Impact and risk evaluation – atmospheric emissions from the offshore facility

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Atmospheric emissions generated on the offshore facility in WA-50-L have the potential to result in localised changes in air quality and subsequent exposure of marine avifauna to air pollutants. Combustion of fuel for power generation and flaring of hydrocarbon gases is the largest source of emissions from the offshore facility. Smoke and particulates will be generated on a temporary basis due to incomplete combustion when flaring during upset conditions or during re-starts following a shutdown.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by atmospheric emissions are:
• marine avifauna.
The only sensitive receptors identified in the airshed are marine avifauna. As described in Section 4.9.4, WA-50-L 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 that overlap WA-50-L and the closest Ramsar site is approximately at 155 km away at Ashmore Reef (Section 4.6.1). Since 2017 when the CPF and FPSO arrived there have been no reports from the workforce of unusual behaviour/large numbers of migrating birds. A large number of BIAs for many marine avifauna species are present within the region (Figure 4-8) the closest of which relate to foraging around Ashmore Reef and Cartier Island, Adele Island and Scott Reef. While not an identified BIA the closest habitat for seabirds is Browse Island (33 km away). Previous surveys have reported a lack of diversity of seabirds breeding there (Clarke 2010) and colonies of nesting crested terns (>1,000 birds) have been observed (Olsen et al. 2018).
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 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). Modelling results also reported mercury concentrations of concern were not detected beyond the CPF and FPSO themselves (RPS APASA 2014). Therefore, changes in air quality are expected to be localised.
A review of the human health and environmental effects of the various air pollutants, as described in the National Pollutant Inventory, indicates that short-term exposures to significant concentrations of pollutants such as CO, NO_X, SO_2, VOCs, and fine particles, could cause symptoms such as irritation to eyes and respiratory tissues, breathing difficulties, and nausea (Manisalidis et al. 2020). Flaring associated with re-starts following maintenance shutdowns or upset conditions will result in the temporary generation of dark smoke until normal operations have resumed. Given the distance from land and population centres no impacts on visual amenity are expected.
Limited literature has been published on the vulnerability of avian species to air pollutants. The avian respiratory system, unlike the mammalian respiratory system, is characterised by unidirectional airflow and cross-current gas exchange, features that improve the</td><td>Insignificant (F)</td></tr>
</table>

efficiency of respiration. Therefore, birds are more likely to be susceptible to high concentrations of reactive gases, aerosols and particles in the air than mammals; and are considered to be useful indicators of air quality (Sanderfoot & Holloway 2017). Exposure to air pollutants may cause respiratory distress in birds, increasing their susceptibility to respiratory infection and may impair the avian immune response (Sanderfoot & Holloway 2017). As a worst case, it is conservatively assumed that a small number of individual marine avifauna may develop some short-term symptoms if they remain in the immediate vicinity of an emissions source where the pollutants are most concentrated. However, rapid recovery is expected after individuals move away from the source and any symptoms are not expected to occur. Chronic exposures are not considered plausible given that marine avifauna would move away (i.e. continue migration or undertake foraging activities elsewhere), and the considerable distance to the closest BIAs for birds. Overall, the consequence of temporary, localised changes in air quality that may result in short-term, sublethal effects to a small number of transient marine avifauna individuals is considered Insignificant (F).			
Identify existing controls			
• The CPF and FPSO will comply with the air emission requirements of Marine Order 97 (as applicable to vessel and engine size, type and class). • The CPF and FSPO will comply with ODS requirements of Marine Order 97. • All controls adopted to mitigate GHG emissions described in Table 7-2.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Remove the ability to flare	No	Flaring of gas is necessary to provide a mechanism for the disposal of surplus gas to ensure safe operations and avoid potential health, safety and environmental impacts.
	Reinject surplus gas instead of flaring	No	As described above, the Ichthys Project is an LNG project therefore there is no surplus gas, as gas is the final product for export. The injection and disposal of gas via dedicated wells into a suitable geological formation is only relevant to oil field developments. Reinjection is therefore not a practicable option.
	Eliminate the use of fossil fuels for power generation on the offshore facility	No	Renewable sources of energy such as solar, wind or wave power are not considered to be reliable, proven technologies in offshore environments such as WA-50-L which is a cyclone zone. Additional space and weight restrictions on the CPF and FPSO for transformers and batteries etc make this an unpractical control with significant technical challenges.
Substitution	Replace gas turbines on GEC systems	No	Combustion gases are emitted from the GEC and booster compression gas turbines. Ichthys' offshore gas turbines are all aero-derivative. On the

			CPF, these are open cycle (MPG turbines and the GEC turbines). The MPG gas turbines on the FPSO have waste heat recovery units. To achieve a higher efficiency of generation than closed-cycle aero-gas turbines would require a radical change to the design and rely on immature and less reliable technology (e.g. methane fuel cells). The current design is ALARP and considered to contribute to reducing atmospheric emissions.
Engineering	Waste heat recovery units - CPF	No	The heat balance on the CPF does not require waste heat recovery. A retrofit to install a waste heat recovery unit on the CPF that has no clear use for the recovered energy, and with limited space and weight available is impracticable.
Procedures and administration	Implement a dark smoke assessment process to log occurrences of the event	No	It is recognised that dark smoke may be generated during re-starts following shutdowns. The environmental impacts to receptors (marine avifauna) of such smoke emissions including particulates are insignificant (F) but it is acknowledged that smoke may cause visual amenity impacts and community concern. The closest town site is 400 km away on the mainland and so the facility, or any dark smoke generated, is not visible. Nearby oil and gas facilities and other marine users such as vessels may be able to see the smoke for the short duration of the flaring event but are not expected to be impacted given the remote location. It is not reasonable or necessary to implement a procedural log in a remote offshore environment with no densely populated areas or community concerns raised.
	Reliability targets for other emissions reduction equipment – interconnector power cable, waste heat recovery, nitrogen system	No	The installation of other emissions reduction equipment/design features described in Table 3-11, although considered to be best practice as they contribute to energy efficiency and an overall reduction in atmospheric emissions; they do not offer the same magnitude of potential emissions reduction as the key systems (FGC, OGR and VOC systems). Therefore, the administrative burden of monitoring performance and reliability for these individual systems is considered to be grossly disproportionate to the environmental benefit gained.

Identify the likelihood	
Likelihood	The likelihood of marine avifauna approaching and/or resting on emissions stacks and exhaust vents during operations and remaining close enough to be exposed to concentrations that result in symptoms such as irritation of eyes and respiratory tissues, breathing difficulties,

	and nausea is unlikely. Marine avifauna that may pass near the facility are unlikely to be in such close proximity to the emissions sources, and of those that may approach close enough, they are likely to pass by before any discernible symptoms of exposure develop. 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 overlap WA-50-L with the closest Ramsar site located 155 km away. Given the presence of alternative resting/foraging habitat (Browse Island) and with the control measures described above in place, the potential for changes to air quality and associated impacts to marine avifauna are reduced. Therefore, the likelihood of the described consequences to marine avifauna occurring is considered Unlikely (4).	
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).	
Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		

Legislative requirements

The activities and proposed management measures are compliant with industry standards, relevant international conventions and Australian legislation, specifically AMSA Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, the POTS Act and MARPOL, Annex VI.

Commonwealth approval (EPBC 2008/4208) was obtained to develop the Ichthys Field in the Browse Basin, comprising of the development of two natural gas and condensate reservoirs, Brewster and Plover, with approval granted for up to 50 wells across 12 – 15 drill centres.

Emissions, energy consumption and energy production data will be reported annually to the Clean Energy Regulator in accordance with NGER requirements. INPEX will comply with the requirements of the NGER (Safeguard Mechanism) Rule which applies to all facilities with Scope 1 emissions of more than 100,000 tonnes of CO_2-e per year. NPI emissions data will be reported annually to the NT EPA in accordance with NPI NEPM requirements. The Paris Agreement provides the international framework and context around Australia's NDC (26-28% below 2005 levels by 2030) and long-term aspirational goal of net zero emissions by 2050. INPEX has a corporate target of net zero emissions by 2050 and a 2030 target to decrease emissions intensity across the group by 30%. Ichthys, as the key contributor to INPEX emissions in the group is required to align with these targets. The long-term targets for INPEX are Paris aligned insofar as net zero emissions by 2050 is the decarbonisation pathway consistent with achievement of well below 2 ^{o}C temperature rise by 2100.

IFC Environment, Health and Safety Guidelines for Offshore Oil and Gas Development refer to the World Bank's Global Gas Flaring Reduction partnership – under which sits the Zero Routine Flaring targets. INPEX's facilities have been designed and constructed with a view to achieving zero routine flaring. Since the start of operation, changes have been executed to key equipment (the flash gas and off gas compressors) to enable the achievement of zero routine flaring on an operational basis. This is in alignment with the IFC guidelines, along with other examples such as: the use of efficient flare tips and optimization of the size and number of burning nozzles; maximising flare combustion efficiency by controlling and optimizing flare fuel, air and stream flow rates to ensure the correct flow of assist stream to flare stream; minimising flaring from purges and pilots through measures including installation of purge gas reduction devices, vapor recovery units, inert purge gas, and installation of conservation pilots; minimising risk of pilot blowout by ensuring

sufficient exit velocity and providing wind guards; use of a reliable pilot ignition system; metering of flare gas; and minimising liquid carryover and entrainment in the gas flare stream with a suitable liquid separation system. Therefore, the installation and operation of the flare systems on both the CPF and FPSO are in line with expectations under the IFC guidance and in line with industry standards. The impacts from atmospheric emissions generated on the offshore facility are acceptable and consistent with the principles of ESD as impacts to receptors within the airshed are insignificant (F) and the precautionary principle has been applied with respect to implementing controls; despite uncertainty around impact thresholds for marine avifauna given the absence of air quality standards or guidelines and the use of human health air quality standards as a proxy. Stakeholder consultation No specific stakeholder concerns have been raised regarding potential impacts and risks associated with atmospheric emissions generated on the offshore facility. Conservation management plans / threat abatement plans Several conservation management plans have been considered in the development of this EP (refer Appendix B), none of the recovery plans or conservation advices have specific threats or actions relating to atmospheric emissions. Although as described in Table 7-2 many of the recovery plans or conservation advices identify climate change as an emerging threat to protected species with research priorities and actions identified to obtain a greater understanding of the impacts of climate change. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	Environmental performance standards	Measurement criteria

Undertake the petroleum activity in a manner such that air quality impacts are localised and do not result in injury/harm to marine avifauna.	Annual verification audits undertaken by a registered organisation confirm that the CPF and FPSO meet the requirements of Marine Order 97, (as applicable to the vessel, engine/propulsion size, type and class), including NO_X and ODS.	EIAPP certificate (or statement of compliance) IAPP certificate (or statement of compliance) ODS record book (if relevant)
	Fuel oil and marine diesel with 0.5% m/m sulfur content will be used.	INPEX fuel specification records confirm that fuel provided to the facility and vessels has 0.5% m/m sulfur content.

Atmospheric emissions – vessels

Table 7-4: Impact and risk evaluation – atmospheric emissions from vessels

Identify hazards and threats	
Routine combustion emissions produced by the vessels are expected to occur from routine power generation engine exhausts and from the incineration of waste on board from time to time, though the scale of emissions from vessels is expected to be significantly less than the emissions from the offshore facility. Atmospheric emissions generated by vessels associated with the petroleum activity in WA-50-L have the potential to result in localised changes in air quality and subsequent exposure of marine avifauna to air pollutants including CO, NO_X, SO_2, VOCs, and particulates. A range of vessels will be used during the activity ranging from large HLVs that may typically consume up to 50 m^3 of fuel per day, to smaller PSVs that typically consume up to 15 m^3 of fuel per day. In general, with the exception of the OSV, vessels are only present in WA-50-L on a temporary, short-term basis. PSVs complete the re-supply and return back to port and vessels associated with IMR are only in WA-50-L for the duration of the IMR activity.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by atmospheric emissions are: • marine avifauna. As described in Section 4.9.4, WA-50-L 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 that overlap WA-50-L and the closest RAMSAR site is approximately at 155 km away at Ashmore Reef. A large number of BIAs for many marine avifauna species are present within the region (Figure 4-8) the closest of which relate to foraging around Ashmore Reef and Cartier Island, Adele Island and Scott Reef. While not an identified BIA the closest habitat for seabirds is Browse Island (33 km away). Previous surveys have reported a lack of diversity of seabirds breeding there (Clarke 2010) and colonies of nesting crested terns (>1,000 birds) have been observed (Olsen et al. 2018). 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 and potential impacts to marine avifauna. The outcome of such assessments typically undertaken for offshore facilities rather than vessels operating offshore have 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). As these modelled predictions are based on operating facilities with significantly larger sources of emissions including combustion engines and flaring, it can be assumed vessels operating offshore will have a much smaller field of effect with respect to potential impacts on receptors within the airshed. This indicates that changes in air quality are expected to be highly localised and limited to the immediate vicinity of the emissions release with atmospheric emissions from vessels in WA-50-L quickly dispersed into the surrounding atmosphere.	Insignificant (F)

A review of the human health and environmental effects of the various air pollutants, as described in the National Pollutant Inventory, indicates that short-term exposures to significant concentrations of pollutants such as CO, NOX, SO2, VOCs, and fine particles, could cause symptoms such as irritation to eyes and respiratory tissues, breathing difficulties, and nausea (Manisalidis et al. 2020). Limited literature has been published on the vulnerability of avian species to air pollutants. The avian respiratory system, unlike the mammalian respiratory system, is characterised by unidirectional airflow and cross-current gas exchange, features that improve the efficiency of respiration. Therefore, birds are more likely to be susceptible to high concentrations of reactive gases, aerosols and particles in the air than mammals; and are considered to be useful indicators of air quality (Sanderfoot & Holloway 2017). Exposure to air pollutants may cause respiratory distress in birds, increasing their susceptibility to respiratory infection and may impair the avian immune response (Sanderfoot & Holloway 2017). As a worst case, it is conservatively assumed that a small number of individual marine avifauna may develop some short-term symptoms if they remain in the immediate vicinity of an emissions source where the pollutants are most concentrated. However, rapid recovery is expected after individuals move away from the source and any symptoms are not expected to occur. Chronic exposures are not considered plausible given that marine avifauna would move away (i.e. continue migration or undertake foraging activities elsewhere), and the considerable distance to the closest BIAs for birds. Overall, the consequence of temporary, localised changes in air quality that may result in short-term, sublethal effects to a small number of transient marine avifauna individuals is considered Insignificant (F).	

Identify existing controls

- ASVs and vessels will comply with the air emission requirements of Marine Order 97 (as applicable to vessel and engine size, type and class)
- ASVs and vessels waste incineration practices will comply with the requirements of Marine Order 97
- ASVs and vessels (as applicable to vessel and engine size, type and class) will comply with ODS requirements of Marine Order 97
- ASVs and vessels (as applicable to vessel, engine/propulsion size, type and class) will comply with energy efficiency requirements of Marine Order 97

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	No incineration of waste	No	Cost associated with transporting waste to shore for landfill and/or incineration outweighs onboard incineration. Health implications for storage of waste onboard, exposure to pathogens etc
Substitution	Replace any ODS systems	No	In accordance with MARPOL Regulation 12, no CFC or halon containing system or equipment is permitted to be installed on ships constructed on or after 19 May 2005 and no new installation of the same is permitted on or after that date on existing ships. Similarly, no HCFC containing system or equipment is permitted to be installed on ships constructed on or after 1 January 2020 and no new installation of the same is permitted on or after that date on existing ships.

			Therefore, only older vessels are considered to potentially have ODS systems installed as confirmed on the IAPP certificate. The costs to retrofit ODS equipment and replace systems are not considered to be warranted given they are being phased out in accordance with MARPOL and it may restrict vessel selection and availability in the short term.
Engineering	None identified	N/A	N/A
Procedures and administration	Preventative maintenance system	Yes	ASV/vessel contractors have a preventative maintenance system in place to ensure diesel powered, power generation equipment is maintained.

Identify the likelihood	
Likelihood	The likelihood of marine avifauna approaching and/or resting on vessels in close proximity to emissions sources/exhaust vents and remaining close enough to be exposed to concentrations of air pollutants that result in symptoms such respiratory failure or impaired immune response is considered Highly Unlikely (5). Although marine avifauna may pass near vessels, they are unlikely to remain close enough for discernible symptoms of exposure develop. It is considered likely that they would move away from any emissions source if they began to experience discomfort. No marine avifauna BIAs or critical habitats overlap WA-50-L. Given the presence of alternative resting/foraging habitat (Browse Island) and with the control measures described above in place, the potential for changes to localised air quality and associated impacts to marine avifauna are reduced. Therefore, the likelihood of the described consequences to marine avifauna occurring is considered Highly Unlikely (5).
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Highly Unlikely (5) the residual risk is Low (10).

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

Assess residual risk acceptability

Legislative requirements

The activities and proposed management measures are compliant with industry standards, relevant international conventions and Australian legislation, specifically AMSA Marine Order 97: Marine Pollution Prevention – Air Pollution, the POTS Act, the *Navigation Act 2012*, and MARPOL, Annex VI.

Emissions, energy consumption and energy production data will be reported annually to the Clean Energy Regulator in accordance with NGER requirements. INPEX will comply with the requirements of the National Greenhouse and Energy Reporting (Safeguard mechanism) Rule 2015 which applies to all facilities with Scope 1 emissions of more than 100,000 tonnes of CO_2-e per year. NPI emissions data will be reported annually to the NT EPA in accordance with NPI NEPM requirements.

Stakeholder consultation

No specific stakeholder concerns have been raised regarding potential impacts and risks associated with atmospheric emissions from vessels in Commonwealth waters.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B), none of the recovery plans or conservation advices have specific threats or actions relating to atmospheric emissions.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standards	Measurement criteria
Planned emissions and discharges from vessels undertaking the petroleum activity are in accordance with MARPOL requirements and industry good practice.	Vessels annual verification audits undertaken by a registered organisation confirm that marine diesel engines on board ASVs and vessels >400 GT meet the requirements of Marine Order 97, (as applicable to the vessel, engine/propulsion size, type and class).	EIAPP certificate IAPP certificate Bunker delivery notes IMO type approval for waste incinerators where installed IEE certificate Ship Energy Efficiency Management Plan
	Fuel oil and marine diesel with 0.5% m/m sulfur content will be used.	INPEX fuel specification records confirm that fuel provided to the facility and vessels has 0.5% m/m sulfur content

	Where present equipment or systems on board ASVs or vessels >400 GT which contain ODS will be recorded and managed in accordance with MARPOL, Annex VI, Regulation 12 (as appropriate to vessel size, type and class.	ODS Record book
	ASVs and vessels have a preventative maintenance system to ensure diesel powered, power generation equipment is maintained.	Preventative maintenance system records

7.1.2 Light

Flaring from the CPF and FPSO will give rise to light emissions. Table 7-5 defines the control measures, environmental performance outcomes and standards and measurement criteria relating to light emissions.

As described for previously (Table 3-11; Section 7.1.1), reliable performance of the FGC and OGR systems is essential to enable routine flaring from the offshore facility to be eliminated. Based on the actual performance of the FGC and OGR systems and in conjunction with publication of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (2020), a new information assessment was conducted in 2020 to confirm that impacts from flaring with respect to light emissions were still ALARP and acceptable. This information has been incorporated into Table 7-5 and reassessed during this EP 5-year revision to ensure that all knowledge accrued since 2019, when normal operations commenced, has been used to support the impact and risk evaluation process.

Light emissions associated with navigational lights from the offshore facility and vessels have the potential to increase ambient light levels and the impacts and risks are evaluated in Table 7-6.

Table 7-5: Impact and risk evaluation – changing light levels from flaring

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Marine turtles and marine avifauna can be particularly sensitive to light emissions. Light emissions associated with flaring at night have the potential to expose light sensitive marine fauna to changes in ambient light levels that could result in behavioural changes. Flares will be permanently lit with a limited amount of pilot gas on the CPF and FPSO, to retain the ability to safely release combustion and hydrocarbon gases in the event of upset conditions or during shutdowns/re-starts following maintenance. This is required to protect the integrity of the facility and to prevent harm to personnel, the environment and equipment.

As described in Section 3, during normal operations, the offshore facility is designed for no routine flaring and has a number emission reduction technologies (Table 3-11). Since July 2019, when normal operations commenced, the actual performance of the FGC and OGR systems, which eliminate the need for routine flaring on the offshore facility, has been inconsistent and has resulted in periods of continuous flaring (for > 72 hours) in WA-50-L. Flaring on a continuous basis e.g. during upset conditions and re-starts following shutdowns, may potentially result in light emissions that are detectable at Browse Island (33 km from the facility) the nearest BIA for marine turtles (green turtle internesting buffer extending 20 km around Browse Island (DEE 2017a)).</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by light emissions from flaring at night are:
• marine turtles (including the green turtle BIA at Browse Island)
• marine avifauna.

Shell (2009) estimated that light from flaring activities can be detected as far as 51 km from the source. Similarly, an assessment by Woodside (2014) for the Browse FLNG development reported that the maximum distance at which flaring under routine operational conditions was detectable was 47.9 km. However, in the event of emergency flaring, Woodside's assessment reported that light may be visible up to ten kilometres further than during normal operating conditions but that any such emergency flaring would be of a short-term duration.

The potential effect of direct light from a flare tip is mitigated by the reduction in intensity of light, which diminishes with the square of the distance (i.e. light is reduced to one-hundredth of the initial intensity after 10 m, one ten thousandth after 100 m, etc.) and by the spectral range of the emitted light. Gas flares emit measurable light energy over the whole range of visible and near infrared wavelengths, with peak intensities in the spectral range from 750 to 900 nanometers (Hick 1995), while the most disruptive wavelengths to turtles are reported to be in the range of 300 to 600 nm (Tuxbury & Salmon 2005; Witherington 1992; DEE 2020). Therefore, the glow that may be visible from flaring light emissions is primarily of the wrong spectral range to cause any disturbance to marine turtles.

Behavioural changes reported in marine turtles exposed to increases in artificial lighting can include disorientation and interference during nesting (Pendoley 2005; DEE 2020). Disorientation may 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). Turtle hatchlings primarily use light cues to orient to water but may also use other secondary cues such as beach slope (DEE 2020), once in the water they generally maintain seaward headings by using wave propagation direction as an orientation cue (Lohmann & Fittinghoff-Lohmann 1992). Adult turtles</td><td>Insignificant (F)</td></tr>
</table>

undertaking internesting, migration, mating or foraging activities do not use light cues to guide these behaviours and there is no evidence, published or anecdotal, to suggest that internesting, mating, foraging or migrating turtles are impacted by light emissions (Woodside 2020). The closest known turtle nesting BIA to WA-50-L is at Browse Island, over 33 km from the offshore facility, with a 20 km internesting buffer surrounding the island for green turtles (DEE 2017a). Light emissions from flaring on the offshore facility (CPF/FPSO) may be visible at Browse Island and within the 20 km internesting buffer during the night. Light emissions associated with flaring are not expected to affect the behaviour of the adult marine turtle population in this area particularly as green turtles are attracted to light of wavelength <600 nm (DEE 2020), which is less than the spectral range of light intensity associated with flaring. Turtle hatchlings are most sensitive to light emissions as they generally emerge at night and rely on brightness cues to locate the ocean by heading towards the brighter oceanic horizon (DEE 2020). Therefore, any sources of artificial light on land can result in misorientation whereby turtles move in the wrong direction. Given the light emissions from flaring on the CPF/FPSO are generated offshore, if visible from Browse Island they would not cause any impacts to turtle hatchlings making their way towards the ocean. Once in the ocean, hatchlings rely on wave direction for orientation. The offshore light emissions associated with flaring in WA-50-L is not expected to have a discernible effect on adult turtles or hatchlings and the potential for light from flaring to attract marine turtles once they are at sea is not expected with an inconsequential ecological significance (Insignificant F). It is stated in the Recovery Plan for Marine Turtles in Australia (DEE 2017a) that 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 noise levels and vessel strike. In considering cumulative impacts of threats on small or vulnerable stocks of marine turtles, it is possible that light emissions may act as contributor to a stock level decline. As described in Section 4.9.4, WA-50-L 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). Artificial light can attract and disorient seabirds, disrupt foraging and potentially cause injury and/or death through collision with infrastructure (DEE 2020). Nocturnal birds are at much higher risk of impact (Wiese et al. 2001; DEE 2020); however, there are no threatened nocturnal migratory seabirds that use the EEA Flyway (DEWHA 2010). Marine avifauna are highly, visually orientated and where bird collision incidents have been reported by industry, low visibility weather conditions (cloudy, overcast and foggy nights) are usually implicated as the major contributing factor and there are seldom collision incidents on clear nights (Wiese et al. 2001). Conditions in WA-50-L are not conducive to fog formation with most rainfall associated with the monsoon season between December and March which is outside the periods of bird migration (Bamford et al. 2008). Where there is important habitat for seabirds within 20 km of a project, the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020) recommends that consideration be given as to whether light is likely to have an effect on those birds. There are no known BIAs for marine avifauna that overlap WA-50-L and the closest RAMSAR site is approximately at 155 km away at Ashmore Reef where light emissions from flaring in WA-50-L will not be visible. The closest habitat for seabirds is Browse Island (33 km away). Previous surveys have reported a lack of diversity of seabirds breeding there (Clarke 2010) and colonies of nesting crested terns (>1,000 birds) have been observed (Olsen et al. 2018). Light emissions from flaring on the CPF/FPSO	

could be visible at Browse Island resulting in possible attraction of seabirds to the flares on the facility but as Browse Island is not considered to be a regionally significant habitat for seabirds and is not a BIA any impacts are expected to be on an individual basis with no effect on population levels and is therefore considered to be of inconsequential ecological significance (Insignificant F). Migratory shorebirds travelling the EAA Flyway may fly over the licence 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 be attracted to flares on the CPF/FPSO and use the facilities for resting therefore potentially causing disorientation to flying birds, disruption to foraging activities or affect stopover selection (DEE 2020). Where there is important habitat for migratory shorebirds within 20 km of a project, the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020) recommends that consideration be given as to whether light is likely to have an effect on those birds. In the case of Ichthys operations in WA-50-L, minimal deviation from migratory pathways and limited potential for behavioural disruption (foraging and stop over site selection) can be expected given the presence of alternative habitat for resting and foraging at Browse Island and Ashmore Reef/Cartier Island. Any impact to migratory shorebirds from light emissions associated with flaring is considered to be of inconsequential ecological significance (Insignificant F).	

Identify existing controls

- Controls for flaring as described in Table 7-2, specifically:
  - no routine flaring during normal operations (excluding during maintenance, process upsets (including re-start following a shutdown or offline equipment/equipment trips), and emergencies).
  - optimisation and monitoring of flare tip performance
  - implementation of procedure to monitor offshore flaring durations/rates during each re-start
  - scheduling of maintenance shutdowns to minimise the required number of re-starts and associated flaring
- Implement the following aspects of the Air emissions management program in relation to flaring (Section 9.6.3) specifically:
  - Key emissions reduction equipment reliability management (Table 9-18)
  - Flaring Management Plan (Table 9-20)
- Scheduled inspections and maintenance of the flare systems (flare tip integrity and ignition systems) undertaken as described in Section 9.6.7 and Table 9-27.

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	Remove the ability to flare.	No	Flaring is required during maintenance, process upsets (including re-start following a shutdown or offline equipment/equipment trips), and emergencies, when it is required to protect the integrity of the facility and to prevent harm to personnel, environment and equipment.

	Reinject surplus gas instead of flaring	No	The Ichthys Project is an LNG project, therefore there is no surplus gas, as gas is the final product for export. The injection and disposal of gas via dedicated wells into a suitable geological formation is only relevant to oil field developments.
Substitution	Exclude flaring during key sensitive periods for marine turtles and avifauna.	No	The ability to flare is required year-round 24/7 to ensure the safety of workers and the environment and cannot be eliminated for particular periods during the year. The consequences of impacts to marine fauna from flaring have been assessed as insignificant.
	Vent non-combusted hydrocarbon gases as an alternative to flaring	No	Gas that requires to be disposed offshore during re-starts, upset or emergency conditions could be disposed by venting offshore rather than flaring. However, this is considered to have a higher environmental impact than flaring with respect to GHG emissions.
Engineering	None identified	N/A	N/A
Procedures and administration	Minimise night-time flaring on the offshore facility	No	The ability to flare is required year-round 24/7 to ensure the safety of workers and the environment and cannot be restricted to only daylight hours. The consequences of impacts from flaring have been assessed as insignificant (F).
	Measure light levels at Browse Island	No	It may be possible to measure the light impact at Browse Island in order to determine the actual light spill; however, this control is not considered reasonable given the high cost, difficultly of access at Browse Island and that it does not reduce an already insignificant impact.
	Implementation of a seabird management plan to prevent seabird landings on the offshore facility (CPF and FPSO) due to attraction from flaring light emissions.	No	A seabird management plan to prevent seabird landings on offshore facilities and to help manage birds appropriately is recommended in seabird foraging areas during breeding season (DEE 2020). However, as shown in Figure 4-8, WA-50-L does not overlap any foraging areas and the closest areas are situated around Ashmore Reef/Cartier Island to the north, Adele Island to the south and Scott Reef to the west. Therefore, this control will not result in a reduction of impact or risk, as the consequence is already insignificant (F) and is ALARP.
	Implementation of a light management plan to prevent impacts to marine turtles from	No	The effect of light emissions resulting in disruption to turtle orientation and behaviour has been observed from up to 18 km away (DEE 2020) and the National Light Pollution Guidelines for Wildlife Including Marine

	light emissions from flaring on the offshore facility (CPF and FPSO).		Turtles, Seabirds and Migratory Shorebirds (DEE 2020) recommends that a 20 km buffer for assessment of impacts be considered around important habitat for turtles. The outer boundary of WA-50-L is approximately 13 km from the outer edge of the Browse Island 20 km internesting buffer at its closest point, with the offshore facility (CPF and FPSO) located 33 to 35 km away from Browse Island itself. Therefore, although light from flares on the facility may be visible to turtles in the BIA, research has indicated that turtles generally stay within 10 km of their nesting beaches. Therefore, this control will not result in a reduction of impact or risk, as the consequence is already insignificant (F) and is ALARP.

Identify the likelihood	
Likelihood	During upset conditions or following periods of shut down for planned maintenance, the duration of flaring events will primarily be governed by the time it takes to stabilise the CPF and FPSO processing trains. Upset or emergency conditions, resulting in some flaring activities, are anticipated to occasionally occur during normal operations. As conditions that require flaring cannot always be predicted, the precautionary principle has been applied and during the life of this EP (5 years) and it is considered that flaring events may at night occur during turtle nesting periods (November to April) or when marine avifauna are transiting the area. Light emissions may be visible at Browse Island; however, impacts to adult and hatchling turtles and marine avifauna are considered Highly Unlikely (5). This is supported by the fact that during periods of continuous flaring (> 72 hours) that have occurred since normal operations commenced in July 2019 there have been no flaring related avifauna deaths (or any other significant fauna events reported).
Residual risk	Based upon a consequence of Insignificant (F) and likelihood of Highly Unlikely (5) the residual risk is Low (10).

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

Assess residual risk acceptability
Legislative requirements The National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds, published in 2020 (DEE 2020), has been used to ensure that the activities covered by this EP align with the guideline (see below conservation management plans/threat abatement plans). Stakeholder consultation During stakeholder consultation, the WA DBCA recommended that INPEX refer to the Commonwealth Department of Agriculture, Water and the Environment's *National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds* as a best-practice industry standard for managing potential impacts of light pollution on marine fauna. The guidelines have been used to ensure that the activities covered by this EP

align with the outcomes and recommendations outlined in the guidelines. There were no other stakeholder concerns raised regarding potential impacts and risks from light emissions due to flaring in WA-50-L.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). The National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020), states that "natural darkness has a conservation value in the same way that clean water, air and soil has intrinsic value" and that artificial light has the potential to stall the recovery of a threatened species. The activities covered by this EP align with the guideline.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. Flaring activities cannot be eliminated entirely as they are required to prevent emergency events and avoid health and safety risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria
Flaring activities are managed in a manner that minimises potential lighting impacts to marine avifauna and turtles.	No routine flaring during normal operations* *excluding during maintenance, process upsets (including re-start following a shutdown or offline equipment/equipment trips), and emergencies.	Records of flaring
	Continued monitoring of flare tip performance	Maintenance records
	Implementation of offshore flaring performance procedure following re-start.	Records of flaring performance procedure
	Scheduling of maintenance tasks to minimise the required number of re-starts and associated flaring	Shutdown plans and schedule

Refer Section 9.6.3 and Section 9.6.7.

Table 7-6: Impact and risk evaluation - change in ambient light levels from navigational lighting on the facility and vessels

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Light emissions associated with facility and vessel lighting (for navigational and safe working condition requirements) in WA-50-L have the potential to expose light sensitive marine fauna, particularly marine turtles, seabirds and migratory birds, to changes in ambient light levels that could lead to behavioural changes.
Low-intensity light spill will be generated from the offshore facility and support vessels as a consequence of providing safe illumination of work and accommodation areas. Additional lighting will be required periodically for the safe loading and unloading of support vessels and export tankers, to minimise the potential for safety and environmental hazards.
Unless specifically required to support over the side activities (e.g. lifting or IMR activities) or for navigational purposes, lighting on the FPSO, CPF and support vessels is directed over the work area, which aids in limiting light spill to the marine environment. During IMR activities, underwater lighting may be generated over short periods of time while ROVs are in use.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by facility and vessel lighting are:
• marine turtles (including the green turtle BIA at Browse Island)
• marine avifauna
• planktonic communities
• fish communities.
Behavioural changes reported in marine turtles exposed to increases in artificial lighting can include disorientation and interference during nesting (Pendoley 2005; DEE 2020). 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). The effect of light emissions resulting in disruption to turtle orientation and behaviour has been observed from up to 18 km away (DEE 2020) and the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020) recommends that a 20 km buffer for assessment of impacts be considered around important habitat for turtles. Browse Island (listed as a C-class reserve) is the closest turtle nesting area (located approximately 33 km south east of WA-50-L) and is surrounded by a 20 km internesting buffer for green turtles between November and March (DEE 2017a) as described in Section 4.9.4.
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). Although light emissions from the offshore facility and associated vessels may be visible within the internesting buffer at Browse Island, significant exposure or changes in ambient light levels are not expected to affect the behaviour of the adult turtle population in this internesting area as adult turtles undertaking internesting, migration, mating or foraging activities do not use light cues to guide these behaviours (Woodside 2020). This assessment was confirmed by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2008) through the formal environmental assessment process, indicating that the risk of light spill adversely impacting any listed threatened</td><td>Insignificant (F)</td></tr>
</table>

species is low. The offshore light emissions generated from facility and vessel lighting is not expected to have a discernible effect on adult turtles' or hatchlings' abilities to orientate to water at Browse Island and the potential for light from the facility or vessels to attract marine turtles once they are at sea is not expected with an inconsequential ecological significance (Insignificant F). It is stated in the Recovery Plan for Marine Turtles in Australia (DEE 2017a) that 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 noise levels and vessel strike. In considering cumulative impacts of threats on small or vulnerable stocks of marine turtles, it is possible that light emissions may act as contributor to a stock level decline. As described in Section 4.9.4, WA-50-L 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). Lighting from offshore facilities and vessels has been found to attract seabirds, particularly those that are nocturnally active (BirdLife International 2012). Artificial light can disorient seabirds, disrupt foraging and potentially cause injury and/or death through collision with infrastructure (DEE 2020). Fledgling seabirds may also become grounded as a result of attraction to offshore vessel lighting (Rodríguez et al. 2017). Nocturnal birds are at much higher risk of impact (Wiese et al. 2001; DEE 2020); 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 et al. (2008) 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. Where there is important habitat for seabirds within 20 km of a project, the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020) recommends that consideration be given as to whether light is likely to have an effect on those birds. There are no BIAs for marine avifauna that overlap WA-50-L and the closest RAMSAR site is approximately at 155 km away at Ashmore Reef and therefore will not be affected by light spill from the offshore facility or vessels in WA-50-L. While not an identified BIA, the closest habitat for seabirds from the licence area is Browse Island (33 km). 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). Migratory shorebirds travelling the EAA Flyway may fly over the licence 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 the offshore facility or associated vessels to rest. However, the possibility of this occurring in WA-50-L is considered low due to the presence of alternative habitat for resting and foraging at Browse Island and Ashmore Reef/Cartier Island. Where there is important habitat for migratory shorebirds within 20 km of a project, the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory	

Shorebirds (DEE 2020) recommends that consideration be given as to whether light is likely to have an effect on those birds. In the case of Ichthys operations in WA-50-L, the closest habitat is at Browse Island located 33 km away therefore minimal deviation from migratory pathways and limited potential for behavioural disruption can be expected. Therefore, any impact to seabirds or migratory birds from light emissions associated with facility and vessel lighting is considered to be of inconsequential ecological significance (Insignificant F).

Planktonic and fish communities may be attracted to sources of underwater light or light spill at the sea surface from topsides/decks (Meekan et al. 2001). Any species attracted to light spill can be considered a food source for larger marine predatory species such as tuna (Shaw et al. 2002). However, any increased levels of predation are not expected to reduce the abundance of plankton or fish populations in WA-50-L or the wider region given the short-term nature of any lifting/IMR activities. Therefore, any impacts are considered to be localised and of inconsequential ecological significance (Insignificant F).

Identify existing controls

Vessel and facility personnel will receive an induction/training to inform them of the requirements to minimise external artificial lighting in accordance with Table 9-3.

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	Do not use lighting at night-time.	No	Lighting is required for navigational and safety purposes and cannot be eliminated. This is in accordance with the *Navigation Act 2012* and associated Marine Orders (which are consistent with COLREGS requirements). Unnecessary outdoor/deck lighting is already eliminated.
Substitution	Exclude offshore lighting during key sensitive periods for marine turtles and avifauna.	No	In general, bird migrations occur over six months of the year: between March and May (northward) and between August and November (southward) (Bamford et al., 2008). Green turtle internesting at Browse Island occurs between November to March (DEE 2017a). Lighting of offshore facilities and vessels is required year-round to ensure the safety of workers and the environment and cannot be eliminated for certain periods during the year.
Engineering	Reduce light intensity and/or frequencies which may attract turtles.	No	Lighting will be designed in accordance with the relevant Australian and international standards to ensure that worker and vessel/facility safety is not compromised. The deployment of low-pressure sodium vapour lamps or other technologies which reduce/eliminate frequencies which have been

			shown to attract turtles would not result in any significant benefit regarding turtle hatchling attraction from the nesting beaches on Browse Island, given the distance to Browse Island (33 km) and wave-front orientation cues (rather than light cues) of hatchlings once they are in the ocean.
	Light shielding	No	The deployment of light shielding on the facility and vessels to reduce light spill would not result in any significant benefit regarding turtle hatchling attraction from the nesting beaches on Browse Island, given the distance to Browse Island (33 km) and wave-front orientation cues (rather than light cues) of hatchlings once they are in the ocean.
Procedures and administration	Limit the duration and frequency of planned night-time-based vessel activities such as IMR during key sensitive periods for marine turtles and avifauna.	No	All IMR vessels/activities associated with the petroleum activity only work in the operational area (WA-50-L). IMR vessels operate on a 24/7 basis and IMR activities use ROVs for inspection and maintenance work including deploying and recovering infrastructure between seabed and deck, and therefore require safe levels of lighting on decks. The majority of IMR activities will be undertaken on the SPS at the drill centres. As shown in Figure 1-1, these locations are to the north/north-west of Browse Island and therefore further away from the internesting buffer. Vessels supporting the CPF and FPSO also must have an ability to operate 24/7, as operation and maintenance onboard the facilities occurs on a 24/7 basis, and vessels are responsive to the facility needs. While certain activities may be precluded (based on risk assessment) from occurring at night-time, a large number of routine planned operations can still safety occur at night. Stopping night-time vessel activities would have significant consequences to the safe and efficient operation of CPF and FPSO. The consequence of light impacts for all identified receptors at all times of the year has been assessed as Insignificant (F). Given artificial light sources in proximity to the operational area, such as the offshore facility permanently located in WA-50-L and the lighthouse on Browse Island (Section 4.4.3), external vessel lighting during routine night-time activities will not result in additional light impacts. In general, routine IMR activities are relatively short in duration (5 – 60 days; Section 3.5). The addition of this control does not reduce the risk or impact, which is

			already insignificant, and given the potential for negative operational consequences it has not been adopted.
	Premobilisation review and planning of vessel lighting to be undertaken prior to IMR activities commencing.	No	Vessels will maintain the minimum navigational and deck lighting to provide safe working conditions. The consequence of light impacts for all identified receptors at all times of the year has been assessed as Insignificant (F). Given artificial light sources in proximity to the operational area, such as the offshore facility permanently located in WA-50-L and the lighthouse on Browse Island (Section 4.4.3), external vessel lighting will not result in additional light impacts. The addition of this control does not reduce the risk or impact, which is already insignificant, and given the potential for negative operational consequences it has not been adopted.
	Implementation of a seabird management plan to prevent seabird landings on vessels or the offshore facility (CPF and FPSO) due to attraction from artificial lighting.	No	A seabird management plan to prevent seabird landings on vessels and to help manage birds appropriately is a recommendation for vessels working in seabird foraging areas during breeding season (DEE 2020). However, as shown in Figure 4-8, WA-50-L does not overlap any foraging areas and the closest areas are situated around Ashmore Reef/Cartier Island to the north, Adele Island to the south and Scott Reef to the west. There have been no reported issues with seabirds interacting with the facilities in WA-50-l since their arrival in 2017. The addition of this control does not reduce the risk or impact, which is already insignificant, and given the absence of marine avifauna impacts since 2017 is not considered to be warranted.
	Implementation of a light management plan to prevent impacts to marine turtles from artificial lighting on vessels or the offshore facility (CPF and FPSO).	No	The effect of light emissions resulting in disruption to turtle orientation and behaviour has been observed from up to 18 km away (DEE 2020). The outer boundary of WA-50-L is approximately 13 km from the outer edge of the Browse Island 20 km internesting buffer at its closest point, with the majority of Ichthys infrastructure located 33 to 50 km away from Browse Island itself. Therefore, although light from the facility and vessels may be visible to turtles in the BIA, research has indicated that turtles generally stay within 10 km of their nesting beaches and are therefore not expected to be impacted by facility or vessel lighting. The addition of this control is unlikely to reduce the already insignificant risk and it has therefore not been selected.

<table>
<tr><td></td><td></td><td></td><td>Vessels (IMR and routine supply) transiting between the offshore facility in WA-50-L and Darwin/Broome typically remain >25 km from Browse Island (Table 3-6). However, exact vessel routes will be influenced by sea state conditions. Vessels would only be expected to enter the BIA for short durations (12-48 hours) in order to shelter e.g. from cyclones. During such times, vessel lighting would be kept to only that required for safety and navigational purposes.</td></tr>
<tr><td colspan="4">Identify the likelihood</td></tr>
<tr><td>Likelihood</td><td colspan="3">Although light may potentially be visible, given the distance from WA-50-L to the closest turtle nesting beaches (approximately 33 km to Browse Island) impacts to turtles from navigational light emissions is Highly Unlikely (5). While impacts to seabirds from lighting of offshore platforms and vessels have been reported in the industry, given the presence of alternative resting/foraging habitat (Browse Island) and that there are several other permanently moored offshore installations in the vicinity of WA-50-L, 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 offshore facility and vessels is considered Highly Unlikely (5).</td></tr>
<tr><td>Residual risk</td><td colspan="3">Based upon a consequence of Insignificant (F) and likelihood of Highly Unlikely (5) the residual risk is Low (10).</td></tr>
<tr><td colspan="4">Residual risk summary</td></tr>
<tr><td>Consequence</td><td>Likelihood</td><td colspan="2">Residual risk</td></tr>
<tr><td>Insignificant (F)</td><td>Highly Unlikely (5)</td><td colspan="2">Low (10)</td></tr>
<tr><td colspan="4">Assess residual risk acceptability</td></tr>
<tr><td colspan="4">Legislative requirements

Navigational lighting is required under the Navigation Act 2012 (which is consistent with COLREGS requirements) for the safe operation of facilities and vessels. The facility has been designed to meet Australian and international standards for safety purposes, including the requirements of the Navigation Act 2012. The National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds, published in 2020 (DEE 2020), has been used to ensure that the activities covered by this EP align with the guideline (see below conservation management plans/threat abatement plans).

Stakeholder consultation

During stakeholder consultation, the WA DBCA recommended that INPEX refer to the Commonwealth Department of Agriculture, Water and the Environment's National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds as a best-practice industry standard for managing potential impacts of light pollution on marine fauna. The guidelines have been used to ensure that the activities covered by this EP align with the outcomes and recommendations outlined in the guidelines. In addition, AMSA identified that lighting of vessels should be consistent</td></tr>
</table>

with the requirements of the COLREGS requirements. As noted above all vessels are required to comply with the *Navigation Act 2012*, and associated Marine Orders, which are consistent with the COLREGS requirements. There were no other stakeholder concerns raised regarding potential impacts and risks from light emissions due to facility and vessel lighting. Conservation management plans / threat abatement plans Several conservation management plans have been considered in the development of this EP (refer Appendix B). The National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds was published in 2020 (DEE 2020), states that "natural darkness has a conservation value in the same way that clean water, air and soil has intrinsic value" and that artificial light has the potential to stall the recovery of a threatened species. The activities covered by this EP align with the guideline. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls have been identified that can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the risk of impacts is acceptable because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcomes	Environmental performance standards	Measurement criteria
Refer to Table 9-3		

7.1.3 Routine discharges

Operation of the FPSO, CPF, subsea infrastructure and supporting vessels will give rise to liquid discharges, as summarised in Table 3-7. These can be split into the following waste streams:

- subsea discharges (originating from subsea infrastructure)
- liquid effluent discharges (originating from the CPF, FPSO and supporting vessels).

Subsea discharges

Indicative subsea discharges during operations and IMR activities are listed in Table 7-7 and the impact and risk evaluation is included as Table 7-8.

The SPS uses an open-loop (vent-to-sea) hydraulic system to provide the motive force to actuate subsea asset valves and chokes. Operation and maintenance of subsea open-loop valves will result in minor discharges of subsea control fluids, such as hydraulic fluids and MEG. The main properties required of subsea control fluids are low viscosity, corrosion protection, resistance to bacterial attack and biodegradability. The majority of subsea control fluids are based on fresh water with additives, such as MEG, lubricants, wax and corrosion inhibitors, and surfactants.

Pigging of the GEP in WA-50-L is planned in the life of this EP and will result in releases of MEG and possible seepages of well fluids (gas) from valves. MEG is used to flush liquids from the PLR to avoid introducing liquids in the GEP which could present a GEP integrity issue.

IMR activities such as the replacement of flow control modules, intrusive subsea intervention, MEG flowline repair and riser replacement will result in subsea discharges. Discharge depth will vary depending on the IMR activity for example during riser replacement discharges are expected to occur from either approximately 10–50 m below the sea surface or from a release point approximately 2.5-20 m above sea level. Other discharges such as those released during replacement of flow control modules or MEG flowline repair will be from approximately 2.5 m above the seabed (Table 7-7).

MEG will be used to flush infrastructure, flow control modules or PLRs before recovery. MEG discharges during maintenance and repair activities may contain trace amounts of residual hydrocarbons; however, quantities of hydrocarbons lost will be greatly reduced by flushing components with MEG prior to change outs and are, therefore, considered to be negligible. These activities are expected to be irregular and infrequent.

In an unplanned event e.g. a major repair to a MEG flowline, MEG containing trace hydrocarbons would be discharged to sea. Following the repair recommissioning discharges of MEG will occur and depending on the required residence time of the flooding medium, UV treated seawater or FIS may be used. Fluorescein dye may also be added to aid in leak detection at approximately 80 ppm.

Table 7-7: Indicative subsea discharges during operations and IMR activities

Subsea discharge	Environmental interaction	Maximum volumes (indicative only)	Expected discharge location
Operation:	Release of subsea hydraulic fluid.	3 m^3 per week	Subsea

Subsea discharge	Environmental interaction	Maximum volumes (indicative only)	Expected discharge location
Actuation of subsea valves across all xmas trees, manifolds and control modules.	Note: The hydraulic control fluid is a water–glycol mixture containing additives to protect against wear, corrosion and bacterial degradation, with a fluorescein dye to facilitate leak detection.		
Planned IMR: Launching PIG into the GEP within WA-50 L and recovering the PLR.	Release of MEG, potentially containing trace hydrocarbons.	125 m^3 per activity – Non-continuous/ Infrequent.	Subsea
Unplanned IMR: Leakage of well fluids and MEG past isolation barriers (i.e. closed valves) during intrusive subsea intervention. Leakage of gas past isolation barriers (i.e. closed valves) during planned GEP pigging operations.	Release of well fluids and MEG	Based on industry standard maximum allowable leakage values for in service underwater safety valves Well fluids (gas) – 60 sm^3 per day MEG/condensate – 0.58 m^3 per day Non-continuous/ Infrequent	Subsea
Unplanned IMR: Marine growth / lime-scale removal, if required before undertaking subsea equipment maintenance.	Release of weak acetic acid/sulfamic acid.	<10 m^3 per activity. Non-continuous/ Infrequent.	Subsea
Unplanned IMR: Replacing flow control modules and installation.	Release of MEG, potentially containing trace hydrocarbons.	7–10 m^3 per activity. Non-continuous/ unplanned.	Subsea
Unplanned IMR: MEG flowline repair	Release of MEG, potentially containing trace hydrocarbons.	520 m^3 per activity. Non-continuous/ unplanned.	Subsea

Subsea discharge	Environmental interaction	Maximum volumes (indicative only)	Expected discharge location
	Release of FIS, potentially containing trace hydrocarbons. (may include fluorescein dye ~ 80 ppm)	520 m^3 per activity. Non-continuous/ unplanned.	Subsea
IMR: Riser replacement.	Release of MEG, potentially containing trace hydrocarbons.	88 m^3 per activity. Non-continuous/ unplanned.	Topsides/ subsea
	Release of FIS, potentially containing trace hydrocarbons.	600 m^3 per activity. Non-continuous/ unplanned.	Topsides/ subsea

Table 7-8: Impact and risk evaluation – subsea discharges during operations and IMR activities

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Subsea discharges to the marine environment during operations and IMR activities within WA-50-L may result in a change in ambient water quality potentially impacting transient, EPBC-listed species, fish and benthic communities. The range of subsea discharges may include:
• planned subsea hydraulic fluid from operation of the SPS in the order of approximately 3 m^3 per week
• planned MEG discharges during GEP pigging operations up to approximately 125 m^3 per activity
• gas leakages from valves during planned GEP pigging operations in the order of approximately 60 sm^3 per day
• unplanned well fluid and MEG leakages from valves during intrusive subsea intervention in the order of approximately 60 sm^3 (gas) and 0.58 m^3 (MEG/condensate) per day
• unplanned IMR discharges of weak acid (acetic acid/sulfamic acid) used for marine growth/lime-scale removal approximately <10 m^3 per activity
• unplanned MEG discharges from replacement of flow control modules approximately 7–10 m^3
• unplanned MEG discharges that may contain residual hydrocarbons from MEG flowline or riser replacement ranging from approximately 88 m^3 to 520 m^3 discharged, either subsea or topsides
• unplanned FIS discharges during MEG flowline repair or riser replacement ranging from approximately 520 m^3 to 600 m^3
• leak detection/fluid displacement fluorescein dye approximately 80 ppm.
The majority of subsea control fluids are based on fresh water with additives, such as MEG, lubricants, wax and corrosion inhibitors, and surfactants. In some instances, MEG and FIS discharges may contain residual hydrocarbons. The predominant discharge from subsea infrastructure is MEG, which has a higher density than seawater and therefore will not rise in the water column and combine with discharges released at, or near, the sea surface, particularly given the approximate 250 m water depth in WA-50-L.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by subsea discharges are:
• EPBC-listed species (marine fauna)
• fish (demersal fish communities and commercial species)
• benthic communities.
Subsea discharges could introduce hydrocarbons and hazardous substances into the water column, albeit in low concentrations and in the majority of cases the chemicals are classified as ‘pose little or no risk to the environment’ (PLONOR). However, this could result in a reduction in water quality, and impacts to transient, EPBC-listed species; other pelagic organisms such as fish species (demersal fish community KEF or those species targeted by commercial fisheries) and benthic communities given many of the discharges may occur at or near the seabed.</td><td>Insignificant (F)</td></tr>
</table>

The predominant discharge from subsea infrastructure is MEG, which has a higher density than seawater and therefore will not rise in the water column and combine with discharges released at, or near, the sea surface, particularly given the approximate 250 m water depth. MEG is considered as PLONOR by OSPAR (2012). Well fluids and MEG seepages may occur from valves during IMR activities such as intrusive subsea interventions that may result in the subsea release of gas and MEG/condensate close to the seabed, these volumes are expected to be rapidly dissolved and/or entrained into the water column. Fluorescein dye is non-toxic at the concentrations to be used (approximately 80 ppm in the FIS). During discharge, the dye may cause temporary localised discoloration in the immediate vicinity of the release point; however, as the dye is water soluble, it will rapidly disperse in the marine environment. Discharges of FIS are likely to have depleted oxygen concentrations due to the presence of oxygen scavenger and will contain residual biocide and a non-toxic fluorescein dye used for leak detection. The active chemical components of the oxygen scavenger and biocide are sodium bisulfite (45%) and glutaraldehyde (24%), respectively. Sodium bisulfate is rated as PLONOR by OSPAR (2012) and glutaraldehyde and fluorescein both have a CHARM rating of Gold. In reacting with oxygen in pipe, sodium bisulfite converts to sodium bisulfate, a weak acid. This will cause a reduction in pH of the FIS by approximately 0.5 to 1 unit, resulting in a pH of approximately 7.4. The stability of glutaraldehyde is known to be enhanced in neutral or acidic conditions; however, degradation of glutaraldehyde will continue to occur in the presence of sodium bisulfate. The purpose of adding oxygen scavenger (sodium bisulfite) is to cause anaerobic conditions to develop in the pipeline and hence limit microbial growth. Anaerobic metabolism of glutaraldehyde will result in its biodegradation and, as concentrations decrease, the toxicity will also decrease over time. Biodegradation of glutaraldehyde in anaerobic conditions is expected to occur relatively quickly with approximately 70% degraded in 100 days (McIlwaine 2002) and will result primarily in the formation of 1,5-pentanediol which is non-toxic (Leung 2000). Therefore, the toxicity of the FIS at the time of discharge is expected to be negligible due to the oxygen scavenger having been consumed and the formation of 1,5-pentanediol from the degradation of glutaraldehyde. Potential exposure of transient, EPBC-listed species to subsea discharges including FIS, MEG, well fluids, hydraulic control fluids, fluorescein dye and weak acids from marine growth/lime-scale removal is expected to be localised to the point of release, in WA-50-L, and will disperse through natural physical oceanic processes, such as currents, tides and waves. In the absence of any known BIAs for marine fauna in the licence area, any individuals present are likely to be transiting the area for a short duration. Individual turtles associated with the 20 km green turtle internesting buffer surrounding Browse Island (the closest BIA) are not expected to be present in the vicinity of the discharges given the water depth of approximately 250 m. Similarly, whale sharks present in the foraging BIA approximately 15 km south east of WA-50-L are not expected to be exposed to any subsea discharges. Considering the low volumes and low levels of associated toxicity of the subsea discharges in the dispersive open environment of the licence area, impacts are considered to be of inconsequential ecological significance to transient, EPBC listed species and are therefore considered Insignificant (F). There is the potential for individual fishes, directly adjacent to any discharge points to be exposed to the subsea discharges. Juvenile fish and larvae may experience increased toxicity upon such exposure to such discharges particularly hydrocarbons, because of the sensitivity of these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018). Adult fish exposed to	

entrained hydrocarbons are likely to metabolise them 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). Exposure to subsea discharges is not expected to result in any significant impacts to fishes based on the 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 and any species targeted by commercial fisheries will be short-term and highly localised with inconsequential ecological significance (Insignificant F). Seabed surveys in the licence area indicate benthic habitats are limited to flat and featureless soft substrate areas, typical of deep continental shelf seabed and are widely distributed in the deeper parts of the Browse Basin (RPS 2007). As described in Section 4.8.3, seabed conditions in WA-50-L 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. Subsea discharges are expected to be highly influenced by natural dispersion and dilution processes associated with the currents experienced in the offshore environment. Potential impacts on benthic communities may include lethal and sub-lethal effects; however, impacts are expected to be limited both spatial and temporally due to the low volume and high dilution levels. Therefore, the consequence of the exposure of benthic communities to subsea discharges would be at a local scale with a temporary impact and is ranked as Insignificant (F). As presented in Table 7-7, the discharges are generally of relatively small volumes resulting in temporary plumes with a local scale of potential impact, noting that the largest volumes are generally associated with unplanned IMR activities and so may not occur over the life of this EP. Distances between the drill centres in WA-50-L (the location of many subsea discharges) range from 3.6 km at the closest to over 18 km apart. Given the dispersive environment in WA-50-L and expected high level of dilution, any exposure is expected to be limited to within the immediate vicinity of the individual discharges. Therefore, plumes associated with the subsea discharges are not be expected to overlap. Seabed conditions within the licence area are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. Given the limited toxicity and small volumes any temporary discharge plumes are not expected to overlap resulting in cumulative impacts to pelagic organisms or other submerged receptors from multiple subsea discharges.	

Identify existing controls

- INPEX chemical, assessment and approval procedure for selection of control fluids in accordance with Section 9.6.1 and Table 9-5.
- Subsea flow components will be purged with MEG, to remove residual hydrocarbons before being disconnected
- Subsea Integrity Monitoring and Management Plan
- Subsea Inspection Management System (COABIS)

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification

Elimination	No subsea discharges to be released to the marine environment.	No	During operations and IMR activities it is not possible to eliminate all subsea discharges. Function and pressure testing of key subsea equipment is required to ensure safe and effective operation of the SPS. Hydraulic fluid (water-based) discharges are inherent for the use of subsea equipment e.g. ROVs. There are no practicable ways to eliminate these small volume discharges (< 1 m^3).
	Recover subsea control fluids to the CPF for reuse.	No	The use of return lines offers no discernible technical benefits, and possible technical disadvantages, for only marginal environmental benefit. Therefore, implementing this control is grossly disproportionate to the level of risk reduction achieved for an already inconsequential impact.
Substitution	Use seawater or fresh water as an alternative to FIS during IMR activities.	No	Due to the naturally corrosive nature of seawater, any exposure or contact with the internal walls of the flowlines will cause damage, potentially leading to future integrity problems; therefore, FIS containing a biocide is needed to prevent bacterial growth and subsequent corrosion damage. For short residence times, UV treated FIS may be used in preference to biocide.
	Use a different subsea control fluid.	No	The SPS material selection and hydraulic performance has been confirmed based on a specific control fluid and any changes to this fluid will result in the need for significant re-evaluation and potential modification of the subsea infrastructure. Based on the chemical composition (water/glycol based) the majority of subsea discharges are considered to PLONOR when discharged to the marine environment.
Engineering	FIS discharge water sampling.	No	Volumes of FIS to be discharged present limited environmental impacts (maximum volume 600 m^3); therefore, water sampling to enable chemical characterisation of the FIS discharge, and validate the environmental impact assessment, is not deemed necessary.
Procedures and administration	None identified	N/A	N/A

Identify the likelihood	
Likelihood	Impacts to the EPBC-listed marine fauna, fish and benthic communities in the vicinity of the subsea discharges are not expected to occur and are considered Highly Unlikely (5). This is largely due to the water depth, absence of any known BIAs for mobile, transient EPBC listed species in the licence area and the low toxicity and low volumes of the discharged fluids. The open-ocean, highly dispersive environment in the licence area will also result in high levels of dilution further reducing the likelihood of exposure to the identified receptors.

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

Legislative requirements

Open-loop control valves are widely used in the industry and subsea discharges to the marine environment are considered to be standard practice. There are no relevant Australian environmental legislative requirements that relate specifically to the discharge of subsea control fluids. All chemicals to be discharged subsea have been selected because they present an acceptable environmental hazard using the INPEX *Chemical Assessment and Approval Procedure.*

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from subsea discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B) and chemical discharge has been listed as a threat for marine turtles (DEE 2017a). Actions relating to chemical discharge involve the minimisation of discharges and adherence to best practice guidelines. The management of subsea discharges is consistent with the intent of the actions identified in the conservation management plan.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standards	Measurement criteria
Limit planned discharges from IMR activities so that impacts to water quality will be localised.	Subsea flow components will be purged (100% of volume) with MEG, to remove residual hydrocarbons before being disconnected/replaced.	Documentation from conditioning procedures confirm subsea flow components have been purged with MEG before being disconnected/replaced.
	Subsea integrity inspections of the subsea production system implemented in accordance with the Subsea Integrity Maintenance Management Plan (SIMMP), specifically the frequency specified in risk-based inspection schedule.	Risk-based inspection schedule records confirm subsea production system inspections conducted in accordance with the risk-based inspection schedule specified in the SIMMP.
	Conduct maintenance of the subsea production system in accordance with the findings of the subsea Inspection Management System.	SAP records confirm maintenance of the subsea production system was conducted in accordance with the subsea Inspection Management System.

Liquid effluent discharges

Overview

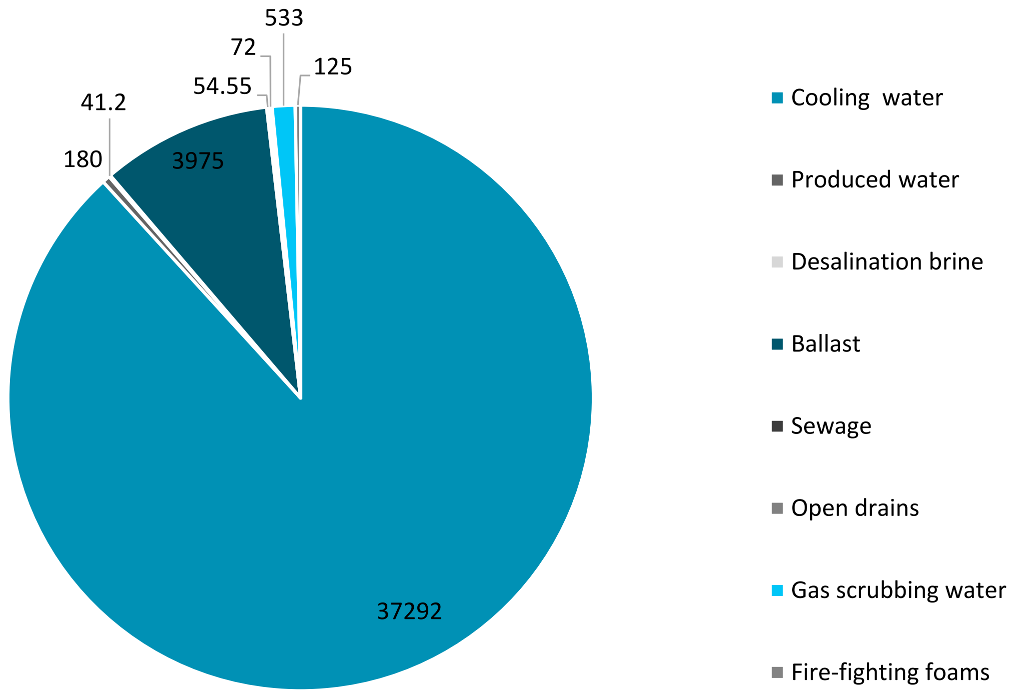
Liquid effluent discharges will arise from the CPF, FPSO, ASVs and support vessels. The CPF and FPSO are permanently moored approximately 4 km apart. During periods of intense activity such as maintenance shutdowns, ASVs may be connected to the offshore facility. Therefore, during these periods any discharge streams from the CPF/FPSO and respective ASV may interact due to their proximity; however, this will be influenced by the discharge depth. A range of other vessels will also support the petroleum activity in WA-50-L, such as PSVs and an OSV that will discharge small, localised sources of liquid effluent.

The main sources of liquid effluent discharge and worst-case maximum discharge flow rates from the petroleum activity have been identified (assuming the equipment is working at full capacity which is unlikely to be sustained on a continuous basis) and a high-level overview is presented in Figure 7-5.

As shown in Figure 7-5 the primary liquid effluent discharge is cooling water representing 88% of the total combined discharge from the CPF, FPSO, ASV and support vessels. The bulk of the cooling water discharge comes from the CPF and FPSO (86%). Ballast water discharges represent the next largest discharge, primarily from the FPSO in order to maintain stability during condensate offloading. However, it should be noted that ballast water discharges are intermittent in nature, and the figures presented reflect the maximum discharge rates for all ballast pumps operating at full capacity which is considered to be an unlikely event. All other streams are minor (<1%). Firefighting foam is only discharged in the event of a fire or through infrequent deluge testing. Cooling water (CW) produced water (PW) and desalination brine are produced continuously, while other all streams are discharged on an intermittent basis. Based on the continuous discharges, CW comprises 99.4%, PW 0.5% and desalination brine 0.1%.

Discharges such as CW, ballast, brine, sewage and drainage are routinely discharged to sea during offshore operations in the oil & gas industry and are regulated through standard management practices, such as compliance with MARPOL. Of all the effluents, the most unique stream is the FPSO PW discharge due to the influence of the specific characteristics and geology of each reservoir. The FPSO discharge is representative of the majority of all liquid effluent discharge streams.

The liquid effluent discharge streams from the CPF, FPSO and vessels (including ASVs) have been fully assessed in the remainder of this section. The potential for interactions and cumulative impacts from multiple liquid effluent discharges is then also assessed.



Stream	**Volume (m^3/h)**	**%**	**Frequency**	**CPF**	**FPSO**	**ASV**	**PSV**	**Total**
				% of each stream				
Cooling water	37292	88.2	C	54	32	3	11	100
Produced water	180	0.4	C	0	100	0	0	100
Desalination brine	41.2	0.1	C	19	0	51	30	100
Ballast	3975	9.4	I	14	86	0	0	100
Sewage	54.55	0.1	I	44	44	10	2	100
Open drains	72	0.2	I	29	69	1	1	100
Gas scrubbing water	533	1.3	I	0	100	0	0	100
Fire-fighting foams	125	0.3	I	29	69	2	0	100
Total	42273	100						

Figure 7-4: Liquid effluent discharge overview

CPF

The CPF is equipped with a range of systems to meet processing requirements. Liquid effluents discharged to the marine environment from the CPF systems include streams from three disposal caissons:

- Seawater dump caisson
  - cooling water
  - ballast
  - desalination brine.
- Sewage disposal caisson
  - sewage, grey water and food waste.
- Open-drains caisson
  - oily water from deck drainage and bilge
  - firefighting foam system.

In addition, the four CPF HVAC systems discharge condensed water directly from each caisson leg.

A summary of the worst-case individual liquid effluent streams discharged from the CPF is provided in Table 7-9. An impact and risk evaluation has been undertaken for each individual liquid effluent stream in the following section. Potential interactions between discharged liquid effluent streams and cumulative impacts to the identified values and sensitivities have then been assessed (*Potential interaction between CPF liquid effluent discharge streams*) to provide an overall indication of the environmental impacts associated with CPF discharges.

Table 7-9: Summary of worst-case liquid effluent discharge streams from the CPF

CPF discharge caisson	Liquid effluent stream	Impact and risk evaluation reference	Potential constituents of concern	Approximate maximum discharge rate	Discharge depth below sea surface
Seawater dump caisson	Cooling water	Table 7-10	Temperature (45° C) Residual NaClO	20,000 m^3 per hour Continuous flow	26 m
	Ballast	Table 7-11	Residual NaClO	575 m^3 per hour Intermittent flow	26 m
	Desalination brine	Table 7-12	Increased salinity	7.7 m^3 per hour Continuous flow	26 m
Sewage disposal caisson	Sewage, grey water and food waste	Table 7-13	Introduction of nutrients	24 m^3 per hour Intermittent flow	12 m
Open-drains caisson	Open drains	Table 7-14	Hydrocarbons, lubricants, cleaning fluids	20 m^3 per hour Intermittent flow	10 m
			AR-AFFF and FFFP firefighting foams (containing organic and fluoro-surfactants)	36 m^3 AR-AFFF concentrate and 2 m^3 FFFP concentrate maximum total volume per application during emergency / test event	10 m

CPF discharge caisson	Liquid effluent stream	Impact and risk evaluation reference	Potential constituents of concern	Approximate maximum discharge rate	Discharge depth below sea surface
				Intermittent flow	
Caisson leg (x 4)	HVAC condensed water	Table 7-14	Increased copper	1.5 m^3 per hour – intermittent flow	Sea surface

Summary of CPF liquid discharge sampling and analysis

In accordance with the Liquid Effluent Management Plan (LEMP) described in Section 9.6.2, sampling and analysis of the seawater dump caisson and open drains caisson has been implemented since start-up of the CPF (2018). Representative samples from the seawater dump caisson have been collected and analysed from the cooling water stream, as samples cannot be obtained from the ballast or desalination brine streams. Sample results have reported residual chlorine concentrations in the cooling water prior to discharge (average free chlorine concentration of 0.7 ppm). Reported metal and metalloid concentrations have been similar to those of the broader Browse Basin with the exception of copper and nickel. Elevated copper and nickel concentrations have routinely been reported and following investigation likely due to the ongoing corrosion of the coarse seawater filters, which are a copper nickel alloy (i.e. Monel). This elevated copper and nickel is also likely driving the measured toxicity of the cooling water stream, which has typically remained low and within mixing zone dilution requirements (i.e. 99% species protection is being achieved at edge of mixing zone).

Samples collected and analysed from the open drains caisson have routinely reported total recoverable hydrocarbon (TRH) concentrations between 5 mg/L and 12 mg/L. Polycyclic aromatic hydrocarbons (e.g. naphthalene and phenanthrene) as well as BTEX have also been routinely reported as well as other organics such as phenols. A range of metals have also been reported in samples from the open drains caisson as well as elevated nutrient concentrations (i.e. total nitrogen and phosphorus), which could be expected given the open drains captures liquid spills, washdown and contaminated run-off on the CPF topsides, as well as operational and maintenance drainage of systems that either do not contain hydrocarbons or systems which have been flushed and/or purged and may contain residual hydrocarbons. Given the presence of organics (e.g. TRH, PAH, BTEX, phenols) and inorganics (e.g. metals and nutrients) in the open drains caisson, toxicity results (as dilution requirements) have been much higher compared to the seawater dump caisson. However, toxicity levels have remained well within mixing zone dilution requirements for the stream.

Table 7-10: Impact and risk evaluation – CPF cooling water discharges

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Cooling water discharges from the CPF have the potential to result in maximum continuous discharge volumes in the order of 20,000 m³/h. The facility has been designed so that cooling water discharges do not exceed 45 °C. Modelling of the thermal plume for the worst-case, highest discharge rate from the CPF was undertaken. The modelling study estimated the dilution and cooling of the thermal discharge based on a maximum discharge of 20,000 m³/h and temperature of 45 °C released at a depth of 26 m below the sea surface (APASA 2011, 2016). The outcome of the modelling indicated that near-field processes of turbulence and entrainment of ambient water should limit the temperature of the discharge plume to no more than 1.6 °C above ambient seawater temperature at 100 m from the discharge point and return to ambient levels within a maximum of 400 m from the point of discharge (APASA 2016). Upon discharge, the plume is forecasted to remain positively buoyant and rise towards the surface once downward momentum is lost. Therefore, additional cooling, due to heat loss to the atmosphere (not considered in the modelling), is expected to result in the actual temperature elevation being less than that predicted.

As detailed in Section 3, the CPF cooling water system is treated continuously with sodium hypochlorite (NaClO), generated through an electrolysis reaction in the biofouling control package. The CPF biofouling control package is designed to dose at a concentration of approximately 3.0 ppm, with shock dosing of approximately 5.0 ppm, for approximately 15 minutes every six hours. These dosing rates will result in an anticipated 24-hour rolling average concentration of 3.1 ppm to 3.5 ppm. The NaClO biocide was selected as the biofouling control option based on it being considered as an established and efficient technology for use in offshore environments and is used throughout the world (Khalanski 2002; Grandison 2012; Anasco 2008; Verween 2009).

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, highlighted 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 (CBP) 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 cooling water is negligible at discharge and unlikely to require further dilution. However, thermal effects may still present an issue, as noted, but will be no more than 1.6 °C above ambient water temperatures within 100 m and return to ambient levels within a maximum of 400 m from the point of discharge (equating to approximately 60 dilutions; APASA 2016) and is, therefore, the remaining focus of the impact evaluation.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Particular values and sensitivities with the potential to be impacted are:
• transient, EPBC-listed species</td><td>Insignificant (F)</td></tr>
</table>

• planktonic communities. Modelling outputs indicate that near-field processes should limit the temperature of the discharge plume to no more than 1.6 °C above ambient temperature at 100 m and that the temperature would return to ambient levels within a maximum of 400 m from the point of discharge for the worst-case scenario. This is in alignment with International Finance Corporation (IFC) guidelines (2015) that recommends discharges should not result in a temperature increase of more than 3 °C at the edge of the mixing zone. It should also be noted that surface waters of the region are tropical year-round, with surface temperatures of ~26 °C in summer and ~22 °C in winter (DSEWPaC 2012). Baseline monitoring in the offshore development area recorded surface water temperatures of ~30 °C in summer (March) and ~26–27 °C in winter (July) (INPEX 2010). Therefore, over the seasons, seawater temperatures naturally vary by around 3 to 4 °C. Effects of elevation in seawater temperature cause 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-50-L, and EPBC-listed species with the potential to be present in the licence area are considered to be transient in nature. The facility is situated in an open-ocean location in a water depth of approximately 250 m in a high current environment; therefore, potential consequences on transient, EPBC-listed species are potentially localised avoidance of thermally elevated water temperatures with an inconsequential ecological significance to protected species (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).	

Identify existing controls			
• Monitoring of NaClO dosing levels (measured as chlorine equivalent)			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharge of CW to the marine environment.	No	Cooling is an inherent requirement of the CPF topsides processing equipment, and its requirement cannot be eliminated. The Brewster and Plover Formations are gas reservoirs for which there is no requirement for pressure maintenance. Therefore, the potential to dispose of cooling water subsurface (i.e. into a geological formation) is not a practicable option.

Substitution	Substitute NaClO with an alternative biofouling control/mechanism.	No	It is necessary to control biofouling within seawater cooling systems. A range of biofouling technologies were evaluated during the design of the facility but were excluded for a number of reasons as detailed below: • Chlorine used as alternative biocide – added directly to seawater instead of using NaClO generated by seawater electrolysis was excluded due to H&S hazards of handling chlorine gas. • Bromine used as alternative biocide – not considered possible due to bromine degrading before reaching all parts of the system and the requirement for a large biofouling control plant with space and weight penalties. • Peroxide used as alternative biocide – discounted due to hazardous nature and possible H&S hazards. • Ozone used as alternative biocide – unproven technology in the offshore environment and uncertainty regarding degradation before reaching all parts of the system. • Non-oxidising biocides such as glutaraldehyde – generally used in closed-loop systems and are unsuitable for an open-circuit cooling system as is in place on the CPF. They are high cost and tend to target either bacteria, or algae, or fungi, rather than provide protection against all biological growth, therefore were discounted. • Biodispersants and biodetergents – Often used in conjunction with biocides, they can be useful to break up biofilms but are not considered an alternative to biofouling prevention. They may cause foaming and are not considered suitable for open-loop cooling systems. UV light – unproven technology in the offshore environment and uncertainty on level of performance due to turbidity affecting the performance of the UV lamps. Hypochlorite is included as a recommended technique in the application of best available techniques (BAT) to industrial cooling systems (European Commission 2001).

Engineering	Use of fin fan coolers.	No	The discharge of warm seawater could, in principle, be avoided by air cooling; however, due to the low specific heat capacity of air, a large cooling requirement, such as the one on the CPF, demands a substantial cooling area and associated structural support, imposing significant space and weight penalties. The CPF is space-limited and air cooling is therefore not considered to be a realistic option.
Procedures & administration	Monitoring of chlorine produced oxidants (HOBr and bromoamines) at the point of discharge to the seawater caisson.	No	Due to the chemical instability of NaClO and chlorine produced oxidants within the system, sampling of the concentration of various reaction products would not provide an accurate measure of actual concentrations when reaching the receiving environment.
	Monitoring of cooling water temperature.	No	The CPF has been designed so that cooling water discharges do not exceed 45°C. The performance of the CPF seawater system has been validated with cooling water discharge temperatures recorded between 33 and 38°C.
	Temporary operating procedure implemented in the event that the biofouling control package is inoperable.	Yes	If the biofouling control package fails, the implementation of temporary arrangements would be put in place to replicate the required dosing.

Identify the likelihood	
Likelihood	Localised impacts to the abundance of plankton within 100 m of the planned CW discharges is considered Possible (3). However, this is ecologically insignificant based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters. Planned discharges of CW may result in localised (within 400 m) avoidance behaviour in transient, EPBC-listed species and is considered Possible (3). However, in the absence of any known BIAs for transient, EPBC-listed species any behavioural impacts are not expected to result in a threat to population viability of protected species.
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Possible (3) the residual risk is Low (8).

Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Possible (3)	Low (8)
Assess residual risk acceptability		
Legislative requirements		

The discharge of return seawater from cooling water systems to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of cooling water. The 45 °C limit (inherent through the design of the CPF) on the discharged cooling water temperature ensures that the discharge plume will be no more than 1.6 °C above the ambient seawater temperature at 100 m from the discharge point. This complies with the Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development published by the IFC. Sodium hypochlorite generated in situ is an OCNS non-CHARM product which is assigned a Group E rating (at a dose rate of 1,000,000 ppm). Group E products are considered to have very low potential environmental hazard.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from cooling water discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). Emissions and discharges are a common threatening process identified in several conservation management documents; however, none of the recovery plans or conservation advices have specific actions relating to cooling water discharges.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standard	Measurement criteria
Impacts to identified values and sensitivities from planned liquid discharges associated with the offshore facility are limited to a localised area.	Inlet concentration of NaClO will not exceed 3.5 ppm, based on a 24-hour rolling average, calculated from two samples per 24-hour period.	NaClO offshore laboratory sampling results.
	In the event that the biofouling control package is inoperable, NaClO concentrations not exceeding 3.5 ppm, based on a 24-hour rolling	NaClO dosing records.

	average will be maintained in accordance with a temporary operating procedure.	

Table 7-11: Impact and risk evaluation – CPF ballast water discharges

<table>
<tr><th colspan="4">Identify hazards and threats</th></tr>
<tr><td colspan="4">Impacts and risks associated with high risk ballast water and biofouling and the potential for introduction and establishment of IMS are addressed in Table 7-33 of this EP. Ballasting on the CPF uses seawater supplied from the seawater cooling system dosed at the point of inlet with NaClO at a concentration of 3 - 3.5 ppm, to inhibit biofouling with no further dosing of ballast tanks with biocide. During normal operating conditions no ballast water will be discharged; however, in the event that unplanned ballasting needs to occur on the CPF for stability reasons, return ballast will be discharged to sea via the seawater dump caisson on an as-required basis. Intermittent flows of ballast water may be discharged (575 m^3/h maximum pump capacity). Ballast water is also used during the quarterly testing of the emergency bilge pumps. As part of the test an estimated 1,320 m^3 per quarter of ballast water might be discharged directly overboard from a purposely designed emergency bilge overboard opening on the CPF top deck approximately 23 m above the operating draft and 80 m to the side of the seawater dump caisson.</td></tr>
<tr><th colspan="3">Potential consequence</th><th>Severity</th></tr>
<tr><td colspan="3">Particular values and sensitivities with the potential to be impacted are:
• planktonic communities.
Ballast water is fed from the cooling water stream, assessed in Table 7-10, and the toxicity is considered to be negligible at discharge. Furthermore, due to the long residence time of seawater within the ballast tanks, the NaClO and CBPs will have been subjected to additional degradation over time. Therefore, potential impacts to planktonic communities are considered to be Insignificant (F).</td><td>Insignificant (F)</td></tr>
<tr><th colspan="4">Identify existing controls</th></tr>
<tr><td colspan="4">Refer to existing controls for CPF cooling water discharges (Table 7-10)</td></tr>
<tr><th colspan="4">Propose additional safeguards/control measures (ALARP evaluation)</th></tr>
<tr><th>Hierarchy of control</th><th>Control measure</th><th>Used?</th><th>Justification</th></tr>
<tr><td>Elimination</td><td>No discharge of ballast water to the marine environment.</td><td>No</td><td>Ballasting and deballasting with seawater is an essential activity to ensure the stability and structural integrity of the CPF and cannot be eliminated. The emergency bilge pumps are safety critical elements and are required to be tested regularly. The onboard storing of ballast water and shipping to the mainland for the duration of operations is grossly disproportionate to the low level of risk associated with this discharge. Additional environmental impacts would also be generated in terms of air emissions and onshore disposal.</td></tr>
<tr><td>Substitution</td><td>Use an alternative method to prevent biofouling of ballast water.</td><td>No</td><td>The feed for the ballast water is supplied from the seawater cooling system and during the design of the facility several biofouling</td></tr>
</table>

			technologies were considered. They were discounted for a number of reasons as described in Table 7-10.
Engineering	None identified	N/A	N/A
Procedures & administration	Monitoring of chlorine produced oxidants (HOBr and bromoamines) at the point of discharge to the seawater caisson.	No	Due to the chemical instability of NaClO and chlorine produced oxidants within the system, sampling of the concentration of various reaction products would not provide an accurate measure of actual concentrations when reaching the receiving environment. This is particularly so given the long residence time of ballast water in the ballast water tanks.

Identify the likelihood	
Likelihood	The discharge of ballast water will be intermittent in nature and is of negligible toxicity. Controls in place concerning monitoring and maintaining concentrations of NaClO are described for the cooling water system (Table 7-10). Given the comparatively small volume of ballast water discharges to the open-ocean environment in WA-50-L, is not expected to affect plankton abundance at the point of discharge or result in impacts of ecological significance based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters (Remote 6).
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Remote (6) the residual risk is Low (10).

Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Remote (6)	Low (10)

Assess residual risk acceptability

Legislative requirements

The discharge of ballast water is a standard practice in industry with insignificant consequences to the environment as identified above. Sodium hypochlorite generated in situ is an OCNS non-CHARM product which is assigned a Group E rating (at a dose rate of 1,000,000 ppm). Group E products are considered to have very low potential environmental hazard. Ballast water discharges will be in accordance with the legislation described in Table 7-33.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from ballast water discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to discharges of ballast water containing residual NaClO. ALARP summary Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	Environmental performance standard	Measurement criteria
Refer to Table 7-10		

Table 7-12: Impact and risk evaluation – CPF desalination brine discharges

Identify hazards and threats			
The continuous discharge of desalination brine has the potential to cause changes in water salinity. Water makers on board the CPF have the capacity to make 100 m^3/day of potable water. At full capacity, this results in a maximum discharge rate of approximately 185 m^3 per day (~7.7 m^3/hour) of desalination brine water for the entire system. The salinity of the discharge is expected to be approximately 50 parts per thousand (ppt) in comparison to ambient seawater with a salinity of 35 ppt (INPEX 2010). The CPF has been designed so that desalination brine is mixed with return seawater from the cooling water system in the seawater dump caisson, this dilution results in the final discharge that enters the receiving environment having a salinity of approximately ambient conditions (i.e. 35 ppt). Therefore, the discharge of desalination brine from the CPF does not result in a discharge of increased salinity above ambient seawater			
Potential consequence			**Severity**
Particular values and sensitivities with the potential to be impacted are: • planktonic communities. The discharge of desalination brine from the CPF does not result in a discharge of increased salinity above ambient seawater. However, in the event that dilution of the brine water was not possible e.g. due to maintenance, undiluted brine may be discharged. Plankton may be directly affected by increased salinity at the immediate point of discharge prior to dispersion and dilution occurring. However, the effects of a temporary and highly localised increase in salinity are not expected to result in any significant ecological impacts to planktonic communities. Therefore, the consequence is considered to be Insignificant (F).			Insignificant (F)
Identify existing controls			
None identified			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate brine discharges from the CPF by shipping fresh water from onshore.	No	The significant financial cost and associated environmental risks associated with transporting fresh water to the CPF from the mainland are not warranted given that upon dilution with return seawater, the discharge will be at or below ambient levels of salinity.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	None identified	N/A	N/A

Identify the likelihood		
Likelihood	Direct effects on plankton from brine discharges are not expected based on the dilution of desalination brine in the seawater dump caisson. If there was a requirement to discharge undiluted brine to the open-ocean environment in WA-50-L it may affect plankton in the immediate location of the discharge. However, it would not be expected to result in an ecological impact to planktonic communities in the Commonwealth marine area. Therefore, the likelihood of impact to planktonic communities is considered Highly Unlikely (5).	
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Highly Unlikely (5) the residual risk is Low (10).	
Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)
Assess residual risk acceptability		

Legislative requirements

The discharge of desalination brine to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of desalination brine. IFC guidelines (2015) were taken into consideration during the design of the facility with respect to brine; in particular, the requirement to consider mixing desalination brine from potable water systems with cooling water or sewage water discharges to reduce potential impacts. Therefore, on the CPF combining small volumes of desalination brine with large volumes of cooling water in the seawater dump caisson will dilute desalination brine to ambient concentrations prior to discharge and is considered to be aligned with best practice.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from desalination brine discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to discharges of desalination brine.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the risk of impacts is acceptable because:

- the activity demonstrates compliance with legislative requirements/industry standards

• the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	Environmental performance standard	Measurement criteria
N/A no controls identified		

Table 7-13: Impact and risk evaluation - CPF sewage, grey water and food discharges

<table>
<tr><th colspan="4">Identify hazards and threats</th></tr>
<tr><td colspan="4">The intermittent discharge of 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.

Sewage generated on the CPF will be macerated and combined/diluted with grey water and food waste before discharge via the sewage disposal caisson. Volumes of sewage effluent, grey water and food waste will vary over the 40-year life of the operation. For example, when the maximum number of personnel is required on board the CPF (i.e. 200 POB), up to 60 m^3/day of sewage effluent and grey water may be generated. The discharge from the facility is not continuous and is considered to be intermittent (or pulsing) in nature and principally occurs during two-hourly peak periods at shift changeover, with smaller volumes generated outside of these times. The maximum flow rate of sewage discharge is in the order of 24 m^3/h and has been used for this assessment to provide a worst-case scenario.

As with sewage and grey water, the volumes of food waste will also vary over the life of the operation influenced by the number of persons on board. Volumes of up to 0.36 m^3 per day are estimated at times when the maximum persons are on board. However, these volumes are also expected to be smaller when less people are on board and will fluctuate during shift changeover and mealtimes. Food waste will be macerated (<25 mm) before discharge via the sewage dump caisson.</td></tr>
<tr><th colspan="3">Potential consequence</th><th>Severity</th></tr>
<tr><td colspan="3">Particular values and sensitivities with the potential to be impacted are:
• planktonic communities.

A study undertaken to assess the effects of nutrient enrichment from 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-50-L at the point of discharge (sewage dump caisson). The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the discharge. Given the deep water (approximately 250 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).</td><td>Insignificant (F)</td></tr>
<tr><th colspan="4">Identify existing controls</th></tr>
<tr><td colspan="4">• Maintenance of sewage macerators on board the CPF in accordance with Section 9.6.7 and Table 9-27.</td></tr>
<tr><th colspan="4">Propose additional safeguards/control measures (ALARP evaluation)</th></tr>
<tr><th>Hierarchy of control</th><th>Control measure</th><th>Used?</th><th>Justification</th></tr>
</table>

Elimination	Eliminate discharges from the CPF by storage of sewage, grey water and food waste on board and ship to the mainland.	No	The significant financial cost and health risks associated with storing sewage, grey water and food waste on board and shipping it to the mainland for the duration of operations is grossly disproportionate to the low level of risk associated with this discharge. Additional environmental impacts would also be generated in terms of air emissions and onshore disposal.
Substitution	Use alternative sewage treatment technologies on the CPF, such as activated sludge, membrane bioreactor or electrolytic treatment.	No	These treatment options require additional cost, space and weight and the packages need to be desludged on a regular basis. In addition to this, these technologies may result in additional impacts and risks through discharge of additional chemicals (such as flocculants and defoaming agents). Equally, technologies such as membrane bioreactors, are liable to clogging, which may impact on their reliability. As such, the cost of installation and implementation of alternative treatment technologies is grossly disproportionate to the level of risk reduction achieved given that the potential consequence is already deemed to be insignificant with the maceration option.
Engineering	None identified	N/A	N/A
Procedures & administration	None identified	N/A	N/A

Identify the likelihood	
Likelihood	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 licence area are unlikely to cause toxic effects, especially considering the rapid dilution provided by the deep water and ocean currents. The maceration of sewage and food waste to a particle size <25 mm prior to disposal, will increase the ability of the effluent stream to disperse rapidly. The sewage system/toilets onboard the CPF operate on a vacuum system, driven by an impellor which macerates; therefore, no sewage can enter the marine environment which has not been macerated. This ensures that the discharge can disperse readily. Localised impacts to the abundance of plankton at the point of the planned discharge are considered to be Unlikely (4) and ecologically insignificant based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters.
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).
Residual risk summary	

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

Legislative requirements

Sewage, grey water and food waste discharges are standard practice in the offshore environment with insignificant consequences to the environment as identified above. Sewage, grey water and food waste disposal from vessels is permissible under MARPOL; however, Annex IV of MARPOL does not apply to the CPF or FPSO.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from sewage, grey water and food waste discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to discharges of sewage, grey water and food waste. The macerators will assist in reducing impacts from this discharge stream, consistent with the intent of the conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standard	Measurement criteria
Refer to Table 9-27		

Table 7-14: Impact and risk evaluation - CPF open drains, HVAC and bilge discharges (deck drainage, HVAC, bilge and firefighting foam)

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Contaminated deck, operational or maintenance drainage and bilge discharges or failure to treat oily water to suitable OIW concentrations prior to discharge has the potential to expose marine fauna to changes in water quality and/or result in impacts through direct toxicity.

CPF oily water discharges are intermittent. The maximum capacity of the open drains centrifuge used to treat oily water on the CPF is 20 m^3 per hour.

The CPF is equipped with firefighting foams and their availability on board 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) testing. Therefore, foam discharges will not be routine, but may be discharged to sea via the open drains in the event that they are required.

If bacterial mitigation is required, a biocide will be used. The exact treatment batch size and frequency would depend on the extent and magnitude of the bacteria proliferation. The biocide will be dosed into the (open drains) drain boxes. The discharge of the biocide to the marine environment has the potential to expose the identified environmental values and sensitivities to changes in water quality.

The four CPF HVAC systems discharge condensed water directly from each caisson leg onto the ocean surface. Whilst the HVAC discharge was designed to be condensed (pure) water only, unexpected corrosion of copper cooling coils on the HVAC system is leaching copper into the HVAC condensed water discharge stream. CPF HVAC discharges containing approximately 2 to 5 mg/L copper, will be intermittently discharged to the marine environment. The discharge of HVAC condensed water, including copper, to the marine environment has the potential to expose identified values and sensitivities to changes in water quality.

Discharge of contaminated deck drainage, bilge, surface water runoff and stormwater drainage is treated through the open drains system prior to discharge through the caisson leg to the marine environment. These discharges have the potential to expose marine flora and fauna to changes in water quality.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Particular values and sensitivities with the potential to be impacted are:
• transient, EPBC-listed species
• planktonic communities

Discharges of oily water are be treated to <15 ppm(v) which is equivalent to the specification prescribed by MARPOL Annex I. This could introduce hazardous substances (mixture of water, oily fluids, lubricants, cleaning fluids, etc.) into the water column, albeit in low concentrations. This could potentially result in a reduction in water quality, and impacts to transient, EPBC-listed species and planktonic communities.

Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in WA-50-L, the potential exposure is likely to be limited to individuals close to the discharge point at the time of the discharge. Worst case impacts 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 environment, a surface expression</td><td>Insignificant (F)</td></tr>
</table>

is not anticipated; therefore, impacts are considered to be of inconsequential ecological significance to transient, EPBC listed species and are, therefore, considered Insignificant (F). There is the potential for planktonic communities within WA-50-L to 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). Firefighting foams such as AR-AFFF and FFFP contain organic and fluorinated surfactants, which can deplete dissolved oxygen in water (Schaefer 2013; ANSUL 2007; IFSEC Global 2014). However, in their diluted form (as applied in the event of a fire or test), 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 (ANSUL 2007). 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). The AR-AFFF and FFFP type foams identified for the CPF are biodegradable and do not bioaccumulate (Mercury Firesafety 2013; Dafo Fomtec AB 2013). In the event that firefighting foam is required (in the event of an emergency or for infrequent testing), the foam systems mix the foam concentrates (3%) with water (97%) prior to application and then further dilution and dispersion following discharge to the open-water environment around the facility is expected to occur before any significant demand for dissolved oxygen or toxicological effects can occur. As toxicological effects from foams proposed to be used are associated with frequent or prolonged exposures, and discharges 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. All biocides are considered to be environmentally hazardous (due to their aquatic toxicity), but the selected biocides are non-bioaccumulative, and readily biodegradable. As such they are not considered to accumulate in organisms and are expected to be rapidly dissolved by biological means (such as bacteria and fungi). Thus, the main risk associated with the discharge is the acute toxicity at the moment of discharge. The concentration of the biocide, based on the CPF open drains dispersion modelling (APASA, 2017), is expected to reach the adjusted No Effect Concentration (NEC)* within 400 m from the point of discharge and that no significant potential environmental impacts would be experienced from that point. It is also expected that the potential biota exposure will be limited to individuals close to the discharge point at the time of the discharge (i.e. potential localised and short-term impacts – Insignificant F). It is important to note that at the time of discharge it is anticipated that the biocide will be spent and therefore the chemical will have lost some (if not most) of its biocidal properties. While it is therefore possible that a temporary impact associated with the discharge could occur in the close vicinity of the discharge. Monitoring of the HVAC discharges between March and August 2019 confirmed an average copper concentration of ~2 mg/L, with all discharges results <5 mg/L. RPS (2019a) conducted dispersion modelling of the CPF HVAC condensed water discharge, to investigate	

the potential for copper to breach the 400 m CPF mixing zone (Table 7-28). The results confirmed that copper concentrations would be below the ANZECC 99% species protection level (0.3 µg/L) within 50 m of the discharge 95% of the time. The modelling was based on the worst-case cumulative HVAC discharge rate (all four units discharging simultaneously) resulting in a flowrate of 1.5 m^3/hr and is considered highly conservative as each pump will not be discharging continuously. Further modelling (RPS 2019a) confirmed that at discharge concentrations of 5 mg/L and 10 mg/L of copper, the HVAC discharge stream would be below the ANZECC 99% species protection level (0.3 µg/L) within 100 m and 250 m of the discharge 95% of the time, respectively. Therefore, given the predictive modelling results in conjunction with the field validation sampling data any potential impacts to transient EPBC-listed species and planktonic communities would be limited to within tens of metres from the discharge point and are expected to the short-term and localised resulting in inconsequential ecological significance (F). It should be noted that copper was not detected above background levels (0.2 µg/L) at any distance from the CPF, during the Q2 2019 in-field water quality sampling program associated with the LEMP (Section 9.6.2). *The method to establish the adjusted NEC is presented in the FPSO produced water section.	

Identify existing controls

- Spills will be managed in accordance with the controls identified in Table 7-38 (accidental release).
- Vessel crew will receive an induction/training to inform them of the deck spill response requirements in accordance with Table 9-3.
- Discharges of oily water are be treated to <15 ppm (v) equivalent to the specification prescribed by with MARPOL Annex I.
- INPEX Chemical assessment and approval procedure has been used to select the firefighting foam and glutaraldehyde-based biocide in accordance with Section 9.6.1 and Table 9-5.
- If a chemical from a closed-loop system requires discharge to the marine environment, an assessment will be undertaken to confirm the mixing zone will not be breached (Table 7-28).
- Maintenance of open drains centrifuge package in accordance with Section 9.6.7 and Table 9-27.

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharges of contaminated deck drainage or bilge to sea.	No	Discharge of deck drainage stormwater runoff or bilge discharges cannot be eliminated from the CPF. There is not sufficient space available on board for storage and onshore disposal is not practicable given the distance to the mainland and the associated emissions and discharges associated with transfer by vessel.
	No discharge of firefighting foam solutions to sea.	No	The use of firefighting foams on board the facility is safety critical and these are required in the event of a fire to prevent potential loss of human life or the occurrence of a significant environmental incident. Therefore, the availability of firefighting foams cannot be eliminated. Drainage of the

			foams from the decks of the facility is also essential as they would present a separate safety hazard and could impede firefighting activities. Therefore, drainage and discharge of foam solution to the sea also cannot be eliminated.
	No discharge of biocide to sea	No	Not treating the open drains would expose the open drains system to a significant bacterial-induced corrosion issue, which in turn would present a significant facility integrity issue (for instance it could jeopardize the integrity of the open drains centrifuge package and its ability to remove hydrocarbons).
	No discharge of HVAC condensed water to sea.	No	The HVAC condensed water must be discharged to sea, either as individual streams, or by diverting the HVAC stream and co-mingling with another discharge stream, such as cooling water discharges. There are no other credible re-use options available (such as service water for other production/operational purposes), especially given the very small and variable rate of generation of HVAC condensed water.
Substitution	None identified	N/A	N/A
Engineering	Use of alternative oily water treatment options.	No	A number of alternative oily water treatment technologies were considered during design for permanent use but were excluded for a number of reasons, as detailed below: • Tilted-plate technology – Although widely used for bilge treatment and with no requirement for chemicals or replacement filters, this was discounted due to concerns about its ability to operate under periods of vessel motion and also an uncertainty about achieving the required discharge specifications, i.e. <15 ppm(v). • Membranes – The use of membranes to remove OIW was discounted due to the propensity for build-up of solids, resulting in a high maintenance burden, however these may be used on a temporary basis because they can be effective. • Mixed-media beds – Proven to remove hydrocarbons to low levels; however, they have a large space and weight requirement and, therefore, were not selected for use.

	Discharge separation and containment system for firefighting foams/open-drains system closure.	No	Given the limited quantities of firefighting foam that may be discharged, the limited (insignificant) consequence of potential impacts that may arise from such a discharge, and the low likelihood/frequency of a discharge occurring (emergency event or infrequent test event), implementing separate drainage systems for firefighting foams is not considered practicable. The cost of implementing such measures is grossly disproportionate to the limited environmental benefit that could be achieved, and during an emergency event, the priority will be ensuring safety and containment of a fire. Implementation of additional engineering measures and procedures to close the open-drains system and re-route firefighting foams is not practicable in a situation when firefighting systems must be activated as soon as possible to contain a fire and the decks adequately drained to ensure the safety of personnel, integrity of the facility, and prevent a significant environmental incident from occurring.
	Filter out copper prior to discharge of HVAC condensed water to sea.	No	The cost and time associated with installing copper filtration systems is not reasonable, because it would not be possible to remove 100% of copper from the discharge, and copper discharge would still be above background levels. As such, monitoring of copper to confirm discharge concentrations would still be required hence the effort to try and filter copper would not significantly reduce risk for the associated cost and time.
Procedures & administration	Statement of compliance from third party inspector confirms equivalence to MARPOL Annex 1.	Yes	Annual verification audits will confirm that the CPF oil-filtering and discharge-monitoring system is equivalent to relevant requirements of MARPOL Annex I.
	Implement the INPEX OIW Measurement System, Calibration, Correlation and Validation Strategy including: • online oil in water analysers will be calibrated (2 yearly) • calibration standard check is performed in accordance with a routine maintenance schedule • weekly validation check • monthly verification check	Yes	This document defines a strategy to correlate and validate the Ichthys offshore OIW measurement systems including the online OIW analysers and the laboratory handheld instrument (refer Section 9.6.6). It describes the interface required between the laboratory and the operating requirements of the OIW system to improve the operating efficiency of the OIW measurement system. Implementation of this strategy ensures that OIW in the CPF open drains discharge stream meet the specified level of < 15 ppm(v). The measurement system is correlated against a proven laboratory measurement technique to prove the initial calibration is accurate and effluent OIW results are accurately and can be confidently reported.

			Calibration of oil in water analysers for marine vessels to comply with Annex I of MARPOL is every 2 years therefore this frequency has been adopted and is considered ALARP. It is also appropriate to ensure there is a defined method to correlate the online analysers to the laboratory handheld analysers. The use of a large data set (e.g. 10 or more points increases accuracy) and a small data set (e.g. 3 points) can be highly variable. Effort and cost increases with the desired level of accuracy. Given that the specified limit of impact is already low, at <15 ppm(v), and that data points able to be obtained are all at the lower end of the OIW concentration (i.e. typically between 2- 30 ppm(v), INPEX has determined that using at 10 point data set, sampled in triplicate and a linear correlation coefficient of >0.7 is ALARP when it is enacted in parallel with a monthly verification process. Meeting a correlation co-efficient of 0.9 would require a broader data set with higher OIW concentrations in a range 0-100 ppm(v) which are not readily available offshore during operations and is therefore not practicable. An EPO and EPSs related to OIW measurement calibration, correlation, validation and verification are presented in Table 9-26.
	In the event the online analysers fail (or they are offline in "Lab test" mode for maintenance purposes), INPEX will undertake sampling and analysis in the offshore laboratory, to confirm OIW concentrations are below 15 ppm(v) on a 6-hourly basis. The overboard discharge valve will be closed manually when a reading above 15ppm(v) is observed.	Yes	Online analysers are an effective way to monitor oily water discharges in real time. However, there are periods when the online analysers may not be switched on or they are not functioning. This occurs during periods of maintenance or for calibration. If discharges need to occur during this time (i.e. when the analysers are offline) an alternative measurement is required to ensure discharges remain under the 15ppm(v) specification and the facility remains capable of discharging the open drains tank. Prior to opening the discharge valve, a reading under 15ppm(v) is required. It is considered reasonable approximate the online analysers purpose by re-testing the discharge stream at 6 hourly intervals to confirm the discharge remains on specification (i.e. <15ppm(v)). Taking samples manually and testing them requires time an effort for technicians to retrieve a sample, conduct the analysis and report back to the Operator the associated oil in water reading. In the event that a manual sample during discharge is higher than 15ppm(v) the operators will be advised and the discharge valve shall be closed. This method approximates

			the performance of the online analysers and discharge valve function and is considered ALARP due the insignificant consequence of oily water discharges and the considerable manual labour involved in determining the oil in water content at a greater frequency. An EPO and EPS related to contingency OIW measurement is presented in Table 9-26.
	Implement reliability targets for OIW analysers	No	The use of reliability targets is not considered warranted because the effectiveness of the online analysers is predicated by their accuracy which is determined by their calibration, maintenance and verification frequency which is described in detail in (Section 9.6.6). There is limited value in applying reliability targets to online analysers that have not been calibrated and maintained correctly because the associated readings would likely be misleading. It is therefore not considered ALARP to apply a reliability target to the use of online analysers when their performance is already managed via INPEX OIW Measurement System, Calibration, Correlation and Validation Strategy.
	Monitor concentration of copper in HVAC condensed water discharge stream on a monthly basis, to confirm concentration is <10 mg/L.	Yes	Modelling results (RPS 2019a) determined that based on a worst-case 1.5 m^3/hr discharge rate, with a discharge concentration of 10 mg/L, copper concentration from the HVAC discharge stream would be below the ANZECC 99% species protection level (0.3 µg/L) within 250 m of the discharge 95% of the time. 10 mg/L is therefore considered to be an appropriate maximum allowable copper concentration in HVAC condensed water discharges. In addition, 10 mg/L provides significant buffer such that in the event of other unplanned copper discharges from other sources on the CPF, the cumulative copper concentration should not breach the CPF 400 m mixing zone.

Identify the likelihood	
Likelihood	Oily water is treated to a maximum concentration of 15 ppm(v) OIW prior to discharge, as specified in MARPOL, Annex 1. HVAC copper concentrations will be monitored to confirm they remain below 10 mg/L. Localised impacts to the abundance of plankton in the vicinity of the planned intermittent open-drains discharge (oily water, firefighting foam and HVAC discharges) are considered to be Possible (3). However, this is 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 WA-50-L, the likelihood of impacts from the discharge after treatment by the open-drains centrifuge and HVAC discharges, 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	Based on a consequence of Insignificant (F) and likelihood of Possible (3) the residual risk is Low (8).	
Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Possible (3)	Low (8)
Assess residual risk acceptability		

Legislative requirements

Oily water discharges from the CPF will meet relevant international regulatory requirements, including MARPOL, enacted by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* in Commonwealth waters. Discharges of OIW of <15 ppm (v) is permitted under MARPOL and is considered as standard practice in the offshore environment.

The firefighting system on the CPF has been designed to meet the requirements specified in Det Norske Veritas (DNV) Standard (DNV-OS-D301), CAP437 (Offshore Helicopter Landing Areas) and relevant National Fire Protection Association Standards.

The selected glutaraldehyde-based biocide is registered on the Australian Inventory of Chemical Substances (AICS).

Copper concentration in HVAC discharges will be monitored to ensure the 99% species protection limit (ANZECC/ARMCANZ 2000) is not exceeded at the edge of the CPF 400 m mixing zone.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from oily water, firefighting foam or HVAC discharges. AMSA (and DNV) provided guidance on how INPEX could demonstrate compliance with MARPOL Annex 1 through the use of equivalence applications and obtaining a ‘Statement of compliance’.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are a common threatening process identified in several conservation management documents; however, none of the recovery plans or conservation advices have specific actions relating to oily water discharges. The controls on oily water discharges are consistent with industry best practice and align with the intent of the conservation management documents, to reduce emissions and discharges.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary		
Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	**Environmental performance standard**	**Measurement criteria**
Impacts to identified values and sensitivities from planned liquid discharges associated with the offshore facility are limited to a localised area.	Oily water treatment system operated to prevent the discharge of >15 ppm(v) to the open drains caisson.	Records confirm OIW concentrations in open drains discharge to open drains caisson is ≤15 ppm(v).
	Statement of compliance from third party inspector confirms equivalence to MARPOL Annex 1.	Statement of compliance from third party inspector.
	Closed loop system discharges assessed to confirm potential toxicity will not exceed the mixing zone described within Table 7-28.	Record of environmental assessments for closed loop system drainages.
	CPF Caisson HVAC condensed water discharges will be monitored on a monthly basis to ensure copper concentrations remain at <10 mg/L.	Monthly sampling records confirm CPF HVAC condensed water copper concentrations were <10 mg/L.

Potential interaction between CPF liquid effluent discharge streams

During operation of the CPF, there is a potential for five separate liquid effluent streams to be received into the marine environment from three discharge caissons at different depths within the water column. Most of the streams are combined to some extent before discharge from the appropriate caisson. As shown in Table 7-9 ballast and brine is mixed with cooling water prior to discharge to sea from the seawater dump caisson, and sewage is combined with grey water and food waste prior to discharge to sea from the sewage disposal caisson. Potential impacts to the identified values and sensitivities present will be affected by the physical state in which any contaminants are introduced into the marine environment, and the inherent chemical properties of the discharge. Chemical contaminants, nutrients, suspended solids, organic matter and thermal discharges entering the marine environment may alter water quality.

Dilution of such effluent streams relatively close to the sea surface (i.e. depths ranging from 10–26 m below sea level), will initially be dictated by the downward momentum of the discharge and subsequent turbulent mixing and entrainment of seawater into the plume upon discharge. Following this, other physical factors, such as the presence of oceanic currents will then predominantly influence the spatial dispersion of the plume (Johnson et al. 2008). Impacts to receptors (transient, EPBC-listed species and planktonic communities) can also vary depending on factors, such as the season, weather and oceanic conditions.

The approximate maximum discharge rate of the combined stream from the seawater dump caisson is estimated to be 20,600 m^3 per hour. This stream will be dominated by the continuously discharged cooling water (~ 97%) with significantly smaller volumes of ballast water (<3% and intermittent) and desalination brine (<1%). Due to commingling of the streams, salinity from the desalination brine stream will be diluted back to near-ambient seawater levels (35 ppt) prior to discharge; as such, the seawater dump caisson plume will be influenced by temperature. The discharge is between 33 – 38°C, with a maximum design capacity of 45 °C, which is approximately 5–10 °C higher than ambient seawater depending on the season.

Thermal impacts can cause a decline in water quality due to the reduction in dissolved oxygen concentrations resulting from elevated water temperature. Plankton present in the localised vicinity of the discharge may also potentially be impacted by thermal shock. For discharges that are warmer than the receiving environment, the plume is expected to remain positively buoyant, relative to the surrounding waters. After the initial downward momentum from the release, the plume is expected to become passive and rise upwards within the water column and may reach the sea surface, until mixing with ambient water reduces the overall temperature of the plume to background (APASA 2011). Given that the seawater dump caisson discharge plume will be subject to mixing processes, with rapid dilution and reduction of temperature upon release, there is little influence on the receiving environment.

Chlorination residues present within the cooling water are reported to degrade rapidly and rates of degradation increase in the presence of dissolved or organic matter (Khalanski 2002; Taylor 2006). Data indicates that the presence of organic material will substantially decrease the efficacy of NaClO to prevent biofouling. However, this rapid degradation rate provides a potential advantage with respect to environmental impacts, as most of the biocidal potential will be gone upon release into receiving waters (Taylor 2006; Landrum et al. 2003). Therefore, upon introduction of the seawater dump caisson discharge plume into the marine environment, other sources of dissolved organic matter within the receiving environment will enable a more rapid degradation of chlorination residues. Temperature is also known to affect the breakdown of chlorination residues with decomposition rates for NaClO reported to double if the temperature increases by approximately 5.5 °C and where the temperature is more than 35 °C, the decomposition reactions are very rapid (Binetti & Attias 2007), which is anticipated in the seawater caisson stream given the elevated temperature of the cooling water stream.

During periods of maintenance and shutdown when processing equipment is not being operated, cooling water may not be required, and undiluted brine may be discharged to the marine environment. The brine is expected to sink within the water column as it will have a greater density and will be subject to rapid dilution and dispersion in the prevailing currents. Given the relatively low volume and rates of brine that may be discharged during maintenance periods, any elevation in salinity will be highly localised to the discharge point (<30 m) (WA EPA 2008). As the brine discharges, released at 26 m below the sea surface, sink within the water column and quickly dissipate, there are no expected interactions with other discharge plumes released at 10–12 m below the sea surface.

The discharge plume associated with sewage, grey water and food waste from the CPF is relatively small (at a maximum of 24 m^3 per hour) but may increase levels of nutrients in the receiving environment. Increased nutrient concentrations are expected to be rapidly taken up by phytoplankton potentially resulting in increased productivity; however, given the assimilative capacity of the open-ocean environment in the vicinity of the discharge, only minor increases would be possible (Waldron et al. 2001). The sewage, grey water, and food waste plume from the sewage disposal caisson at a depth of 12 m will be localised to the discharge point and subject to dilution and dispersion by oceanic currents. However, as the seawater dump caisson plume is expected to rise, due to its elevated temperature, it is possible that these streams could interact within the water column.

Drainage and bilge discharges from the CPF open-drains caisson will have OIW concentrations of 15 ppm (v) or less in accordance with MARPOL, Annex 1. The maximum discharge rate from the open-drains centrifuge package is lower than that of sewage with a treatment capacity of up to 20 m^3 per hour. Any hydrocarbons within the oily water discharge plume will be at low concentrations and subject to rapid dilution and dispersion. The discharge of AR-AFFF firefighting foam, comprising fluorinated surfactants, plus stabilising and anti-freezing additives, may occur infrequently via the CPF open-drains caisson. However, this discharge will only occur if required in the unlikely event of an emergency condition or during a maintenance or practice test of the deluge system. It is possible, as with sewage, grey water and food waste discharges that the plume from the open-drains caisson may interact with the other discharge plumes in the water column.

Cumulative impacts to transient, EPBC-listed species and planktonic communities from interactions between multiple liquid effluent streams released from the CPF have been considered. Once the initial downward momentum of the discharges is lost, it is expected that the positively buoyant plumes will rise and passively mix. The discharges are expected to rapidly dilute and disperse due to the water depth (approximately 250 m) and the influence of oceanic currents in WA-50-L resulting in limited potential for additive or cumulative impacts from the multiple liquid effluent discharges. Transient, EPBC-listed species may be present, both at the sea surface and within the deeper water column and, given their highly mobile nature, any exposure is considered to be minor and temporary. The density of planktonic communities recorded in the development area is considered to be very sparse and indicative of offshore waters, where no significant nutrient sources exist (INPEX 2010). The nature and scale of the cumulative discharges is not expected to impact on local planktonic communities and, as such, will not result in an ecological impact. A full cumulative risk assessment considering all liquid effluent discharges from Ichthys operations and the potential for additive or synergistic effects that may occur from discharge stream interactions in the receiving environment is presented in Table 7-30.

FPSO

The FPSO is equipped with a range of systems to meet processing requirements. Liquid effluents are discharged to the marine environment from the FPSO systems via a series of pipes that enter the discharge moonpool, where the liquid effluent streams commingle with the exception of sewage that is discharged via a dedicated hose at a greater depth. The FPSO discharge streams comprise:

- PW, including degasser fluid, citric acid and MEG pretreatment and bleed stream
- cooling water
- ballast
- open drains, including deck drainage, bilge and the firefighting foam system
- scrubbing water – from the inert gas generator and the pH controller (HCl)
- sewage, grey water and food waste.

Note: Desalination brine on the FPSO is routed back to the seawater intake and is reused within the seawater cooling system.

A summary of the worst-case individual liquid effluent streams discharged from the FPSO is provided in Table 7-15. An impact and risk evaluation has been undertaken for each individual liquid effluent stream in the following section. Potential interactions between discharged liquid effluent streams and cumulative impacts to the identified values and sensitivities have then been assessed (Table 7-30) to provide an overall indication of the environmental impacts associated with FPSO discharges.

Potential contaminants have been identified in each stream and their toxicity assessed to understand the level of dilution that would be required following their discharge to reach acceptable levels; for example, the PNEC or adjusted NEC. In order to estimate the size of the zone of potential impact resulting from the commingled moonpool discharge, the down-current distances to dilution were determined by modelling in both the near-field and far-field.

Table 7-15: Summary of worst-case liquid effluent discharge streams from the FPSO

FPSO discharge	Liquid effluent stream	Impact and risk evaluation reference	Potential constituents of concern	Approximate maximum discharge rate	Discharge depth below sea surface
Comingled in the moonpool and via a flexible hose	Produced Water	Table 7-17	Organic acids, hydrocarbons, alkylphenols, metals/metalloids, NORMs, production chemicals (Table 7-16)	180 m^3 per hour Continuous flow (variable rate)	~20 m
	Degasser fluid	Table 7-17	H_2S scavenger and OIW	6.4 m^3/hr Intermittent flow prior to comingling with the PW stream downstream of the MPPE unit and the PW in-line OIW analysers	~20 m
	Cooling Water	Table 7-18	Temperature (45° C) Residual NaClO	12 000 m^3 per hour Continuous flow	~20 m
	Ballast	Table 7-19	Residual NaClO	3400 m^3 per hour Intermittent flow	~20 m
	Open drains	Table 7-21	Hydrocarbons, lubricants and cleaning fluids	50 m^3 per hour Intermittent flow	~20 m
	Gas scrubbing water (IGG and HCl)	Table 7-22	Temperature, HCl and potential combustion residues	533 m^3 per hour Intermittent flow	~20 m
A dedicated flexible hose extends through (and beyond) the discharge moonpool (i.e. not comingled)	Sewage, grey water and food waste	Table 7-20	Introduction of nutrients	24 m^3 per hour Intermittent flow	~30–35 m

Summary of FPSO sampling and analysis

In accordance with the LEMP (Section 9.6.2), sampling and analysis of the commingled FPSO moonpool was undertaken in the first year of operations. Cooling water accounted for more than 96% of the volume being discharged; as a result, metal concentrations broadly reflected those reported for the Browse Basin although some metals (e.g. aluminium, nickel, iron, zinc) reported slightly elevated concentrations. As expected, low concentrations of hydrocarbons (e.g. TRH, PAH, BTEX) were also reported and likely associated with the produced water and open drains streams entering the FPSO moonpool. The majority of production chemicals were below laboratory limits of reporting.

Following the first 12 months of monitoring, sampling and analysis was undertaken on individual streams entering the FPSO moonpool. Analysis of the produced water stream has reported salinity and the majority of metals to be below laboratory limits of reporting indicating water is likely to be condensed (i.e. pure) water (as shown in Figure 7-5). Hydrocarbon concentrations have been between 12.3 mg/L and 18.4 mg/L, while trace levels of PAHs and BTEXs have been reported. Production chemicals have been reported at varying concentrations with the majority below laboratory limits of reporting. Only two production chemicals (MEG and sodium carbonate) having been detected in all produced water samples to date. High concentrations of total nitrogen (6.1 mg/L to 7.5 mg/L) have also been reported due to high ammonia (6.1 mg/L to 7.3 mg/L).

Cooling water metal concentrations recorded have been similar to background levels reported in the broader Browse Basin. Hydrocarbon concentrations (TRH, PAH and BTEX) in the cooling water have been close to or below laboratory limits of reporting, while residual chlorine concentrations (average free chlorine concentration of 0.8 ppm) have also been reported. Samples from the open drains stream have reported elevated concentrations of metals and hydrocarbons (TRH, PAH and BTEX). Biocides (diesel and glutaraldehyde based) have also been reported in the open drains stream along with elevated concentrations of total nitrogen and phosphorus.

Laboratory analysis of the gas scrubbing stream has consistently reported elevated concentrations of molybdenum and nickel compared to the cooling water stream (same source of water). Slight elevations in chromium and copper in some surveys have also been reported. Total hydrocarbon concentrations have also been low (≤1.1 mg/L), while HCl concentrations have been below laboratory limits of reporting.

Analysis of degasser fluid has reported high concentrations of total organic carbon, total nitrogen, ammonia and copper. Hydrocarbons were also present in the stream at elevated concentrations (i.e. TRH and BTEX). The production chemical H_2S scavenger has also been reported. Note at the time of submission of this EP, only a single sample of the stream has been analysed as prior to 2021 it was commingled with the produced water stream (Figure 3-4). Following a brownfield modification and subsequent MoC in Q1 2021, it became a standalone stream for the purposes of LEMP monitoring.

Overall FPSO moonpool toxicity has shown some variability, which could be expected given the variability in composition of some of the streams entering the moonpool (i.e. open drains and gas scrubbing). The majority of toxicity results (as dilution requirements) have remained within mixing zone dilution requirements (i.e. 99% species protection is being achieved at edge of mixing zone).

Dispersion modelling

To understand how the moonpool discharge will be diluted and dispersed once it enters the receiving environment, modelling was undertaken by APASA (APASA 2013, 2014, 2015). The modelling has been used to provide an indication of the extent of the environment that may be affected by the commingled discharge, based on the amount of dilution required for constituents to reach an acceptable threshold. Since all streams commingle, the worst-case concentrations of constituents have been adjusted to incorporate the volume of return seawater/cooling water and used as input parameters for the dispersion modelling.

The discharge was modelled for a release from a depth of 5–15 m below the FPSO moonpool (approximately 20–30 m below sea level), at a temperature of approximately 45 °C (approximate cooling seawater discharge temperature), with salinity close to ambient seawater (approximately 35 ppt).

The near-field mixing and dispersion was simulated using the model, Updated Merge (UM3), a three-dimensional lagrangian plume model designed for simulating single and multiport submerged discharges (APASA 2014). During the near-field modelling, 24 simulations were modelled to provide the necessary dilution information.

The far-field stochastic modelling was carried out using the 3D discharge and plume behaviour model MUDMAP (APASA 2015) with 200 replicates of discharge simulated, with each representing continuous discharge for 3 days. Modelling was carried out for both near-field and far-field for summer (October to March), winter (May to August), and transitional (April and September) weather conditions.

The results of the dispersion modelling are summarised below:

- For all weather conditions, modelling indicated that the discharge plume would initially plunge due to momentum and then rise and become trapped in the upper surface layers. Consequently, it will be influenced by surface currents.
- The near-field modelling reported that dilution at the edge of the near-field mixing zone was predicted to range from 17 to 95 times. The range of dilutions achieved through near-field processes, will be affected by current speeds and seasonal temperature differences between the discharge and ambient seawater. It was predicted that the maximum size of the near-field mixing zone extended up to 98 m (equivalent to a dilution factor of 95).
- The far-field modelling results for all simulations indicated that the discharge plume would drift up to the near-surface layer as a relatively thick (10–15 m) layer and would continue to drift horizontally with the currents prevailing in the near-surface layer, while undergoing vertical and horizontal dispersion.
- Variable and patchy concentrations were predicted within the plume, which is attributable to large variations in the current flows past the discharge point. Lower concentrations (resulting from higher dilution) were generally predicted to occur during stronger currents.
- Individual simulations of the far-field model predicted that localised zones, or patches, of higher concentrations may occur during the turning of the tide or during periods of weak drift currents resulting in 'second dosing', where the effluent plume may move back under the discharge at a later time, due to the oscillatory nature of the tide.

Produced water

Produced water may contain a mixture of inorganic salts from geological formations, dissolved organic compounds (including H_2S and CO_2), liquid hydrocarbons, metals, low levels of NORMs and residual production chemicals.

PW rates and composition will be dependent on condensed and formation water rates, which will vary over the life of the reservoirs. Low flow rates of formation water are expected in early years, from the Brewster reservoir, while significantly higher volumes of formation water are predicted when the Plover reservoir is brought online. Average volumes of produced formation water and condensate water from the offshore facility over the 40-year life of the Ichthys project are shown in Figure 7-5.

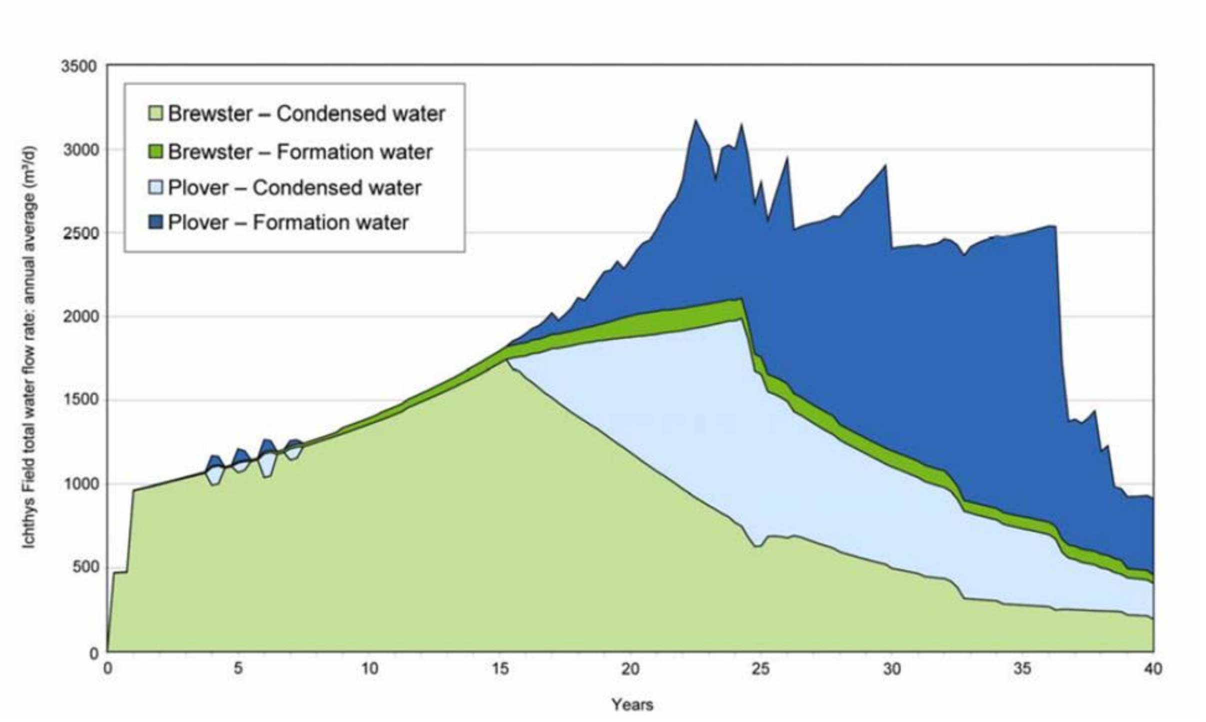


Figure 7-5: Predicted produced water flow rates for the Ichthys Project (INPEX 2010)

During operations, production chemicals are injected into the process fluids (subsea and topside). MEG is injected into the subsea manifolds to prevent the formation of hydrates. It is also injected into the wells for valve leak test actuation and to prevent hydrate formation when the wells are shut in. MEG, combined with the reservoir fluids, is received on the CPF where the gas is compressed for export, and the condensate and rich MEG (CRM) is transferred to the FPSO. On arrival at the FPSO, the CRM is separated into two streams: the condensate, which is exported by offloading tanker; and the rich MEG, which is processed into lean MEG to be reused, and a resulting PW stream.

Some of the injected chemicals are more soluble in oil than water, so they remain in the condensate exported via the offtake tanker. Others are water-soluble and remain in the PW stream which is discharged via the moonpool.

Naturally occurring monovalent salts, e.g. sodium chloride (NaCl), and divalent salts, e.g. predominantly inert calcium carbonate ($CaCO_3$) with minor amounts of strontium carbonate ($SrCO_3$) and magnesium hydroxide ($Mg(OH)_3$) contained in the reservoir fluids are also likely to form part of the PW stream.

In the MEG system these salts are removed from the MEG to prevent scaling and corrosion. The salts are recombined with PW and discharged through the FPSO moonpool. Residual citric acid from periodical descaling of the MEG system is also discharged to sea with the produced water discharge stream via the FPSO discharge moonpool.

The discharge of PW may potentially result in a decline in water quality from liquid components of the PW discharge with a potential to impact transient, EPBC-listed species, and planktonic communities. Particulate components of the PW discharge may also result in a decline in water quality potentially impacting planktonic communities and fish. In addition to water quality, a decline in sediment quality through the deposition of particulate matter in the PW discharge was also identified as having the potential to impact benthic communities.

During field life, the volume of PW to be discharged will vary depending on the quantity and quality of the reservoir fluids extracted. The maximum design flow rate of treated PW is expected to be 180 m^3/h; although, during initial field operations, it will be less than 90 m^3/h. Within the FPSO moonpool, the PW is commingled with around 12 000 m^3/h of return seawater from the cooling system. This is equivalent to, a minimum dilution factor of approximately 1:70 with mixing (which will further assist in reducing the acute toxicity of the PW discharge). The hydrocarbon processing operations undertaken on board the FPSO cannot function without sufficient cooling. Therefore, in the event that the FPSO's cooling water system is not operational, there is no ability to continue operations and, consequently, some discharges will be shutdown. No PW will be discharged in the event that the cooling water system is not operating.

Potential sources of contamination within the PW discharge stream that may result in a reduction in water quality are residual hydrocarbons (after treatment), natural contaminants from within the reservoir itself, and chemicals added to the process to facilitate gas production.

To assess potential impacts and risks associated with contaminants in PW discharges, the principal reservoir constituents and their concentrations have been identified from well-stream fluids sourced from the Ichthys Field (INPEX 2010). In the absence of well-stream fluid data, published literature sources (OGP 2005; Neff et al. 2011) have been considered; whereby, the most conservative values for comparable gas installations have been used in preference to data obtained from crude oil production operations.

For the identified reservoir constituents, the adjusted NEC and the required dilutions to reach threshold guidelines (PNEC/adjusted NEC) have been established (Table 7-16). Values are presented for steady state operations. Increased concentrations of some production chemicals and OIW within the PW discharge are expected to occur, given the potential for short-term chemical imbalances that may arise during upset conditions or when new wells are introduced. Examples of increased production chemicals and reasons why they may occur in the PW discharge stream include:

- TEG: in the event of inefficient gas stripping of TEG because the dehydration towers have not achieved steady state (i.e. the flow of gas is not constant, which might impact the performance of the dehydration towers).
- Scale inhibitor: when bringing on new wells, the first flow of reservoir fluids presents a greater scale risk due to the potential of elevated salt levels arising from wellbore fluids.
- Process biocides (either glutaraldehyde-based or tetrakis (hydroxymethyl) phosphonium sulfate-based): if sludges form as a result of poor process separation; for example, due to lack of heat to the separation train, or the presence of wellbore fluids/solids, additional process biocide may be required for integrity management.
- H2S scavenger: when steady state conditions are not achieved, as may be expected during upset conditions, H2S scavenging may become inefficient, which may result in increased levels of H2S scavenger being discharged.
- Reverse emulsion breaker (clarifier): when steady state conditions are not achieved, as may be expected during upset conditions, water clarification may become inefficient which may result in increased level of reverse emulsion breaker (clarifier) being discharged.

Any increases in concentrations are expected to range in duration from a few hours to 18 days. To reflect this level of uncertainty, the impact and risk evaluation for PW discharges has considered worst-case values with respect to the number of dilutions to inform the mixing zone.

The PNEC is an estimate of the highest concentration of a chemical at which no adverse effects are expected. It therefore provides an estimate of the sensitivity of the ecosystem to a certain chemical. In general, the PNEC represents a toxicity threshold, derived from standard toxicity data (NOEC, LC_{50}, EC_{50}). For production chemicals, the adjusted NEC was obtained by dividing the least favourable toxicity data by an extrapolation factor. An extrapolation factor of 100 was used for chemicals being injected for less than 24 hours (i.e. batch chemicals), and a factor of 1000 was used for chemicals being injected for more than 24 hours (i.e. continuous chemicals). This method follows the principal of the pelagic predicted no effect concentration ($PNEC_{pelagic}$) calculation presented in the chemical hazard assessment and risk management guide (Thatcher et al. 2005). To reflect the limitation of the data available, the highest possible extrapolation factors presented in the guide were used. It is therefore considered that the adjusted NEC values are conservative.

To assess potential impacts and risks associated with the hydrocarbon component of PW discharges, hydrocarbons are expected to be at a concentration of no greater than 30 mg/L OIW during normal operations. Aromatic hydrocarbons and BTEX in particular, are considered some of the most toxic discharge components from the oil & gas industry. BTEX occurs in all PW, but there may be significant differences in concentration between oil and gas fields. It is reported that benzene and toluene are found in significantly higher concentrations in gas fields than in oil fields (OGP 2005). Ichthys Field production is based on an MEG system which is expected to result in higher BTEX concentrations in the PW than other types of offshore production facilities. As such, the facility has been specifically designed to remove BTEX, along with other PW constituents, through primary and secondary treatment.

Factors which could affect OIW concentration and effectiveness of the MPPE package include bringing reservoir fluids and separation equipment (including the MPPE) up to operational temperature and pressure; achieving constant flow of liquids through the equipment; and optimisation of production chemicals to achieve desired fluid separation.

In 2021, a brownfield modification was made to the FPSO in relation to the PW discharge stream. H_2S scavenger used as a production chemical was shown to be causing interference with OIW inline analysers being used to monitor the OIW concentration of the PW stream. To eliminate this interference, the degasser fluid (which contains the H_2S scavenger) was re-routed, to combine with the PW stream downstream of the MPPE unit and PW OIW inline analysers (Figure 3-3). This modification does not result in any change in risk to the marine environment, as the MPPE unit does not extract any triazine (the active/toxic component of the H_2S scavenger). In addition, while the degasser fluid has some OIW content the degasser flowrate and total hydrocarbon load is so small it would not be detectable within the PW OIW concentration 24hr rolling average.

Particulates discharged within the PW stream, or generated upon release of the PW stream into the receiving environment (e.g. due to flocculation or oxidation reactions), have the potential to increase total suspended solids (TSS) to above ambient levels, potentially resulting in a reduction in water quality. The deposition of heavier materials may also lead to a decline in sediment quality through smothering and bioaccumulation; in particular, from metals that may accumulate in sediments over time. However, this potential impact pathway is not considered to exist for the FPSO, given the water depth and nature of the predicted PW discharge.

An evaluation of the impacts and risks associated for steady state PW discharge is provided in Table 7-17 for all identified values and sensitivities.

Table 7-16: Potential PW constituents, maximum predicted concentrations and dilutions required to reach threshold values in the receiving environment

Chemical/ component	**Maximum end-of-pipe discharge concentrations (ppm) [reference]**	**No effect concentration (ppm)** **e.g. adjusted NEC/PNEC**	**Dilutions to reach adjusted NEC/ PNEC**	**Dilutions to reach adjusted NEC/PNEC following moonpool commingling**
Organic acids				
N/A				
Hydrocarbons				
Oil-in-water (OIW)	30 [Basis of Design]	0.05[1]	600	9
Benzene	0.0434 [OGP 2005]	0.5[2]	1	Below NEC at discharge
Toluene	0.0265 [OGP 2005]	0.11[2]	1	Below NEC at discharge
Naphthalene**	0.115 [OGP 2005]	0.05[2]	3	Below NEC at discharge
Phenanthrene**	0.0209 [OGP 2005]	0.0006[2]	35	Below NEC at discharge
Alkylphenols				
Phenols and substituted phenols	2.49 [OGP 2005]	0.27[2]	10	Below NEC at discharge
Metals/metalloids				
Arsenic	0.09 [Neff 2011]	0.0023[2]	40	Below NEC at discharge
Barium	5.1 [Ichthys well-stream data]	1[2]	5	Below NEC at discharge
Cadmium	0.005 [OGP 2005]	0.0007[2]	8	Below NEC at discharge
Chromium	1.6 [OGP 2005]	0.00014[2]	11,429	164
Copper	0.137 [Neff 2011]	0.0003[2]	457	7
Iron	5.3 [Ichthys well-stream data]	0.3[2]	18	Below NEC at discharge
Lead	0.045 [Neff 2011]	0.0022[2]	21	Below NEC at discharge
Manganese	7 [Neff 2011]	0.08[2]	88	2

Chemical/ component	Maximum end-of-pipe discharge concentrations (ppm) [reference]	No effect concentration (ppm) e.g. adjusted NEC/PNEC	Dilutions to reach adjusted NEC/ PNEC	Dilutions to reach adjusted NEC/PNEC following moonpool commingling
Mercury	0.0027 [Neff 2011]	0.0001[2]	27	Below NEC at discharge
Molybdenum	0.0022 [Neff 2011]	0.023[2]	1	Below NEC at discharge
Nickel	0.42 [Neff 2011]	0.007[2]	60	Below NEC at discharge
Vanadium	0.0012	0.05[2]	1	Below NEC at discharge
Zinc	0.145 [OGP 2005]	0.007[2]	21	Below NEC at discharge
Naturally occurring radioactive materials (NORMs)				
226Ra (Bq/L)[3]	1.199 [Neff 2011]	0.0005[4]	2,141	31
228Ra (Bq/L)[3]	0.056 [Neff 2011]	0.002[4]	28	0.4
Production chemicals				
MEG	3241	10[5]	324	5
TEG	148	1[5]	148	3
Oxygen scavenger	21	1[5]	21	Below NEC at discharge
Scale inhibitor	150	0.031[5]	4839	70
TEG corrosion inhibitor	50	3[5]	17	Below NEC at discharge
TEG pH control	0.08	0.6[5]	-	Below NEC at discharge
TEG antifoam	2	1[5]	2	Below NEC at discharge
Diesel biocide	0.0002	0.00003[5]	7	Below NEC at discharge
Process biocide (glutaraldehyde- based)	8	0.014[5]	714	11
Process biocide (THPS-based)	8	0.002[5]	4,000	58
H_2S scavenger	90	0.0037[5]	24,325	347

Chemical/ component	**Maximum end-of-pipe discharge concentrations (ppm) [reference]**	**No effect concentration (ppm)** **e.g. adjusted NEC/PNEC**	**Dilutions to reach adjusted NEC/ PNEC**	**Dilutions to reach adjusted NEC/PNEC following moonpool commingling**
Reverse emulsion breaker (clarifier)	10	1[5]	10	Below NEC at discharge
Citric acid (50 wt. %)	139	10[5]	14	Below NEC at discharge
Sodium carbonate (20 wt. %)	150	10[5]	15	Below NEC at discharge
Chlorine scavenger	1	0.1[5]	10	Below NEC at discharge
HCl (5 wt. %)	5	10[5]	-	Below NEC at discharge

* Organic acids have been omitted from this assessment as they are benign and readily biosynthesised and biodegraded by bacteria, fungi and plants, and represent a source of nutrients (Neff 2011). Volatile organic acids are present at high levels in PW at some installations in the North Sea. Small amounts of aromatic acids (e.g. benzoic acid) also may be present (Neff 2002). However, they contribute little to the marine toxicity of PW and are irrelevant for risk assessment because these compounds in general have a low toxicity and are expected to disappear quite rapidly from the water following PW discharge, because they are highly volatile (OSPAR 2014).

** PAHs are represented by naphthalene and phenanthrene for this assessment. The 2-ring (naphthalene), 3-ring (particularly phenanthrene) PAHs, and their alkyl homologues most often represent more than 95% of total PAHs in PW (US DOE 1997; OOC 1997; Røe Utvik, 1999).

1 Assessment threshold as defined in Table 8-2.

2 99% species protection guideline value ANZG 2018

3 The principle of environmental radiation protection for flora and fauna is based on the International Commission on Radiological Protection (ICRP) recommendation (ICRP 1991). If people are protected by certain radiological standards, then biota are also protected.

4 National Health and Medical Research Council (NHMRC) and Natural Resource Management Ministerial Council *Australian Drinking Water Guidelines* (NHMRC & NRMMC 2011).

5 Calculated using methods detailed in Thatcher et al. 2005 as described in section 2.1.2 of INPEX FPSO Produced Water Key Environmental Parameters Identification (PER-2152643602).

Table 7-17: Impact and risk evaluation - FPSO PW discharges

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Discharging the PW stream to the marine environment has the potential to expose identified values and sensitivities to changes in water quality and sediment quality from liquid and particulate components of the PW discharge stream. The PW stream will be discharged from the FPSO on a continuous basis, from a depth of approximately 20 m below the sea surface. Following a brownfield modification in 2021, in relation to the PW discharge stream, degasser fluid which contains the production chemical H_2S scavenger was re-routed to combine with the treated PW stream downstream of the MPPE unit and PW OIW inline analysers. Worst-case concentrations identified by well-stream fluids analysis and published literature sources have been used to provide a conservative indication of the number of dilutions required for discharged PW components to reach adjusted NECs/PNECs (Table 7-16) following moonpool commingling (note that the PW system cannot operate without the cooling water system; therefore, commingling of PW with the cooling water stream will always occur). The size of the PW discharge zone for the discharge plume is driven by the presence of H_2S scavenger, a production chemical in the PW discharge stream. H_2S scavenger required the greatest number of dilutions to reach the adjusted NEC, requiring 347 dilutions equating to a maximum distance from the discharge point of 1,514 m.

Based on predicted concentrations of solids within the PW discharge stream (reservoirs' insoluble salts from the MEG system), over time the concentration of TSS may be in the order of 44 mg/L on entry to the moonpool, where the stream is then commingled with large volumes of cooling water (approximately 12,000 m^3/h). Upon release to the receiving environment, it is expected that TSS will be in the order of 0.6 mg/L above ambient. In addition to these solids, other particulates may form when the PW stream is discharged to sea, as a result of flocculation and oxidative reactions, which may also contribute to TSS levels. It should be noted that from sampling of the PW stream to date, TSS levels have been below laboratory limits of detection (<1 mg/L) indicating that the PW stream is likely to be condensed (i.e. pure) water rather than formation water as is expected at this stage in field life (Figure 7-5).

Compounds that are soluble in water are expected to rapidly dilute, whereas particulate matter and insoluble products typically settle on the seabed. Insoluble salts may result in impacts to sediments from particulate components of the PW discharge stream. The majority of salts removed from the produced fluids (80%) are monovalent, soluble salts that will dissolve upon discharge to the moonpool. The remaining 20% comprise low-solubility (divalent) salts, predominantly calcium carbonate ($CaCO_3$), with minor amounts of strontium carbonate ($SrCO_3$) and magnesium hydroxide [$Mg(OH)_2$]. These solids are not considered toxic within the marine environment. $CaCO_3$ and $Mg(OH)_2$ are classified as PLONOR (OSPAR 2012). The size of the solids is expected to be between 1 µm and 90 µm. Depending on their size, they will either remain suspended in the water column and contribute to TSS or settle to the bottom.</td></tr>
<tr><th>Potential consequence – liquid components</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted are:
• transient, EPBC-listed species (marine fauna)
• planktonic communities.

Within the PW discharge zone, there are no known BIAs; however, due to the open-ocean location in WA-50-L, there is the potential for threatened and migratory species to pass through the plume. Given that NECs are based upon smaller organisms and early life stages, with higher sensitivity to changes in water quality, transient, EPBC-listed species would need to be exposed to the PW plume for a relatively long period for toxic exposure to occur. As they are generally transiting the area, exposure times are likely to be much</td><td>Insignificant (F)</td></tr>
</table>

lower than the 96-hour chronic exposure periods usually applied in tests to assess toxicity. Furthermore, the plume will generally be diluting exponentially from the source, so the area where toxicity is highest will be localised to the point of discharge, thereby limiting exposure to transient, EPBC-listed species. In the absence of any known BIAs, or key aggregation or feeding habitats within the discharge zone for PW, any exposure is expected to be incidental and not result in any long-term behavioural or physical effects. In the event that transient, EPBC-listed species are exposed to higher concentrations of PW constituents through 'at-source' exposure, there is the potential for limited effects; however, these would only be expected at an individual level with inconsequential ecological significance to protected species (Insignificant F). Planktonic communities present in the surface waters of WA-50-L may be exposed to PW discharges above threshold concentrations if they directly encounter the discharge plume as it vertically and horizontally disperses with the prevailing currents. Any potential for acute or chronic toxicity to planktonic communities would be expected to be limited to within 1,514 m from the discharge source (95th percentile) (APASA 2015). It should be noted that NEC values are typically based on 96-hour exposure data; whereas the likely residence time for organisms drifting into the impact area is approximately anywhere between 20 and 80 minutes, depending on the speed of the current (Section 4.8.2). Nevertheless, plankton in the vicinity of the discharge point could be exposed to the PW plume for a sufficient enough time to elicit a toxic response. The potential consequence on planktonic communities is a localised impact on plankton abundance at the point of discharge with inconsequential ecological significance (Insignificant F).	
Potential consequence – particulate components	Severity
The particular values and sensitivities with the potential to be impacted are: • planktonic communities • demersal fish communities and fisheries • benthic communities. Changes in ambient TSS levels due to discharges of PW have the potential to result in a decline in water quality. Increased water turbidity decreases the passage of light through water and can slow photosynthesis by phytoplankton species and reduce primary productivity (Davies-Colley et al. 1992). Baseline water quality, representative of conditions in WA-50-L, identified that TSS were relatively low, with 3.7 mg/L, 5.0 mg/L and 3.8 mg/L concentrations reported for near surface, mid depth and near seabed locations, respectively (URS 2010). The TSS discharged from the moonpool is therefore expected to be an order of magnitude lower than ambient concentrations, due the high ratio of mixing obtained with the cooling water and, therefore, no direct effects on plankton are expected. Any impacts that could occur would not result in an ecological impact based on the naturally high spatial and temporal variability in plankton distribution in Australian tropical waters (Insignificant F). Fish eggs and larvae are more vulnerable to suspended sediments than older life stages. Jenkins and McKinnon (2006) reported that levels of suspended sediments greater than 500 mg/L are likely to produce a measurable impact upon the larvae of most fish species, and levels of 100 mg/L will affect the larvae of some species if exposed for periods greater than 96 hours. Levels of 100 mg/L are also likely to affect the larvae of a number of marine invertebrate species (e.g. abalone, sea urchins and bivalves). The FPSO is approximately 12 km from the nearest KEF, the continental slope demersal fish community. As the TSS associated with the PW	Insignificant (F)

discharge is at or below ambient TSS levels, there is a limited potential to affect fish eggs, larvae, phytoplankton and marine invertebrates (Jenkins & McKinnon 2006). On this basis, no impact to this KEF or fisheries is expected (Insignificant F). A change in sediment quality has the potential to harm benthic communities through smothering and bioaccumulation, potentially resulting in reduced ecosystem productivity or diversity. Heavier materials, such as insoluble salts, will gradually fall through the water column and settle on the seabed. As they pass through the water column, they will be subject to natural dispersion through oceanographic processes. In the deep waters around the FPSO (approximately 250 m), Stokes' Law indicates a settlement time of approximately 630 days for a 70 µm calcite particle, which is the primary particle to be discharged and maximum particle size expected from the FPSO. Therefore, all anticipated particles which will range up to a maximum size of <70 µm including insoluble salt particles, will not settle locally under the FPSO and are likely to be dispersed throughout the broader Browse Basin. It would likely be impossible to detect the dispersion of these salts given the primary discharged particulate is calcite, which is not a contaminant and occurs naturally in the marine environment in large quantities. WA-50-L is not situated within an AMP and seabed topography is relatively flat, with no seafloor features, such as boulders, reef pinnacles or outcropping hard layers identified. Furthermore, the seabed is suggestive of strong bottom currents and mobile sediments (RPS 2007). Altogether, these characteristics do not favour the development of diverse epibenthic communities. Surveys of the seabed in WA-50-L have identified only very limited numbers of epibenthic fauna. Infaunal assemblages within marine sediments in the area are dominated by polychaete worms and crustaceans which contribute around 70% of the animal species. The polychaetes consist of tube-dwelling deposit feeders and surface deposit feeders, while the crustacean assemblage is made up of small shrimp-like species (RPS 2007). Upon release, metals from the anoxic PW stream can precipitate when mixed with oxygen rich receiving waters. Results from regulatory environmental effects monitoring programs in generally show that natural dispersion processes appear to control the concentrations of toxic metals in the water column and sediments just slightly above natural background concentrations (Neff et al. 2011). PAHs tend to have a low solubility in water, generally remaining associated with oil droplets that can bind tightly to particulates. Although PAHs are of concern environmentally, due to their toxicity and persistence in the environment, they have a low bioavailability to aquatic organisms (OGP 2005; Neff 2002). It should be noted that from sampling of the PW stream to date, the majority of metals have been reported to below laboratory limits of reporting and only trace levels of PAHs have been detected. Metals and hydrocarbons have the potential to accumulate within sediments as a result of PW discharges dispersed potentially over a large area, rather than concentrated in one specific location. The benthic substrate in WA-50-L is comprised of mobile sediments under the influence of very strong currents (RPS 2007). Consequently, once particles have settled, they are expected to be transported further, resulting in additional dispersion. On this basis and given the water depth (approximately 250 m) this impact pathway is not considered relevant to the FPSO. Mercury from the Brewster and Plover reservoirs is elemental mercury (Hg), which is relatively unreactive, has little tendency to dissolve in water, and readily volatises into the atmosphere (Neff 2002). Conversion of elemental mercury to methylmercury ($MeHg^{+}$), with a potential to bioaccumulate and to be toxic, does not occur in well-oxygenated environments (Neff 2002), such as those in WA-50-L. Given that dispersion of these particles will be heavily influenced by drift and strong currents, sediments will settle over a wide area, if at all, for smaller particles. Based on the low ecological diversity of benthic communities and dispersive open ocean environment in WA-50-L, PW discharges are not expected to result in damage to benthic communities from smothering. Impacts to sediment quality from the deposition of	

particulate matter is not expected to occur, given the small particle sizes, long settling times, and expected dispersion within the water column, resulting in widespread low level distribution, with a limited potential for concentrations to accumulate that could result in damage to benthic communities (Insignificant F).	

Identify existing controls
• Achieve OIW discharge specification of ≤ 30 mg/L on a 24-hour rolling average. • Use primary PW treatment consisting of a series of buffer and skimmer tanks to remove hydrocarbons. • Use secondary PW treatment consisting of MPPE. • When a new well is brought online, use of primary and secondary PW treatment systems to achieve OIW discharge specification of <50 mg/L on a 24-hour rolling average for a period not exceeding three days. • Production chemicals discharged to sea assessed using INPEX chemical assessment and approval procedure to ensure those with a low environment hazard rating are preferentially selected in accordance with Section 9.6.1 and Table 9-5. • Maintenance of PW treatment system in accordance with Section 9.6.7 and Table 9-27.

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	Reinject PW into reservoir.	No	The generation of PW cannot be avoided as water is a component of the reservoir fluids. Reinjection of PW into the reservoir or an alternative suitable formation requires a reinjection system using high-pressure water injection pumps. A contingency must also be allowed for when the reinjection system is unavailable, such as during maintenance. Providing a PW reinjection system with backup treatment capability (e.g. an MPPE system) would ensure zero discharge to sea during normal operations and the ability to adequately treat PW during periods of system outage. However, given the substantial cost, space and weight impacts of the MPPE system, and its ability to meet the OIW concentration of less than 30 mg/L on a standalone basis, its use as a backup is considered to be excessive and unjustifiable. Providing the PW reinjection system with buffer storage would eliminate the need for backup treatment. However, within the existing dimensions of the FPSO, the requirement for PW storage capacity would result in a corresponding loss of condensate storage space, with operational implications, and is therefore not considered reasonably practicable. In summary, PW reinjection with either backup treatment or storage is considered impracticable for the management of the PW on the FPSO. It is also noted that the drilling of dedicated PW disposal wells within the Ichthys

			Field would result in additional significant and disproportionate cost and introduce new HSE risks.
Substitution	None identified	N/A	N/A
Engineering	Use hydrocyclones and induced gas flotation as a secondary PW treatment system.	No	The use of hydrocyclones followed by induced gas flotation is not proven to significantly remove aromatics (and BTEX in particular). Since a major requirement of the secondary treatment system is the removal of the potentially high BTEX content in the PW, as well as meeting the ≤30 mg/L OIW discharge specifications, hydrocyclones were not considered.
	Use hydrocyclones and adsorbent filtration as a secondary PW treatment system.	No	Hydrocyclones and adsorbent filtration is considered to offer a greater potential to remove aromatics from PW than induced gas floatation; however, there is a requirement for frequent replacement and disposal of spent media that would present high logistical, cost, safety and environmental concerns and is therefore not considered to be practicable.
	Further treatment of OIW discharge to meet <1 mg/L, on a rolling 24-hour average.	No	After primary and secondary treatment, the PW is commingled with other liquid effluents in the FPSO moonpool at a ratio of at least 70:1. The OIW concentrations, before commingling, will be ≤30 mg/L. Calculations, allowing for the 70:1 ratio indicate that the expected OIW concentrations at the point of discharge into the receiving environment will be <1 mg/L. However, demonstrating this consistently is not reasonably practicable since the risk is already ALARP, based on the primary and secondary levels of treatment, as described above.

Procedures & administration	Implement the INPEX OIW Measurement System, Calibration, Correlation and Validation Strategy including: • online oil in water analysers will be calibrated (6 monthly) • weekly validation check • monthly verification check	Yes	This document defines a strategy to correlate and validate the Ichthys offshore OIW measurement systems including the online OIW analysers and the laboratory handheld instrument (refer Section 9.6.6). It describes the interface required between the laboratory and the operating requirements of the OIW system to improve the operating efficiency of the OIW measurement system. Implementation of this strategy ensures that OIW in the FPSO PW discharge stream meet the specified level of < 30 mg/L. The measurement system is correlated against a proven laboratory measurement technique to prove the initial calibration is accurate and effluent OIW results are accurately and can be confidently reported. It is also appropriate to ensure there is a defined method to correlate online and laboratory handheld analysers. The use of a large data set (e.g. 10 or more points increases accuracy) and a small data set (e.g. 3 points) can be highly variable. Effort and cost increases with the desired level of accuracy. Given that the specified limit of impact is already low, at <30 mg/L, and that data points able to be obtained are all at the lower end of the OIW concentration (i.e. typically between 2- 30 mg/L, INPEX has determined that using at 10 point data set, sampled in triplicate and a linear correlation coefficient of >0.7 is ALARP when it is enacted in parallel with a monthly validation process. Meeting a correlation co-efficient of 0.9 would require a broader data set with higher OIW concentrations in a range 0-100 mg/L which are not readily available offshore during operations and is therefore not practicable. An EPO and EPSs related to OIW measurement calibration, correlation, validation and verification are presented in Table 9-26.

	In the event the online analysers fail (or they are offline in "Lab test" mode for maintenance purposes) INPEX will undertake sampling and analysis in the offshore laboratory, to confirm OIW concentrations are below 30 mg /L on a 12-hourly basis. The overboard discharge valve will be closed manually if a reading above 30 mg/L is observed.	Yes	Online analysers are an effective way to monitor oily water discharges in real time. However, there are periods when the online analysers may not be switched on or they are not functioning. This occurs during periods of maintenance or for calibration. If discharges need to occur during this time (i.e. when the analysers are offline) an alternative measurement is required to ensure discharges remain under the 30 mg/L specification and the facility remains capable of discharging the produced water tank. Prior to opening the discharge valve, a reading under 30 mg/L is required. It is considered reasonable approximate the online analysers purpose by re-testing the discharge stream at 12 hourly intervals to confirm the discharge remains on specification (i.e. <30 mg/L). Taking samples manually and testing them requires time and effort for technicians to retrieve a sample conduct the analysis and report back to the Operator the associated oil in water reading. The PW package is inherently more reliable than the open drains is not likely to produce off-specification water. In the event that a manual sample during discharge is higher than 30 mg/L the operators will be advised and the discharge valve shall be closed. This method approximates the performance of the online analysers and discharge valve function and is considered ALARP due the insignificant consequence of oily water discharges and the considerable manual labour involved in determining the oil in water content at a greater frequency. An EPO and EPS related to contingency OIW measurement is presented in Table 9-26.
	Implement reliability targets for OIW analysers	No	The use of reliability targets is not considered warranted because the effectiveness of the online analysers is predicated by their accuracy which is determined by their calibration, maintenance and verification frequency which is described in detail in (Section 9.6.6). There is limited value in applying reliability targets to online analysers that have not been calibrated and maintained correctly because the associated readings would likely be misleading. It is therefore not considered ALARP to apply a reliability target to the use of online analysers when their performance is already managed via INPEX OIW Measurement System, Calibration, Correlation and Validation Strategy.

	Monitor the degasser fluid OIW concentration via daily laboratory sampling.	No	Degasser fluid OIW concentrations are several orders of magnitude less than PW OIW concentrations discharged to the marine environment, and therefore would not be detectable within the PW OIW 24/hr rolling average concentration. Therefore, it is not reasonable to require daily manual laboratory sampling to determine the OIW concentration of the degasser fluid. LEMP sampling program includes monitoring of the degasser fluid H_2S concentration, and OIW concentration can also be verified via the LEMP sampling program as described in Section 9.6.2.

Identify the likelihood

Likelihood	Given the proposed safeguards that will be in place, localised impacts from liquid and particulate components of the PW discharge to the abundance of plankton within the vicinity of the point of discharge is considered to be Possible (3). However, this is 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 WA-50-L or within the discharge zone for PW (1,514 m), the likelihood of impacts from liquid components of the PW discharge after treatment and subsequent dilution and dispersion is considered Unlikely (4) and is not expected to result in a threat to population viability of protected species. The likelihood of impacts to benthic communities and demersal fish communities (KEF) and fisheries from particulate components of the PW discharge is considered to be Unlikely (4) given that the TSS associated with the PW discharge is below ambient levels.
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Possible (3) the residual risk is Low (8).

Residual risk summary

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

Assess residual risk acceptability

Legislative requirements

Commonwealth approval (EPBC 2008/4208) was obtained to develop the Ichthys Field in the Browse Basin, comprising of the development of two natural gas and condensate reservoirs, Brewster and Plover, with approval granted for up to 50 wells across 12 – 15 drill centres.

Discharge of treated PW is standard industry practice. Although the previous regulations regarding OIW concentrations have been withdrawn, the facility design and treatment system was completed to meet the 30 mg/L concentration. This limit aligns with other countries, including the USA and those covered by OSPAR (North-East Atlantic). There are no other relevant Australian environmental legislative requirements that relate specifically to the discharge of PW.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from planned discharges of PW including degasser fluid.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are a common threatening process identified in several conservation management documents; however, none of the recovery plans or conservation advices have specific actions relating to PW discharges.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standard	Measurement criteria
Impacts to identified values and sensitivities from planned liquid discharges associated with the offshore facility are limited to a localised area.	During normal operations, no discharge to the moonpool of PW OIW >30 mg/L, based on a 24-hour rolling average.	Records confirm PW OIW concentrations to moonpool are ≤30 mg/L.
	PW primary treatment will be used to ensure no discharge to the moonpool of PW OIW >30 mg/L, based on a 24-hour rolling average.	Records confirm PW OIW concentrations to moonpool are ≤30 mg/L.
	PW secondary treatment systems (MPPE) will be used to ensure no discharge to the moonpool of PW OIW >30 mg/L, based on a 24-hour rolling average.	Records confirm PW OIW concentrations to moonpool are ≤30 mg/L.
	During three-day 'new well online' period, PW primary and secondary treatment systems and OIW analyser are operated to ensure no discharge to moonpool of PW OIW >50 mg/L based on a 24-hour rolling average.	Records confirm PW OIW concentrations to moonpool are <50 mg/L.

Table 7-18: Impact and risk evaluation - FPSO cooling water discharges

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Cooling water discharges from the FPSO have the potential to result in maximum continuous discharge volumes in the order of 12,000 m³/h. The facility has been designed so that cooling water discharges do not exceed 45 °C. As described previously, Table 7-10 (APASA 2011, 2016), modelling of the thermal plume has been considered. Despite the modelling being undertaken for the CPF, due to water depth and similarities in the nature of the discharge (temperature) and metocean conditions, it is applicable to use as a proxy for FPSO cooling water discharges. The modelling is conservative, as discharge rates from the CPF exceed those from the FPSO. The outcome of the modelling indicated that near-field processes of turbulence and entrainment of ambient water should limit the temperature of the discharge plume to no more than 1.6 °C above ambient seawater temperature at 100 m from the discharge point and return to ambient levels within a maximum of 400 m from the point of discharge (APASA 2016). Upon discharge, the plume is forecasted to remain positively buoyant and rise towards the surface once downward momentum is lost. Therefore, additional cooling, due to heat loss to the atmosphere (not included in the modelling), is expected to result in the actual temperature elevation being less than that predicted.

As detailed in Section 3, the FPSO cooling water system is treated continuously with NaClO, generated through an electrolysis reaction in the biofouling control package. The FPSO biofouling control package is designed to dose at a concentration of approximately 3 ppm, with shock dosing of approximately 5.0 ppm, for approximately 15 minutes every 6 hours. These dosing rates will result in an anticipated 24-hour rolling average concentration of 3.1 ppm to 3.5 ppm. The NaClO biocide was selected as the biofouling control option based on it being considered as an established and efficient technology for use in offshore environments and is used throughout the world (Khalanski 2002; Grandison 2012; Anasco 2008; Verween 2009). The effects of chlorination on the marine environment have been summarised in Table 7-10 and indicate that the toxicity of the cooling water is negligible at discharge and unlikely to require further dilution. However, thermal discharge may still present an issue, as noted, but will be no more than 1.6 °C above ambient temperatures within 100 m and return to ambient levels within a maximum of 400 m of the point of discharge (equating to approximately 60 dilutions; APASA 2016) and is, therefore, the remaining focus of the impact evaluation.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Particular values and sensitivities with the potential to be impacted are:
• transient, EPBC-listed species
• planktonic communities.

Modelling outputs indicate that near-field processes should limit the temperature of the discharge plume to no more than 1.6 °C above ambient temperature at 100 m and that the temperature would return to ambient levels within a maximum of 400 m from the point of discharge for the worst-case scenario. This is in alignment with International Finance Corporation (IFC) guidelines (2015) that recommends discharges should not result in a temperature increase of more than 3 °C at the edge of the mixing zone. It should also be noted that surface waters of the region are tropical year-round, with surface temperatures of ~26 °C in summer and ~22 °C in winter (DSEWPaC 2012). Baseline monitoring in the offshore development area recorded surface water temperatures of ~30 °C in summer (March) and ~26–27 °C in winter (July) (INPEX 2010). Therefore, over the seasons, seawater temperatures naturally vary by around 3 to 4 °C.</td><td>Insignificant (F)</td></tr>
</table>

Effects of elevation in seawater temperature cause 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-50-L, and EPBC-listed species with the potential to be present in the licence area are considered to be transient in nature. The facility is situated in an open-ocean location in a water depth of approximately 250 m in a high current environment; therefore, potential consequences on transient, EPBC-listed species are potentially localised avoidance of thermally elevated water temperatures with an inconsequential ecological significance to protected species (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).	

Identify existing controls			
• Monitoring of NaClO dosing levels (measured as chlorine equivalent)			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharge of CW to the marine environment.	No	Cooling is an inherent requirement of the CPF topsides processing equipment, and its requirement cannot be eliminated. The Brewster and Plover Formations are gas reservoirs for which there is no requirement for pressure maintenance. Therefore, the potential to dispose of cooling water subsurface (i.e. into a geological formation) is not a practicable option.
Substitution	Substitute NaClO with an alternative biofouling control/mechanism.	No	It is necessary to control biofouling within seawater cooling systems. A range of biofouling technologies were evaluated during the design of the facility but were excluded for a number of reasons as detailed below: • Chlorine used as alternative biocide – added directly to seawater instead of using NaClO generated by seawater electrolysis was excluded due to H&S hazards of handling chlorine gas. • Bromine used as alternative biocide – not considered possible due to bromine degrading before reaching all parts of the system and the requirement for a large biofouling control plant with space and weight penalties.

			• Peroxide used as alternative biocide – discounted due to hazardous nature and possible H&S hazards. • Ozone used as alternative biocide – unproven technology in the offshore environment and uncertainty regarding degradation before reaching all parts of the system. • Non-oxidising biocides such as glutaraldehyde – generally used in closed-loop systems and are unsuitable for an open-circuit cooling system as is in place on the CPF. They are high cost and tend to target either bacteria, or algae, or fungi, rather than provide protection against all biological growth, therefore were discounted. • Biodispersants and biodetergents – Often used in conjunction with biocides, they can be useful to break up biofilms but are not considered an alternative to biofouling prevention. They may cause foaming and are not considered suitable for open-loop cooling systems. • UV light – unproven technology in the offshore environment and uncertainty on level of performance due to turbidity affecting the performance of the UV lamps. • Hypochlorite is included as a recommended technique in the application of best available techniques (BAT) to industrial cooling systems (European Commission 2001).
Engineering	Use of fin fan coolers.	No	The discharge of warm seawater could, in principle, be avoided by air cooling; however, due to the low specific heat capacity of air, a large cooling requirement, such as the one on the CPF, demands a substantial cooling area and associated structural support, imposing significant space and weight penalties. The CPF is space-limited and air cooling is therefore not considered to be a realistic option.
Procedures & administration	Monitoring of chlorine produced oxidants (HOBr and bromoamines) at the point of discharge to the seawater caisson.	No	Due to the chemical instability of NaClO and chlorine produced oxidants within the system, sampling of the concentration of various reaction products would not provide an accurate measure of actual concentrations when reaching the receiving environment.
	Monitoring of cooling water temperature.	No	The FPSO has been designed so that cooling water discharges do not exceed 45°C. The performance of the FPSO seawater system has been validated with cooling water discharge temperatures recorded between 33 and 38°C.

	Temporary operating procedure implemented in the event that the biofouling control package is inoperable.	Yes	If the biofouling control package fails, the implementation of temporary arrangements would be put in place to replicate the required dosing.

Identify the likelihood	
Likelihood	Localised impacts to the abundance of plankton within 100 m of the planned CW discharges is considered Possible (3). However, this is ecologically insignificant based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters. Planned discharges of CW may result in localised (within 400 m) avoidance behaviour in transient, EPBC-listed species and is considered Possible (3). However, in the absence of any known BIAs for transient, EPBC-listed species any behavioural impacts are not expected to result in a threat to population viability of protected species.
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Possible (3) the residual risk is Low (8).

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

Assess residual risk acceptability

Legislative requirements

The discharge of return seawater from cooling water systems to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of cooling water. The 45 °C limit (inherent through the design of the CPF) on the discharged cooling water temperature ensures that the discharge plume will be no more than 1.6 °C above the ambient seawater temperature at 100 m from the discharge point. This complies with the Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development published by the IFC. Sodium hypochlorite generated in situ is an OCNS non-CHARM product which is assigned a Group E rating (at a dose rate of 1,000,000 ppm). Group E products are considered to have very low potential environmental hazard.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks cooling water discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). Emissions and discharges are a common threatening process identified in several conservation management documents; however, none of the recovery plans or conservation advices have specific actions relating to cooling water discharges.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	Environmental performance standard	Measurement criteria
Impacts to identified values and sensitivities from planned liquid discharges associated with the offshore facility are limited to a localised area.	Inlet concentration of NaClO will not exceed 3.5 ppm, based on a 24-hour rolling average, calculated from two samples per 24-hour period.	NaClO offshore laboratory sampling results.
	In the event that the biofouling control package is inoperable, NaClO concentrations not exceeding 3.5 ppm, based on a 24-hour rolling average will be maintained in accordance with a temporary operating procedure.	NaClO dosing records

Table 7-19: Impact and risk evaluation - FPSO ballast water discharges

Identify hazards and threats			
Impacts and risks associated with high risk ballast water and biofouling and potential for introduction and establishment of IMS are addressed in Table 7-33 of this EP. Ballasting on the FPSO uses seawater pumped from the inlet moonpool that is dosed at the point of inlet with NaClO at a concentration of 3–3.5 ppm, to inhibit biofouling with no further dosing of ballast tanks with biocide. Return ballast is discharged to sea via the moonpool on an as-required basis. Intermittent flows of ballast water will be discharged (3400 m^3/h maximum capacity).			
Potential consequence			**Severity**
Particular values and sensitivities with the potential to be impacted are: • planktonic communities. Based on the assessment in Table 7-10, the toxicity of the ballast water fed from the cooling water stream is considered to be negligible at discharge. Furthermore, due to the long residence time of seawater within the ballast tanks, the NaClO and CBPs will have been subjected to additional degradation over time. Therefore, potential impacts to planktonic communities are considered to be Insignificant (F).			Insignificant (F)
Identify existing controls			
Refer to existing controls for FPSO cooling water discharges (Table 7-18)			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharge of ballast water to the marine environment.	No	Ballasting and deballasting with seawater is an essential activity to ensure the stability and structural integrity of the FPSO particularly for offloading operations and cannot be eliminated. The onboard storing of ballast water and shipping to the mainland for the duration of operations is grossly disproportionate to the low level of risk associated with this discharge. Additional environmental impacts would also be generated in terms of air emissions and onshore disposal.
Substitution	Use an alternative method to prevent biofouling of ballast water.	No	The feed for the ballast water is supplied from the seawater cooling system and, during the design of the facility, several biofouling technologies were considered. They were discounted for a number of reasons as described in Table 7-10.
Engineering	None identified	N/A	N/A

Procedures & administration	Monitoring of chlorine produced oxidants (HOBr and bromoamines) at the point of discharge to the moonpool.	No	Due to the chemical instability of NaClO and chlorine produced oxidants within the system, sampling of the concentration of various reaction products would not provide an accurate measure of actual concentrations when reaching the receiving environment. This is particularly so given the long residence time of ballast water in the ballast water tanks.

Identify the likelihood	
Likelihood	The discharge of ballast water will be intermittent in nature and is of negligible toxicity. Controls in place concerning monitoring and maintaining concentrations of NaClO are described for the cooling water system (Table 7-10). Given the comparatively small volume of ballast water discharges to the open-ocean environment in WA-50-L, is not expected to affect plankton abundance at the point of discharge or result in impacts of ecological significance based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters (Remote 6).
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Remote (6) the residual risk is Low (10).

Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Remote (6)	Low (10)

Assess residual risk acceptability
Legislative requirements The discharge of ballast water is a standard practice in industry with insignificant consequences to the environment as identified above. Sodium hypochlorite generated in situ is an OCNS non-CHARM product which is assigned a Group E rating (at a dose rate of 1,000,000 ppm). Group E products are considered to have very low potential environmental hazard. Ballast water discharges will be in accordance with the legislation described in Table 7-33. Stakeholder consultation No stakeholder concerns have been raised regarding potential impacts and risks from ballast water discharges. Conservation management plans / threat abatement plans Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to discharges of ballast water containing residual NaClO. ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	Environmental performance standard	Measurement criteria
Refer to Table 7-18		

Table 7-20: Impact and risk evaluation - FPSO sewage, grey water and food waste discharges

<table>
<tr><th colspan="4">Identify hazards and threats</th></tr>
<tr><td colspan="4">Discharging 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.
Sewage generated on the FPSO will be macerated and combined/diluted with grey water and food waste before discharge via a dedicated hose in the discharge moonpool at a depth of approximately 30–35 m. Volumes of sewage effluent, grey water and food waste will vary over the 40-year life of the operation. For example, when the maximum number of persons on board (POB) is required for the FPSO (i.e. 200), up to 60 m^3/day of sewage effluent and grey water may be generated. The discharge from the facility is not continuous and is considered to be intermittent (or pulsing) in nature, and principally occurs during two-hourly peak periods at shift changeover, with smaller volumes generated outside of these times. The maximum flow rate of sewage discharge is in the order of 24 m^3/h and has been used for this assessment to provide a worst-case scenario.
As with sewage and grey water, the volumes of food waste will also vary over the life of the operation influenced by the number of POB. Volumes of up to 0.36 m^3/day are estimated at times with maximum POB. These volumes, however, are also expected to be smaller when less people are on board and will fluctuate during shift changeover and mealtimes. Food waste will be also macerated (<25 mm) before discharge via a dedicated hose within the moonpool at a depth of approximately 30–35 m.</td></tr>
<tr><th colspan="3">Potential consequence</th><th>Severity</th></tr>
<tr><td colspan="3">Particular values and sensitivities with the potential to be impacted are:
• planktonic communities.
A study undertaken to assess the effects of nutrient enrichment from 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-50-L at the point of discharge (dedicated discharge hose within the moonpool). The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the discharge. Given the deep water (approximately 250 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).</td><td>Insignificant (F)</td></tr>
<tr><th colspan="4">Identify existing controls</th></tr>
<tr><td colspan="4">• Maintenance of sewage macerators on board the FPSO in accordance with Table 9-27.</td></tr>
<tr><th colspan="4">Propose additional safeguards/control measures (ALARP evaluation)</th></tr>
<tr><th>Hierarchy of control</th><th>Control measure</th><th>Used?</th><th>Justification</th></tr>
</table>

Elimination	Eliminate discharges from the FPSO by storage of sewage, grey water and food waste on board and ship to the mainland.	No	The significant financial cost and health risks associated with storing sewage, grey water and food waste on board the FPSO and shipping it to the mainland for the duration of operations is grossly disproportionate to the low level of risk associated with this discharge. Additional environmental impacts would also be generated in terms of air emissions and onshore disposal.
Substitution	Use alternative sewage treatment technologies on the FPSO, such as activated sludge, membrane bioreactor or electrolytic treatment.	No	These treatment options require the package to be desludged on a regular basis. In addition to this, these technologies may result in additional impacts and risks through discharge of additional chemicals (such as flocculants and defoaming agents). Equally, technologies, such as membrane bioreactors, are liable to clogging, which may impact on their reliability. As such, implementing alternative treatment technologies is grossly disproportionate to the level of risk reduction achieved, given that the impacts are already deemed to be insignificant.
Engineering	None identified	N/A	N/A
Procedures & administration	None identified	N/A	N/A

Identify the likelihood	
Likelihood	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 licence area are unlikely to cause toxic effects, especially considering the rapid dilution provided by the deep water and ocean currents. The maceration of sewage and food waste to a particle size <25 mm prior to disposal, will increase the ability of the effluent stream to disperse rapidly. The sewage system/toilets onboard the FPSO operate on a vacuum system, driven by an impellor which macerates; therefore, no sewage can enter the marine environment which has not been macerated. This ensures that the discharge can disperse readily. Localised impacts to the abundance of plankton at the point of the planned discharge are considered to be Unlikely (4) and ecologically insignificant based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters.
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).

Residual risk summary		
Consequence	Likelihood	Residual risk

Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		

Legislative requirements

Sewage, grey water and food waste discharges are standard practice in the offshore environment with insignificant consequences to the environment as identified above. Sewage, grey water and food waste disposal from vessels is permissible under MARPOL; however, Annex IV of MARPOL does not apply to the CPF or FPSO.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from sewage, grey water and food waste discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to discharges of sewage, grey water and food waste. The maceraters will assist in reducing impacts from this discharge stream, consistent with the intent of the conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standard	Measurement criteria
Refer to Table 9-27		

Table 7-21: Impact and risk evaluation – FPSO Open drains and bilge discharges (deck drainage, bilge and firefighting foam)

<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, has the potential to expose marine fauna to changes in water quality and/or result in impacts through direct toxicity.

FPSO oily water discharges are infrequent due to the large storage tanks. The maximum capacity of the open-drains centrifuge to treat oily water on the FPSO is 50 m^3 per hour. The oily water burden of the FPSO is greater than that of the CPF due to the requirement for tank cleaning and other cargo and process system-flushing operations. Therefore, upstream of the open-drains centrifuge package is a slops tank where bulk separation of oil and water occurs through gravity separation, with recovered oil recycled back through the process. The oily water is pumped to the open-drains centrifuge for treatment and then on to a downstream OIW monitor where, if it meets specification, i.e. ≤15 ppm (v), it is discharged to sea via the moonpool. If it is off-specification, the water is recycled to the slops tank.

The FPSO is equipped with firefighting foam and its availability on board is a safety-critical requirement. The foam system supplies 3% FFFP foam which will be used in the event of an incident or infrequent testing. Therefore, foam discharges will not be frequent or routine, but will be discharged to sea via the open drains in the event they are required.

If biocidal treatment is required, a glutaraldehyde-based biocide will be used. The exact treatment batch size and frequency would depend on the extent and magnitude of the bacteria proliferation. The biocide will be dosed into the (open drains) drain boxes. A worst-case batch of up to 63 L/day could be dosed into the open drains. The discharge of the biocide to the marine environment has the potential to expose identified values and sensitivities to changes in water quality.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Particular values and sensitivities with the potential to be impacted are:
• transient, EPBC-listed species
• planktonic communities.

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, etc.) into the water column albeit in low concentrations. This could potentially result in a reduction in water quality, and impacts to transient, EPBC-listed species and planktonic communities.

Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in WA-50-L, the potential exposure is likely to be limited to individuals close to the discharge point at the time of the discharge. Worst case impacts 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 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>

There is the potential for planktonic communities within WA-50-L to 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). Firefighting foams, such as FFFP, contain organic and fluorinated surfactants which can deplete dissolved oxygen in water (Schaefer 2013; ANSUL 2007; IFSEC Global 2014). However, as described for the CPF, this type of foam is considered to have a relatively low toxicity to aquatic species used in its diluted form (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 (ANSUL 2007). The FFFP type foam identified for the FPSO is biodegradable and does not bioaccumulate (Dafo Fomtec AB 2013). In the event that firefighting foam is required (in the event of an emergency or for infrequent testing), the foam systems mix the foam concentrates (3%) with water (97%) prior to application and then further dilution and dispersion following discharge to the open-water environment around the facility is expected to occur before any significant demand for dissolved oxygen or toxicological effects can occur. As toxicological effects from the foam proposed to be used are associated with frequent or prolonged exposures, and discharges 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. Glutaraldehyde based biocides are considered to be environmentally highly hazardous (due to their aquatic toxicity), non-bioaccumulative, and readily biodegradable. As such they are not considered to accumulate in organisms and are expected to be rapidly dissolved by biological means (such as bacteria and fungi). Thus, the main risk associated with the discharge is the acute toxicity at the moment of discharge. A batch of 63 L would represent a concentration of 0.22 mg/l at the point of discharge. At such a concentration, based on the FPSO moonpool dispersion modelling (see Dispersion modelling section), it is expected that the adjusted NEC* would be reached within 98 m from the point of discharge and that no significant potential environmental impacts would be experienced from that point. It is also expected that the potential biota exposure will be limited to individuals close to the discharge point at the time of the discharge (i.e. potential localised and short-term impacts – Insignificant F). It is important to note that at the time of discharge it is anticipated that the biocide will be spent and therefore the chemical will have lost some (if not most) of its biocidal properties. While it is therefore possible that a temporary impact associated with the discharge could occur in the close vicinity of the discharge, INPEX has no knowledge of such event occurring in the offshore oil and gas industry through the use of glutaraldehyde-based biocides. *The method to establish the adjusted NEC is presented in the produced water section.	
Identify existing controls	
• Spills will be managed in accordance with the controls identified in Table 7-38 (accidental release) • Vessel crew will receive an induction/training to inform them of the deck spill response requirements in accordance with Table 9-3. • Discharges of oily water are be treated to <15 ppm (v) equivalent to the specification prescribed by with MARPOL Annex I.	

- INPEX Chemical, assessment and approval procedure has been used to select the firefighting foam and glutaraldehyde-based biocide in accordance with Section 9.6.1.
- If a chemical from a closed-loop system requires discharge to the marine environment, an assessment will be undertaken to confirm the mixing zone will not be breached (Table 7-28).
- Maintenance of open drains centrifuge package in accordance with Table 9-27.

Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharges of contaminated deck drainage or bilge to sea.	No	Discharge of deck drainage stormwater runoff or bilge discharges cannot be eliminated from the FPSO. There is not sufficient space available on board for storage and onshore disposal is not practicable given the distance to the mainland and the associated emissions and discharges associated with transfer by vessel.
	No discharge of firefighting foam solutions to sea.	No	The use of firefighting foams on board the facility is safety critical and these are required in the event of a fire to prevent potential loss of human life or the occurrence of a significant environmental incident. Therefore, the availability of firefighting foams cannot be eliminated. Drainage of the foams from the decks of the facility is also essential as they would present a separate safety hazard and could impede firefighting activities. Therefore, drainage and discharge of foam solution to the sea also cannot be eliminated.
	No discharge of glutaraldehyde-based biocide to sea	No	Not treating the open drains would expose the open drains system to a significant bacterial-induced corrosion issue, which in turn would present a significant facility integrity issue (for instance it could jeopardize the integrity of the open drains centrifuge package and its ability to remove hydrocarbons).
Substitution	None identified	N/A	N/A

Engineering	Use of alternative oily water treatment options.	No	A number of alternative oily water treatment technologies were considered during design for permanent use but were excluded for a number of reasons, as detailed below: • Tilted-plate technology – Although widely used for bilge treatment and with no requirement for chemicals or replacement filters, this was discounted due to concerns about its ability to operate under periods of vessel motion and also an uncertainty about achieving the required discharge specifications, i.e. <15 ppm(v). • Membranes – The use of membranes to remove OIW was discounted due to the propensity for build-up of solids, resulting in a high maintenance burden, however these may be used on a temporary basis because they can be effective. • Mixed-media beds – Proven to remove hydrocarbons to low levels; however, they have a large space and weight requirement and, therefore, were not selected for use.
	Discharge separation and containment system for firefighting foams/open-drains system closure.	No	Given the limited quantities of firefighting foam that may be discharged, the limited (insignificant) consequence of potential impacts that may arise from such a discharge, and the low likelihood/frequency of a discharge occurring (emergency event or infrequent test event), implementing separate drainage systems for firefighting foams is not considered practicable. The cost of implementing such measures is grossly disproportionate to the limited environmental benefit that could be achieved, and during an emergency event, the priority will be ensuring safety and containment of a fire. Implementation of additional engineering measures and procedures to close the open-drains system and re-route firefighting foams is not practicable in a situation when firefighting systems must be activated as soon as possible to contain a fire and the decks adequately drained to ensure the safety of personnel, integrity of the facility, and prevent a significant environmental incident from occurring.
Procedures & administration	Statement of compliance from third party inspector confirms equivalence to MARPOL Annex 1.	Yes	Annual verification audits will confirm that the CPF oil filtering and discharge monitoring system is equivalent to relevant requirements of MARPOL Annex I.

	Implement the INPEX OIW Measurement System, Calibration, Correlation and Validation Strategy including: • online oil in water analysers will be calibrated (2 yearly) • weekly validation check • monthly verification check	Yes	This document defines a strategy to correlate and validate the Ichthys offshore OIW measurement systems including the online OIW analysers and the laboratory handheld instrument (refer Section 9.6.6). It describes the interface required between the laboratory and the operating requirements of the OIW system to improve the operating efficiency of the OIW measurement system. Implementation of this strategy ensures that OIW in the FPSO open drains discharge stream meet the specified level of < 15 ppm(v). The measurement system is correlated against a proven laboratory measurement technique to prove the initial calibration is accurate and effluent OIW results are accurately and can be confidently reported. Calibration of oil in water analysers for marine vessels to comply with Annex I of MARPOL is every 2 years therefore this frequency has been adopted and is considered ALARP. It is also appropriate to ensure there is a defined method to correlate online and laboratory handheld analysers. The use of a large data set (e.g. 10 or more points increases accuracy) and a small data set (e.g. 3 points) can be highly variable. Effort and cost increases with the desired level of accuracy. Given that the specified limit of impact is already low, at <15 ppm(v), and that data points able to be obtained are all at the lower end of the OIW concentration (i.e. typically between 2- 30 ppm(v), INPEX has determined that using at 10 point data set, sampled in triplicate and a linear correlation coefficient of >0.7 is ALARP when it is enacted in parallel with a monthly validation process. Meeting a correlation co-efficient of 0.9 would require a broader data set with higher OIW concentrations in a range 0-100 ppm(v) which are not readily available offshore during operations and is therefore not practicable. An EPO and EPSs related to OIW measurement calibration, correlation, validation and verification are presented in Table 9-26.
	In the event the online analysers fail (or they are offline in “Lab test” mode for maintenance purposes), INPEX will undertake sampling and analysis in the offshore laboratory, to confirm	Yes	Online analysers are an effective way to monitor oily water discharges in real time. However, there are periods when the online analysers may not be switched on, or they are not functioning. This occurs during periods of maintenance or for calibration. If discharges need to occur during this time (i.e. when the analysers are offline) an alternative measurement is

	OIW concentrations are below 15 ppm(v) on a 6-hourly basis. The overboard discharge valve will be closed manually when a reading above 15ppm(v) is observed.		required to ensure discharges remain under the 15ppm(v) specification and the facility remains capable of discharging excess water. Prior to opening the discharge valve, a reading under 15ppm(v) is required. It is considered reasonable approximate the online analysers purpose by re-testing the discharge stream at 6 hourly intervals to confirm the discharge remains on specification (i.e. <15ppm(v)). Taking samples manually and testing them requires time an effort for technicians to retrieve a sample, conduct the analysis and report back to the Operator the associated oil in water reading. In the event that a manual sample during discharge is higher than 15ppm(v) the operators will be advised and the discharge valve shall be closed. This method approximates the performance of the online analysers and discharge valve function and is considered ALARP due the insignificant consequence of oily water discharges and the considerable manual labour involved in determining the oil in water content at a greater frequency. An EPO and EPS related to contingency OIW measurement is presented in Table 9-26.
	Implement reliability targets for OIW analysers	No	The use of reliability targets is not considered warranted because the effectiveness of the online analysers is predicated by their accuracy which is determined by their calibration, maintenance and verification frequency which is described in detail in (Section 9.6.6). There is limited value in applying reliability targets to online analysers that have not been calibrated and maintained correctly because the associated readings would likely be misleading. It is therefore not considered ALARP to apply a reliability target to the use of online analysers when their performance is already managed via INPEX OIW Measurement System, Calibration, Correlation and Validation Strategy.
Identify the likelihood			
Likelihood	Oily water is treated to a maximum concentration of 15 ppm(v) OIW prior to discharge, as specified in MARPOL, Annex 1. Localised impacts to the abundance of plankton in the vicinity of the planned intermittent open-drains discharge (oily water and firefighting foam) are considered to be Possible (3). However, this is 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 WA-50-L, the likelihood of impacts from the discharge after treatment by the open-drains centrifuge 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	Based on a consequence of Insignificant (F) and likelihood of Possible (3) the residual risk is Low (8).	
Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Possible (3)	Low (8)
Assess residual risk acceptability		

Legislative requirements

Oily water discharges from the CPF will meet relevant international regulatory requirements, including MARPOL, enacted by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* in Commonwealth waters. Discharges of OIW of <15 ppm (v) is permitted under MARPOL and is considered as standard practice in the offshore environment.

The firefighting system on the FPSO has been designed to meet the requirements specified in Det Norske Veritas (DNV) Standard (DNV-OS-D301), CAP437 (Offshore Helicopter Landing Areas) and relevant National Fire Protection Association Standards.

The selected glutaraldehyde-based biocide is registered on the Australian Inventory of Chemical Substances (AICS).

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from oily water and firefighting foam discharges.

AMSA (and DNV) provided guidance on how INPEX could demonstrate compliance with MARPOL Annex 1 through the use of equivalence applications and obtaining a 'Statement of compliance'.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are a common threatening process identified in several conservation management documents; however, none of the recovery plans or conservation advices have specific actions relating to oily water discharges. The controls on oily water discharges are consistent with industry best practice and align with the intent of the conservation management documents, to reduce emissions and discharges.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standard	Measurement criteria
Impacts to identified values and sensitivities from planned liquid discharges associated with the offshore facility are limited to a localised area.	Oily water treatment system operated to prevent the discharge of >15 ppm(v) to the moonpool.	Records confirm OIW concentrations in open drains discharge to the moonpool is ≤15 ppm(v).
	Statement of compliance from third party inspector (confirms equivalence to MARPOL Annex 1).	Statement of compliance from third party inspector.
	Closed loop system discharges assessed to confirm potential toxicity will not exceed the mixing zone described within Table 7-28.	Record of environmental assessments for closed loop system drainages.

Table 7-22: Impact and risk evaluation – FPSO gas scrubbing water discharges

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">On the FPSO, the inert gas system will be used to generate inert gases for use as a blanket gas within hydrocarbon-containing tanks. Fuel gas and nitrogen will be used in preference; however, when fuel gas and nitrogen gas are unavailable, inert gas will be derived from the combustion of fuel gas (with diesel as a backup) for use as a blanket gas to prevent the ingress of oxygen. Seawater scrubbing is necessary to cool the inert gas before use, and the return seawater has the potential to result in an increase in ambient water temperature and will contain residual NaClO, as the seawater is dosed with NaClO at the inlet moonpool. The production of combustion residues is not expected and would only occur if combustion is not optimised, i.e. due to damaged or incorrectly fitted equipment, or when diesel is used, as diesel is more likely to result in soot generation compared to fuel gas. The scrubbing water discharge from the inert gas generator will be intermittent in nature and only in the event that nitrogen is unavailable. The maximum discharge rate is expected to be 528 m^3/h.

Seawater is also used as a scrubbing media to remove HCl vapour or fumes from pH controller storage tanks and vent lines in the HCl gas scrubbers. The treated seawater to be discharged from the HCl gas scrubbers comprises residual NaClO and HCl at approximately 1900 mg/L and is directed to the moonpool for intermittent discharge at a maximum rate of 5 m^3/h, where it is then commingled before discharge to the receiving environment.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Particular values and sensitivities with the potential to be impacted are:
• planktonic communities
• benthic communities.

Potential impacts to identified values and sensitivities from discharges with elevated temperatures above ambient levels are described in Table 7-10 and Table 7-18. Given that the scrubbing water is intermittent and a significantly smaller discharge volume, it is not expected to have any effect on the commingled moonpool discharge which includes the larger volume return seawater cooling water discharge.

The gas scrubbing process within the inert gas system is undertaken to remove sulfur and combustion residues. There is limited reported data on wash-water analyses from inert gas scrubbers, but it is generally accepted that, given the required volumes of seawater to sufficiently cool the gas, the concentrations of scrubbed components, predominantly particulates such as soot, are very low (Kjølholt, J. et al. 2012) and are only expected to be present if the combustion process is not optimised. Changes in ambient TSS levels due to combustion residues, such as sooty particles, may result in a decline in water quality. Increased water turbidity decreases the passage of light through water and can slow photosynthesis by phytoplankton species and reduce primary productivity (Davies-Colley et al. 1992). Given the small volumes discharged, water depths and the dispersive open-ocean environment, it is not expected that gas scrubbing water particulates will result in water quality impacts due to elevated TSS levels. Therefore, no direct effects on plankton abundance due to TSS levels are expected. Any impacts that could occur would not result in an ecological impact based on the naturally high spatial and temporal variability in plankton distribution in Australian tropical waters (Insignificant F).

Seabed topography in WA-50-L is relatively flat, with no seafloor features, such as boulders, reef pinnacles or outcropping hard layers. Due to the strong bottom currents and mobile sediments (RPS 2007), these characteristics do not favour the development of diverse</td><td>Insignificant (F)</td></tr>
</table>

epibenthic communities. Surveys of the seabed in the licence area indicate benthic habitats are limited to flat and featureless soft substrate areas, typical of deep continental shelf seabed and are widely distributed in the deeper parts of the Browse Basin (RPS 2007) and have identified only very limited numbers of epibenthic fauna. Infaunal assemblages within marine sediments in the area are dominated by polychaete worms and crustaceans which contribute around 70% of the animal species. Discharges of combustion residues into the water column have a potential to impact sediment quality, with the potential to harm benthic communities through smothering and bioaccumulation. It is reported that particles released into the water column will be subject to natural dispersion through oceanographic processes. The size of the combustion residues (sooty particulates) associated with the gas scrubbing water discharges are not expected to settle out due to their small size and, given the low ecological diversity of benthic communities in WA-50-L, impacts are not expected (Insignificant F). Hydrogen chloride (HCl) is highly soluble and will rapidly dissociate when discharged to sea, with potential effects resulting from a change in pH rather than through direct effects associated with exposure to hydrogen chloride/hydrochloric acid. Due to the disassociation into water and chloride ions, no accumulation of hydrogen chloride in living organisms is expected (OECD SIDS 2002). Based on the low intermittent maximum discharge rate (5 m^3 per hour), the predicted concentration of HCl within the moonpool, once commingled with other discharge streams, is expected to be approximately 1 mg/L. Acute toxicity from changes in pH for aquatic organisms is known to be highly variable and can be explained by the variation in buffer capacity of the receiving environment. For example, LC50 values of acute fish toxicity tests varied from 4.92 to 282 mg/L (OECD SIDS 2002) and the Material Safety Data Sheet reports an ecotoxicity value of 282 mg/L. The effect of scrubbing water discharges, containing hydrochloric acid, from the FPSO moonpool on local plankton abundance will be influenced by the buffering capacity of the seawater at the point of discharge which may affect the ionisation and neutralisation of the discharge. It is not considered useful to calculate a PNEC for hydrochloric acid, as factors such as the buffering capacity, the natural pH and the fluctuation of the pH are very specific for individual ecosystems (OECD SIDS, 2002). A significant decrease of the pH of the receiving water is not expected, and changes in pH of the receiving water should stay within the natural range of the pH as the scrubbing water comprises a very small component of the total liquid effluent discharge from the moonpool. HCl will likely be rapidly neutralised due to the very large buffering capacity of seawater outside of the moonpool. Nevertheless, plankton in the vicinity of the discharge point could be exposed to decreased pH levels for a sufficient enough time to elicit a toxic response if exposed to undiluted HCl discharges (no comingling with CW). The potential consequence on planktonic communities is a localised impact on plankton abundance at the point of discharge with inconsequential ecological significance (Insignificant F).	

Identify existing controls			
• Use of fuel gas and nitrogen as blanket gas in preference to inert gas • Maintenance of IGG and HCl scrubber in accordance with Table 9-27.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification

Elimination	Eliminate use of gas scrubbing.	No	Gas scrubbing is required to cool gas in the IGG so that a blanket gas can prevent oxygen ingress into the hydrocarbon cargo tanks and, therefore, prevent an explosive atmosphere from developing. Scrubbing of the HCl vapour to remove fumes from the pH controller tanks / vent line is a safety requirement given the potential harm to FPSO personnel from such vapours and, therefore, HCl vapour cannot be vented to atmosphere.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	None identified	N/A	N/A

Identify the likelihood	
Likelihood	The discharge of scrubbing water, with an elevated temperature, potential combustion residues, and HCl concentrations of approximately 1 ppm (following commingling in the moonpool), will be intermittent in nature. Localised impacts on the abundance of plankton within the vicinity of point of discharge are considered to be Unlikely (4). However, based on the comparatively small volume of the gas scrubbing discharges (maximum rates of 528 m^3 per hour for the IGG and 5 m^3 per hour for the HCl scrubber), and the dispersive open-ocean environment in WA-50-L, this is considered ecologically insignificant, based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters. Based on the water depths and the small volumes of discharged scrubbing water, increased levels of TSS due to combustion residues in the discharge are not expected to impact benthic communities. Therefore, the likelihood of the consequence occurring is considered Remote (6).
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).

Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		
Legislative requirements		

The discharge of gas scrubbing water to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of gas scrubbing water.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from gas scrubbing water discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are a common threatening process identified in several conservation management documents; however, none of the recovery plans or conservation advices have specific actions relating to gas scrubbing water. The controls are consistent with industry best practice and align with the intent of the conservation management documents, to reduce emissions and discharges

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed control is expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standard	Measurement criteria
Impacts to identified values and sensitivities from planned liquid discharges associated with the offshore facility are limited to a localised area.	Fuel gas and nitrogen system operated to avoid continual use of IGG as a blanket gas.	Records of use of the fuel gas and nitrogen system.

Potential interaction between FPSO liquid effluent discharge streams

During operation of the FPSO, there is a potential for six separate liquid effluent streams to be received into the marine environment from two different depths within the water column. As shown in Table 7-15, PW, ballast, open drains and gas scrubbing water is mixed with return seawater for cooling, prior to discharge to sea from the moonpool at a depth of approximately 15–20 m below sea level. Sewage is combined with grey water and food waste prior to discharge to sea at a depth of approximately 30–35 m.

Dilution of such effluent streams relatively close to the sea surface (depths ranging from 15–35 m below sea level), will initially be dictated by the downward momentum of the discharge and subsequent turbulent mixing and entrainment of seawater into the plume upon discharge.

Approximate maximum discharge rates of the combined stream from the FPSO are estimated to be 16,275 m^3 per hour with temperatures generally between 33-38°C, approximately 5-10 °C higher than the ambient seawater temperature. Thermal impacts may arise from the cooling water and gas scrubbing water discharges that have the potential to cause a decline in water quality due to the reduction in dissolved oxygen concentrations resulting from elevated water temperature. Plankton present in the localised vicinity of the discharge may be impacted by thermal shock. For discharges that are warmer than the receiving environment, the plume is expected to become passive and rise upwards within the water column and may reach the sea surface, until mixing with ambient water reduces the overall temperature of the plume to background. Given that the cooling water discharge plume will be subject to mixing processes, with rapid dilution and reduction of temperature upon release, there is little influence on the receiving environment.

Chlorination residues present within the return seawater are reported to degrade rapidly and rates of degradation increase in the presence of dissolved or organic matter (Khalanski 2002; Taylor 2006). Data indicates that the presence of organic material will substantially decrease the efficacy of NaClO to prevent biofouling; however, this rapid degradation rate provides a potential advantage with respect to environmental impacts, as most of the biocidal potential will be gone upon release into receiving waters (Taylor 2006; Landrum et al. 2003). Therefore, upon introduction of the moonpool commingled discharge plume into the marine environment, other sources of dissolved organic matter within the receiving environment will enable a more rapid degradation of chlorination residues. Temperature is also known to affect the breakdown of NaClO with decomposition rates reported to double if the temperature increases by approximately 5.5 °C, and where the temperature is more than 35 °C the decomposition reactions are very rapid (Binetti & Attias, 2007), which is anticipated given the elevated temperature of the cooling water and gas scrubbing streams.

Drainage and bilge discharges from the FPSO will have OIW concentrations of 15 ppm (v) or less in accordance with MARPOL, Annex 1. Any hydrocarbons within the oily water discharge plume will be at such low concentrations, and be subject to rapid dilution and dispersion, that no interactions with other liquid effluent streams are expected.

The discharge plume associated with sewage, grey water and food waste is relatively small and is released at a greater depth than the other liquid effluent streams from the FPSO at approximately 30–35 m below sea level. The plume may contain increased levels of nutrients; however, given the assimilative capacity of the open-ocean environment in the vicinity of the discharge, only minor increases would be possible (Waldron et al. 2001). It is possible that despite dilution and dispersion by oceanic currents, interactions may occur if the sewage, grey water and food waste plume rises within the water column and intermingles with the other liquid effluent streams discharged at a depth of approximately 15–20 m.

Cumulative impacts to transient, EPBC-listed species, benthic communities, planktonic communities, demersal fish communities, and fisheries from the release of multiple liquid effluent streams from the FPSO have been considered. Once the initial downward momentum of the discharges is lost, it is expected that the positively buoyant plumes will rise and passively mix. The discharges are expected to rapidly dilute and disperse due to the water depth (approximately 250 m), and the influence of oceanic currents in WA-50-L, resulting in limited potential for additive or cumulative impacts from the multiple liquid effluent discharges. The discharge of H2S scavenger, a production chemical within the PW discharge, is calculated to require the greatest number of dilutions to reach NEC with potential impacts limited to within a maximum of 1,514 m of the discharge point (Table 7-28). Therefore, within this defined boundary, impacts may occur to the identified values and sensitivities.

Transient, EPBC-listed species will be present, both at the sea surface and within the deeper water column and, given their highly mobile nature, any exposure is considered to be minor and on a temporary basis. Marine fauna also have the ability to avoid the area given its open-ocean location. The density of planktonic communities recorded in the development area is considered to be very sparse and indicative of offshore waters where no significant nutrient sources exist (INPEX 2010). Cumulative discharges may have an impact on localised planktonic communities but will not result in an ecological impact. Benthic communities are not expected to be impacted by the fallout and settlement of particulate material, based on the predicted particle sizes and net dispersion within the open-ocean environment. Increased levels of TSS have the potential to impact on fish eggs and larvae, and marine invertebrates which may affect recruitment for fisheries. However, potential impacts are considered to be insignificant, based on water depth and dispersion at the point of discharge. A full cumulative risk assessment considering all liquid effluent discharges from Ichthys operations and the potential for additive or synergistic effects that may occur from discharge stream interactions in the receiving environment is presented in Table 7-30.

Vessels

As described in Section 3, a range of vessels will be required to support the activity. These include the following:

- ASVs will be present in WA-50-L to provide additional accommodation during periods of intense activity such as major shutdowns where extra personnel are required. It is anticipated that ASVs may be present in WA-50-L for around 2–3 months on approximately 2-3 occasions within the life of this EP.
- PSVs to provide logistical support, such as resupply for the CPF and FPSO. PSVs may be present within WA-50-L every 3–4 days for approximately 24–48 hours; however, a PSV may remain in the licence area for up to two weeks continuously, depending on operational requirements.
- The OSV will be present in WA-50-L to assist and support offloading operations, except for during crew changes or other reasons, such as maintenance.
- During IMR activities, a range of vessels may be present in WA-50-L ranging from HLVs to smaller vessels equipped with cranes and ROVs, depending on the nature of the IMR operations required.
- Small logistical support vessels may be called upon on an ‘as-required’ basis to deliver equipment to the CPF or FPSO in WA-50-L.

All support vessels shall comply with the relevant MARPOL requirements and are each provided with a range of auxiliary and marine systems in support of their activities. It should be noted that when the ASVs are connected to the CPF and FPSO, they will be on station through dynamic positioning (DP) and will be operating as part of the offshore facility, i.e. not as vessels in accordance with MARPOL. Therefore, ASV discharges will be made on a stationary basis, in contrast to support vessel discharges that can be made while in transit.

The liquid effluents discharged to the marine environment from vessels include:

- desalination brine
- sewage, grey water and food waste
- oily water from open drains/deck drainage and bilge
- cooling water.

A summary of the individual liquid effluent streams discharged from vessels operating within WA-50-L is provided in Table 7-23. An impact and risk evaluation has been undertaken for each individual liquid effluent stream in the following section.

The potential for individual discharge streams to interact when released into the receiving environment resulting in cumulative impacts has also been assessed to consider potential interactions between discharged liquid effluent streams and cumulative impacts. Maximum discharge rates for support vessels have been determined from previous related Ichthys Project EPs enabling discharge rates to be confirmed.

Table 7-23: Summary of worst-case liquid effluent discharge streams from vessels

Liquid effluent stream	Impact and risk evaluation reference	Potential constituents of concern	Maximum discharge rate	Discharge depth
Desalination brine	Table 7-24	Increased salinity	21 m^3 per hour Continuous flow	Surface
Sewage, grey water and food	Table 7-25	Introduction of nutrients	5.5 m^3 per hour Intermittent flow	Surface
Oily water (deck drainage & bilge) and firefighting foam	Table 7-26	Hydrocarbons, lubricants, cleaning fluids	1 m^3 per hour Intermittent flow	Surface
Cooling water	Table 7-27	Temperature	4167 m^3 per hour Continuous flow	Surface

Table 7-24: Impact and risk evaluation – vessel desalination brine discharges

<table>
<tr><th colspan="4">Identify hazards and threats</th></tr>
<tr><td colspan="4">Potable water will be generated on the vessels using a RO unit 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 to the marine environment has the potential to cause changes in water salinity. RO units on board ASVs typically have the capacity to make 3 m^3/hour of potable water. At full capacity, this would result in a maximum discharge rate of approximately 21 m^3 per hour (~500 m^3/day) of desalination brine water for the entire system. For smaller support vessels the estimated volume of brine discharge is lower and is estimated to be in the order of 6.25 m^3 per hour per vessel. The salinity of the discharge is expected to be approximately 45–50 parts per thousand (ppt) in comparison to ambient seawater with a salinity of 35 ppt (Section 4.8).</td></tr>
<tr><th colspan="3">Potential consequence</th><th>Severity</th></tr>
<tr><td colspan="3">Particular values and sensitivities with the potential to be impacted are:
• planktonic communities.

Discharging desalination brine from vessels 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) indicate that effects on planktonic communities in areas of high mixing and dispersion, such as those found in WA-50-L, are generally limited to the point of discharge only.

Given the water depths in WA-50-L (approximately 250 m) and the dynamic marine environment (i.e. tides and currents) it is expected that vessel brine discharges 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).</td><td>Insignificant (F)</td></tr>
<tr><th colspan="4">Identify existing controls</th></tr>
<tr><td colspan="4">None identified</td></tr>
<tr><th colspan="4">Propose additional safeguards/control measures (ALARP evaluation)</th></tr>
<tr><th>Hierarchy of control</th><th>Control measure</th><th>Used?</th><th>Justification</th></tr>
<tr><td>Elimination</td><td>Eliminate brine discharges from vessels</td><td>No</td><td>The significant financial cost and health risks associated with providing fresh water to vessels from the mainland via vessel transfer or transiting directly to port for resupply is grossly disproportionate to the low level of risk associated with this discharge. Steaming time to the closest port facilities for</td></tr>
</table>

			resupply is approximately 18 - 24 hours. This would also generate additional environmental impacts in terms of air emissions and increased demands to onshore supplies.
Substitution	None identified	N/A	N/A
Engineering	Use of a diffuser on vessels to increase mixing in the receiving environment.	No	Given the water depth and oceanic currents in WA-50-L and the small volumes of discharges, retrospective installation of a diffuser on all vessels is not considered practicable, given the insignificant consequence from brine discharges.
Procedures & administration	None identified	N/A	N/A

Identify the likelihood	
Likelihood	Direct effects on plankton from vessel desalination brine discharges may occur in WA-50-L 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 Unlikely (4).
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).

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

Assess residual risk acceptability
Legislative requirements The discharge of desalination brine to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of desalination brine. Stakeholder consultation No stakeholder concerns have been raised regarding potential impacts and risks from desalination brine discharges. Conservation management plans / threat abatement plans Several conservation management plans have been considered in the development of this EP (refer Appendix B), none of the recovery plans or conservation advice documents have specific threats or actions relating to discharges of desalination brine in remote offshore waters. ALARP summary

<table>
<tr><td colspan="3">Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.
Acceptability summary
Based on the above assessment, the risk of impacts is acceptable because:
• the activity demonstrates compliance with legislative requirements/industry standards
• the activity takes into account stakeholder feedback
• the activity is managed in a manner that is consistent with the intent of conservation management documents
• the activity does not compromise the relevant principles of ESD
• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.</td></tr>
<tr><th>Environmental performance outcome</th><th>Environmental performance standard</th><th>Measurement criteria</th></tr>
<tr><td colspan="3">N/A no controls identified</td></tr>
</table>

Table 7-25: Impact and risk evaluation – vessel 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 associated with the petroleum activity will occur in WA-50-L, which is located in the open ocean and is more than 12 nm from the nearest land. The average volume of sewage and greywater expected from vessels (including domestic wastewater) generated by a person per day is approximately 230 L (based on calculations in Hänninen & Sassi 2009). Therefore, based on the assumption that when there are two vessels present in WA-50-L, each with 50 POB, the combined rate of discharge of sewage, grey water and food waste is conservatively considered to be approximately 25 m^3 per day (or 1.05 m^3 per hour). When connected to the CPF or FPSO, ASVs will use approved (MARPOL) sewage treatment plants (STPs) which can bio-treat sewage before discharge. ASVs are expected to be in WA-50-L only during periods of intense maintenance activity on a temporary basis (around 2-3 months on approximately 2 to 3 occasions during the next 5 years). Peak load for an ASV (estimated to be approximately 132 m^3/day or 5.5 m^3 per hour) has been calculated based on a maximum capacity of 500 POB. Discharges from ASVs are generally intermittent (or pulsing) in nature and principally occur during two-hourly peak periods at shift changeover, with smaller volumes generated outside of these times.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by sewage, grey water and food waste discharges are: • planktonic communities. 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-50-L. 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 250 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 existing controls	
• Vessels will manage the discharge of sewage effluent and grey water in accordance with Marine Order 96 (as appropriate to class) • ASVs will be equipped with an approved STP compliant with Marine Order 96	

• Vessels will manage the discharge of garbage in accordance with Marine Order 95 (as appropriate to class) • Vessels and ASVs will macerate food waste to a particle size of <25 mm before disposal in WA-50-L.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate discharges from vessels by storage of sewage, grey water and food waste on board and ship to the mainland.	No	The significant financial cost and health risks associated with storing sewage, grey water and food waste on board and transporting it to the mainland for the duration of operations is grossly disproportionate to the low level of risk associated with this discharge, permitted under legislation. Additional environmental impacts would also be generated in terms of air emissions and onshore disposal. In the event that macerators malfunction when ASVs are connected to the CPF or FPSO, there is an ability to freeze and retain a certain amount of food waste on board that may then be transferred for onshore disposal. No unmacerated food waste will be disposed at sea.
Substitution	None identified	N/A	N/A
Engineering	STP installed and used on all vessels	No	While the ASVs have a STP for use when connected to the CPF or FPSO in WA-50-L, a requirement for all vessels to have STPs installed is not practicable and costs are considered to be grossly disproportionate for what is a permitted discharge under relevant legislation.
Procedures & administration	None identified	N/A	N/A
Identify the likelihood			
Likelihood	Sewage and garbage discharges for the vessels including ASVs will be in accordance with legislative requirements (MARPOL Annex IV & V, Marine Orders 95 & 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 licence area are unlikely to cause toxic effects, especially considering the rapid dilution provided by the deep water and ocean currents.		

	Based on the expected high dispersion due to the open-ocean environment of WA-50-L, localised impacts to plankton at the point of the planned intermittent discharge are considered to be Unlikely (4).	
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).	

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

Assess residual risk acceptability

Legislative requirements

Sewage, grey water and food waste discharges are standard practice in the offshore environment and the disposal at sea is permitted under AMSA (2018) Marine Order – Part 96: Marine Pollution Prevention – Sewage, which gives effect to MARPOL, Annex IV and Marine Order – Part 95: Marine Pollution Prevention – Garbage, which gives effect to MARPOL, Annex V.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from planned discharges of sewage, grey water and food waste.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to discharges of sewage, grey water and food waste. The maceraters will assist in reducing impacts from the discharge stream, consistent with the intent of the conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standards	Measurement criteria
Planned emissions and discharges from vessels undertaking the petroleum activity are in accordance with MARPOL requirements and industry good practice.	Comply with Marine Order 96 including: • Current International Sewage Pollution Prevention Certificate (ISPPC).	ISPPC
	ASVs have an approved sewage treatment plant, or sewage comminuting and disinfecting system, or sewage holding tanks are installed and functional, in accordance with Marine Order 96.	Premobilisation inspection records
	Comply with Marine Order 95 including: • Garbage that has been ground or comminuted to particles <25 mm: >3 nm from the nearest land. • Garbage disposal record book maintained.	Garbage disposal record book
	Vessels and ASVs will not dispose of unmacerated food waste in WA-50-L.	Garbage disposal record book

Table 7-26: Impact and risk evaluation – vessel oily water, bilge discharges & firefighting foam (deck drainage)

<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 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.
In general, the capacities of OWS on vessels range from 100–1000 litres per hour. Therefore, conservatively based on maximum rates, each vessel present in WA-50-L could potentially discharge 1 m^3 per hour. Therefore, if two vessels were present in WA-50-L, the combined rate of oily water discharge would be approximately 48 m^3 per day.
Vessels are equipped with fire suppression systems, which may include firefighting foam systems, as a safety critical requirement. The foam systems generally supply 3% AR-AFFF and 3% FFFP foams to be used in the event of an incident. No maintenance testing of vessel foam systems will occur in WA-50-L during the activity; therefore, any foam discharges to sea will be the result of an incident and not a planned discharge.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by deck drainage, bilge and firefighting foam discharges are:
• EPBC listed species
• fish (demersal fish communities KEF and commercial species)
• planktonic communities.
Discharges of oily water from all vessels 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, etc.) into the water column and at the sea surface, 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 by commercial fisheries).
Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in the licence 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 to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away). Additionally, a whale shark foraging BIA is located approximately 15 km south-east from the licence area at its closest point (Figure 4-7); however, based on the levels of whale shark abundance observed in numerous studies (as described in Section 4.9.4), the potential for whale sharks to be present 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</td><td>Insignificant (F)</td></tr>
</table>

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). 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 fish 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 from the intermittent discharge. 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 & Field 2000). As toxicological effects from foams are associated with frequent or prolonged exposures, and any discharges during the activity are expected to be as a result of an incident only (infrequent) and rapidly disperse, it is not expected that any impacts will occur to transient, EPBC-listed species or fish. 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 existing controls
• Vessels are equipped with oil–water separators (OWS) which remove traces of oil from the bilge and drainage water prior to discharge to sea. • Vessels will have equipment to ensure oily water discharges meet <15 ppm in accordance with Marine Order 91. Bilge water and waste that does not meet the discharge requirements will be retained onboard for controlled disposal at a port reception facility. • Spill kits will be available on-board vessels. • Vessel crew will receive an induction/training to inform them of deck spill response requirements in accordance with Table 9-3.
Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification

Elimination	No discharges of contaminated deck drainage or bilge to sea.	No	Discharge of deck drainage stormwater runoff or bilge discharges cannot be eliminated from vessels. There is not sufficient space available on board for storage and onshore disposal is not practicable given the distance to the mainland and the associated emissions and discharges associated with transfer by vessel.
	No discharge of firefighting foam solutions to sea.	No	Firefighting foams on board vessels are safety critical and are required in the event of a fire to prevent potential loss of human life or the occurrence of a significant environmental incident. Therefore, the availability of firefighting foams cannot be eliminated. Therefore, drainage and discharge of foam solution to the sea also cannot be eliminated.
Substitution	None identified	N/A	N/A
Engineering	Discharge separation and containment system for firefighting foams.	No	Given the limited (insignificant) consequence of potential impacts that may arise from such a discharge and the low potential for occurrence (emergency event only), implementing separate drainage systems for firefighting foams is not considered practicable. The cost of implementing such measures is grossly disproportionate to the limited environmental benefit that could be achieved, and during an emergency event. Implementation of additional engineering measures and procedures to reroute firefighting foams is not practicable in a situation when firefighting systems must be activated as soon as possible to contain a fire and the decks adequately drained to ensure the safety of personnel and integrity of the vessel.
Procedures & administration	Vessels will not test firefighting foam systems when in WA-50-L.	Yes	To avoid unnecessary discharges of firefighting foams all vessels in WA-50-L will not perform tests of their firefighting foam systems.
Identify the likelihood			
Likelihood	Deck drainage and bilge discharges are treated to a maximum concentration of 15 ppm (v) OIW prior to discharge as specified in MARPOL, Annex 1; Marine Order 91: Marine Pollution Prevention - Oil. Impacts to the abundance of plankton or fish 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 licence 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	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).		
Residual risk summary			
Consequence		Likelihood	Residual risk
Insignificant (F)		Unlikely (4)	Low (9)
Assess residual risk acceptability			

Legislative requirements

Vessel oil–water separators (OWS) meet relevant international regulatory requirements, including MARPOL; Marine Order 91: Marine Pollution Prevention - Oil. The discharge of oil in water of <15 ppm (v) is permitted under MARPOL.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from deck drainage, bilge or firefighting foam discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to deck drainage/bilge/firefighting foam discharges. Managing oily water discharges in accordance with legislative requirements is consistent with the intent of the conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD

• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcomes	Environmental performance standards	Measurement criteria
Planned emissions and discharges from vessels undertaking the petroleum activity are in accordance with MARPOL requirements and industry good practice.	Vessel contractors will comply with the *Navigation Act 2012* – Marine Order 91 including: • Vessels (of appropriate class) 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 (Annex I).	Record of current International Oil Pollution Prevention (IOPP) certificate. Calibration and maintenance records of the OWS.
	Vessel and ASV liquids from drains will only be discharged if the oil in water content does not exceed 15 ppm.	Documented use of oil record book to record all oil disposal.
	Firefighting foams will only be deployed in the event of an emergency.	Incident log.
	Spill kits will be located on vessels to allow clean-up of any spills to the deck.	Inspection records confirm spill kits are available and stocked.

Table 7-27: Impact and risk evaluation – vessel cooling water discharges

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">Sea water is used as a heat exchange medium for the cooling of machinery engines on vessels. It is pumped aboard and may be treated with biocide (e.g. hypochlorite) before circulation through heat exchangers. It is subsequently discharged to the sea surface on a continuous basis.

Vessel cooling water 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. Maximum discharge rates based on equipment capacities and specifications range from approximately 20,000 m^3 per day for a PSV; 27,000 m^3 per day for an ASV and up to approximately 100,000 m^3 per day (4,167 m^3 per hour) for a HLV. The temperature of the CW discharge will be approximately 40 °C, in contrast to ambient surface-water temperatures of 26 °C to 30 °C as recorded in the Ichthys Field (Section 4.7).</td></tr>
<tr><td>Potential consequence</td><td>Severity</td></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by cooling water discharges are:
• EPBC listed species
• planktonic communities.

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-50-L, and EPBC listed species with the potential to be present in the licence area (within close enough proximity to the discharge to be affected) are considered to be transient in nature (Section 4.9.4). The closest BIA to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away) between November and March. Additionally a whale shark foraging BIA is located approximately 15 km south east from the licence area at its closest point (Figure 4-7); however, based on the levels of whale shark abundance observed in numerous studies (Section 4.9.4), the potential for whale sharks to be present within this BIA is considered very low, with no specific seasonal pattern of migration. The vessels will be operating in a water depth of approximately 250 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).

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).</td><td>Insignificant (F)</td></tr>
</table>

The use of biocide (hypochlorite) for the control of biofouling is 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 existing controls			
None identified			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No discharges of CW to sea	No	Engines and machinery require cooling to safely and efficiently operate, so cooling water cannot be eliminated. Storage and containment of cooling water to allow the water to cool on board the vessels prior to discharge is not considered practicable given the size/space requirements, i.e. large surface areas are required to sufficiently cool the water. Onshore disposal was also not considered practicable given the distance to the mainland, frequency of trips required, and the associated emissions and discharges generated by such transfers.
Substitution	Substitute hypochlorite with an alternative biofouling control/mechanism.	No	Hypochlorite is an established and efficient technology for use in offshore environments and is a recommended technique in the application of best available techniques (BAT) to industrial cooling systems (European Commission 2001). The retrofitting of alternative biofouling control mechanisms to all vessels is

			not considered to be practicable given the low environmental impact from vessel cooling water discharges.
Engineering	None identified	N/A	N/A
Procedures & administration	None identified	N/A	N/A

Identify the likelihood	
Likelihood	CW discharges are expected to rapidly disperse in the open-ocean environment of WA-50-L. Vessel CW 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 the licence area 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	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).

Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Unlikely (4)	Low (9)
Assess residual risk acceptability		

Legislative requirements

The discharge of return seawater from cooling water systems to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of cooling water. Ichthys offshore facility CW discharge modelling (using a higher discharge temperature and greater volumes of CW discharged) predicted a maximum 1.6 ^{o}C at 100 m from discharge point. Therefore, the CW discharge plume from any vessels is expected to be considerably lower than the IFC requirement (no more than 3 °C above the ambient seawater temperature at 100 m from the discharge point) based on the lower CW temperature and volumes discharged from vessels.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from CW discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B), none of the recovery plans or conservation advice documents have specific threats or actions relating to CW discharges in remote offshore waters.

ALARP summary		
Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.		
Acceptability summary		
Based on the above assessment, the risk of impacts is acceptable because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	**Environmental performance standards**	**Measurement criteria**
N/A no controls identified		

Potential interactions between vessel liquid effluent discharge streams

During periods when vessels are present in WA-50-L, there is a potential for four separate liquid effluent streams to be received into the marine environment. Dilution of such effluent streams released at, or just below, the sea surface, is initially dictated by physical factors, such as the presence of oceanic currents which will predominantly influence the spatial extent of contaminant/plume dispersal.

Due to an increase in salinity and density, when discharged to the marine environment, brine is expected to sink within the water column and will be subject to rapid dilution and dispersion in the prevailing currents. Given the relatively low volume and rates of brine to be discharged, any elevation in salinity will be highly localised (i.e. <30 m) to the discharge point. As the brine discharges are expected to sink within the water column and quickly dissipate, potential interactions with other discharge plumes released at, or just below, the sea surface are not expected.

The discharge plume associated with sewage, grey water and food waste from the vessels and ASVs in WA-50-L is relatively small but may contain increased levels of nutrients. Increased nutrient concentrations are expected to be rapidly taken up by phytoplankton, potentially resulting in increased productivity; however, given the assimilative capacity of the open-ocean environment in the vicinity of the discharge, only minor increases would be possible (Waldron et al. 2001). Treated sewage plumes are reported to have lower salinity than ambient seawater, generally 1 to 5 ppt lower (Gray 1996) and so will not sink to the same extent as brine discharges. Given the relatively low volume and discharge rates of treated sewage, grey water and food waste, the plume will be localised to the discharge point and subject to dilution and dispersion by oceanic currents, with little interaction with other discharge streams expected.

Drainage and bilge discharges from vessels and ASVs will have oil–in-water (OIW) concentrations of 15 ppm (v) or less in accordance with MARPOL, Annex 1. The maximum discharge rate is lower than that of brine or sewage with a treatment capacity of up to 1 m^3 per hour per vessel. Any hydrocarbons within the oily water discharge plume will be at very low concentrations and subject to rapid dilution and dispersion.

The largest liquid effluent stream associated with the operation of the vessels and ASVs in WA-50-L is cooling water (CW). Approximate maximum discharge rates are estimated to range from 1125 m^3 per hour for ASVs and 4167 m^3 per hour for a HLV with temperatures ranging from 32 to 36 °C, which is expected to be approximately 10 °C higher than the ambient seawater temperature. Thermal impacts can cause a decline in water quality due to the reduction in dissolved oxygen concentrations resulting from elevated water temperature. Plankton present in the localised vicinity of the discharge may also be impacted by thermal shock. For discharges that are warmer than the receiving environment, the plume is expected to remain positively buoyant, relative to the surrounding waters. The plume is expected to become passive and remain at the sea surface, until mixing with ambient water reduces the overall temperature. Given that the cooling water discharge plumes will be subject to mixing processes, with rapid dilution and reduction of temperature upon release, there is little influence on the receiving environment. A full cumulative risk assessment considering all liquid effluent discharges from the Ichthys operations and the potential for additive or synergistic effects that may occur from discharge stream interactions in the receiving environment is presented in Table 7-30.

Cumulative impacts to transient, EPBC-listed species and planktonic communities from the release of multiple liquid effluent streams from vessels including ASVs have been considered. Support vessels operating in WA-50-L will be relatively mobile and will be discharging while moving, albeit at low speeds. This will facilitate the dispersion of liquid effluent discharges and increase the spatial distribution and extent of the plumes. ASVs will be present in WA-50-L on a relatively temporary basis (2-3 months on approximately 2-3 occasions over the next 5 years) and discharges are expected to rapidly dilute and disperse due to the influence of water depth and oceanic currents. Transient, EPBC-listed species will be present, both at the sea surface and within the deeper water column and, given their highly mobile nature, any exposure is considered to be on a temporary basis. The density of planktonic communities recorded in the development area is considered to be very sparse and indicative of offshore waters where no significant nutrient sources exist (INPEX 2010). The nature and scale of the cumulative discharges are not expected to impact on local planktonic communities and will not result in an ecological impact on the Commonwealth marine area.

Cumulative impact assessment for all liquid effluent discharge streams

When all the liquid effluent discharge streams that interact in the marine environment mingle, they form a mixing zone. A mixing zone in modelling terms is the area in which initial dilution occurs with the furthest extent (i.e. the boundary) occurring when concentrations are no longer at toxic levels and have returned to background or ambient levels. The mixing zone can therefore be used to assess the potential nature and scale of impact based on the mixing zone volume where toxicity is elevated.

The following cumulative impact assessment has been undertaken on the calculated mixing zone using the key liquid effluent discharge streams from the offshore facility (CPF and FPSO). It is considered possible that discharge streams in close proximity may interact potentially resulting in additive or synergistic effects i.e. discharges at depth with elevated temperatures may rise upwards within the water column and interact with discharges released at or near the sea surface. The key findings are summarised below and form the basis for a cumulative impact assessment.

- Cooling water is the largest source of liquid effluent discharge from the CPF and FPSO (Figure 7-4); however, because of the rapid conversion of biocide generated by the electrolysis reaction into non-toxic components, discharge of this stream is not expected to impact beyond 400 m from the point of discharge when the thermal plume returns to ambient temperature levels.
- PW discharged from the FPSO represents the greatest contaminant risk due to potential environmental impacts associated with the discharge of carried over reservoir components and production chemicals.
- All other sources of liquid effluent are much smaller, generally intermittent and are common to routine offshore operations in the oil and gas industry and are regulated through standard management practices, such as compliance with MARPOL.

Mixing zone

A summary of the predicted distances of individual liquid effluent streams that influence the mixing zone are presented in Table 7-28, to reflect the worst-case discharge scenarios, from all liquid effluent discharge streams, previously described in Table 7-9, Table 7-15 and Table 7-23. Table 7-28 provides an indication of the potential extent of the discharge plumes with distances predicted for all three seasons (summer, winter and transitional). Worst-case distances have been presented to afford a high level of conservatism. Figure 7-6 illustrates the theoretical extent of the mixing zone from the CPF and FPSO using the worst-case constituents as defined in Table 7-28.

Table 7-28: Worst-case constituents from multiple liquid effluent streams that drive the mixing zone

Liquid effluent discharge constituent	Steady state predicted distance to reach guideline / NEC values (m)
FPSO PW – H_2S scavenger	347 dilutions – 1,514 m
CPF CW – temperature	60 dilutions – 400 m*
Area covered by the mixing zone	FPSO: 1.12 km^2 CPF: 0.20 km^2

*12,220 dilutions are predicted for CPF open drains at edge of 400 m mixing zone

The mixing zone for the FPSO is driven by the production chemical, H_2S scavenger within the PW stream which, requires 347 dilutions (Table 7-16) to reach adjusted NEC/PNEC, resulting in a 1,514 m mixing zone. The CPF mixing zone is driven by the thermal plume associated with CW discharge, which requires 60 dilutions to reach ambient temperature levels at a maximum of 400 m from the discharge point. Note for the CPF open drains stream discharge (i.e. intermittent flow; max ~20 m^3/hr) dispersion modelling results suggest rapid dilution and, based on the 95th percentile results, 12,220 dilutions are predicted to occur within the defined CPF worst-case mixing zone distance of 400 m (RPS 2017; RPS pers. comm. 2018).

The defined FPSO (PW) and CPF (CW) dilutions and distances have been used to calculate the size of area (km^2) covered by the mixing zone from the FPSO and CPF as shown in Table 7-28. Under worst case conditions the combined mixing zones from the CPF and FPSO are predicted to cover an area of approximately 1.32 km^2. Potential impacts from discharges arising from the ASVs connected to the CPF and FPSO, and supporting vessels are also expected to be captured within this area.

WA-50-L is located entirely within the NWMR that comprises of Commonwealth waters, from the WA–NT border in the north, to Kalbarri in the south covering approximately 1,070,000 km^2 of tropical and subtropical waters (DSEWPaC 2012a). Therefore, even using worst case scenarios, the extent of the mixing zones and potential area in which impact may occur is considered to be comparatively small in the wider context of the NWMR.

The CPF and FPSO are located 4 km apart and discharge plumes are not predicted to overlap (Figure 7-6). The closest proposed offshore development from Ichthys is the Shell Prelude facility approximately 17 km to the north-east. The outcome of the predictive modelling indicates that there would be no overlap between the liquid effluent discharge plumes, assuming that other oil and gas activities are subject to the relevant Commonwealth environmental approvals process and incorporate appropriate environmental management measures.

It should be noted that the mixing zones may be re-determined over time based on the monitoring results obtained through implementation of the LEMP described in Section 9.6.2. Three years of data (i.e. chemical characterisation and toxicity) for each of the discharge streams (FPSO moonpool, CPF cooling water and CPF open drains) has been collected to date under the LEMP. Toxicity data for the FPSO has shown that toxicity results (i.e. dilutions) have typically remained within mixing zone dilution requirements (i.e. 99% species protection is being achieved at edge of mixing zone). Dilution requirements during start-up (i.e. first 12 months of operations) were typically higher than those reported in years two and three of operations (i.e. steady state operations). Dilution requirements during steady state have ranged between 16 and 167, well within the worst-case 347 dilutions predicted (Table 7-28). Comparison of these results to the modelled mixing zone (APASA 2015) indicate that safe dilutions (i.e. 99% species protection) have been achieved between approximately 6 m and 1,140 m respectively. Although results to date indicate safe dilutions are being met and the mixing zone could potentially be re-determined, further data should be collected prior to this occurring. This is because data to date is reflective of condensed PW discharges from the Brewster reservoir. This PW stream is predicted to change within the life of the EP due to the introduction of the Plover reservoir which will include both formation and condensed water (Figure 7-5), and thus likely have increased toxicity. Increased production chemical use may also occur with introduction of the Plover reservoir, which could also lead to potential increases in toxicity. Under the LEMP, sampling will be undertaken when the Plover reservoir is introduced to determine if there is a change in toxicity and if safe dilutions are being achieved. Once sufficient data has been collected from both reservoirs, the mixing zone may be re-determined to ensure impacts and risks are acceptable and ALARP.

Toxicity results for the CPF CW have shown that dilutions (17 to 48) have typically remained within mixing zone dilution requirements (60 dilutions). There was one exception in start-up, where dilution requirements were an order of magnitude higher, however upon investigation this was primarily driven by a new test species and toxicity result with low reliability. Comparison of CPF CW mixing zone dilution requirements results to the modelled mixing zone (APASA 2016) indicate that safe dilutions are being achieved between approximately 100 m and 300 m respectively.

Toxicity results for the CPF open drains have also shown that dilutions (59 to 5,263) have remained within mixing zone dilution requirements (12,220 dilutions). Comparison of results to the modelled mixing zone (APASA 2017) indicate that safe dilutions is being achieved within approximately 150 m. Note the CPF mixing zone (400 m) is driven by the CPF CW (see Table 7-28) and given CPF open drains safe dilutions are being met inside the CPF CW mixing zone, there is no requirement to adjust the CPF mixing zone.

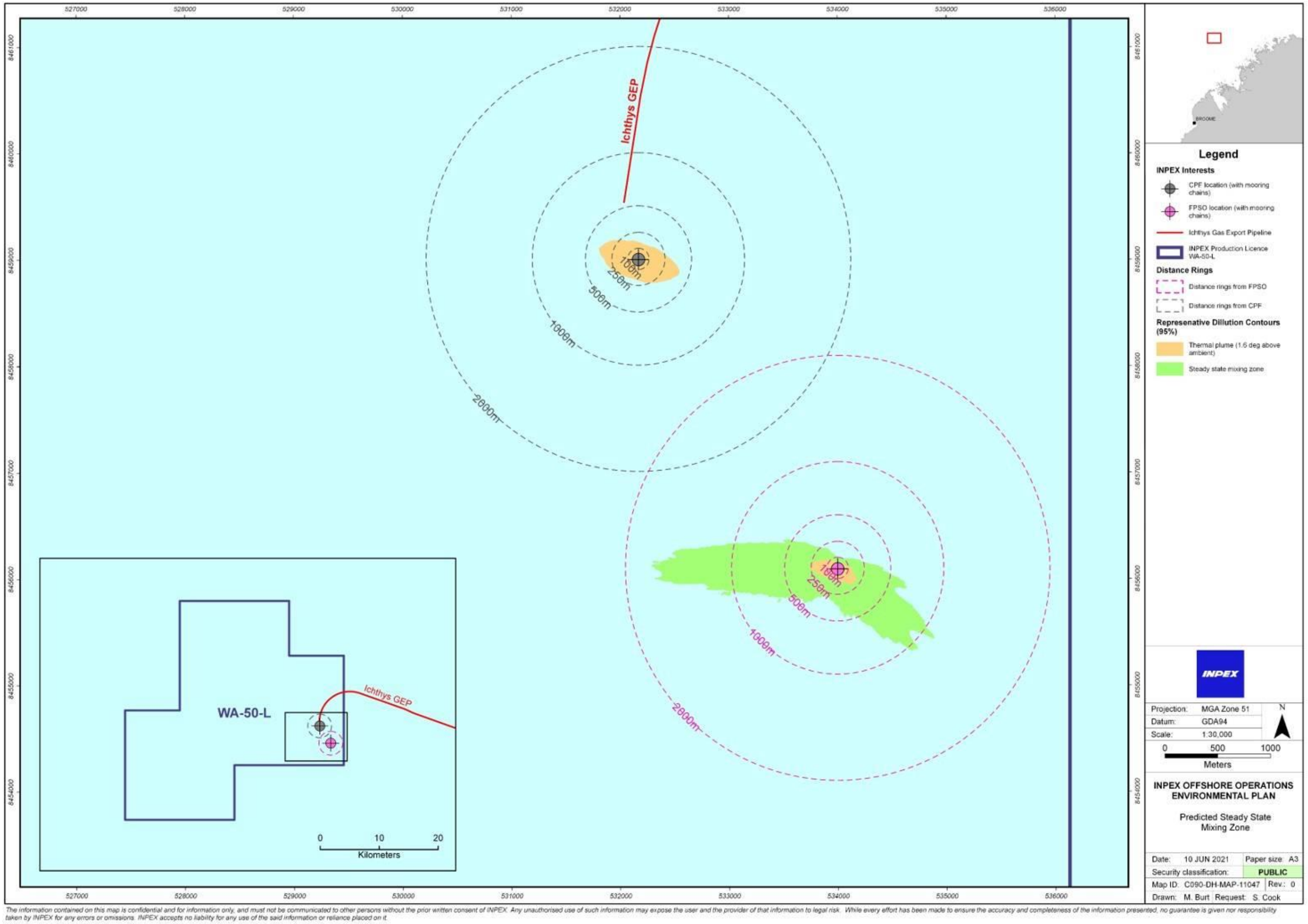


Figure 7-6: Predicted mixing zone from CPF and FPSO liquid effluent discharges

It should be noted that during the cumulative impact assessment of multiple liquid effluent streams entering the marine environment, a number of assumptions have been made. The basis for these assumptions is to reflect the uncertainty regarding the exact composition of the PW stream and the potential for additive or synergistic effects arising between streams upon discharge. Therefore, to provide a high degree of conservatism to the assessment, in order to reflect uncertainty, the following assumptions have been applied:

- dosing concentrations for production chemicals are based on worst-case maximum injection rates.
- the assessment assumes that none of the injected process chemicals have been expended during the process (i.e. the discharge received into the mixing zone essential contains neat chemicals). Whereas, in reality, production chemicals are only injected to specifically perform a function within the process, during which time the chemicals become spent and will be significantly below the dosing concentrations upon discharge.
- maximum PW flow rates have been used (Figure 7-5), however as expected and described in Section 9.6.2, only low rates of condensed water have been reported to date.
- worst-case concentrations for PW constituents have been used (Table 7-16) e.g. metals and PAHs concentrations based on highest values in OGP (2005) and Neff (2011) whereas only low rates of uncontaminated condensed water have been reported to date, as expected.
- for production chemicals, the adjusted NEC values were calculated by using the most conservative/worst-case toxicity data and application of the highest possible extrapolation factors of either 100 (batch) or 1000 (continuous) to be most conservative.
- the hydrodynamic model used to assess the extent of the field of effect is known to be conservative as it is based on worst-case metocean conditions for 95% of the time.

The cumulative impact assessment of liquid effluent streams is considered to be highly conservative. Despite the above assumptions, any uncertainties from liquid effluent discharges, such as additive or synergistic effects will be confirmed through the implementation of a LEMP (Section 9.6.2).

Monitoring cumulative impacts

From a technical perspective the LEMP has been designed based on parameters predicted to be present within the discharges from the CPF and FPSO because they are the source of the greatest proportion of the liquid effluent discharges. The FPSO also contains the stream with the highest potential toxicity due to the discharge of production chemicals within the PW stream. Sampling locations within each of these facilities and the testing parameters are shown in Table 7-29.

When designing the LEMP, it was recognised that an assessment of the combined streams entering the receiving environment was required to confirm any uncertainties regarding potential interactions either additive or synergistic, that may arise as the liquid effluent discharge streams leave the CPF and FPSO. Monitoring on both the facility (CPF and FPSO) and in the receiving environment will enable cause and effect pathways to be confirmed as being low risk.

The LEMP is comprised of both routine and adaptive monitoring (Table 7-29). Routine monitoring allows for checks on the potential risk to the receiving environment from the discharge of liquid effluent on a routine basis; while adaptive monitoring supports additional monitoring and testing on an as required basis linked to triggers and a hierarchical management response as outlined in Section 9.6.2.

Table 7-29: Liquid effluent management plan summary

Sampling location	Type of monitoring
Routine monitoring	
Facility based – FPSO and CPF	Formation water (water cut) monitoring Chemical injection monitoring Chemical characterisation Whole effluent toxicity (WET) testing
Receiving environment (gradient out to 10 km from the FPSO)	Water quality including ecotoxicity testing Sediment quality
Adaptive monitoring	
Dependent on the scenario but could be facility based and/or receiving environment	Chemical characterisation, WET testing, water quality, sediment quality and/or any other monitoring as required

As further described in Section 9.6.2, receiving environment monitoring in the LEMP, out to 10 km from the FPSO is proposed. The receiving environment monitoring for water and sediment quality is primarily based on CPF and FPSO discharges; however, may also be used for other discharge sources (e.g. ASV and support vessels) in proximity to the facility. As such, the LEMP provides a routine check on the state of the receiving environment in the Ichthys Field.

To assess potential changes in water and sediment quality in the receiving environment associated with liquid effluent discharges, the first routine check was undertaken in 2019 (within 12 months of start-up). Water and sediment sampling were undertaken within the FPSO and CPF mixing zones, as well as outside the mixing zone (up to 10 km from the FPSO). Water samples and profiles completed within the FPSO mixing zone, including within 50 m of the FPSO, reported no discernible changes in water quality associated with discharges (refer to Table 9-11 for list of parameters). Similarly, water samples and profiles were also completed within the CPF mixing zone, including within 50 m of the CPF, with no discernible changes in water quality (refer to Table 9-12 for list of parameters). Sediment samples collected in vicinity of the facility also found no discernible changes that may be associated with discharges from the facility. These results indicate that liquid effluent discharges are likely having a highly localised and temporary impact on water quality in proximity to the discharge point.

Information gathered through implementation of the LEMP has and will continue to provide a proof of concept regarding the prediction of dilution and dispersion of contaminants in the receiving environment to represent risk from all liquid effluent streams. The implementation of the LEMP demonstrates a commitment to continually reduce impacts and risks from liquid effluent discharges to ALARP.

Table 7-30 provides the impact and risk evaluation relating to cumulative impacts from multiple liquid effluent discharges.

Table 7-30: Impact and risk evaluation - cumulative impacts of liquid effluent discharges

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">A number of liquid effluent streams are discharged to sea during the operation of the offshore facility and associated vessels in WA-50-L, ranging from one-off or intermittent discharges (e.g. open drains) to long-term discharges (e.g. cooling water, PW). Where possible, the previous assessments of liquid effluent discharges have been based on the known or predicted constituents using worst-case discharge flow rates in order to conservatively assess potential impacts.
Predictive dispersion modelling of the worst-case constituents that drive the mixing zone, i.e. constituents requiring the greatest number of dilutions to reach guideline values or NEC from the FPSO and CPF during steady state (Table 7-28), has been undertaken to assess any cumulative or additive effects as illustrated in Figure 7-6.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>Particular values and sensitivities with the potential to be impacted are:
• transient EPBC-listed species
• planktonic communities
• benthic communities
• demersal fish communities and fisheries.
As described in previous subsections of Section 7.1.3, several routine discharges will occur, not only from the CPF and FPSO, but also from associated vessels (including ASVs) and subsea infrastructure. Environmental impacts from the routine discharges are now assessed to consider potential additive effects or cumulative impacts to the values and sensitivities identified for each liquid effluent discharge stream. Planned, routine operational subsea discharges have not been assessed further, given that the small volume discharges will occur at, or near, the seabed. The predominant discharge from subsea infrastructure is MEG, which has a higher density than seawater and, therefore, will not rise in the water column and combine with discharges released at, or near, the sea surface, particularly given the approximate 250 m water depth. In addition, based on the distances between drill centres and the distance from the CPF and FPSO, interactions with the larger liquid effluent discharge plumes from the facility are not considered plausible.
The effect of multiple liquid effluent discharges may increase turbidity in the receiving environment potentially resulting in a range of impacts, from light reduction, to impairment of feeding in marine flora and fauna. Turbidity is generally not thought of as a cumulative stressor (Gaylard 2009). Changes in ambient TSS levels may arise from multiple liquid discharges. Increased water turbidity decreases the passage of light through water and can slow photosynthesis by phytoplankton species and reduce primary productivity (Davies-Colley et al. 1992). In coastal waters with poor dispersion, evidence suggests that there are occasions where highly turbid waters can remain entrained in the water column for many days, resulting in a reduction in light penetration, impacting sensitive components of the benthos, such as seagrass, making the impact of turbidity potentially cumulative (Gaylard 2009). Predictive modelling indicated that the discharge plumes from the FPSO and CPF do not overlap; therefore, increases in turbidity due to the discharge of multiple streams is not expected with limited potential for cumulative impacts. Given the dispersive nature of the open-ocean environment in</td><td>Insignificant (F)</td></tr>
</table>

WA-50-L, no cumulative impacts from liquid discharges associated with turbidity are expected (Insignificant F). This is further supported by the expected TSS of the FPSO moonpool discharge, which is an order of magnitude lower than ambient concentrations due the high ratio of mixing obtained with the cooling water. Impacts to transient, EPBC-listed species and planktonic communities are not expected due to slight increases in turbidity. Additionally, given the distance from shore in an open-ocean environment, the water depth of approximately 250 m, in conjunction with rapid dilution and dispersion, seabed habitats and benthic communities are unlikely to receive organic matter fallout from plumes released at, or near, the sea surface. The interaction of multiple liquid effluent streams may result in a decrease in dissolved oxygen (DO) concentrations mainly through elevations in water temperature, such as from cooling water discharges, and from increased biological oxygen demand due to the presence of organic materials and nutrients in the receiving environment from sewage, grey water and food waste discharges. Concentrations of DO are known to be highly dependent on temperature, salinity, biological activity (microbial, primary production) and rate of transfer from the atmosphere (Johnson et al. 2008) and, under natural conditions, DO will change, sometimes considerably, over a daily (or diurnal) period. The lethal and sublethal effects of reduced levels of DO are related to the concentration of DO and period of exposure of the reduced oxygen levels. A number of animals have behavioural strategies to survive periodic events of reduced DO which include avoidance by mobile animals, such as fish and macrocrustaceans, shell closure and reduced metabolic rate in bivalve molluscs, and either decreased burrowing depth or emergence from burrows for sediment dwelling crustaceans, molluscs and annelids (Cole et al. 1999). Given the water depth (approximately 250 m) and discharge depths (10–35 m) for the liquid effluent streams, benthic communities are not expected to encounter reduced DO levels as a result of multiple liquid effluent discharge streams from the CPF, FPSO or vessels. Stiff et al. (1992) and Nixon et al. (1995) identified crustaceans and fish as the most sensitive organisms to reduced DO levels, with the early life stages of fish particularly sensitive. In freshwater, a concentration of 5 ppm DO is recommended for optimum fish health and sensitivity to low levels of DO is species-specific. Generally, most species of fish become distressed when DO levels fall to 2–4 ppm and mortality is reported to occur at concentrations less than 2 ppm (Francis-Floyd 2014). Background levels of DO at the Ichthys Field are reported to mirror water temperatures, with constant levels of 6–6.5 ppm recorded at or above the thermocline in both summer and winter (INPEX 2010). Saltwater fish have a higher tolerance for low DO concentrations, as saltwater species generally have lower oxygen requirements than freshwater species (CoRIS 2016). Those species of fish found near coral reefs may require higher levels of DO; however, there are no coral reefs in WA-50-L or within the field of effect of the discharges (mixing zone <1,514 m based on 347 dilutions). Concentrations of DO available for pelagic fish in the vicinity of the facility and the demersal fish community (KEF) situated approximately 12 km from the FPSO, are not expected to be impacted by cumulative liquid effluent discharges. This is based on the oceanic currents and mixing expected in the open-ocean environment of WA-50-L enabling re-oxygenation. Therefore, liquid effluent discharges are not expected to reduce DO concentrations to levels significantly below background ambient conditions and not to levels where fish mortality is possible. Given the limited spatial extent of multiple liquid effluent discharge plumes within the wider marine region (Table 7-28), which do not overlap between the CPF and FPSO, the drifting nature of plankton, and highly mobile nature of fish and other transient marine fauna (transient, EPBC-listed species) with the ability to avoid plumes within the water column (approximately 250 m water depth), any impacts are expected to be temporary and Insignificant (F). Potential cumulative or additive	

effects from liquid effluent discharges, above those already described previously for potential interactions between discharge streams, are not expected to occur and the consequence of any potential impact is considered to be Insignificant (F).			
Identify existing controls			
• Controls to reduce or avoid the individual contributions of the CPF, FPSO and vessels are provided in the preceding tables within Section 7.1.3 (Table 7-10 to Table 7-27). • Implement a LEMP comprising of facility-based monitoring, receiving environment monitoring and adaptive monitoring within an adaptive monitoring framework management in accordance with Section 9.6.2 and Table 9-13.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	None identified	N/A	N/A
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures and administration	None identified	N/A	N/A
Identify the likelihood			
Likelihood	Predictive modelling using the worst-case discharge rates from the facility indicated that the liquid effluent plumes and mixing zone are relatively limited in size and that they do not overlap (Figure 7-6). Therefore, the likelihood of impacts resulting in reduced ecosystem productivity or diversity to the identified values and sensitivities from cumulative or additive effects from liquid effluent discharges is considered to be Highly Unlikely (5). Implementation of the LEMP and any identified management actions, if trigger levels are exceeded, will provide further understanding of the mixing zone and reduce the level of uncertainty around potential impacts and risks from multiple liquid effluent discharges.		
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Highly Unlikely (5) the residual risk is Low (10).		
Residual risk summary			
Consequence	Likelihood	Residual risk	
Insignificant (F)	Highly Unlikely (5)	Low (10)	
Assess residual risk acceptability			
Legislative requirements			

The discharge of liquid effluents from offshore facilities is standard industry practice. In the absence of relevant Australian environmental legislative requirements that relate specifically to cumulative liquid effluent discharges, the standards and guidelines which the facility has been designed to meet are described in the acceptability justifications for each individual liquid effluent stream described in Section 7.1.3.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential cumulative impacts and risks from planned liquid effluent discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to the liquid effluent discharges (i.e. PW, oily water, cooling water, ballast water, scrubbing water, brine or sewage, grey water and food waste). Managing liquid effluent discharges as described for each liquid effluent stream described in Section 7.1.3 is consistent with the intent of the conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, and the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standards	Measurement criteria
Refer to Table 9-13		

7.2 Waste management

7.2.1 Inappropriate waste handling and disposal

Operation of the FPSO, CPF, ASVs and support vessels will generate a range of non-hazardous and hazardous waste, and may include:

- domestic waste, e.g. paper, plastics, glass, packing materials
- construction/maintenance waste, e.g. scrap metal offcuts, scrap rubber and hoses, packing materials, synthetic ropes
- liquid mercury
- spent solid catalysts from the mercury-removal unit MRU and sulfur-removal units (SRUs)
- mercury contaminated adsorbents and filters
- MPPE media column
- solids (sand) from inlet separators and vessels, potentially containing NORMs
- ash from vessel incinerators
- waste oil and filters, oily rags, degreasers, batteries, paints and solvents.

If waste materials are inappropriately handled, stored or transferred it may be accidentally lost overboard. In addition, any equipment or materials e.g. hoses, attachments, caissons, bolts, etc. identified as missing during inspection campaigns will be reported as waste. An evaluation of the potential impacts and risks associated with waste is included in Table 7-31.

Table 7-31: Impact and risk evaluation – inappropriate waste handling and disposal

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">The offshore facility and associated vessels will generate a variety of non-hazardous and hazardous wastes, which will not be intentionally discharged to the marine environment. 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 (through the leaching of chemicals from wastes, such as liquid mercury, mercury contaminated adsorbent filters, spent catalysts, MPPE column, ash from incinerators, spilt chemicals, paints and solvents), 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 species that ingest waste materials.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by improper waste management are:
• planktonic communities
• EPBC-listed species (marine fauna).
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).
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).
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 2018). 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>Insignificant (F)</td></tr>
<tr><th colspan="2">Identify existing controls</th></tr>
<tr><td colspan="2">• Spill containment and recovery equipment
• Implementation of offshore waste/garbage management plan
• Vessels manage waste in accordance with MARPOL Annex V, specifically the requirement to have a garbage management plan.</td></tr>
<tr><th colspan="2">Propose additional safeguards/control measures (ALARP evaluation)</th></tr>
</table>

Hierarchy of control	Control measure	Used?	Justification
Elimination	None identified	N/A	N/A
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures & administration	Use of licensed onshore waste facility or contractor to receive / dispose of waste.	Yes	The use of licensed onshore waste receiving facilities/contractors provides assurances that wastes will be correctly handled and disposed of once unloaded from vessels.
	Reporting of equipment lost to sea	Yes	Any equipment or materials and waste lost to the marine environment will be reported.

Identify the likelihood	
Likelihood	During recent years of operation of the offshore facility and associated vessels, the accidental release/loss of waste overboard has occurred on several occasions often through incorrect storage. Therefore, impacts to transient, EPBC-listed species and planktonic communities from the unplanned release of waste to the ocean are considered Possible (3). However, this is considered to be ecologically insignificant given the absence of any known BIAs and the dispersive open ocean environment in WA-50-L.
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Possible (3) the residual risk is Low (8).

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

Assess residual risk acceptability

Legislative requirements

The existing preventative and mitigation measures outlined to prevent accidental release of hazardous and non-hazardous wastes are consistent with, and typical of, good industry practice. Waste disposal procedures are outlined in a waste management plan, as a requirement of Condition 7 of the EPBC Act referral decision 2008/4208 and MARPOL, Annex V, meaning that waste disposal pathways are clearly outlined for appropriate waste handling, storage, transfer, and disposal.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from operational and general wastes.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris was listed in August 2003 as a key threatening process under the EPBC Act as detailed in the 'Threat abatement plan for impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans' (DEE 2018). The entanglement and ingestion of marine debris is also identified as a threat in the 'Recovery Plan for Marine Turtles in Australia" (DEE 2017a). Specific actions which contribute to the long-term prevention of marine debris (Objective 1 of the 'Threat abatement plan for marine debris on vertebrate marine life' (DEE 2018)) have been adopted in this EP including compliance with applicable legislation in relation to the improvement of waste management practices, such as MARPOL, Annex V.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria
No unplanned loss of equipment, materials or wastes to the marine environment during the petroleum activity.	Implementation of garbage management plan.	Incident report of waste lost overboard.
	Spill kits will be available on board the CPF, FPSO and vessels including ASVs	Inspection records confirm spill kits are available and stocked.
	Waste management plans will be provided on each of the CPF, FPSO, ASVs and support vessels in accordance with condition 7 of EPBC Act 2008/4208 (Appendix A) and Marine Order 95; Annex V of MARPOL (garbage), and specifically include: • procedures for collecting, storing, processing and disposing of all waste types (including segregation and labelling) • the use of waste storage and transfer equipment	Inspection records confirm waste management plans is implemented on the CPF, FPSO, ASVs and support vessels.

	• the use of waste incinerators (if present on vessels) • the use of food waste macerators/comminuters • garbage record keeping requirements, including discharges, incinerations and disposals of waste in a Garbage Record Book • Communication of waste management practices and awareness materials for crew.	
	Onshore transfer/disposal of facility/vessel waste will be completed using a licensed waste facility or contractor.	Garbage Record Book demonstrates onshore transfer/disposal of facility/vessel waste via a licensed waste facility or contractor.

7.3 Noise and vibration

Operation of the FPSO, CPF, ASVs and support vessels will generate noise emissions from a range of sources. Examples include power generation and other systems equipment onboard the facility (topsides), vessel engines and propulsion systems (underwater) and underwater acoustic techniques such as MBES and SSS.

An evaluation of the potential impacts and risks associated with noise is included in Table 7-32.

Table 7-32: Impact and risk evaluation – noise and vibration

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Marine fauna may be exposed to several sources of noise emissions during the petroleum activity, as summarised below:
• Operation of the offshore facility including topsides equipment, propulsion systems and subsea infrastructure will generate noise emissions throughout field life. Noise generated from topsides equipment is not predicted to pose a credible risk to marine fauna as most processing equipment is located on the deck, with storage facilities below deck. This in conjunction with the Ichthys Venturer's double-hull provides further insulation from topsides noise emissions to the marine environment. Propeller cavitation noise is typically the loudest emission associated with offshore production vessels when using thrusters for positioning (Erbe et al. 2013). Erbe et al. (2013) reported that although FPSOs, tankers, and tugs will also produce machinery noise, this will be well below cavitation noise from thrusters. A study into FPSO underwater noise emissions for six FPSOs located on the NWS determined the median (50th percentile) level to be in the order of 181 dB re 1 µPa at 1 m (Erbe et al. 2013).
• Operating vessels have the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels with vessel engines and dynamic positioning thrusters capable of generating continuous (non-impulsive) 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). Higher sound levels are typically associated with the use of the thrusters (Jiménez-Arranz et al. 2017), such as when a vessel is using dynamic positioning on station.
• A range of inspections may be undertaken during the activity (Section 3.5) that will use underwater acoustic techniques including MBES and SSS. The use of such acoustic equipment has 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 SSS transmit at high frequencies (approximately 70 – 400 Hz) and produce a highly focussed beam of sound down towards the seabed, due to this there is very limited horizontal sound propagation. Indicative ranges of sound outputs at source are 163 - 221 dB re 1 µPa at 1 m and 137 - 200 dB re 1 µPa at 1 m, for MBES and SSS respectively.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by noise emissions are:
• transient, EPBC-listed species (cataceans, turtles and sharks)
• fish (including commercial species).
Sudden exposure of noise-sensitive marine fauna to very high sound levels or exposure for prolonged periods to high sound levels can result in injury or a permanent threshold shift (PTS) or temporary threshold shift (TTS) in hearing. Sound level thresholds above which PTS/TTS or behavioural disturbance may occur vary widely between species and potentially between individuals of the same species. A range of behavioural changes can occur in marine fauna in response to sound pressure levels. Onset of behavioural disturbance to cetaceans has been reported to occur for sound levels 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 (Southall et al. 2007). The US National Marine Fisheries Service 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 2014).
Marine turtles are not reported to use sound for communication; however, it is suggested 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 for impulsive sounds,</td><td>Insignificant (F)</td></tr>
</table>

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 to impulsive sound by turtles (McCauley et al. 2000; NSF 2011). The potential occurrence of EPBC-listed species including cetaceans, turtles and sharks in WA-50-L is summarised in Section 4.9.4. No BIAs for these species overlap WA-50-L, with the closest relating to the 20 km green turtle internesting buffer at Browse Island (33 km away) and the whale shark forgaing BIA approximately 15 km south-east of the licence area. Based on the expected noise emissions associated with the operation of the offshore facility and associated vessels during the activity in WA-50-L, 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. 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 may be audible to marine fauna over several kilometres, with the likelihood of behavioural impacts increasing in close proximity to the facility/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 licence area, and as such any impacts are considered to be Insignificant (F). MBES and SSS are high-frequency, low-energy acoustic instruments, which are significantly less intrusive than high-energy seismic instruments. As described in Section 3.5, sound source levels produced by these different instruments range from 137–221 dB re 1 μPa at 1 m. The propagation of the very high frequency sounds from MBES cannot be reliably estimated using normal sound propagation equations. Modelling of MBES equipment has been undertaken by Zykov (2013) and McPherson & Wood (2017). The studies indicate that the single pulse and accumulated sound exposures outside of the MBES beam are below the threshold levels for injury, PTS or TTS to cetaceans, turtles, fish and sharks. It is not expected that fauna would persist in close proximity to the MBES long enough for impacts to occur. Based on the relative risk criteria proposed by Popper et al. (2014) and recognising the rapid attenuation of high-frequency sound, behavioural effects (in animals that can detect the high-frequency signals) are likely limited to within tens of metres. Therefore, no impacts to these species' groups are expected. Hearing impairment or significant behavioural impacts to marine fauna from MBES surveys have not been reported previously. Therefore, the consequence is considered to be Insignificant (F). A limited number of commercially significant fish stocks may be present in WA-50-L that may be exposed to underwater noise emissions (Section 4.11.3). Given the deep waters, commercially significant fish stocks in WA-50-L are primarily limited to highly mobile pelagic species such as tuna and billfish. The water depths and absence of suitable habitats mean the licence area 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) (Section 4.11.3). 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-50-L 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 2021b; Harte & Curtotti 2018). Timing of scampi spawning is uncertain, but studies of similar species suggest that spawning occurs in September-October (AFMA 2021b).	

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 and of higher energy than MBES and SSS. 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. Therefore, the effect of MBES and SSS on scampi is not expected to result in any mortality or impacts to their eggs or larvae. If disturbed, it is likely that scampi will move to avoid the immediate area with any effects of sound to scampi considered to be Insignificant (F). Pelagic fish species such as tuna and billfish may also be present in WA-50-L but these species are highly mobile and belong to a group of fish with limited sensitivity to sound (Popper et al. 2014). Fish may avoid waters immediately surrounding the acoustic equipment, 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-50-L, 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 existing controls			
Controls for marine fauna disturbance including implementation of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05) *Interacting with cetaceans* (modified to include turtles), and other controls relating to whale sharks are described in Table 7-34.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate use of facility/vessels	No	The use of the offshore facility and vessels to undertake the activity cannot be eliminated.
	Eliminate the use of DP vessels	No	The use of thrusters to maintain vessel position is known to generate increased noise emissions. However, in WA-50-L where there is significant subsea infrastructure, the potential for damage from vessel anchoring leading to damage to wellheads/flowlines etc is unacceptable therefore DP to accurately maintain positioning cannot be eliminated.
	Eliminate the use of acoustic equipment for inspections	No	Inspection of the subsea infrastructure in WA-50-L is required. Other acoustic instrumentation does not typically provide the same resolution as is required from MBES and SSS inspections. Given that the potential risk is already low, it is not practicable to eliminate (or substitute) the use of MBES and SSS.

Substitution	Only undertake MBES and SSS inspections outside of sensitive periods for internesting turtles at Browse Island (Nov – March)	No	The ability to undertake inspections using acoustic equipment is required year-round. Additionally, any noise emissions from MBES and SSS are low frequency and short term in duration with no predicted impacts to marine fauna.
Engineering	None identified	N/A	N/A
Procedures & administration	Marine fauna observations and shut-down procedures during MBES and SSS inspections	No	Shut-down procedures are typically applied during some noise generating activities to prevent injury/PTS or reduce the risk of TTS effects in marine fauna. Given that MBES and SSS will not result in injury or hearing impairment from sudden exposures, and behavioural effects will be localised, this control does not provide any significant environmental benefit.
	Routine marine fauna observations to inform commencement of planned night-time vessel-based operations such as IMR activities	No	All IMR vessels/activities associated with the petroleum activity will be confined to the operational area (WA-50-L). IMR vessels may operate on a 24/7 basis and IMR planned activities general use ROVs for inspection, and maintenance work. As described in Section 4.9.4 there are no BIAs for marine fauna that overlap WA-50-L. The closest BIAs are whale shark foraging (15 km), internesting buffer for green turtles at Browse Island (33 km), humpback whales (resting/calving) 120 km SE and blue whales 60 km NW for migration and foraging 98 km at Scott Reef. Given the distances to sensitive receptors/critical habitats and that IMR vessel engines/activities will not result in injury or hearing impairment from sudden exposures, implementing this control does not provide any significant environmental benefit. The costs to have MFOs onboard all IMR vessels is grossly disproportionate.
	Implement EPBC Regulations 2000 - Part 8 Division 8.1 (Regulation 8.07 - aircraft) specifically maintaining separation distances for helicopters.	No	As described in Section 4.9.4 there are no BIAs for marine fauna that overlap WA-50-L. Given the distances to sensitive receptors/critical habitats and that helicopter approaches to the offshore facility will not result in injury

			or hearing impairment implementing this control does not provide any significant environmental benefit.
	Soft start procedures	No	MBES and SSS instruments do not have the capability for soft-starts (ramp up of noise levels). In addition, MBES and SSS will not result in injury or hearing impairment, and behavioural effects will be highly localised.

Identify the likelihood	
Likelihood	Despite the absence of any BIAs or important habitats in WA-50-L, transient marine fauna individuals (particularly green turtles at Browse Island and commercial fish species) may be present within the licence area. Due to the increased sound source levels and expected propagation distances associated with presence of the offshore facility, associated vessels and acoustic inspection equipment, noise emissions may be audible; however, impacts to marine fauna are considered Unlikely (4).
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Unlikely (4) the residual risk is Low (9).

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

Assess residual risk acceptability

Legislative requirements

EPBC Regulations 2000 – Part 8, Division 8.1 will be implemented with regards to separation distances and vessel speeds.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from noise emissions.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Anthropogenic noise has been identified as a threat to pygmy blue whales in the Conservation Management Plan for the Blue Whale (DoE 2015). Noise interference has also been identified as a threat to marine turtles (DEE 2017a). The above listed controls to be adopted during the petroleum activity are in alignment with the actions identified in the various conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

<table>
<tr><td colspan="3">Acceptability summary
Based on the above assessment, the risk of impact is acceptable because:
• the activity demonstrates compliance with legislative requirements/industry standards
• the activity takes into account stakeholder feedback
• the activity is managed in a manner that is consistent with the intent of conservation management documents
• the activity does not compromise the relevant principles of ESD
• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.</td></tr>
<tr><th>Environmental performance outcome</th><th>Environmental performance standards</th><th>Measurement criteria</th></tr>
<tr><td colspan="3">Refer to Table 7-34</td></tr>
</table>

7.4 Biodiversity and conservation protection

7.4.1 Introduction of invasive marine species

The risk posed by an IMS reflects both the likelihood that a non-native species is introduced to a region outside its native distribution, and the potential for adverse consequences typically once a self-sustaining, abundant population is established.

For an IMS to be translocated from a donor region (e.g. an infected port) and establish a self-sustaining reproductive population in a recipient region, it must successfully pass through a series of stages along an invasion pathway. An evaluation of potential impacts and risks associated with IMS, as they relate to the FPSO, CPF and vessels, are described in Table 7-33.

The CPF and FPSO arrived in WA-50-L mid-2017. Post-arrival monitoring and sampling confirmed no IMS of concern had survived the 6,000 km tow from the South Korean shipyards to the warm tropical waters of WA-50-L. However, post-arrival monitoring (2017) and subsequent genetic analysis (2018) confirmed that both the CPF and FPSO had the IMS *D. perlucidum* growing on external areas of the hull. The observations made by independent IMS experts (Biofouling Solutions (BFS)) indicated that settlement of *D. perlucidum* on the FPSO and CPF occurred after they reached WA-50-L, and there was no clear evidence of any other IMS on the FPSO and CPF. As described in Section 4.10, *D. perlucidum* is reported to be widespread within WA and NT waters.

Opportunistic observations

Monitoring of submerged surfaces of offshore infrastructure for the presence of introduced species using opportunistic ROV footage has been conducted since completion of the post-arrival studies in 2017.

In 2018, 2019 and 2020, ROV survey footage was obtained during various IMR campaigns in WA-50-L. Opportunistic video footage from a variety of submerged locations on the FPSO and the CPF were reviewed and assessed by a qualified third-party, with further independent expert review of select images undertaken by BFS.

The outcome of the annual IMS observations over three years indicated there was no evidence of any new marine pests on the offshore facility (FPSO and CPF). Some images from the FPSO and CPF showed growth consistent with the colonial ascidian *Didemnum* sp. It is likely that this is the marine pest *D. perlucidum*, given this species was previously confirmed to be present on both the FPSO and CPF in 2017; however, this is widespread within WA and NT waters (Section 4.10).

The annual observation reports also indicate the level of biofouling on most of the structures is primary or secondary, which is associated with a lower risk of IMS. The level of biofouling and types of species present is typically driven by water depth and period of deployment with access to light allowing for the growth of photosynthetic organisms like algae. Mooring chain images taken in deeper water were dominated by barnacles and oysters which are less reliant on light for growth and survival. The tertiary level of biofouling observed on the mooring chains also indicates a longer period of deployment.

The presence or absence of IMS was also assessed using video footage collected during UWILD surveys of four project support vessels in 2019 and 2021. A review of footage undertaken by BFS for two support vessels (MMA Plover and the Far Sword) in July 2019 did not indicate any macroscopic IMS of concern on the vessels.

In July 2020, a remote real-time visual survey and review of images of the MMA Brewster while the vessel was dry-docked in Henderson, WA was undertaken by BFS.

The reported concluded that despite the MMA Brewster regularly visiting and interacting with Ports and infrastructure which are known to be contaminated with *D. perlucidum*, overall the external hull was relatively clean apart from a complete coverage of diatom slimes and acorn and gooseneck barnacles and that the MMA Brewster and potentially other offshore support vessels with similar operating profiles are unlikely to act as a significant vector for this species between Ports and offshore infrastructure.

In June 2021 BFS inspected INPEX's OSV (the Go Koi) for IMS of concern while dry-docked at the Dampier Supply Base. The aim of the inspection was to better understand the OSV's potential as a vector for *D. perlucidum* between ports on the mainland and WA-50-L infrastructure. The Go Koi has routinely transited between Broome and the Ichthys Field at approximately 5 weekly intervals since 2018, typically spending approximately 48 hours alongside in Broome Port before transiting back to WA-50-L. Once in WA-50-L the vessel remains in the Field, idle and attached to a mooring buoy, or mobile at low speeds assisting offtake support for tankers every 7-10 days. The results of the external hull inspection confirmed that no IMS of concern were detected. BFS concluded that the Go Koi was unlikely to be a significant vector for IMS of concern between ports and offshore infrastructure.

Table 7-33: Impact and risk evaluation – IMS

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">IMS are non-native 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.
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, due to changes to the structure of benthic habitats and native marine organisms through predation and/or competition for resources, leading to a change in ecological function. 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).
There are several pathways for the introduction and spread of IMS of concern associated with the petroleum activity including the mobilisation of vessels from international and domestic waters, domestic conveyances associated with support vessels during planned operations and domestic conveyances during unplanned events, such as vessels seeking shelter in the lee of offshore islands during adverse sea conditions or cyclone events. If unmanaged, these may act as a pathway through the discharge of high-risk ballast water containing IMS and/or IMS present on submerged vessel hulls in the vicinity of sensitive, unaffected environments (with no previously reported presence of IMS).</td></tr>
<tr><td>Potential consequence</td><td>Severity</td></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted are:
• benthic communities – such as BPPH and shallow water coastal environments in WA marine parks and reserves, the closest of which to WA-50-L is Browse Island, however other offshore islands and shoals with sensitive benthic habitats, where vessels may seek shelter during adverse sea conditions or cyclone events have the potential to be affected.
• commercial, traditional, and recreational fishing including aquaculture.
Shallow water, coastal marine environments are most 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 islands and shoals such as those found in WA marine parks and reserves as presented in Figure 4-2. Many of these marine parks and reserves contain sensitive benthic habitats with a potential to be impacted by invasive populations.
D. perlucidum was the only IMS detected on the offshore facility during post-arrival sampling and is thought to have been recruited locally once the facility had arrived in WA-50-L. The presence of D. perlucidum in WA waters was first documented in 2010 (Smale & Childs 2012) and following its first detection in Australia, monitoring programs supported by molecular analysis have documented the distribution of D. perlucidum throughout WA and NT waters (Dias 2016). There is no active management of D. perlucidum in WA with the exception of targeted management undertaken by DPIRD at the Montebello Islands (Section 4.10).</td><td>Significant (C)</td></tr>
</table>

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. There is a potential for the transfer of viable IMS propagules to sensitive benthic communities that may survive, find suitable habitat and establish a self-sustaining population within the shallow water benthic habitats of WA/NT waters. This may result in impacts, such as altering the ecosystem health within benthic communities. Vessels supporting the activity that remain stationary in proximity to the CPF/FPSO for greater than 7 days, such as ASVs or specialist construction vessels may act as a source 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 vessels. 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. Based on the habitat preferences of IMS (shallow water environments), the closest shallow water habitat to WA-50-L is Browse Island, located approximately 33 km away. However, it is neither disturbed nor contains artificial structures that IMS prefer. Dias et al. (2016) reported in a global mapping study of *D. perlucidum* distribution that that the majority of *D. perlucidum* colonies were found on artificial structures within ports, harbours and marinas. In WA, with the exception of the Swan River, *D. perlucidum* has not been recorded in natural habitats such a marine reefs, which is consistent with previous studies that have only identified the species at sites under anthropogenic influence both in Australia and overseas (Dias et al. 2016). Relevant ports related to the petroleum activity are Broome and Darwin, located approximately 400 km and 900 km away respectively. The high frequency of vessels visits from a range of destinations, and habitat preference for IMS (artificial substrate, disturbed habitats, shallow coastal waters) have resulted in these ports having a confirmed presence of certain IMS (Section 4.11.5). IMS originating from these ports may present a potential impact to the facility itself and sensitive habitats in WA/NT waters that has the potential to result in medium to large scale impacts to benthic communities with a consequence rating of Significant (C). The transfer of IMS propagules via anthropogenic dispersal mechanisms and/or stepping-stone dispersal from offshore infrastructure or vessels colonised with IMS, has the potential to affect distant commercial, traditional and recreational fishing including aquaculture. Of particular significance is aquaculture located in shallow coastal areas of WA waters which are potentially susceptible to IMS. The successful introduction of IMS in these areas may impact aquaculture resulting in a loss of revenue. Other fishing activities that may be impacted include traditional Aboriginal fishing known to occur at several IPAs located along the Kimberley coastline (Section 4.11.3) and recreational fishing that is known to occur around Broome, Wyndham and Darwin (Section 4.11.3). In the event an IMS is translocated into WA-50-L, then transfers and subsequently establishes a self-sustaining population, values and sensitivities with the potential to be exposed include regionally important areas of high diversity, such as shoals, banks and coral reefs. It is considered that the establishment of an IMS in WA/NT waters has the potential to result in a medium to large scale event with a medium term impact on the environment, also potentially resulting in regional community disruption with significant impact on economic or recreational values with a consequence rating of Significant (C).	

Identify existing controls

• Support vessels and, ASVs , the FPSO and CPF have an antifouling coating applied that is 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).
• All PSVs and the OSV, on a long-term contract to INPEX will follow commercial vessels survey requirements, as applicable to their class type which includes out of water surveys.
• Vessels will have an approved ballast water management plan and valid ballast water management certificate, unless an exemption applies or is obtained.
• PSVs on long term contracts (> 5 years) will have an approved ballast water management system and marine growth prevention systems installed.
• OSV on long-term contract (for > 5 years) will have a sealed ballast tank system and will have a biofouling management plan and maintain a biofouling record book.
• Support vessels operating within Australian seas will manage ballast water discharge using one of the following approved methods of management (DAWE 2020):
  o an approved ballast water management system
  o ballast water exchange conducted in an acceptable area *
  o 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)
  o retention of high-risk ballast water on board the vessel
  o discharge to an approved ballast water reception facility.
* Acceptable area is as defined in the Biosecurity (Ballast Water and Sediment) Determination 2019. For high risk ballast water an acceptable area for ballast water exchange is defined as (DAWE 2020):
- Vessels servicing an offshore facility: at least 500 m from the facility, and no closer than 12 nm from the nearest land
- All other vessel movements: at least 12 nm from the nearest land and in water at least 50 m deep; not within 12 nm of the Great Barrier Reef or Ningaloo Reef ballast water exchange exclusion areas.
• All vessels that use ballast water will comply with the Regulation D2 discharge standard of the Ballast Water Management Convention.
• Complete a biofouling risk assessment (including immersible equipment) for vessels (including the ASVs) mobilised from international waters, and implement mitigation measures commensurate to the risk, as appropriate to ensure the mobilisation of the vessel poses a low risk of introducing IMS in accordance with Figure 9-9.
• Implement the adaptive IMS risk-based monitoring program (IMSMP) in accordance with Section 9.6.4 and Table 9-24.
• Vessel masters will be advised to reduce time spent near high value sensitive areas such as offshore island and shoals and no ballast water to be exchanged in order to limit the potential spread of IMS.

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 IMR activities and supply or support the facility that is practicable and cost efficient.
Substitution	Only use local support vessels.	No	Using only local vessels could result in delays when sourcing an appropriate vessel. Local vessels are not always capable of meeting the specific requirements of the activity. The potential cost and time needed to source a capable vessel locally is disproportionate to the minor environmental gain potentially achieved.
Engineering	None identified	N/A	N/A
Procedures & administration	Complete a domestic biofouling risk assessment for ASV's (and other long term construction vessels with similar profile) mobilised from other regions in Australia, and implement mitigation measures commensurate to the risk, as appropriate to ensure the mobilisation of the vessel poses a low risk of introducing IMS.	Yes	The operational profile of ASV's and construction support vessels that are likely to spend prolonged periods (i.e. >7 days) alongside the CPF or FPSO are more likely to act as a vector for IMS if any are present.
	Complete a domestic biofouling risk assessment for 'short-term supply vessels' operating routinely between Darwin, Broome and offshore facility.	No	As described in Section 7.4.1, IMS monitoring of short-term vessels has been undertaken and this has confirmed that these vessels are not acting as significant vector for IMS. During consultation with NT DITT – Aquatic Biosecurity Unit and WA DPIRD acknowledged vessels that operate in a domestic setting, over time, would gradually have a higher risk rating as their antifoulant paint gets to the end of its effective life. However, they further clarified that the marine pest biofouling risk posed by short-term supply vessels used by the Project did not change if the vessels were just travelling between Darwin, Broome and the offshore facility as no marine pests of concern had been detected at any of these locations. DPIRD and NT DITT confirmed that the movement of short-term vessels between these locations was considered to pose a low biosecurity risk. Given the existing controls these vessels are required to adhere to (i.e. antifouling coatings, commercial vessel survey requirements, etc) and in consideration of the advice received from stakeholders regarding the

			low biosecurity risk posed by short-term supply vessels and their movements, the requirement to undertake a domestic risk assessment is not warranted.
	Implement a routine IMS monitoring plan for the project (facility and support vessels).	Yes	The IMSMP described in Section 9.6.4 includes a 5 yearly review of monitoring data and is based on an adaptive management approach that was established in consultation with independent IMS experts and relevant stakeholders, namely the WA DPRID, NT DITT-Aquatic Biosecurity Unit and DAWE. Based on the data generated from the implementation of the IMSMP since 2018, the maintenance of the Low risk status of the facility and the controls in place to manage IMS risks, the implementation of the IMSMP is considered to be an effective control.
	Undertake frequent in-water IMS inspections of all PSVs and the OSV, when in port to confirm the performance and maintenance of antifouling coating.	No	An out-of-water survey will occur every 5 years as part of the commercial vessels survey requirements (renewal survey completed every 5 years, at which point new antifouling paint is applied and antifoul certificates are amended). As confirmed by the inspection of several of INPEX support vessels between 2019 and 2021, the potential for such domestic vessels transiting between WA-50-L and the mainland to act as a vector for the spread of IMS of concern is considered unlikely as no IMS of concern were present on the hulls of the vessels. More frequent and out of schedule in-water inspections of PSVs and the OSV (using ROV or divers in port) introduces additional health and safety risks, and a risk of delay to support services required by the facility. Implementation of this control on a frequent basis is not reasonable assuming that the IMS risk profile does not change. Noting that through the implementation of the adaptive IMSMP further inspections may be triggered (Section 9.6.4).
	Limit time in port for support vessels to reduce the potential for IMS colonisation.	No	As described in Section 4.11.5, the most commonly used ports by INPEX vessels are Broome and Darwin. Both of these ports have the potential to act as a source of IMS, which may then be translocated by INPEX vessels, if they were colonised in port. Typically, the PSVs may spend ~48 hours alongside. For operational reasons, the time vessels spend loading and unloading may be subject to unforeseen delays either

			logistical or weather based. INPEX has limited control once its vessels are alongside in port, as this is managed by the relevant port authority. 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. In order for limiting time alongside to be an effective control, vessels would have to complete loading/unloading within unrealistic timeframes (<24 hours). Although specific timeframes for vessel loading operations cannot be guaranteed, guidance from DPIRD has been adopted. Additionally, INPEX seeks to reduce time spent in port as the supply requirements for the facility are considered to be high and there are financial implications with vessels using port facilities. In addition, the inspection of several INPEX support vessels between 2019 and 2021, to investigate the potential for domestic vessels to act as a vector for the spread of IMS of concern confirmed that none of the vessels had any IMS of concern present and therefore are unlikely to act as a vector.
	Implement routine visual IMS inspections of the facility using ROV techniques.	No	Use of this technique as an ongoing approach is not considered warranted given the IMS status of the facility has been confirmed to be Low. INPEX has an EIS commitment (INPEX 2010) to collect opportunistic ROV footage of the facility during e.g. IMR operations. As an alternative to dedicated ROV surveys for IMS inspection the footage collected for other purposes will be assessed.
	Implement a facility-based sampling program to confirm if biofouling communities are present over the 40-year life of the facility contain IMS of concern.	No	Implementation of a facility-based sampling program is not considered practicable or warranted provided the IMS risk profile does not change and is therefore considered to be ALARP. Any change in the IMS risk profile will be managed using the adaptive IMSMP (Section 9.6.4).
	Vessels will have biofouling management plans and record books.	Yes	Biofouling management plan that includes 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) enables the capture of management controls to be

			recorded by the vessel. It is a prudent control that can be implemented with little additional cost and is considered ALARP.

Identify the likelihood	
Likelihood	The likelihood of an IMS becoming successfully established at a recipient location depends on a range of factors including physical characteristics of the environment falling within the tolerance ranges of the IMS (i.e. salinity, temperature, nutrient availability, etc.), and the biological characteristics of the species and the natural environment (i.e. reproductive properties, presence of appropriate prey species, predation pressure, etc.). This potential is known to be dependent on a range of factors including propagule pressure, density of the colonised population, and a range of biotic interactions and abiotic factors specific to the local marine environment. For an IMS to establish a self-sustaining reproductive population in a recipient region, it must successfully pass through a series of stages along an invasion pathway, which include a range of selective filters. Selective filters affect the total number of organisms that can survive and successfully transition to the next stage of the invasion pathway. Offshore selective filters in the invasion pathway are likely to be more significant than for coastal environments, given there is little availability of artificial surfaces or suitable settlement habitats for propagules, and greater dilution of propagule plumes. As a result, in offshore oceanic environments propagule plumes from infrastructure colonised by IMS are likely to be highly dispersed with low densities of propagules present in the water column. In turn, if propagules are able to survive the extended periods necessary for them to be transferred to coastal waters, this is still likely to result in low densities of propagules encountering suitable habitat in shallow coastal environments. As a result, propagule pressure will be low and therefore establishment potential constrained. It is now widely accepted that 'propagule pressure' (or the number of individuals introduced), is a primary determinant of establishment success for introduced populations (Lockwood et al. 2005, Simberloff 2009). Propagule pressure is also important for the post-establishment success of IMS populations. As propagule pressure increases, it becomes more likely that the founder population will survive or has sufficient genetic variation to adapt to local conditions and establish a self-sustaining population (Lejeusne et al. 2014; Roman & Darling 2007) thereby becoming 'introduced'. Many propagules may be released but never survive to join local populations. Globally, IMS species have expanded their range due to human-mediated transportation. Mechanisms of potential natural dispersion are less well documented but are reported to include 'rafting' on plant material which has been identified as an important process for the population dynamics of many organisms including ascidians, with a strong influence on coastal biodiversity (Simpson et al. 2016). Rafting on eelgrass is a previously described method of transport and spread for other ascidian species including Botryllids and *Ciona intestinalis* and has been suggested as a method of spread for other Didemnum sp. In addition to forming new colonies through larval settlement, Didemnum sp. have also been reported to have the ability to form new colonies asexually by fragmentation and at subtidal sites in Maine, USA, divers have observed lobes break off, become lodged on the surrounding substrata and over the course of several months reattach and thrive in their new locations (Bullard et al. 2007). The larval durations and dispersal distances of *D. perlucidum* remain to be experimentally established (Muñoz and McDonald 2014) with evidence suggesting that larval durations are expected to be short, in the range of several hours, with settlement only likely over short distances (metres to tens of metres) (BFS 2018). Given the offshore, open ocean environment of WA-50-L, the distance to the nearest sensitive habitat (Browse Island – 33 km away) and the lack of reported colonies establishing on natural habitats, the spread of *D. perlucidum* from the facility via natural dispersion is considered Remote (6).

	Marine pests known to be present in WA and NT waters (including the ports of Broome and Darwin) are described in Sections 4.10 and 4.11.5. The offshore facility (CPF and FPSO) permanently moored in WA-50-L is considered to have an IMS risk status of Low as confirmed by independent IMS experts and relevant stakeholders based on the results of opportunistic monitoring undertaken over the last 3 years (2018-2020) since arrival in WA-50-L in 2017. Opportunistic monitoring of the facility has indicated that no IMS of concern have been established on the hulls of the CPF and FPSO as a result of INPEX operations in the last 5 years. Additionally, monitoring completed for the PSVs and OSV, routinely supporting operations in WA-50-L, undertaken between 2019 and 2021, that confirmed the absence of any IMS of concern on vessel hulls. Therefore, adherence to the above-described controls for biofouling and ballast water management results in a low potential for the spread of IMS (Remote 6). Vessel masters will select appropriate transit routes between Broome/Darwin ports and WA-50-L based on sea state conditions. During adverse sea conditions or cyclone events, due to safety reasons, vessels may seek shelter in protected areas. Typically, this would be on the leeward side of offshore islands or shoals, with vessels remaining on DP in water depths of >100 m. Many offshore islands and shoals contain sensitive, pristine benthic habitats with respect to IMS. Therefore, access to these habitats by vessels is not permitted under normal circumstances. However, sheltering during cyclone events for safety reasons, may result in these habitats being exposed to vessels that have been alongside known sources of IMS (e.g. the facility or in port). Water depths where vessels would seek shelter will be approximately 100-150 m, as this affords the vessel the greatest protection from oncoming swells. Such deep water, sheltering locations are unlikely to provide optimal conditions for the recruitment of IMS based on a lack of hard substrate (either natural or artificial). Additionally, an advantage of sheltering on the leeward side of an island/shoal is that based on the prevailing current, the vessel will likely be downwind and therefore potential IMS propagules released from any biofouling assemblages on vessel hulls (ballast water exchange is not planned during these times) would be released downstream of the islands/shoals. Therefore, any propagules will be carried in the current away from sensitive benthic habitats. During sheltering events, considered infrequent, the vessel controls in place for planned operations are considered to be sufficient to manage potential risks. Typically, during adverse sea conditions or cyclonic events, vessels may spend approximately 12 - 48 hours in sheltered locations and therefore it is considered to be of relatively short duration and an infrequent activity. With described controls in place, the potential for colonisation of vessels is considered to be highly unlikely and hence the potential for spread of *D. perlucidum* (or other IMS of concern) via domestic conveyances during unplanned operations is considered to be Remote (6). Based on ongoing controls such as using a risk-based approach in the adaptive IMSMP to manage the pathways and vectors that are responsible for the establishment of an IMS, the likelihood of an IMS becoming established is Remote (6)
Residual risk	Based on a consequence of Significant (C) and likelihood of Remote (6) the residual risk is Moderate (8).

Residual risk summary		
Consequence	Likelihood	Residual risk
Significant (C)	Remote (6)	Moderate (8)
Assess residual risk acceptability		

Legislative requirements

Vessel ballast water will be managed in accordance with the intent of the Australian Ballast Water Requirements Version 8 (DAWE 2020) and the *Biosecurity Act 2015*. Biofouling will be managed through vessel and equipment risk assessments and mitigation measures, in accordance with the National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2018). All vessels that use ballast water are required to meet the Regulation D2 discharge standard of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Convention) if they were constructed after 2017 or at their next renewal survey after September 2019. All ships must meet the D2 standard by 8th September 2024 and this will lead to an ongoing reduction in potential risk from ballast water discharges over the life of this EP. The control measures described are consistent with NOPSEMA's Information Paper: Reducing marine pest biosecurity risks through good practice and biofouling management, IP1899 (NOPSEMA 2020d).

Stakeholder consultation

The annual reports and vessel inspection reports were provided to WA DPIRD, DAWR Aquatic Biosecurity Unit and NT DITT, for information. A summary of proposed changes to the IMS monitoring program and domestic risk assessment process were provided for discussion. The stakeholders acknowledged (in the context of the controls applied by INPEX) that actual marine pest biofouling risk posed by support vessels operating vessel between Broome – Darwin – and offshore facilities is a low risk and that no IMS of concern have been identified to date from these activities.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (refer Appendix B). IMS have been identified as a threat in many conservation management plans, with actions focusing on the prevention of their introduction. The control measures described are consistent with the actions described in the conservation management documentation.

ALARP summary

Given level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "moderate", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standard	Measurement criteria

No establishment of IMS of concern in the Commonwealth Marine Area or coastal waters via ballast water or biofouling attributable to the petroleum activity.	ASVs and 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).	Current International Anti-fouling Systems certificate or a Declaration on Anti-fouling Systems for each vessel/facility.
	PSVs and the OSV, on long-term contract to INPEX (for ≥ 5 years) will follow commercial vessels survey requirements, as applicable to their class type including performance and maintenance of antifouling coating verified by an IMS expert during the: • out of water surveys (renewal survey) every 5 years • out of water survey or UWILD or IWS will occur between year 2 and 3 of the 5-year survey schedule.	Vessel class survey inspection records.
	PSVs on long-term contract to INPEX (for ≥ 5 years) will have: • an approved ballast water management system installed, and maintained • marine growth prevention systems installed • Biofouling management Plan that includes 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).	Vessel premobilisation inspection and annual verification audit reports confirm PSVs on permanent contract to INPEX, have an approved ballast water management system installed and maintained, and marine growth prevention systems installed. Biofouling management records are available in the biofouling record book.
	OSV have a sealed ballast tank system installed and maintained. No uptake/discharge from/to the marine environment will occur.	Vessel premobilisation inspection and annual verification audit reports confirm OSV has a sealed ballast tank system installed and maintained.
	OSV will have a Biofouling Management Plan that includes 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 management records are available in the biofouling record book.

	Support vessels operating within Australian seas will manage ballast water discharge using one of the following approved methods of management (DAWE 2020) including: • an approved ballast water management system • exchange of ballast water exchange conducted in an acceptable area • 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) • retention of high-risk ballast water on board the vessel • discharge to an approved ballast water reception facility. • 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).	Vessel premobilisation inspection and annual verification audit reports confirm through ballast water records that an approved ballast water management option has been used.
	Vessels that use ballast water will comply with the Regulation D2 discharge standard in accordance with the Ballast Water Management Convention.	Records confirm vessels meet D2 discharge standard.
	A biofouling risk assessment will be completed by an independent IMS expert for all 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.	Vessel-specific biofouling risk assessment and any records of mitigation measures implemented confirming the vessel presents a low risk.
	Domestic biofouling risk assessment for ASV’s (and other long term construction vessels with similar profile) mobilised from other regions in Australia, and implement mitigation measures commensurate to the risk, as appropriate to ensure the mobilisation of the vessel poses a low risk of introducing IMS.	Domestic biofouling risk assessment.

	All support vessels will have: • an approved ballast water management plan, unless an exemption applies or is obtained • a valid ballast water management certificate, unless an exemption applies or is obtained.	Approved vessel-specific ballast water management plan maintained, or record of DAWE issued exemption (if not automatic exemption) on board. Valid ballast water management certificate or record of DAWE issued exemption (if not an automatic exemption) on board.
	Vessel masters notified to reduce time spent near high value areas such as offshore islands and shoals and no ballast water exchange to be undertaken to limit the potential spread of IMS.	Records of adverse weather planning communications including environmental assessment of vessel movements.

7.4.2 Interaction with marine fauna

The presence of vessels operating within WA-50-L has a potential to result in the injury or mortality of marine fauna from vessel strike. Table 7-34 provides a summary of the risk assessment and defines the control measures, environmental performance outcomes and standards and measurement criteria relating to vessel strike.

Table 7-34: Impact and risk evaluation – interaction with marine fauna (vessel strike)

Identify hazards and threats	
The physical presence and use of vessels in WA-50-L has the potential to result in collision (vessel strike) with marine fauna which may result in death or injury to individuals. Increased vessel traffic may result in increased turtle/vessel interactions and disruption to internesting behaviours.	
Potential consequence	**Severity**
Particular values and sensitivities with the potential to be impacted are: • transient, EPBC listed species; specifically, marine mammals, whale sharks and turtles. Vessels supporting the petroleum activity have the potential to interact with transient, EPBC-listed species; specifically, marine mammals, whale sharks and turtles. In a worst-case, this may result in death of marine fauna from vessel strike, where interactions are non-fatal marine fauna may suffer and potentially have reduced fitness (DEE 2017c). 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 fauna when vessel speeds are greater than 14 knots (Laist et al. 2001; Vanderlaan & Taggart 2007; Hazel et al. 2007; Cates et al. 2017). The potential for vessel strike applies to all marine mammals, whale sharks and turtle species within the region; however, humpback whales have a potentially higher likelihood due to their extended surface time. The potential for collision during the petroleum activity is however reduced as the licence 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 120 km south-east from WA-50-L at its closest point) and the blue whale migration corridor located approximately 60 km north west from WA-50-L 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 (Appendix B) 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 60 km to the west of WA-50-L) is the blue whale, which is also subject to a DEE Conservation Management Plan (Appendix B). 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.	Minor (E)

Whale sharks do not breach the surface as cetaceans do; however, they are known to spend considerable time close to the surface increasing their vulnerability to vessel strike (DEE 2017c). Whale sharks reportedly spend 40% of their time in the upper 15 m of the water column which leaves them vulnerable to collision with smaller vessels as well as larger commercial vessels that have drafts that extend greater than 20 m below the surface (Wilson et al. 2006, Gleiss et al. 2013). The foraging area for whale sharks (BIA) is located approximately 15 km south east of WA-50-L and whale sharks are also subject to a DEE Conservation Advice (Appendix B) which notes that the threat to the recovery of the species includes strikes from vessels. While the DEE Conservation Advice does not specify any particular measures for whale shark strike reporting, a control measure requiring compliance with the Whale Shark Wildlife Management Program no. 57 (DPaW 2013b) addresses avoidance of whale sharks and, as such, is considered to align with the Conservation Advice for whale sharks. 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; Hazel et al. 2007). Within the PEZ, marine turtle BIAs are known to occur (Figure 4-6). 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-50-L, 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 licence area which is located approximately 33 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 WA-50-L, 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-50-L. 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 existing controls	
• Implementation of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05) • Vessel speed restrictions and separation distances maintained for whale sharks	

• Vessel crew will receive an induction/training to inform them of the requirements of EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.05) in accordance with Table 9-3 (INPEX Australia Support Vessels Marine Fauna Awareness Training).			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate the use of vessels	No	Vessels are the only form of transport that can undertake the activity.
	Prevention of vessels entering internesting area during November to March to avoid disturbance to nesting green turtles at Browse Island	No	The introduction of an exclusion zone within the Browse Island internesting BIA buffer (20 km) is not considered to be warranted given support vessels transiting between the offshore facility in WA-50-L and Darwin/Broome typically remain >25 km from Browse Island. However, exact vessel routes will be influenced by sea state conditions and under adverse sea conditions (e.g. cyclone sheltering) vessels may enter the BIA but would remain on DP in water depths of >100 m. Given the short duration (12-48 hours) of any sheltering events and that research has indicated that internesting green turtles generally stay within 10 km of their nesting beaches, the need for a total exclusion zone (during nesting season) from the 20 km buffer is not considered necessary.
	Reduce the frequency of supply vessel visits to the offshore facility	No	Reducing the number of vessel supply trips would decrease the potential for vessel interactions with marine fauna; however, the frequency of re-supply by support vessels is already optimised to be as low as practicable and cannot be further reduced.
Substitution	Use smaller vessels for resupply of the offshore facility	No	Using smaller vessels, travelling at slower speeds may decrease the potential to harm or fatally injure marine fauna in the event that a vessel strike occurred; however, smaller vessels would require more frequent journeys or may have space and weight limitations for equipment required on the offshore facility.
Engineering	None identified	N/A	N/A

Procedures and administration	Vessel speed restrictions or separation distances maintained for turtles	No	It is reported that turtles generally stay close to their nesting beaches during the internesting period, so only individuals would be likely to be present in the licence area given the distance from Browse Island (33 km). Additionally, turtles reportedly spend a small portion (3–6%) of their time at the surface, this makes turtle observations by crew from the bridge of a vessel very difficult given that turtles are considerably smaller than whales or whale sharks. On this basis, reducing vessel speeds and maintaining separation distances is not considered to be an effective control and will not be implemented.
	Dedicated marine fauna observers on vessels	No	The use of dedicated MFO's onboard vessels may improve the ability to identify marine fauna at risk of collision. However, this is not considered to be practicable given POB limits on vessels and through implementation of the environmental awareness program for crew (Table 9-2) is not considered to provide additional environmental benefit for the increase in cost associated with implementing this control.
Identify the likelihood			
Likelihood	Collisions with large vessels often go unnoticed and/or unreported (Cates et al. 2017). A preliminary examination of vessel collision reports between 1840 and 2015 was undertaken by Peel et al. in 2016, referenced in the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Fauna (DEE 2017c). Peel et al. (2016) identified 109 records of ship strike in Australian waters predominantly involving humpback whales (47%). The records showed that the majority of events were in Queensland, with 10 events recorded in WA waters between 1995 and 2015. This suggests that despite the growing presence of oil & gas activities on the NWS/Timor Sea, and the steady increase (9% per year) in humpback whale numbers (Bejder et al. 2016), whale populations have not been affected by collisions with oil & gas related vessels. An internesting BIA for green turtles at Browse island (20 km buffer, DEE 2017a) has identified habitat critical for survival between November and March each year, however internesting turtles are likely to stay within 10 km of their nesting beach. Nevertheless, support vessel routes will not encroach on the 20 km buffer unless in adverse sea conditions, as they shall remain beyond the 12 nm territorial sea limit (12 nm equates to approximately 22 km). During weather events i.e. sheltering during cyclone events, support vessel may seek shelter in lee of Browse Island for safety reasons. The duration of such activities is expected to be limited to 12-48 hours and therefore the likelihood of interactions with marine turtles is further reduced. The controls described above are commensurate with the level of risk and given the absence of any known BIAs or critical habitats in WA-50-L the likelihood of a vessel strike causing injury or death to a transient, EPBC-listed species is considered to be Highly Unlikely (5). There have been no incidents of vessel strike during Ichthys operational activities to date		

Residual risk	Based on a consequence of Minor (E) and likelihood of Highly Unlikely (5) the residual risk is Low (9).	
Residual risk summary		
Consequence	Likelihood	Residual risk
Minor (E)	Highly Unlikely (5)	Low (9)
Assess residual risk acceptability		

Legislative requirements

EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.05) will be implemented with regards to vessel speeds and separation distances.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from the physical presence of vessels and potential for vessel strike associated with the petroleum activity.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). Actions identified in the Blue Whale Conservation Management Plan and conservation advice documents for humpback whales and whale sharks regarding vessel strike incident reporting will be implemented and controls in this EP are in alignment with the intent of the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Fauna (DEE 2017c).

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standards	Measurement criteria

<table>
<tr>
<td rowspan="2">No injury/ mortality of cetaceans, whale sharks or turtles resulting from interactions with vessels undertaking the petroleum activity.</td>
<td>Interactions between support vessels and cetaceans will be consistent with EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.05) Interacting with cetaceans (modified to include turtles):
• Support vessels will not travel faster than 6 knots within 300 m of a cetacean or turtle (caution zone) and minimise noise.
• Support vessels will not approach closer than 50 m to a dolphin or turtle and/or 100 m for a whale (with the exception of bow riding).
• If a cetacean shows signs of being disturbed, support vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots.</td>
<td>Records of event reports if vessel strike occurs in WA-50-L.</td>
</tr>
<tr>
<td>Interactions between support vessels and whale sharks will be consistent with the Whale Shark Wildlife Management Program no. 57 (DPaW 2013b); specifically, support vessels will not travel faster than 8 knots within 250 m of a whale shark (exclusive contact zone) and not approach closer than 30 m of a whale shark.</td>
<td>Records of breaches of whale shark code of conduct are documented.</td>
</tr>
</table>

7.5 Seabed disturbance

7.5.1 Seabed intervention activities

Undertaking seabed intervention IMR activities has the potential to disturb the seabed close to the subsea infrastructure in WA-50-L. In the event that seabed interventions are required for example, to stabilise and protect subsea infrastructure or enable access to subsea infrastructure for repairs, physical disturbance of the seabed and/or localised generation of silt plumes could affect the surrounding benthic communities. Table 7-35 provides a summary of the risk assessment and defines the control measures, environmental performance outcomes and standards and measurement criteria relating to seabed disturbance.

Table 7-35: Impact and risk evaluation – seabed intervention IMR activities

Identify hazards and threats	
Over the life of this EP, seabed intervention activities may be required, for example, to stabilise and protect subsea infrastructure, enable access to the SPS for inspection, or for repairs to installed infrastructure within WA-50-L. IMR activities may include: • physical seabed intervention/excavation or disturbance for or alongside infrastructure to adjust sand levels to gain access to, or enable repairs of infrastructure including flowline deburial • jetting or mass flow excavation • permanent installation of grout bags, concrete mattresses, rock placement, or other physical structures to stabilise and protect infrastructure on the seabed • temporary set down of ROV tooling, baskets and equipment on the seabed. Undertaking such seabed intervention activities has the potential to physically disturb the seabed close to the subsea infrastructure in WA-50-L. A disturbance to benthic communities has the potential to result in reduced ecosystem productivity or diversity. The area of seabed disturbance is directly related to the nature of the inspection, maintenance or repair activity being performed and therefore cannot be confirmed. A range of reasonably foreseeable activities such as ROV set downs may occur for a matter of hours and disturb an area approximately 2 - 4 m^2. Potential excavations may vary in length from a few metres to 100 m and may be in the order of 2 - 4 m wide. Installation of other physical structures such as grout bags or mattresses, or temporary items such as tooling baskets may vary from <1 m^2 up to approximately 50 m^2. In addition to physical disturbance, seabed intervention activities may also result in the localised generation of silt plumes could affect the surrounding benthic communities. Dropped objects may result in physical disturbance at the immediate location of the dropped object.	
Potential consequence	**Severity**
The particular values and sensitivities identified as having the potential to be impacted by seabed intervention IMR activities are: • benthic communities. Physical disturbance of the seabed may cause temporary disturbance to benthic habitats and loss of associated infauna and epifauna. As described in Section 4.8.3, seabed habitat surveys have been undertaken in the Ichthys Field, Echuca and Heywood Shoals located approximately 79 km and 96 km from WA-50-L respectively. The results of the surveys observed that seabed topography was relatively flat and featureless (INPEX 2010a) 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). Benthic habitats within WA-50-L 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). Survey data also confirmed the seabed in WA-50-L has heavily rippled sediments suggestive of strong near seabed currents and a lack of	Insignificant (F)

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-50-L (INPEX 2010a). The total disturbance footprint from seabed intervention IMR activities may range from approximately <1 m^2 - 50 m^2 from the placement of grout bags/concrete mattresses up to approximately 400 m^2 for excavations. The activities 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 disturbance and loss of habitat will represent a very small fraction of the widespread available habitat, given that WA-50-L covers an area of approximately 57,000 ha (570 km^2). Following removal of the temporarily positioned equipment e.g. ROV tooling or baskets, the soft sediments will be left disturbed; however, benthic habitats would remain viable and are expected to recolonise through the recruitment of new colonists from planktonic larvae in adjacent undisturbed areas (Guerra-Garcia & Garcia-Gomez 2006). Displacement of sediments may occur during equipment deployment, and through sediment jetting or excavation. This 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 20 km south of WA-50-L 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 Echuca and Heywood Shoals located 79 km and 96 km away from WA-50-L respectively. The potential consequence on benthic communities is a localised impact from physical disturbance within the footprint of the seabed intervention IMR activities in WA-50-L. Any impact is expected to be limited given the sparse cover of benthic communities reported in the licence area and expected recovery through recolonisation. Therefore, it is assessed to be of inconsequential ecological significance (Insignificant F). Several commercially significant fish stocks, considered as key indicator species, may be present in the waters of WA-50-L (Table 4-6). Although they may be present, given the deep waters and absence of suitable habitats, WA-50-L is not considered to offer spawning or aggregation habitat (Section 4.11.3). Disturbance to seabed habitats from the activity is therefore not expected to affect fish spawning habitats (Insignificant F).	
Identify existing controls	
• Dynamic positioning (DP) vessels used to ensure no planned anchoring • Differential Global Positioning System (DGPS) or other subsea positioning equipment used to ensure subsea activities conducted at the correct locations • Engineering analysis/ environmental assessment of possible seabed intervention techniques when planning maintenance/repair scenario except for small scopes such as placing a basket on the seabed.	

Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	No seabed intervention IMR activities	No	Seabed intervention around the subsea infrastructure in WA-50-L is necessary to ensure the integrity and operability of the SPS. Regular IMR of subsea infrastructure cannot be eliminated as the requirement to maintain subsea equipment/property in good condition as a requirement of S572 OPGGS Act.
Substitution	Use divers for inspections	No	The use of divers to perform inspections of subsea infrastructure in WA-50-L can present unacceptable health and safety risks.
Engineering	None identified	N/A	N/A
Procedures & administration	Subsea infrastructure inspection process	Yes	Using a Risk Based Inspection (RBI) approach all subsea assets have an Inspection Maintenance and Monitoring (IMM) plan and an Ichthys Field subsea inspection work instruction manual. Each task in the IMM plan is entered into SAP to ensure tasks are actioned and tracked to be completed within the specified timeframes.

Identify the likelihood	
Likelihood	Given the controls in place, the likelihood of impacting of benthic communities in WA-50-L, as a result of seabed intervention IMR activities is considered to be Possible (3). However, this is 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 sparse coverage of benthic communities present in WA-50-L and the small area potentially impacted i.e. total disturbance footprint relative to the widespread available habitat.
Residual risk	Based on a consequence of Insignificant (F) and likelihood of Possible (3) the residual risk is Low (8).

Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Possible (3)	Low (8)
Assess residual risk acceptability		
Legislative requirements		

Although there is no specific environmental legislation or guideline regarding the environmental management of seabed intervention activities with respect to impacts on benthic communities, these activities align with INPEX corporate policies through the reduction of environmental impacts and risks to ALARP. During the planning for maintenance/repair scenarios an engineering analysis undertaken includes an environmental assessment.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from seabed intervention IMR activities.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B). The draft recovery plan for sawfish and river sharks specifies habitat degradation and modification as a principle threat and details actions to reduce impacts on critical sawfish and river shark habitats. There are no critical habitats for sawfish or river sharks in WA-50-L and therefore no specific actions relating to seabed intervention activities apply.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcome	Environmental performance standards	Measurement criteria
Seabed disturbance is limited to planned IMR activities and locations.	DP vessels will be used as required to eliminate the need for anchoring.	Pre-mobilisation inspection records confirm DP vessels contracted for work scope.
	Accurate positioning of vessels will be maintained using DGPS or other subsea positioning equipment to ensure seabed intervention IMR activities are undertaken within the pre-designed disturbance area.	Pre-mobilisation inspection records (OVID / Marine Warranty Survey) confirm DGPS and subsea positioning equipment is present and appropriately maintained.

	Seabed intervention options assessment will include an environmental assessment prior to selection of seabed intervention IMR techniques.	Seabed intervention options assessment documentation.
		Records of seabed intervention activities demonstrate activity conducted in accordance with engineering design.
	Subsea infrastructure inspection process implemented using a RBI approach with an IMM in place for all subsea assets.	SAP records demonstrate IMM tasks completed within the specified timeframes.

7.6 Social and cultural heritage

7.6.1 Physical presence – disruption to other marine users

The physical presence of vessels operating within WA-50-L has a potential to result in disruption to other marine users of the area, such as shipping operators or fisheries that operate within the licence area. Table 7-36 provides a summary of the risk assessment and defines the control measures, environmental performance outcomes and standards and measurement criteria relating to disruption to other marine users.

Table 7-36: Impact and risk evaluation – physical presence disruption to other marine users

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">The continued physical presence of the permanently moored offshore facility and associated vessels in WA-50-L 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 fishing activities in the licence area. The offshore infrastructure in WA-50-L has gazetted petroleum safety zones (PSZ) in place for safety purposes and specifically to prevent collisions. All vessels other than those associated with the petroleum activity must remain outside the PSZ. The PSZs extend to a distance of 500 m around each drill centre and also around the CPF, FPSO and hydrocarbon transfer lines and risers. The PSZs are marked on Australian Hydrographic Service navigation charts. Potential interference with and/or exclusion of other users from the areas covered by the PSZs may result in a loss of revenue for commercial users including fisheries.</td></tr>
<tr><td>Potential consequence</td><td>Severity</td></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by disruption from the physical presence of the offshore facility and associated vessels are:
• Shipping operators and commercial, traditional, and recreational fisheries.
Other marine users in the vicinity of WA-50-L may be impacted by the presence of the offshore facility and vessels due to 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 AMSA’s vessel traffic data for the Browse Basin since May 2019 confirmed the absence of any major shipping lanes within the licence area. A large proportion of the high-density vessel traffic in and around WA-50-L 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. Therefore, in some areas of WA-50-L heavy vessel traffic will occur.
Individual vessels may have to slightly alter their sailing routes to avoid the offshore facility and vessels in WA-50-L, potentially leading to longer journey times; however given the distance to established shipping lanes and the relatively small size of the PSZs in relation to the licence area, any disruption to the shipping industry is expected to cause a minor impact and not result in any economic losses. Therefore, the consequence is considered to be insignificant (F).
Several Commonwealth and State managed fisheries overlap the licence area and PEZ (Section 4.11.3). In many instances, although the area of the fishery overlaps WA-50-L, no fishing effort actually occurs in the licence area based on the water depth, water temperature and lack of suitable habitat. Of the fisheries overlapping WA-50-L, 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 Ichthys Field (AFMA 2021a). Based on the low level of identified commercial fishing activity and the relatively small spatial area occupied by the facility and vessels in comparison to the entire extent of the fishing grounds available to commercial operators, the potential loss of navigable space in which a fishing operator could conduct their activities is considered to be insignificant (F).</td><td>Insignificant (F)</td></tr>
</table>

WA-50-L is situated within the MoU box for Indonesian traditional fishing (DSEWPaC 2012a 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-50-L as Scott Reef and Browse Island are located south of the licence area. Therefore, interference and disruption are not expected, and impacts are expected to be insignificant (F). There is no evidence that recreational fishing occurs within WA-50-L due to the distance from land and a lack of features of interest. Recreational fishing occurs off the WA coast during certain times of the year mainly around population centres such as Broome, Derby and Wyndham. Therefore, the potential for loss of access to the recreational fishing industry as a result of facility and vessel physical presence is considered to be of Insignificant consequence (F).	

Identify existing controls

- Ongoing stakeholder consultation with relevant stakeholders as per Section 9.8.3 and Table 9-29.
- Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the *Navigation Act 2012* and associated Marine Orders (consistent with COLREGS requirements).

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate vessels and reduce the size of the PSZs.	No	Vessels are the only form of transport that can undertake the required level of supply and support for the offshore facility that is practicable and cost efficient. The implementation of the PSZ promotes the safety of other sea users and the integrity of the facility. In accordance with the OPGGS Act, PSZs are required.
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures and administration	Annual stakeholder fact sheet	No	As required by the OPGGS (E) Regulations 2009, INPEX has implemented a stakeholder engagement plan and to date has provided consultation factsheets on an annual basis to inform stakeholders of the Project status and activities. The frequency of the factsheets (annual) was considered appropriate during the initial construction of the Ichthys offshore infrastructure. However, now that the Project is in the operations phase an annual factsheet is not deemed necessary and likely to be of limited effectiveness due to stakeholder fatigue. Ongoing stakeholder consultation is still undertaken on an as required in accordance with Section 5.6 and Section 9.8.3.

Identify the likelihood		
Likelihood	Reduction of available navigable space, resulting from the physical presence of the offshore facility and associated vessels in WA-50-L, will have an insignificant impact 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. 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	Based on a consequence of Insignificant (F) and likelihood of Highly Unlikely (5) the residual risk is Low (10).	
Residual risk summary		
Consequence	Likelihood	Residual risk
Insignificant (F)	Highly Unlikely (5)	Low (10)
Assess residual risk acceptability		

Legislative requirements

Vessels will be equipped with navigation equipment as required by the *Navigation Act 2012*. In accordance with the OPGGS (E) Regulations 2009, consultation with relevant authorities of the Commonwealth, a state or territory, and other relevant interested persons or organisations has been undertaken to inform and update other marine users of the Project including a description of the nature of the activities and timeframe/schedule.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from the physical presence of support vessels associated with the petroleum activity. This includes the NWSTF, the only known commercial fishery that overlaps WA-50-L. AMSA identified that lighting of vessels should be consistent with the requirements of the COLREGS requirements. All vessels are required to comply with the *Navigation Act 2012*, and associated Marine Orders, which are consistent with the COLREGS requirements.

Conservation management plans / threat abatement plans

Several conservation management plans have been considered in the development of this EP (Appendix B) none of the recovery plans or conservation advices are relevant to the physical presence of vessels disrupting shipping or fishing operators.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary		
Based on the above assessment, the proposed control is expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	Environmental performance standard	Measurement criteria
Interference with other marine users is limited to the extent necessary for the reasonable exercise of the right conferred by the petroleum title.	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 vessels to ensure compliance with the *Navigation Act 2012.*

7.7 Loss of containment

7.7.1 Accidental release

The petroleum activity will require the handling, use and storage of chemicals and hydrocarbon materials, including wastes. These materials may include, but are not limited to:

- aviation fuel
- condensate
- MGO/diesel
- IFO 180
- HFO 380
- hydraulic oil
- grease
- paint/solvents
- MPPE media (solids) in PW discharge stream
- process chemicals, e.g. demulsifiers or deoilers, gas hydrate inhibitors, oxygen scavengers, scale inhibitors, dissolvers, MEG and TEG.

Operating the offshore facility introduces the potential for loss of containment events. These events may be classified as Level 1, Level 2 or Level 3 incidents, in accordance with the INPEX *Browse Regional OPEP* (described in Table 8-12 of this EP).

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 8 of this EP.

A summary of the loss of containment events (and emergency conditions) associated with this EP, together with their characterisation and classification, is included in Table 7-37. 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 INPEX *Browse Regional OPEP* (Table 8-12).

Table 7-37: Representative loss of containment events and emergency conditions identified for the petroleum activity

Scenario		**Basis of volume calculation**	**Type**	**Indicative incident level**	**EP Section**
Source	Threat				
Management of chemicals, hydrocarbons and waste products on board	Inappropriate use/handling/spills. Failure of hydraulic hoses on equipment	Failure of an intermediate bulk container, estimated to be in the order of 1 m^3	Various	1	Table 7-38
Cargo transfers	Dropped objects	10 m^3 – based on the volume of a tote tank which, if lost during cargo transfer, has the potential to result in a full loss of contents	Various	1	Table 7-38
PW treatment system	MPPE media lost from MPPE column	1,700 kg - MPPE beads if entire contents of one bed limiter is lost	MPPE media (beads)	1	Table 7-38
Hydrocarbon transfers	Split hose during diesel bunkering	2.5 m^3 – based on 15 minutes of loss to the environment until shut-off after leak detection	Group II – marine gas oil (MGO)/ diesel	1	Table 7-38
Helicopter refuelling	Spill during refuelling on board the CPF, FPSO or ASVs	4 m^3 – volume stored on board the facility (FPSO) 10–12 m^3 – volume stored on board ASVs	Group I (i.e. aviation fuel)	1	Table 7-38
Condensate offloading operations from FPSO to offloading tanker	Unplanned disconnection of offtake hose during tanker offloading operations	110 m^3 – based on volume in offtake hose and additional flow for 28 seconds prior to emergency shutdown valve closure	Group I – condensate	1	Table 7-38

Scenario		**Basis of volume calculation**	**Type**	**Indicative incident level**	**EP Section**
Source	Threat				
Structural failure of FPSO topside infrastructure	Structural integrity failure	33 m^3 – conservatively based on the catastrophic loss of containment of CRM (condensate) from the largest vessel on the FPSO topsides. This estimate was assumed to be an instantaneous surface liquid release and did not credit any capture that may occur by the FPSO bunding and drainage systems	Group I – condensate	1	Table 7-38
Structural failure of CPF/FPSO topside infrastructure	Structural integrity failure	125 m^3 – based on loss of containment of diesel from a diesel storage tank on the CPF/FPSO	Group II – diesel	1	Table 7-38
Emergency conditions (refer to Section 8)					
CPF/FPSO bunkers Support vessels (i.e. IMR vessel, PSV/OSV, ASV)	Vessel collision	Volume of largest fuel tank - Spill volumes have been calculated based on AMSA (2013) guidance and the vessel types/classes expected to be used during the activity. Tank sizes range from 5,700 m^3 for FPSO condensate storage to <250 m^3 for small logistical support vessels using MGO/diesel	Group I – condensate Group II – MGO/ diesel	2	Table 8-7
Installation vessel (i.e. IMR vessel)			Group IV – intermediate fuel oil (IFO 180)		
Heavy-lift vessel (i.e. IMR vessel)			Group IV –heavy fuel oil (HFO 380)		

Scenario		Basis of volume calculation	Type	Indicative incident level	EP Section
Source	Threat				
Offloading tanker		776 m³ – based on volume of largest wing tank less the volume of fuel used since last bunkering and fuel transfer pumping in the event of a hull breach	Group I – condensate Group IV –heavy fuel oil (HFO 380)	3	
Loss of containment of production well	Structural integrity failure	255,475 m³ – based on 3,193 m³ per day for an 80-day blowout	Group I – Brewster condensate	3	Table 8-11
		116,856 m³ - based on 1,082 m³ per day for a 108-day blowout.	Group 1 – Plover condensate	3	
Subsea umbilical/ riser/ flowline/CRM transfer flowline	Structural integrity failure	350 m³ – based on a 30-minute release of condensate from a small leak in the CRM line at the seafloor point closest to the FPSO.	Group I – condensate	2	

Table 7-38: Impact and risk evaluation – loss of containment: accidental release

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Several loss of containment events have been identified (Table 7-37), including minor spills on board (<1 m³); loss of tote tank during cargo transfer (10 m³); loss of MPPE media from the PW treatment system (1,700 kg); loss of hydrocarbon fuels (vessels and helicopters) during refuelling transfers (2.5 m³ to 12 m³); loss of condensate during offloading to tankers (110 m³); and loss of Group II fuel (diesel) from topside fuel tanks onboard the CPF/FPSO (125 m³).

MPPE media (insoluble, polypropylene grains) if lost from the MPPE column where they are contained, would be discharged to sea via the PW stream at approximately 20 m depth. The MPPE media would likely rise and remain either floating on the sea surface or entrained in the upper water column (top 20 m). Higher levels of shallow entrainment will occur in higher wind speeds, and greater surfacing will occur during calm periods (similar to buoyant oil spill droplets). Therefore, floating/shallow entrained MPPE media may present a hazard to receptors present within the upper water column and 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.

Predictive spill modelling of a 250 m³ diesel surface release in WA-50-L (RPS 2019b) has been used as a proxy to conservatively assess the potential impacts from the two worst-case loss of containment events (110 m³ condensate and 125 m³ diesel). The spill of any hydrocarbons (Group I and Group II) in WA-50-L will rapidly disperse due to their volatility, low levels of persistency in the environment and the short-term surface expression expected due to the generally small volumes and the weathering at the sea surface.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>In the event of a loss of containment event, the particular values and sensitivities identified as having the potential to be impacted are:
• fisheries (commercial, recreational and traditional)
• transient, EPBC-listed species (marine fauna)
• planktonic communities.

Potential accidental releases from loss of containment events may result in the exposure of marine fauna, including commercial fish species, transient EPBC-listed species and plankton, to a range of chemicals and Group I and Group II hydrocarbons. Foreseeable loss of chemicals to the marine environment are expected to be small volumes and impacts would generally be of lower consequence; therefore, the focus of this assessment is based on the largest spill volume associated with a loss of hydrocarbons and the loss of MPPE media.

The values and sensitivities associated with commercial, traditional and recreational fisheries (seafood quality and employment) could be impacted due to entrained/dissolved/dispersed oil. Exclusion zones may impede access to fishing areas for a short-term to medium-term (ITOPF 2011). However, the majority of the species targeted by commercial fisheries that overlap WA-50-L are demersal and therefore the potential for exposure to accidental releases of chemicals/hydrocarbons at the sea surface is low. Any impacts from this type of spill on commercial fishing are expected to be highly localised and of short duration. There is no evidence that recreational fishing occurs within</td><td>Minor (E)</td></tr>
</table>

WA-50-L due to the distance from land and a lack of features of interest. Recreational day-fishing is concentrated around the population centres of Broome, Derby and Wyndham, as well as other readily accessible coastal settlements. Therefore, recreational fishing would not be impacted by this type of spill. Further, traditional Aboriginal fishing, which occurs along the Kimberley coast at Bardi Jawi IPA, Dambimangari IPA and Uunguu IPA, would not be impacted by this type of spill based on the distance from the licence area. WA-50-L is situated within the MoU box for Indonesian traditional fishing (DSEWPaC 2012a) 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-50-L as Scott Reef and Browse Island are located south of the licence area. Therefore, interference and disruption are not expected, and impacts are expected to be insignificant (F). Therefore, the socioeconomic impacts on commercial, traditional and recreational fisheries from loss of containment events (hydrocarbons) are expected to be short-term to medium-term and, therefore, the consequence is considered to be Insignificant (F). Given the anticipated volumes (worst-case 110 m^3 condensate and 125 m^3 of diesel), potential exposure is expected to be localised (i.e. in the vicinity of WA-50-L as any topsides spill is expected to be at least partially captured within the open-drains system) with some lower concentration expressions extending into the EMBA. Hydrocarbons will disperse through natural physical oceanic processes, such as currents, tides and waves, and photochemical and biological degradation. A release of condensate at the sea surface would immediately start to weather, with the volatile constituent compounds rapidly evaporating at ambient temperatures, with >75% expected to evaporate within the first 24 hours. Condensate (Group I) is much lighter and less persistent than Group II hydrocarbons, such as MGO and diesel. Therefore, a surface expression is expected to weather and dissipate in a relatively short time, thereby providing limited potential for exposure to surfacing marine fauna. In the absence of any known BIAs for marine fauna in WA-50-L, any individuals present are likely to be transiting the area for a short duration. The closest identified BIAs relate to whale shark foraging (15 km south-east of WA-50-L) and the 20 km internesting buffer for green turtles surrounding Browse Island between November and April (peak nesting season). Based on the levels of whale shark abundance observed (Section 4.9.4), the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration. Nevertheless, there is the potential that transient, EPBC-listed species could be exposed to these events if they are present in the immediate vicinity at the time of the release. Given the limited duration of exposure due to expected weathering and dispersion in an open-ocean environment, the level of consequence is expected to present a minor and temporary impact on a small proportion of a protected species (Minor E). 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). Given the high temporal and spatial variability in plankton community, and small size of impact area resulting from accidental releases, the potential consequence in regard to plankton is considered to be Insignificant (F). MPPE media used in PW treatment consists of small plastic beads (insoluble, polypropylene grains). INPEX investigated the potential environmental impact associated with the release of 1,200 kg of MPPE media beads from the PW treatment system (based on 70% loss of	

a single MPPE bed within an MPPE column). To evaluate the potential impacts of the beads, an ecological risk assessment was conducted through the development of a conceptual site model, establishment of the exposure point, and evaluation of impacts to sensitive ecological receptors. The environmental fate and transport of the MPPE beads was modelled using a particle transport model (CHEMMAP) that included oceanographic (current and temperature) data to determine the areas of impact. The 3-dimensional model was based on a 40,000 m^2 (200x200 m) grid and utilised 5 m vertical layers. The model also used 5 m bathymetry contours. The model assumed that when a particle/bead contacted the bathymetry, that the particle was trapped/settled at that location. The model used variable release rates (replicating FPSO PW system operational data), with the modelled release period spanning 120 days between September to December 2020. The model simulation indicated that beads would tend to remain within 20 m of the water column and be concentrated toward the water surface. Tidal currents were found to be the main driver of bead motion upon initial release, with beads migrating offshore and inshore with the tidal currents operating along a north-west to south-east axis. Over longer time scales, prevailing drift currents were found to have the larger effect on bead distributions. Drift currents frequently followed the continental shelf over the simulation period, indicating a simulated bead drift pattern towards the north-east and south-west, across the tidal axis. The output of the model showed that the mass expected to reach shoreline was 144 kg (12%), with the majority (1,056 kg; 88%) remaining in the water column at the end of the modelling period. Over longer time periods, floating beads would be expected to become more widely distributed within the Indian Ocean/Southern Ocean, eventually reaching background levels for ocean plastic pollution. However, the model also predicted that a proportion of the beads are expected to travel towards shore and settle over several reef systems in proximity to the release location in WA-50-L. The model assumed that any time a bead intercepted the seabed bathymetry, the bead became 'trapped' at that seabed location. The maximum instantaneous concentration of MPPE beads per m^2 were predicted for the following reefs: • Browse Island – 55.48 beads/m^2 • Scott Reef South – 11.17 beads/m^2 • Scott Reef North – 8.93 beads/m^2 • Ashmore Reef – 0.46 beads/m^2 • Cartier Island – 1.04 beads/m^2 • Adele Island – 47.26 beads/m^2 • Buccaneer Archipelago – 140.98 beads/m^2. The model predicted that the beads would remain within the top 20 m of the water column, and maximum instantaneous concentrations of beads per m^3 within the water column in proximity to following reefs were predicted to be: • Browse Island – 3.11 beads/m^3 • Scott Reef South – 0.71 beads/m^3 • Scott Reef North – 0.10 beads/m^3 • Ashmore Reef – 0.02 beads/m^3	

- Cartier Island – 0.02 beads/m^3
- Adele Island – 0.62 beads/m^3
- Buccaneer Archipelago – 0.71 beads/m^3.

To address the worst-case ecological impacts from both reef and water column exposure to MPPE beads, several conservative assumptions were made, as follows:

1. The model assumed that all MPPE particles did not encounter any marine snow or other debris which would have resulted in flocculation and downward transport of the beads to the seabed, where the beads would have become incorporated/locked into the sediment.
2. Ecological impact was addressed using exposure to benthic and water column organisms by selecting the two most sensitive receptors in those exposure zones. Coral polyps were used as the receptor for benthic exposure, while zooplankton (e.g. copepods) were used for water column exposure.
3. It was assumed that the likelihood of encountering a bead was 100% (i.e. assumption that any bead which encountered the seabed also contacted a coral polyp, therefore assuming 100% coral cover on all seabeds), and that all available beads contacted zooplankton in the water column.
4. The release of the MPPE beads from the FPSO would occur post-treatment and each bead would be exposed to the hydrocarbon-containing PW stream. Therefore, each bead was assumed to be fully saturated with TPH or PAH.
5. To ensure the most conservative result based on contact with a bead, it was assumed that any individual encountering a bead either through ingestion or dermal contact resulted in a 100% lethal outcome. Furthermore, for coral polyps it was assumed that if a given polyp encountered a bead it would die, and all six surrounding coral polyps (i.e. its nearest colonial neighbors) would also die. This would result in seven coral polyps dying for every bead impacting the sediment. In the water column it was assumed that each zooplankton that encountered a bead would die and sink to the bottom. No neighbor plankton would be affected.

Coral polyp densities for the four dominant coral species found at each of the seven impacted reef systems are *Acropora spp.* 20 – 125 polyps per cm^2; *Montipora spp.*160 polyps per cm^2; *Pocillopora spp.* 33 – 130 polyps per cm^2 and *Porites spp.*7 – 75 polyps per cm^2 (Berkelmans & Willis 1999; Clayton 1985; Madin et al. 2016). Assuming that a bead encounter results in seven dead coral polyps, and assuming the highest bead density of 141 beads per m^2 of reef, the overall percent (%) of coral polyps impacted from the MPPE beads would range between 0.061% to 0.13% of the coral population.

Planktonic species in the Kimberley region are dominated by copepods accounting for over 85% of the zooplankton abundance (McKinnon et al. 2015). Plankton density varies by season (wet/dry) and mean zooplankton density (SD ind. m-3) is reported as 7038 +/- 3913 and 1892 +/- 708 for the wet and dry seasons respectively. Based on the highest water column concentration of MPPE beads (3.11 beads per m^3), a release during the wet season, mean concentration of zooplankton (7038 individuals per m^3), and under the assumption that encountering a bead is 100% lethal, only 0.044% of zooplankton would be impacted. Using the dry season average of 1892 individuals per m^3, only 0.15% of zooplankton would be impacted in the dry season based on the highest water column modelled concentration of MPPE beads at sensitive receptor locations.

Taken together, under the extremely conservative assumptions included in this assessment, ecological impacts to the coral and plankton communities resulting from MPPE exposure would be negligible (<1%). While the assumptions are overly conservative here, it would not be expected that encountering beads would be 100% lethal. Toxicity data for TPH and PAHs to corals and plankton indicate that the actual

toxicity of the MPPE beads (i.e., the toxicity based on the volume of TPH/PAH which can be adsorbed onto an individual MPPE bead) is much lower than the TPH/PAH toxicity limits for corals and plankton. Therefore, the assumption of 100% lethal outcome is highly conservative. In addition, the encounter rate of beads onto corals would be much lower than 100%, as it is rare to find 100% live coral cover, and most beads arriving at a seabed location would be expected to contact and become trapped in the sediment profile, not ingested by live coral. The CHEMMAP model and associated conceptual site model conclude that that a release of MPPE beads would result in an insignificant ecological impact to the Kimberley and Northwest Shelf ecological communities. Therefore, the potential consequence is considered to be Insignificant (F). MPPE plastic beads could be ingested by marine fauna; however, EPBC-listed species would need to be exposed to the MPPE plume for a relatively long period for any significant exposure/ingestion to occur, particularly given the maximum instantaneous concentration of 3.11 beads per m^3, with most maximum instantaneous concentrations modelled at sensitive receptor locations (i.e. marine fauna BIA locations) ranging from 0.71 to 0.02 beads/m^3. Due to the very small size (akin to a small grain of sand), any ingested MPPE media would be expected to pass through the gut of any adult EPBC-listed species such as marine avifauna, turtles and even larger filter feeders such as whale sharks and baleen whales. Small fish or other very small filter feeding organisms could potentially ingest and retain the MPPE beads. Very small site attached EPBC-listed species such as seahorses or pipefish would not be impacted as they are demersal and would not feed/ingest MPPE media floating on the sea surface or entrained within the upper water column where MPPE beads would be expected to be found. Therefore, the consequence associated with the loss of MPPE media to EPBC-listed species is expected to be of insignificant ecological consequence (Insignificant F). Commercial fisheries operating in WA-50-L and the surrounding area are described in Section 4.11.3. The majority of the species targeted by these fisheries are demersal and therefore the potential for exposure to floating MPPE beads associated with any unintentional release is low. The species associated with surface feeding habits such as those targeted by the Western Tuna and Billfish, Western Skipjack and Mackerel-managed fishery, are large fishes where any MPPE beads are expected to pass through the gut. Given the maximum instantaneous concentration of 3.11 beads per m^3, with most maximum instantaneous concentrations modelled at sensitive receptor locations ranging from 0.71 to 0.02 beads/m^3, exposure will be limited and the consequence is not considered to be ecologically significant (Insignificant F).	
Identify existing controls	
• Appropriate storage of hydrocarbons and chemicals including their associated waste constituents • Spill containment and recovery equipment will be available on the CPF, FPSO and support vessels including ASVs • Personnel will receive an induction/training to inform them of deck spill response requirements in accordance with Section 9.3.3 and Table 9-3 • Dry break/marine break couplings or similar used during diesel bunkering • Emergency release coupling for offtake hose • Emergency shut off for pump during offtake operations • Implementation of bunkering and offloading procedures (CPF bunkering, FPSO bunkering and FPSO offtake) • All vessels >400 GT will have a SOPEP (or SMPEP) in accordance with Marine Order 91 • INPEX lifting standard and cargo transfer procedures	

• Maintenance of hydraulic equipment including hoses on the CPF, FPSO and vessels in accordance with Section 9.6.7 and Table 9-27 • Implementation of the INPEX chemical assessment and approval procedure in accordance with Section 9.6.1 and Table 9-5.			
Propose additional safeguards/control measures (ALARP evaluation)			
Hierarchy of control	Control measure	Used?	Justification
Elimination	Eliminate the use of chemicals and hydrocarbons on board.	No	Chemicals and hydrocarbons are required for safe and efficient operations and cannot be eliminated.
	No bunkering or offloading from the FPSO in WA-50-L.	No	Bunkering is required to ensure that the facility remains suitable supplied to be operable. Tanker offloading operations cannot be eliminated from WA-50-L as they are the only way to transport the condensate for export to market.
	No cargo transfers in WA-50-L.	No	Cargo transfers cannot be eliminated, as this is the only practicable option for supplying the facility in an offshore location.
	Eliminate the use of condensate hose.	No	There are no credible alternatives available to transfer stabilised condensate from the FPSO to tankers for export to market.
Substitution	None identified	N/A	N/A
Engineering	Basket strainer installed down stream of MPPE packages on FPSO.	Yes	A basket strainer has been installed downstream of the MPPE packages to act as a final barrier to prevent MPPE media discharge into the moonpool
	Dry-break, breakaway couplings or other marine break couplings (MBC) installed in the bunker transfer hose during condensate offtake.	No	The use of MBC can quickly (i.e. within seconds) stop flow during bunkering operations and is effective for bunkering transfers of diesel where low pressure flows are experienced and hose tension can change due to the dynamic nature of vessels conducting such transfers. Only minor quantities (i.e. millilitres) are typically lost when the couplings are released. However, condensate offloading operations are conducted at much higher rates e.g. approximately 5,000 m^3/hr. The use of MBC at this rate would exert a high pressure on the pipework leading into the hose and result in a spill to deck and/or the ocean. While it is possible to insert MBC into the FPSO offtake hose, the setting would have to allow the flow to be cut off over a period of ~30 seconds to prevent damage to the hose and/or piping. MBCs also introduce a hard/pressure point in the hose which increases the risk of damage to the hose and its integrity during reel operations. As such the use of MBC in the condensate transfer hose is not considered to be an

			effective control due to a potential to result in uncontrolled releases to deck/sea and decrease the integrity and life of the hose.
	Floating hose emergency release coupling (ERC) for FPSO offloading operations.	Yes	An ERC is installed to allow the operator to release the hose to sea if tension increases to the point where the hose may tear. The use of an ERC with a gradual valve closure period prevents the build-up of back-pressure against the condensate loading pumps, preventing damage to other FPSO equipment during ERC closure and hose-release.
	Hawser used during FPSO offloading operations.	Yes	A hawser will be in place and its length is designed to prevent tension building on the FPSO condensate offtake hose during offloading operations.
	Hawser tension alarm used during FPSO condensate offloading operations.	Yes	A hawser tension alarm will be installed to monitor hawser tension during offloading operations, and if high tension alarm occurs, this indicates to operators that the FPSO condensate loading hose ERC may need to be activated.
	FPSO offtake hose design allows slack during offloading operations.	Yes	Allowing slack in the FPSO offtake hose permits time for offloading to be stopped (i.e. stop pumping) prior to tension being increased in the hose. This is because the hawser length in relation to the offtake hose length prevents tension on the offtake hose. The hawser tension can be monitored which allows for a tension criteria to be met and pumping to be stopped before the risk of tension on the hose occurs.
Procedures and administration	Monitoring for presence of MPPE media in the basket strainer installed downstream of the MPPE packages on FPSO.	Yes	The basket strainer installed downstream of the MPPE packages on FPSO will be monitored to detect of changes in differential pressure indicating potential presence of MPPE media in the basket strainer, triggering further investigation as required.
	Offloading procedures will be implemented.	Yes	Offloading procedures are a common offshore process to ensure that all HSE risks are addressed and minimised. Visual monitoring of hoses allows for the rapid identification of any leaks during offloading operations. Other controls to reduce the potential for spills will be implemented such as watchkeeping, weather monitoring, continuous hawser tension monitoring and open radio contact between tanker, FPSO control room and supporting OSV.
Identify the likelihood			

<table>
<tr><td>Likelihood</td><td colspan="2">Given the low volumes, expected weathering of spilled chemicals/hydrocarbons, absence of any important habitats within WA-50-L and in conjunction with the controls in place the likelihood of a loss of containment event causing harm to the identified receptors is not considered likely. However, based on the continuous nature and long-term duration of the operation along with vessel activities supporting the facility the potential to impact the identified receptors from a loss of containment event is considered to be Possible (3).</td></tr>
<tr><td>Residual risk</td><td colspan="2">Based on a consequence of Minor (E) and likelihood of Possible (3) the residual risk is Moderate (7).</td></tr>
<tr><td colspan="3">Residual risk summary</td></tr>
<tr><td>Consequence</td><td>Likelihood</td><td>Residual risk</td></tr>
<tr><td>Minor (E)</td><td>Possible (3)</td><td>Moderate (7)</td></tr>
<tr><td colspan="3">Assess residual risk acceptability</td></tr>
<tr><td colspan="3">Legislative requirements
The activities and proposed management measures are compliant with industry standards and relevant Australian legislation, specifically concerning prevention pollution, including Marine Order 91: Marine Pollution Prevention - Oil.
Stakeholder consultation
No stakeholder concerns have been raised regarding potential impacts and risks from accidental release/loss of containment.
Conservation management plans / threat abatement plans
Several conservation management plans (Appendix B) identify oil or chemical spills as key threatening processes, through both direct/acute impacts, as well as indirect impacts through habitat degradation. The prevention of loss of containment events and reducing impacts to the marine environment through the preventative controls in place and spill response preparedness, demonstrates alignment with the various conservation management plans.
ALARP summary
Given the level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.
Acceptability summary
Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:
• the activity demonstrates compliance with legislative requirements/industry standards
• the activity takes into account stakeholder feedback
• the activity is managed in a manner that is consistent with the intent of conservation management documents
• the activity does not compromise the relevant principles of ESD</td></tr>
</table>

• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "moderate", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcome	**Environmental performance standards**	**Measurement criteria**
No loss of containment of hydrocarbons, chemicals or MPPE media (via PW stream) to the marine environment.	Bunded areas or other secondary containment will be available and used for the storage and handling of hydrocarbons and chemicals (including waste constituents).	Inspection records confirm bunding or other secondary containment is available and used for the storage of hydrocarbons and chemicals (including waste constituents).
	Spill kits will be available on board the CPF, FPSO and vessels including ASVs	Inspection records confirm spill kits are available and stocked.
	Dry-break/breakaway couplings be installed on diesel bunkering hoses.	Records confirm dry-break, breakaway couplings are installed.
	Emergency shut off pump will be confirmed to be operational prior to commencing offloading operations.	Pre-offloading check records confirm emergency shut off pump is operational.
	Bunkering procedures will be implemented for all bulk hydrocarbon and chemical transfers, specifically: • use of dry-break, breakaway couplings, visual monitoring of hoses, couplings and the sea surface will be undertaken • radio contact will be maintained between the CPF/FPSO and vessels during refuelling and offloading operations.	Bunkering procedure records.
	Premobilisation inspections and annual verification audits undertaken by a registered organisation will confirm that all vessels >400 GT have SOPEPs (or SMPEP) compliant with Marine Order 91.	Inspection confirms SOPEP/SMPEP is available on board.
	INPEX lifting standard and cargo transfer processes are implemented.	Training records of personnel involved in lifting and cargo transfer activities retained in SAP.
	Basket strainer installed downstream of MPPE packages on FPSO to prevent MPPE media discharge to marine environment.	SAP records confirm installation of basket strainer.
	Monitoring for presence of MPPE in the downstream basket strainer.	Plant historian (Pi) data.
	Floating hose ERC will be installed and checked prior to offloading commencing.	Pre-offloading check records confirm ERC is operational.

	Hawser used during offloading operations.	Pre-offloading check records confirm hawser is operational.
	Hawser tension alarm used during offloading operations.	Pre-offloading check records confirm hawser tension alarm is operational.
	FPSO offtake hose design allows slack during offloading operations.	Pre-offloading check records confirm offtake hose is correct specification to enable slack during offloading operations.
	Offloading procedures implemented specifically: • watch keeping and regular rounds on tanker deck during an offtake • terminal loading masters station on bridge of tankers during bulk loading operations • open radio contact between tanker bridge, FPSO Control Room and Deck and supporting OSV • access for loading master to Portable Pilot Unit to aid offtake including tanker position and hawser tension • weather monitoring in field for the duration of offtake. • provision of weather and metocean data and adherence to offtake weather, sea and visibility limits. • availability of FPSO thruster use for heading control for duration of offtake. • immediate availability of tanker main engines whilst in static tow • pre-determined emergency actions in case of FPSO- tanker misalignment • continuous hawser tension monitoring during an offtake.	Completed offloading records.

8 EMERGENCY CONDITIONS

An evaluation of potential spill sources and worst-case spill scenarios (WCSS) identified various potential emergency conditions related to the petroleum activity (Table 7-37). The emergency conditions are summarised in Table 8-1.

Table 8-1: Potential emergency conditions

Scenario		**Hydrocarbon type**	**Release location**
Source	Threat		
Support vessels, IMR vessels or condensate offloading tanker	Collision	Group I – condensate	Surface
		Group II – diesel	Surface
		Group IV – IFO/HFO	Surface
Rupture/damage Subsea umbilical/riser/flowline/CRM transfer flowline	Structural integrity failure	Group I – condensate	Subsea
Loss of containment of production well	Structural integrity failure	Group I – condensate	Subsea

8.1 PEZ and EMBA based on oil spill modelling

As described in Section 4, the PEZ has been derived to inform the outer boundary of potential exposure for risk assessment and oil spill scientific monitoring purposes using low thresholds described in NOPSEMA bulletin #1 (NOPSEMA 2019a). The low thresholds used may not be ecologically significant because 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 the PEZ and EMBA (area where potential environmental impact may occur) is described in Table 8-2. 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 8-1.

Table 8-2: Hydrocarbon exposure thresholds

Threshold		**Description**
Surface hydrocarbon exposure	PEZ 1 g/m^2	To define the outer extent of potential exposure, a low surface exposure threshold of 1 g/m^2 has been used to provide an indication of the furthest extent at which a visible sheen may be observed on the sea surface. It is considered too low for ecological impact assessment purposes and is used to inform oil spill scientific monitoring purposes (water quality) as per NOPSEMA (2019a).

Threshold		**Description**
		The low exposure threshold also provides an indication of socioeconomic receptors, such as oil and gas industry, tourism and fishing activities that may be affected by safety concerns associated with a light/visible surface expression.
	EMBA 10 g/m^2	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 (furred mammals are not present within the EMBA of this EP). 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 2015b).
Entrained hydrocarbon exposure	PEZ 10 ppb	The low exposure threshold of 10 ppb has been used to inform the outer extent of potential exposure to entrained hydrocarbons in the water column. It is considered too low for ecological impact assessment and is used to inform oil spill scientific monitoring purposes (water quality) as per NOPSEMA (2019a).
	EMBA 100 ppb	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).

Threshold		Description
		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). Comparatively, the lowest no observed effect concentration 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). In addition to potential toxicity impacts, entrained oil droplets (although less bioavailable) may present smothering impacts to submerged receptors. Physical and chemical effects of the entrained oil droplets have been demonstrated through direct contact with receptors through physical coating of gills and body surfaces, and accidental ingestion (NRC, 2005). To be conservative, a 100 ppb entrained threshold is proposed to account for any ecological impacts (toxicity and smothering) in the EMBA.
Dissolved hydrocarbon exposure	PEZ -	As dissolved hydrocarbons are the soluble component of entrained hydrocarbons, the conservative low exposure threshold used for entrained hydrocarbons at 10 ppb encompasses the dissolved component to identify the furthest extent of potential exposure used for oil spill planning and scientific monitoring purposes (water quality) as per NOPSEMA (2019a).
	EMBA 50 ppb	The 99% species protection threshold of 50 ppb for PAH (ANZG 2018) has been selected to indicate the zones where acute exposure could potentially occur over shorter durations, following a spill.
Shoreline accumulation	PEZ 10 g/m^2	Certain industries, such as tourism may be affected by visible sheen on sandy beaches, therefore a shoreline accumulation of 10 g/m^2 has been included for information purposes to inform the PEZ, that may indicate potential socioeconomic impact as per NOPSEMA (2019a). However, it is considered too low for ecological impact assessment purposes.

Threshold		Description
	EMBA 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 recommended from the review by French-McCay (2009) based on exposure to birds and smothering of invertebrates in intertidal habitats. This threshold is also proposed to be an acceptable minimum thickness that does not inhibit recovery and is best remediated by natural coastal processes (AMSA 2015b).

As described in Section 4, the spatial extent of the PEZ, used as the basis for the EPBC Protected Matters Database search (Appendix B), was determined using stochastic spill modelling by applying the low thresholds. The EMBA, used as the basis for the impact and risk evaluation presented in this section of the EP, was determined by applying the defined impact exposure thresholds detailed in Table 8-2.

The stochastic spill modelling results from the WCSS (Table 7-37) including a loss of production well containment from both Brewster and Plover reservoirs, and vessel collision scenarios (HFO and condensate), during all seasons (summer, winter and transitional) and under different hydrodynamic conditions (e.g. currents, winds, tides, etc.) were overlaid and is presented in Figure 8-1. The furthest extent of the PEZ and EMBA within this EP is driven by the outer extent of entrained oil and shoreline contacts, from the WCSS.

Overlaying of multiple stochastic spill modelling results provides a highly conservative representation of the PEZ and EMBA from all potential loss of containment events to ensure that the EPBC Protected Matters Database search identifies 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 PEZ and EMBA. Example model outputs from individual spill events are available in the INPEX *Browse Regional OPEP Basis of Design and Field Capability Assessment Report* (Table 8-12).

Deterministic modelling is a single spill simulation using one set of wind and weather conditions over time. Deterministic modelling runs are often paired with stochastic modelling to place the large stochastic footprint into perspective. Specific deterministic analysis or the use of a selection of worst case individual stochastic run(s) (selected from the stochastic analysis) are utilised as the basis for developing the response plans and field capability/equipment needs for a realistic spill response as described in the INPEX *Browse Regional OPEP*.

Figure 8-1: Combined PEZ and EMBA for all credible spill scenarios

8.2 Vessel collision

As presented in Table 7-37, the two worst-case spills resulting from a vessel collision associated with the petroleum activity are a 5,700 m^3 surface release of condensate and a 776 m^3 surface release of HFO. Other smaller potential releases were also identified; however, the modelling and the focus of this section of the EP are on the two WCSS described below.

8.2.1 Location

The release point for the modelling studies was a location within WA-50-L approximately 35 km NE of Browse Island. This location was selected as the FPSO is anchored to the seabed at this position, and the HFO risk only exists from condensate offloading tankers (located adjacent to the FPSO), or from a vessel installing a PLR onto the GERB, again located in close proximity to the CPF and FPSO.

8.2.2 Volume and duration

AMSA guidance was used to inform maximum credible volumes of hydrocarbons potentially spilled to the marine environment in the event of a vessel collision. The AMSA guidance specifies that the maximum credible spill volume for a vessel collision ('other vessel') should be based on the volume of the largest fuel tank. Therefore, an evaluation of the types of vessels (and corresponding volumes of the largest fuel tanks) that will be supporting the activity is presented in Table 8-3. An indication of the potential spill volumes has been provided based on a review of the specifications (volumes of largest fuel tanks) of known and proposed vessels for the activity described in this EP.

Table 8-3: Maximum credible volumes associated with vessel collisions in WA-50-L

Source	Indicative volume (m^3)	Fuel type
Support vessel (IMR vessel/PSV/OSV)	250	Group II (MGO/diesel)
ASV	503	
CPF/FPSO (bunkers)	962	
Installation vessel (i.e. IMR vessel)	376	Group IV (IFO 180)
Heavy-lift vessel (i.e. IMR vessel)	100	Group IV (HFO 380)
Offloading tanker (cargo)	5175	Group I (condensate)
Offloading tanker (bunkers)	776	Group IV (HFO 380)
FPSO (condensate storage tank)	5700	Group I (condensate)

With respect to the offloading tanker loss of containment spill volume, the AMSA guidance recommends for an 'oil tanker non-major collision' that either 100% of largest wing tank or 50% if protected by double hull is an appropriate spill volume. However, INPEX does not select the tankers that arrive in WA-50-L and there is uncertainty around the tanker specification and general arrangements.

The calculation of the potential spill volume was based on the general arrangements of an Aframax[3] tanker (100% of largest wing tank) and acknowledged the distance between WA-50-L and the nearest bunkering port in Singapore as well as the ability for fuel to be transferred from a damaged wing tank in the event of a breach. Due to the uncertainty and variability in tanker specifications potentially arriving in WA-50-L, the volume of fuel modelled (i.e. 776 m^3) is considered to adequately provide an indication of a credible worst-case spill in the marine environment from a collision involving an offloading tanker.

This information forms the basis for the predictive spill modelling undertaken with the purpose of evaluating potential impacts and risks to inform oil spill response strategies. Given that modelling only provides an indication of the potential impacts and risks, the condensate (5700 m^3), and HFO 380 (776 m^3) spill events were considered to be the worst-case scenarios, because of their volume, ability to spread quickly, and/or their persistence in the environment.

Modelling of the 5700 m^3 condensate spill scenario was undertaken based on a 2-hour release at sea surface, with the stochastic modelling running for a further 49 days. After 49 days, 96 per cent of the original spill volume had either evaporated or decayed and, therefore, the modelled duration is considered to be appropriate to inform the impact and risk evaluation (RPS 2021a).

Modelling of the 776 m^3 HFO spill scenario was also undertaken based on a 2-hour release at the sea surface, with the stochastic modelling running for a further 70 days. After 70 days, no further evaporation or biological/photochemical degradation was predicted to occur, leaving approximately 10 per cent of the original spill volume remaining and, therefore, the modelled duration is considered to be appropriate to inform the impact and risk evaluation (RPS 2021b).

8.2.3 Hydrocarbon properties

Hydrocarbon properties associated with the vessel collision scenario used for the modelling study are presented in Table 8-4.

Table 8-4: Group I (Brewster condensate) and Group IV (HFO) properties

Hydrocarbon type	**Density at 15 ˚C (g/cm^3)**	**Viscosity – centipoise (cP) – at 15 ˚C**	**Characteristic**	**Volatile (%)**	**Semi-volatile (%)**	**Low volatility (%)**	**Residual (%)**
			Boiling point (˚C)	<180	180–265	265–380	>380
Condensate	0.764	1.200	% of total	62.0	23.0	12.0	3.0
HFO 380	0.99	29,850		0.03	3.8	10.1	86.1

[3] Aframax refers to an oil tanker with a deadweight between 80,000 and 120,000 metric tonnes

8.2.4 Modelling results

The surface release of condensate (5,700 m^3) would expose the oil to UV degradation and evaporation, where a high percentage of the oil mass should evaporate within the first 24 hours after the spill if sea conditions are calm and the condensate remains on the surface. As Brewster and Plover condensates have low viscosity, slicks will be subject to dispersion into the upper water column due to the mixing effect of breaking surface waves, with the condensate maintained in suspension as entrained droplets if breaking waves persist. Once entrained, the condensate will cease to evaporate and will drift and disperse in the water column, where it will be subject to other weathering processes including sedimentation and biodegradation decay.

The surface release of HFO (776 m^3) scenario would expose the oil to transport, spreading and weathering processes that occur at the sea-air interface. Due to the high viscosity of unweathered HFO, and the rise in viscosity that would occur over time through emulsification and evaporation of distillate components, the oil will tend to remain at or just below the water surface under the action of sea-waves and will not break up into droplets and entrain into the water column. By floating at the water surface, the wind will have a strong influence on slick movement. These characteristics, together with the high proportion of residual components indicate that oil slicks and patches would persist and would travel on the water surface for several weeks. The oil contains low concentrations of soluble aromatics and these would primarily evaporate from the surface of slicks with a minor proportion dissolving from the lower surface of slicks. Consequently, low concentrations of soluble hydrocarbons can be expected in the water column from this spill scenario.

Modelling results are summarised in Table 8-5 and Table 8-6. The impact and risk evaluation for the EMBA, based on hydrocarbon exposure thresholds for impact are described in Table 8-7.

Table 8-5: Comparison of condensate (RPS 2021a) and HFO (RPS 2021b) vessel collision spill modelling results

Result	5700 m^3 FPSO condensate tank rupture	776 m^3 HFO spill at FPSO location
Max lineal distance (km) floating oil >1g/m^2	633	1157
Max lineal distance (km) floating oil >10g/m^2	374	862
Minimum time (days) to shoreline oil accumulation >10 g/m^2	1 (30 hours)	1 (29 hours)
Minimum time (days) to shoreline oil accumulation >100 g/m^2	1 (30 hours)	1 (29 hours)
Longest length (km) or number of segments of shoreline oiled > 10 g/m^2	8	295
Longest length (km) or number of segments of shoreline oiled > 100 g/m^2	3	75
Worst-case volume (m^3) of oil on shoreline >100 g/m^2 at any time	63	267

Table 8-6: Vessel collision spill modelling results summary

Hydrocarbon exposure	Condensate (5700 m^3) Source: RPS 2021a	HFO 380 (776 m^3) Source: RPS 2021b
Surface	Concentrations of hydrocarbons at the sea surface, greater than the impact threshold of 10 g/m^2 are predicted to occur at distances of up to 374 km from the source.	Concentrations of hydrocarbons at the sea surface, greater than the impact threshold of 10 g/m^2 are predicted to occur at distances of up to 862 km from the source.
Entrained and dissolved	Entrained oil concentrations >100 ppb were predicted to extend up to 1,110 km from the source. Worst-case instantaneous entrained oil concentrations predicted were as 35,566 ppb in the vicinity of the release location and 34,921 ppb at Browse Island. Other shallow receptors received the following worst-case entrained oil concentrations: Heywood shoal (9,704 ppb), Echuca shoal (1,859 ppb), Seringapatam Reef (4,348 ppb) and Scott Reef (4,470 ppb). Cross-sectional transects in the vicinity of the release site indicated that entrained oil concentrations at or greater than the 100 ppb threshold are not predicted to reach depths greater than approximately 160 m. Worst-case dissolved aromatic hydrocarbon concentrations were calculated as 533 ppb in the vicinity of the release location and 123 ppb at Browse Island. Other shallow receptors received the following worst-case dissolved aromatic hydrocarbon concentrations: Kimberley MP (60 ppb), Heywood shoal (40 ppb), Echuca shoal (33 ppb), Seringapatam Reef (10 ppb). Cross-sectional transects in the vicinity of the release site indicated that dissolved aromatic hydrocarbon concentrations at or greater than the 50 ppb threshold are not predicted to reach depths greater than approximately 40 m.	HFO is not expected to break up and entrain into the water column under the environmental conditions of WA-50-L and the model indicated no exposure to any sensitive receptor in any of the replicate simulations. HFO contains low concentrations of highly soluble aromatic compounds and moderately soluble aromatic compounds. A higher proportion of these compounds are expected to evaporate from the floating oil than would dissolve from the slicks into the water column. The model indicated no exposure to any sensitive receptor in any of the replicate simulations.

Hydrocarbon exposure	Condensate (5700 m^3) Source: RPS 2021a	HFO 380 (776 m^3) Source: RPS 2021b
Shoreline	The highest potential volumes on shorelines, in the worst-case replicate was predicted for Browse Island (63 m^3), Cartier Island MP (51 m^3), and Clerke Reef (Rowley Shoals) (33 m^3). The highest potential concentration of oil on shore, through accumulation, was calculated as 3,052 g/m^2 for both Browse Island and shorelines in Cartier Island MP, and 1,229 g/m^2 at Clerke Reef. In the worst-case replicate, the shortest elapsed time before exposure could occur at any shoreline was predicted as 30 hours for Browse Island. With shortest times to contact at Cartier Island MP and Clerke Reef calculated as 221 hours (9.2 days) and 331 hours (13.8 days) respectively.	The highest potential volume on shorelines, in the worst-case replicate was predicted for Bonaparte Archipelago (267 m^3). Other representative shorelines included Browse Island (218 m^3), Ashmore Reef MP (95 m^3), Cartier Island MP (70 m^3), Indonesia (Nusa Tengarra Timur) (187 m^3), Cassini Island (179 m^3) and Sandy Islet (87 m^3). The highest potential concentration of oil on shore was calculated as 13,834 g/m^2 at Browse Island. Other notable shorelines received predicted highest concentrations of 5,786 g/m^2 (Bonaparte Archipelago), 3,544 g/m^2 (Ashmore Reef MP), 8,948 g/m^2 (Cartier Island MP), 3,086 g/m^2 (Indonesia - Nusa Tengarra Timur), 5,818 g/m^2 (Cassini Island) and 6,586 g/m^2 (Sandy Islet). In the worst-case replicate, the shortest elapsed time before exposure could occur at any shoreline was predicted as 29 hours for Browse Island. Other shortest times to contact include Bonaparte Archipelago (405 hours), Ashmore Reef MP (547 hours), Cartier Island MP (163 hours), Indonesia (Nusa Tengarra Timur) (592 hours), Cassini Island (192 hours) and Sandy Islet (153 hours).

8.2.5 Impact and risk evaluation

Table 8-7: Impact and risk evaluation – vessel collision

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Group I (condensate) and Group IV (HFO) hydrocarbons that reach the marine environment have 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 Table 8-2. The predicted physical extent of the worst-case vessel collision spill scenarios are presented in Table 8-5 and Table 8-6.</td></tr>
<tr><th>Potential consequence – surface hydrocarbons</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be exposed to surface hydrocarbon may include:
• commercial, traditional and recreational fisheries including aquaculture (within approximately 1157 km from the release location based on the visible sheen threshold)
• EPBC-listed species (within approximately 862 km from the release location based on 10 g/m^2 impact threshold).
• planktonic communities (within approximately 862 km from the release location based on 10 g/m^2 impact threshold).
The values and sensitivities associated with aquaculture, commercial, traditional and recreational fisheries (seafood quality and employment) could be impacted by a visible sheen on the sea surface. Although the visible sheen is predicted to possibly extend up to 1157 km from the release location it would not be a continuous surface expression. Exclusion zones may impede access to fishing areas for a short-to-medium term, and nets and lines could become oiled (ITOPF 2011). There is no evidence of any recreational fishing that occurs within the licence area because of its distance from land, lack of features of interest and the deep waters. Recreational day-fishing is concentrated around the population centres of Broome, Derby and Wyndham, as well as other readily accessible coastal population settlements which are generally at the edge of, or outside of the PEZ, and therefore unlikely to be impacted by this type of spill.
Commercial fisheries that transect the PEZ predominantly operate in the shallower waters of the PEZ, with generally low levels of fishing activity reported (refer to Section 4.11.3). Traditional fishing, particularly at Browse Island, Scott Reef and along the Kimberley coast at various IPAs including on intertidal reef platforms, could also be affected by impacts to fish and benthic habitats from entrained oil, discussed below. Based on the expected rapid weathering of condensate at the sea surface by evaporation, photo-oxidation 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 (RPS 2021a). However, patches of oil from an HFO spill could persist at the sea surface for several weeks and result in local to medium scale impacts with regional community disruption (Moderate D).
There are no known BIAs or aggregation areas for EPBC-listed species within WA-50-L that are predicted to be exposed to surface expressions above the 10 g/m^2 impact threshold. However, within the EMBA there are a range of marine fauna that may be present (turtle BIAs at Browse Island, Scott Reef, Ashmore Reef and Cartier Island; blue whale migration corridor and foraging at Scott Reef;</td><td>Significant (C)</td></tr>
</table>

humpback whale migration corridor; dugong foraging at Ashmore Reef; and several marine avifauna BIAs centered around Ashmore Reef, Cartier Island, Scott Reef and Adele Island (Section 4.9.4). 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 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). Weathered oil residues, particularly from a Group IV spill event, may persist for long periods, causing a potential risk to the feeding systems of baleen whales. Browse Island (listed as a C-class reserve) is the closest turtle-nesting area (located approximately 33 km south-east of WA-50-L) and is surrounded by a 20 km internesting buffer for green turtles between November and March (DEE 2017a) as described in Section 4.9.4. 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 2018). 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 2018). 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). WA-50-L is located within the East Asian–Australasian Flyway. 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 that overlap WA-50-L. However, the EMBA overlaps two Ramsar sites (Ashmore Reef and Coburg Peninsula) and several nationally important wetland sites at Mermaid Reef and along the Kimberley coastline. Additionally, the PEZ includes other Ramsar sites and nationally important wetlands (Section 4.6), and there are a large number of BIAs for marine avifauna species present within the region (Figure 4-8). Marine avifauna have the potential to directly interact with hydrocarbons on the sea surface during 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 (WA DoT 2018). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019). The predicted extent of surface hydrocarbons at >10 g/m^2 may extend over approximately 860 km from an HFO release or 374 km for a condensate release. With a condensate (Group I) spill, rapid evaporation of volatile components during light wind conditions and rapid entrainment during increased wind conditions is expected. This will reduce the duration of any surface expression and potential for impacts to marine fauna at the sea surface. For a Group IV, HFO release however, the presence of hydrocarbons at the sea surface will	

be for a longer duration due to the increased persistence in the marine environment. Despite natural weathering processes, impacts to EPBC-listed species could represent a medium to large scale event with no threat to overall population viability (Significant). In summary, the potential extent of surface hydrocarbon with a concentration >10 g/m^2 may result in widespread exposure to marine fauna (including EPBC-listed species, such as marine mammals, turtles and seabirds). 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 a surface expression of hydrocarbon from the identified vessel collision scenarios is considered to be Significant (C). 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
As described in Table 8-6, HFO is not expected to break up and entrain into the water column and the model indicated no exposure to any sensitive receptor in any of the replicate simulations. Similarly, for dissolved aromatic hydrocarbons, the model indicated no exposure to any receptors. Therefore, the focus of this subsection is the condensate release where entrained hydrocarbons (> 100 ppb) could extend up to 1,110 km from the release location in WA-50-L. The values and sensitivities with the potential to be affected by entrained and dissolved hydrocarbon exposure include: • commercial, traditional and recreational fisheries including aquaculture • KEFs and associated biodiversity (fish communities, BIA - whale shark foraging) • benthic primary producer habitats / benthic habitats (corals, seagrasses and mangroves) • planktonic communities • EPBC-listed species (BIAs - marine mammals, turtles and avifauna). The values and sensitivities associated with commercial, traditional and recreational fisheries including aquaculture (seafood quality and employment) could be impacted due to entrained/dissolved oil. The impact to fish communities from exposure to entrained and dissolved hydrocarbons above threshold values, is primarily associated with toxicity resulting in impacts to seafood quality. Predictive oil spill modelling (RPS 2021a) concluded that the highest concentrations of entrained/dissolved hydrocarbons will occur within the top layers of the water column. No exceedance of the entrained hydrocarbon impact threshold (100 ppb) is predicted below 160 m and no exceedance of the dissolved hydrocarbon impact threshold (50 ppb) is predicted below 40 m. Therefore, pelagic fish, and site attached fish on coral reefs, such as Heywood Shoal, Echuca Shoal, Ashmore Reef, Cartier Island and Browse Island, have the potential to be exposed to entrained/dissolved hydrocarbons above the 100 ppb and 50 ppb impact thresholds. Whereas demersal fish communities (such as the continental slope demersal fish community KEF which intersects WA-50-L) and fish associated with other KEFs or deeper benthic habitats are less likely to be exposed above impact thresholds in deeper waters. 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 2018). Juvenile fish and larvae may	Significant (C)

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 2018). 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/dissolved hydrocarbon plumes for extended periods, and limited acute impacts or risks associated with the exposure are expected. However, within the EMBA there are several sawfish BIAs (along the WA coastline) and a whale shark foraging BIA (approximately 15 km south-east of WA-50-L). Whale sharks reportedly spend 40% of their time in the upper 15 m of the water column and are therefore likely to be exposed to entrained and dissolved hydrocarbons. 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/dissolved hydrocarbons (Campagna et al. 2011). In the event that an oil spill from a vessel collision occurred during whale shark foraging activities, there is the potential for a small proportion of the population to be affected; however, as there are no whale shark aggregations (such as the Ningaloo Reef aggregation) and reported low abundance, the overall population viability is not expected to be threatened. Site attached fish, such as reef fish within the EMBA may be exposed above the hydrocarbon exposure thresholds for a more extended duration. Therefore, medium to large scale, medium term impacts could occur to site attached fish and sharks. As such, the consequence of entrained/dissolved hydrocarbons on fisheries (commercial, recreational and traditional), fish and shark populations is considered to be Significant (C). Benthic communities, including benthic primary producers, such as coral reefs, seagrass and mangroves, and deeper water filter-feeding communities could be exposed to entrained hydrocarbons above impact thresholds (down to 160 m depth) and dissolved aromatic hydrocarbons (down to 40 m depth). Studies undertaken on benthic communities have found a wide range of variation in their associated toxicity threshold levels (Tsvetnenko 1998; NRC 2005). This is to be expected, as benthic communities are made up of a large variety of different organisms. In some cases, little to no impact is observed on benthic communities. For example, in the case of the Montara oil spill, where impacts were assessed at locations such as Ashmore Reef, Cartier Island, Barracouta Shoal and Vulcan Shoal, there was no observed impact on benthic communities (Heyward et al. 2010a; 2010b; 2011; 2013). Benthic communities in the EMBA including coral reefs, would be exposed to entrained/dissolved hydrocarbons above the impact thresholds. 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 2018), 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). A study by Nordborg et al. (2018) reported that the presence of ultraviolet radiation increases the hazard posed by dissolved hydrocarbons to tropical, shallow-water coral reefs due to phototoxicity. PAH phototoxicity occurs through the formation of radical oxygen species and/or transformation of PAHs into more toxic products. Therefore,	

co-exposure to ultraviolet radiation may considerably enhance negative impacts and the risks to coral larvae may be substantially underestimated in shallow-water tropical reef systems (Nordborg et al, 2018). 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 et al. 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. As summarised in Table 8-6, Browse Island, the closest receptor to WA-50-L, was predicted to receive a worst-case concentration of entrained hydrocarbons of approximately 35,000 ppb, and other coral reefs at locations such as Heywood Shoal (9,704 ppb), Echuca Shoal (1,859 ppb), Seringapatam Reef (4,348 ppb) and Scott Reef (4,470 ppb) also predicted to be exposed above impact threshold values. Dissolved aromatic hydrocarbon concentrations, above impact threshold values were recorded as 533 ppb (WA-50-L), 123 ppb at Browse Island and 60 ppb in the waters of the Kimberley MP. 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 & 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-50-L, 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 Minor (E). 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-50-L 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 also 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, 1998b). 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 (WA DoT 2018). There are no known BIAs or aggregation areas within WA-50-L. However, the EMBA overlaps two Ramsar sites (Ashmore Reef and Coburg Peninsula) and several nationally important wetland sites at Mermaid Reef and along the Kimberley coastline. Additionally, the PEZ includes other Ramsar sites and nationally important wetlands (Section 4.6), these sites provide important habitat for marine avifauna. Small proportions of populations of protected species could be impacted, therefore the consequence is considered to be Moderate (D). In summary, the potential extent of entrained/dissolved hydrocarbons with concentrations above impact threshold values 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 the identified vessel collision scenarios is considered to be Significant (C).	
Potential consequence – shoreline hydrocarbons	Severity
As presented in Table 8-6, both the condensate and HFO vessel collision scenarios resulted in shoreline contact. Hydrocarbons were predicted to accumulate at multiple locations within the EMBA at concentrations in excess of the 100 g/m^2 impact threshold. Indicative quantities of oil that could potentially accumulate on shorelines within the EMBA included but were not limited to: • Browse Island (218 m^3 – HFO; 63 m^3 - condensate) • Cartier Island (70 m^3 – HFO; 51 m^3 – condensate) • Ashmore Reef (95 m^3 – HFO) • Cassini Island (179 m^3 – HFO) • Bonaparte Archipelago (251 m^3 – HFO)	Moderate (D)

- Indonesia (Nusa Tengarra Timur) (187 m^3 – HFO)
- Sandy Islet (87 m^3 – HFO).

In both modelled scenarios the minimum time for shoreline contact was 29 hours (HFO) and 30 hours (condensate) at Browse Island. In general, time to contact for other shorelines was in the order of 6 to 25 days. Given this time to reach shorelines, any surface release is expected to have weathered due to several physical and biological processes, such as evaporation of volatile/toxic components, 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 2018). 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)
- 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).

Two Ramsar sites (Ashmore Reef and Coburg Peninsula) and several Nationally important wetlands are present within the EMBA (Section 4.6). 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).

Given the predicted time to contact, locations in the EMBA with mangrove communities is in the order of many days and 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 weathered hydrocarbons will generally be less toxic in nature (Stout et al. 2016). Given the predicted times to contact and significant expected weathering of any hydrocarbons accumulating on shorelines, any impacts to benthic primary producer or intertidal habitats are expected to be localised and of short to medium term with a consequence of Moderate (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 2017a). At locations with longer times for shoreline contact, there is a high potential for hydrocarbons to become more 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). Given the modelling results (time to contact and predicted volumes on shorelines), there is the potential for local-to-medium-scale impacts with medium-term effects on nesting populations of turtles at individual nesting beaches/locations (Moderate D). Birds coated in hydrocarbons may suffer toxic effects where the oil 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 vessel collision (HFO/condensate), 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 potentially impacting a small portion of a population of protected species. On this basis, the potential consequence associated with shoreline accumulation from the identified spill events is considered to be Moderate (D).	
Identify existing controls	
• Vessel fitted with lights, signals an automatic identification system (AIS) and navigation equipment as required by the *Navigation Act 2012* and associated Marine Orders (consistent with COLREGS requirements). • Double-walled skin and outboard ballast tanks provide protection to FPSO condensate tanks • Implement field management plan • PSZ maintained around the CPF, FPSO, drill centres and CRM and flash fuel gas lines.	
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 maintain ongoing logistical supply to the facility. Vessels are also necessary to undertake IMR activities in a fashion that is practicable and cost efficient.
Substitution	Substitute vessels in the field with other forms of transport to eliminate the potential for SIMOPs/vessel collision risk.	No	
	Specify MGO as fuel type for offtake tankers which is less persistent than HFO if spilled in the marine environment.	No	The specific offtake tankers that enter WA-50-L to complete offloading operations are beyond the control of INPEX and only form part of the petroleum activity when connected to the FPSO during offloading operations. Due to the uncertainty and variability in tanker specifications it is not possible for INPEX to specify the tanker fuel type.
Engineering	None identified	N/A	N/A
Procedures and administration	Implement Browse Regional Oil Pollution Emergency Plan	Yes	The INPEX BROPEP defines the processes that will be used to maintain oil spill preparedness and implement effective response measures, in the event of a spill.

Identify the likelihood	
Likelihood	The structural design and tank arrangements within the FPSO hull are such that a powered vessel would need to collide with impact energies of at least 150 MJ in order to first breach the double-walled skin, then penetrate the greater-than-10-m width of the outboard ballast tanks, before finally penetrating an inboard cargo tank. A ship collision risk assessment undertaken to support the INPEX *FPSO Ship Collision Study* (Doc No. S770-AH-REP-10051) has 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 is 3.5×10^{-7}, or once every 2.9 million years. These annual frequencies are low because Zone 1 is in a low-traffic region. Loss of containment of the FPSO as a consequence of collision with an infield support vessel is not considered credible. This is not due to the low likelihood of collision, which is naturally higher than for passing vessels, but because the smaller size of the infield support vessels and their achievable velocities means that the frequency of imparting a collision energy of more than 150 MJ is predicted to be zero. Loss of containment from the FPSO as a consequence of an offloading tanker collision with the FPSO is also not considered credible. This is because a taught-hawser tandem cargo offloading arrangement will be employed in all cases, which means that any collision involving an offloading tanker with the FPSO during offloading would occur at the stern (machinery space) of the

	FPSO, away from the condensate cargo tanks. In addition, a drifting collision would impart impact energies of only between 50 MJ and 100 MJ. The likelihood of third-party or support vessel collision with an offloading tanker is of similarly low likelihood as the FPSO collision scenarios, especially considering the offloading tankers will only be present in the Field Management Area for approximately 24 hours, every 5–10 days. Given the controls in place to minimise the potential for vessel collision and subsequent loss of containment, the likelihood of the consequence occurring is considered Remote (6).
Residual risk	Based on the worst-case consequence for all hydrocarbon exposure mechanisms (surface/entrained/dissolved/shoreline) Significant (C) and likelihood (Remote 6) evaluations, the residual risk is ranked as Moderate (8).

Residual risk summary		
Consequence	Likelihood	Residual risk
Significant (C)	Remote (6)	Moderate (8)
Assess residual risk acceptability		

Legislative requirements

The activities and proposed management measures are compliant with industry standards and with relevant Australian legislation, specifically concerning navigational safety requirements, including AMSA *Marine Order 30: Prevention of Collisions, Issue 8* (Order No. 5 of 2009). The OPGGS Act (Section 616) details the requirement for a PSZ for the purposes of protecting a well, structure or any equipment, in an offshore area, by notice published in the Gazette, administered by NOPSEMA.

Stakeholder consultation

Stakeholders have been engaged throughout the development of the EP. Where relevant, the controls in place have been developed in consultation with relevant stakeholders (e.g. WA DoT, AMSA). AMSA identified that lighting of vessels should be consistent with the requirements of the COLREGS requirements. All vessels are required to comply with the *Navigation Act 2012*, and associated Marine Orders, which are consistent with the COLREGS requirements.

Conservation management plans / threat abatement plans

Several conservation management plans (Appendix B) identify oil spills as a key threatening process, through both direct/acute impacts of oil, as well as indirect impacts through habitat degradation (which is a potential consequence of an oil spill). The prevention of vessel collisions and reducing impacts to the marine environment through oil spill response preparedness and response (refer INPEX *Browse Regional OPEP*), demonstrates alignment with the various conservation management plans.

ALARP summary

Given the level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “moderate”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

Environmental performance outcomes	Environmental performance standards	Measurement criteria
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 all vessels to ensure compliance with the *Navigation Act 2012.*
	FPSO designed with double-walled skin and outboard ballast tanks, to protect the inboard condensate storage and fuel tanks.	Design/construction records confirm FPSO walls have a double-walled skin and ballast tanks are located outside of condensate storage and fuel tanks.
	A Field Management Plan will be implemented, specifically: • The INPEX Field Manager will provide permission for vessels to enter the Field Management Area • The INPEX Field Manager will identify, coordinate and manage activities which are deemed to constitute SIMOPS and concurrent operations (CONOPS).	500 m checklists for all vessels entering the Field Management Area. SIMOPs and CONOPs documentation for vessel activities in the Field Management Area.
	A 500 m PSZ, issued by NOPSEMA, will be maintained around Project infrastructure.	Gazette Notice of PSZ. 500 m checklists issued under the Field Management Plan, for authorised entry into the PSZ.

		Records of reporting of unauthorised entry into the PSZ.
Refer to the INPEX *Browse Regional OPEP* for environmental performance outcomes, standards and measurement criteria related to mitigative controls.		

8.3 Structural integrity failure

As described in Table 7-37, the following two loss of containment scenarios from a production well have been identified and modelled:

- uncontrolled blowout releasing Brewster condensate (255,475 m^3 – based on 3,193 m^3 per day for an 80-day blowout; RPS 2021c)
- uncontrolled blowout releasing Plover condensate (116,856 m^3 - based on 1,082 m^3 per day for a 108-day blowout; RPS 2019b).

For a WCSS well blowout, Brewster and Plover condensate are very similar in composition; however, the Brewster reservoir has approximately twice the condensate flowrate compared to the Plover reservoir. Therefore, the Brewster scenario is considered to represent the WCSS.

8.3.1 Location

A location on the SE corner of the Brewster reservoir, known as the Holonema-B location, was selected as the release location in the modelling (RPS 2021c) as it is the closest location of that reservoir to the nearest shoreline receptor (Browse Island approximately 38 km away). The selection of this location should result in the fastest time to shoreline contact and greatest volume of oil ashore, during the wet season, which is dominated by westerly wind-flow. The modelled release was undertaken for a water depth of 235 m. The Holonema-B location is considered to be the WCSS for any well blowout associated with the Brewster and Plover reservoirs within the Ichthys Field and other permit areas overlying the Brewster/Plover reservoirs in the Browse Basin.

The Plover blowout modelling was undertaken for a location within WA-50-L approximately 47 km north-west of Browse Island in a water depth of 263 m (RPS 2019b).

8.3.2 Volume and duration

The volume of Brewster condensate used in the modelling was 255,475 m^3, based on an uncontrolled blowout of a production well during development drilling. The duration of the hydrocarbon release was 80 days (based on 80 days to complete a relief well / well-kill operation). The overall duration of the modelled simulations was 108 days, to account for the fate of hydrocarbons after the well has been contained.

The volume of Plover condensate used in the modelling was 116,856 m^3, based on an uncontrolled blowout of a production well during development drilling with no restrictions within the well bore. The duration of the hydrocarbon release was 108 days based on the time to complete a relief well / well-kill operation. A well-kill for a Plover reservoir well blowout may be longer than a Brewster well, due to deeper reservoir depth and associated deeper relief well drilling requirements. However, because of differences in reservoir properties, the overall Plover condensate release volume would be approximately 50% of the volume of a Brewster reservoir scenario. The overall duration of the modelled simulations was 122 days, to account for the fate of hydrocarbons after the well has been contained.

8.3.3 Hydrocarbon properties

Hydrocarbon properties associated with the Group I Brewster and Plover condensate used for the modelling studies (RPS 2021c; RPS 2019b) are presented in Table 8-8.

Table 8-8: Group I condensate properties

Hydrocarbon type	Density at 15 ˚C (g/cm³)	Viscosity – centipoise (cP) – at 15 ˚C	Characteristic	Volatile (%)	Semi-volatile (%)	Low volatility (%)	Residual (%)
			Boiling point (˚C)	<180	180–265	265–380	>380
Brewster condensate	0.764	1.200	% of total	64.3	17.6	12.1	6.0
Plover condensate	0.780	0.878		59.5	16.1	18.0	6.4

8.3.4 Modelling results

Overview

A comparison of the Brewster (Holonema-B) and Plover spill modelling results is presented in Table 8-9. The Brewster modelling results can be considered as the WCSS with respect to extent of floating oil at the sea surface, minimum time to shoreline contact, length of shoreline exposed and worst-case volume of oil on shoreline. On this basis, further discussion throughout this section of the EP is focussed on the Brewster modelling results only, presented in Table 8-10, Figure 8-2 and Figure 8-3.

The results of the OILMAP Deep simulation predicted that the subsea release will generate a cone of rising gas that will entrain the oil droplets and ambient sea water up to the water surface. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of around 8.9 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be approximately 30.5 m. The results suggest that beyond the immediate vicinity of the blowout most of the released hydrocarbons will be present in the upper layers of the water column, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Based on the discharge characteristics, the properties of the oil and its expected weathering behaviour, floating oil will be susceptible to entrainment into the wave-mixed layer under typical wind conditions. Evaporation rates will be significant, given the high proportion of volatile and semi-volatile compounds in the oil (81.9%). The low-volatility fraction of the oil (12.1%) will take longer durations, of the order of days, to evaporate, and the residual fraction of 6% is expected to persist in the environment until slower degradation process occur. The condensate contains approximately 11% as soluble aromatics that will be subject to dissolution during the rise of condensate droplets to the water surface. Soluble aromatics that remain in condensate slicks at the surface, will be subject to evaporation and dissolution.

Table 8-9: Comparison of Brewster (RPS 2021c) and Plover (RPS 2019a) spill modelling results

Result	Brewster (Holonema-B)	Plover
Max lineal distance (km) floating oil >1g/m^2	883	548
Max lineal distance (km) floating oil >10g/m^2	263	167
Minimum time (days) to shoreline oil accumulation >10 g/m^2	3 (67 hours)	4 (107 hours)
Minimum time (days) to shoreline oil accumulation >100 g/m^2	3 (68 hours)	6 (137 hours)
Longest length (km) or number of segments of shoreline oiled > 10 g/m^2	158	N/A[1]
Longest length (km) or number of segments of shoreline oiled > 100 g/m^2	27	9
Worst-case volume (m^3) of oil on shoreline >100 g/m^2 at any time	433	120

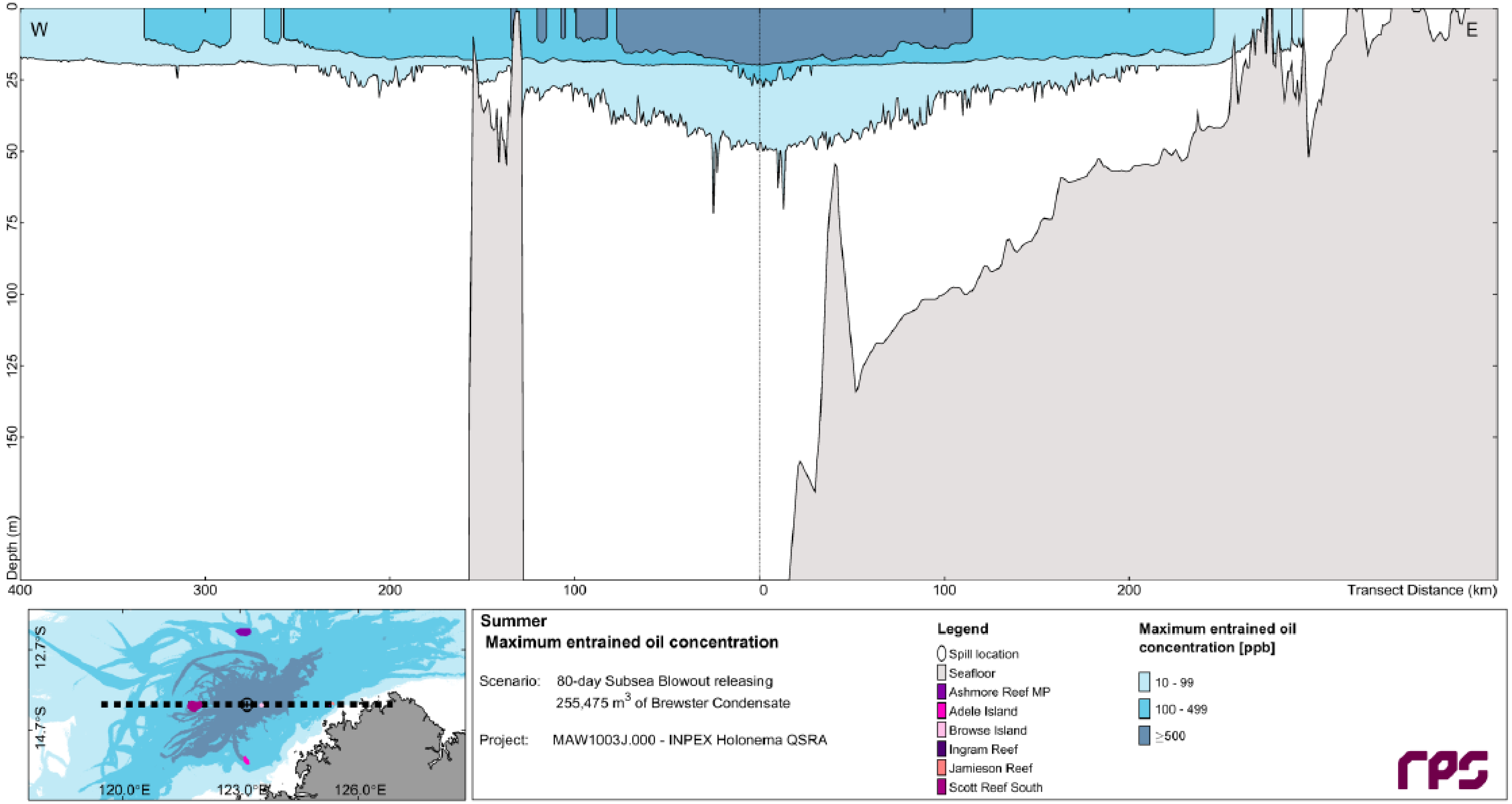
[1] This parameter was not calculated/reported

Table 8-10: Brewster (Holonema-B) spill modelling results summary (RPS 2021c)

Hydrocarbon exposure	Summary of results
Surface	Concentrations of hydrocarbons at the sea surface, greater than the impact threshold of 10 g/m^2 are predicted to occur at distances of up to 263 km from the source.
Entrained/ dissolved	Entrained oil concentrations, greater than the impact threshold of 100 ppb were predicted to extend up to a maximum of 897 km from the source. Worst-case instantaneous entrained oil concentrations predicted were 16,082 ppb in the vicinity of the release location and 2,851 ppb at Browse Island. Other representative shallow receptors received the following worst-case entrained oil concentrations: Ashmore Reef (482 ppb), Cartier Island (313 ppb), Kimberley MP (1,802 ppb) Adele Island (654 ppb), Heywood shoal (840 ppb), Echuca shoal (52 ppb), Seringapatam Reef (662 ppb), Sandy Islet (447 ppb) and Scott Reef (655 ppb). Cross-sectional transects in the vicinity of the release site indicated that entrained oil concentrations at or greater than the 100 ppb threshold are not predicted to reach depths greater than approximately 30 m (Figure 8-2).

Hydrocarbon exposure	Summary of results
	Dissolved aromatic hydrocarbons, greater than the impact threshold of 50 ppb were predicted to extend up to approximately 450 km from the source. Worst-case dissolved aromatic hydrocarbon concentrations were calculated as 8,958 ppb in the vicinity of the release location and 3,376 ppb at Browse Island. Other representative shallow receptors received the following worst-case dissolved aromatic hydrocarbon concentrations: Ashmore Reef (439 ppb), Cartier Island (382 ppb), Kimberley MP (1,492 ppb) Adele Island (84 ppb), Heywood shoal (1,477 ppb), Echuca shoal (953 ppb), Seringapatam Reef (952 ppb), Sandy Islet (1,088 ppb) and Scott Reef (1,088 ppb). Cross-sectional transects in the vicinity of the release site indicated that dissolved aromatic hydrocarbon concentrations at or greater than the 50 ppb threshold are not predicted to reach depths greater than approximately 130 m (Figure 8-3).
Shoreline	Predicted highest potential volumes on shorelines, in the worst-case replicate included Browse Island (433 m^3), Ashmore Reef (207 m^3), shorelines in the North Kimberley MP (198 m^3), Cassini Island (106 m^3), Sandy Islet (62 m^3), Cartier Island MP (55 m^3) and the Bonaparte Archipelago (30 m^3). Highest potential concentrations of oil on shore, through accumulation, were calculated as 19,262 g/m^2 (Browse Island), 3,636 g/m^2 (Sandy Islet), 3,195 g/m^2 (Cassini Island), 3,195 g/m^2 (North Kimberley MP), 3,182 g/m^2 (Ashmore Reef), 2,150 g/m^2 (Cartier Island) and 887 g/m^2 (Bonaparte Archipelago). In the worst-case replicate, the shortest elapsed time before exposure could occur at any shoreline was predicted as 68 hours for Browse Island. With other times to contact ranging from 221 hours (9 days) at Sandy Islet, 254 hours (11 days) at Cartier Island, 305 hours (13 days) at Ashmore Reef up to 1,409 hours (59 days) at Bonaparte Archipelago.

a)



W
E
Depth (m)
0
25
50
75
100
125
150
400
300
200
100
0
100
200
Transect Distance (km)
12.7°S
14.7°S
120.0°E
123.0°E
126.0°E
Summer
Maximum entrained oil concentration
Scenario: 80-day Subsea Blowout releasing 255,475 m3 of Brewster Condensate
Project: MAW1003J.000 - INPEX Holonema QSRA
Legend
Spill location
Seafloor
Ashmore Reef MP
Adele Island
Browse Island
Ingram Reef
Jamieson Reef
Scott Reef South
Maximum entrained oil concentration [ppb]
10 - 99
100 - 499
≥500

b)

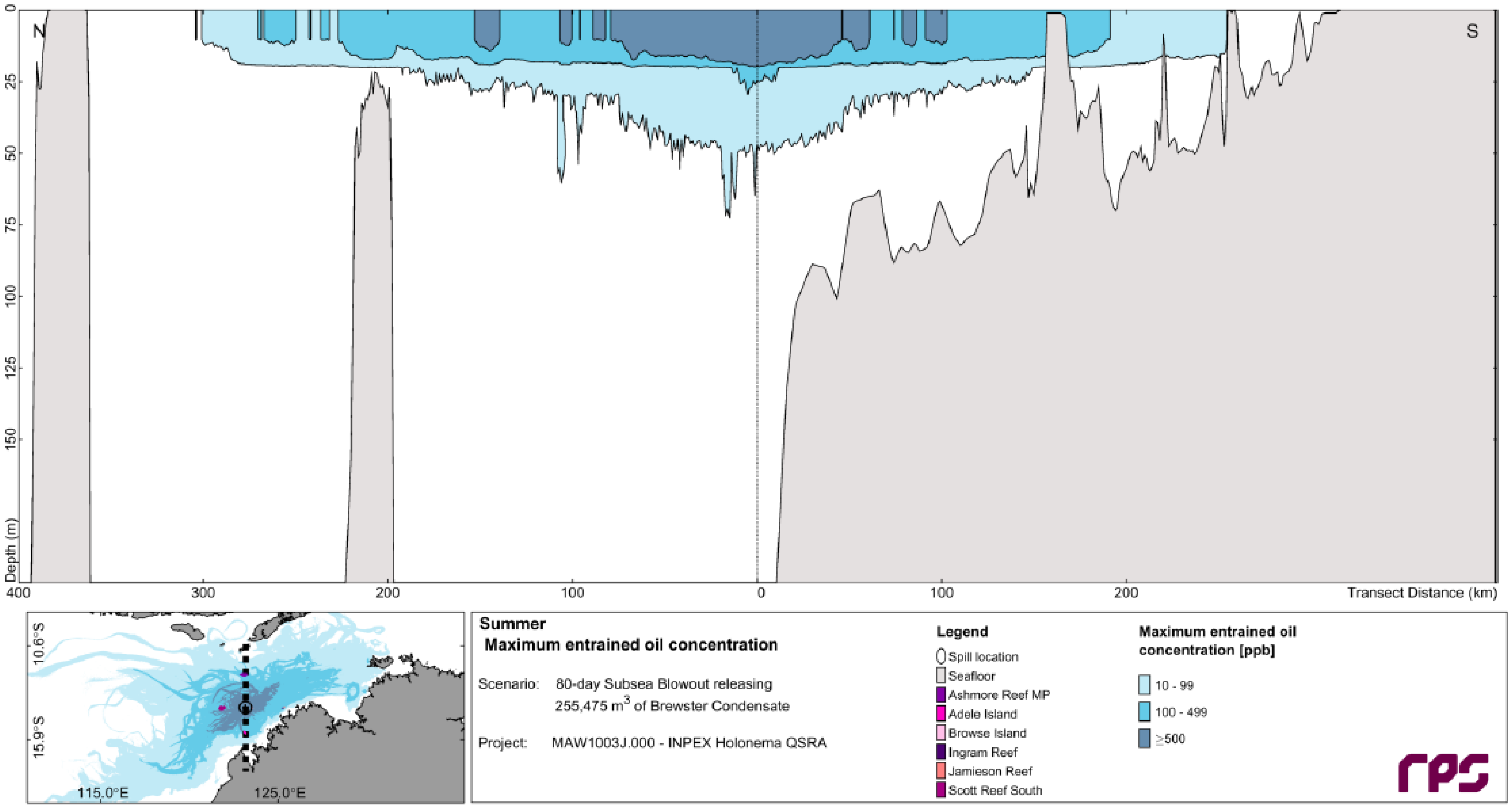
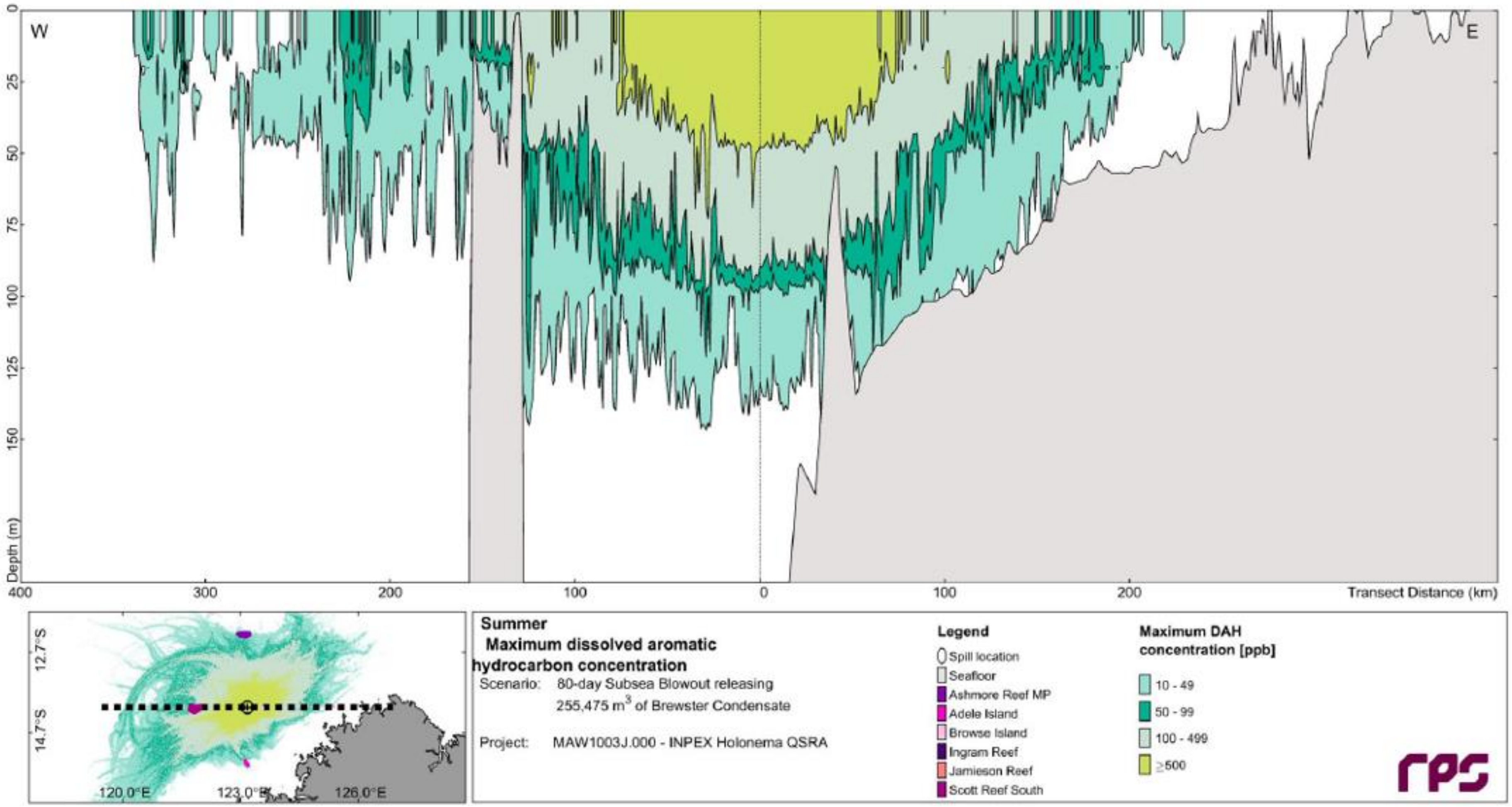


Figure 8-2: Cross-section transect of entrained hydrocarbons from a Brewster condensate blowout a) east-west (summer) b) north-south (summer)

a)



W
E
Depth (m)
0
25
50
75
100
125
150
400
300
200
100
0
100
200
Transect Distance (km)
12.7°S
14.7°S
120.0°E
123.0°E
126.0°E
Summer
Maximum dissolved aromatic hydrocarbon concentration
Scenario: 80-day Subsea Blowout releasing 255,475 m3 of Brewster Condensate
Project: MAW1003J.000 - INPEX Holonema QSRA
Legend
Spill location
Seafloor
Ashmore Reef MP
Adele Island
Browse Island
Ingram Reef
Jamieson Reef
Scott Reef South
Maximum DAH concentration [ppb]
10 - 49
50 - 99
100 - 499
≥500

b)

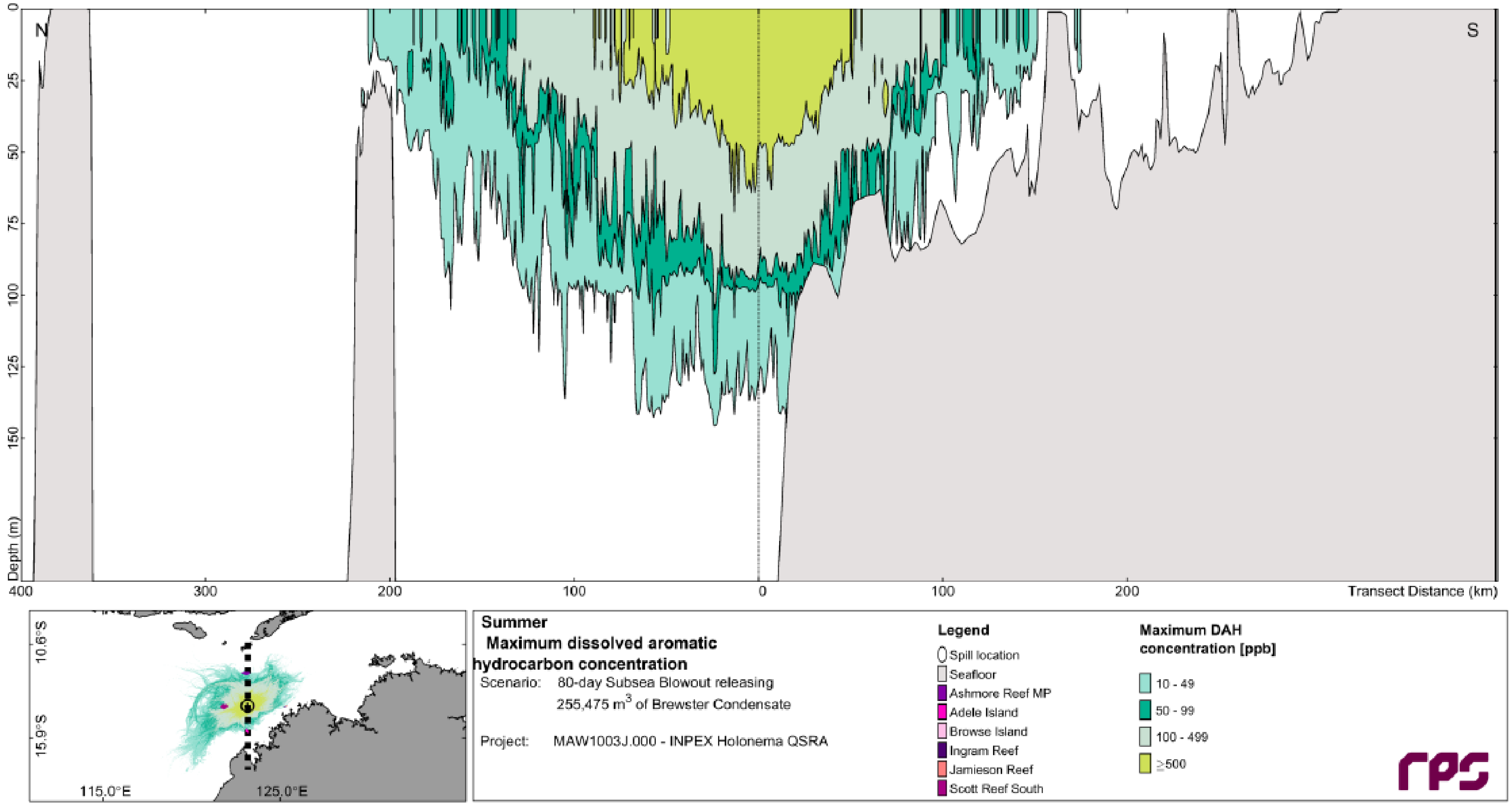


Figure 8-3: Cross-section transect of dissolved aromatic hydrocarbons from a Brewster condensate blowout a) east west (summer) b) north-south (summer)

8.3.5 Impact and risk evaluation

Table 8-11: Impact and risk evaluation – structural integrity failure

Identify hazards and threats	
A subsea release of Group I hydrocarbons (condensate) has the potential to result in changes to water quality through surface, entrained/dissolved and shoreline accumulation hydrocarbon exposure. The threshold for impacts associated with such hydrocarbon exposures are described in Table 8-2. The predicted physical extent of the worst-case blowout (Brewster: Holonema-B) is presented in Table 8-9, Table 8-10, Figure 8-2 and Figure 8-3.	
Potential consequence – surface hydrocarbons	Severity
The particular values and sensitivities with the potential to be exposed to surface hydrocarbon may include: • commercial, traditional and recreational fisheries including aquaculture (within approximately 883 km from the release location based on the visible sheen threshold) • EPBC-listed species (within approximately 263 km from the release location based on 10 g/m^2 impact threshold). • planktonic communities (within approximately 263 km from the release location based on 10 g/m^2 impact threshold). Based on the properties of condensate (Group I) any slick forming at the sea surface following a subsea release will undergo rapid evaporation of volatile components during light wind conditions and rapid entrainment during increased wind conditions (RPS 2021c). This will reduce the duration of any surface expression and potential for impacts to marine fauna at the sea surface. Potential consequences to the identified values and sensitivities from exposure to surface hydrocarbons are described in Table 8-7 and at a worst-case could result in a medium to large scale event (Significant C).	Significant (C)
Potential consequence – entrained/dissolved	Severity
A subsea release of condensate due to the structural integrity failure of a production well in WA-50-L could result in entrained hydrocarbons (>100 ppb) potentially extending up to 897 km from the release location at depths of up to 30 m below sea level. Concentrations of dissolved aromatic hydrocarbons >50 ppb may also extent over a wide area (approximately 450 km) at depths of up to 130 m below sea level. The values and sensitivities with the potential to be affected by entrained and dissolved aromatic hydrocarbon exposure include: • commercial, traditional and recreational fisheries including aquaculture • KEFs and associated biodiversity (fish communities, BIA - whale shark foraging) • benthic primary producer habitats / benthic habitats (corals, seagrasses and mangroves) • planktonic communities • EPBC-listed species (BIAs - marine mammals, turtles and avifauna). As described in Table 8-7, impacts to commercial, traditional and recreational fisheries including aquaculture (seafood quality and employment) could be impacted due to exposure to entrained and dissolved oil. The impact to fish communities from such exposure, above threshold values, is primarily associated with toxicity resulting in impacts to seafood quality.	Significant (C)

Following a subsea release from a production well, the plume of gas/condensate will rise through the water column and become entrained in the upper layers of the water column (top 30 m) (Figure 8-2). Soluble aromatics components will dissolve as the plume rises through the water column, with concentrations >50 ppb predicted in the top 130 m (Figure 8-3). Pelagic fish, and site attached fish on coral reefs within the EMBA, such as Heywood Shoal, Echuca Shoal, Ashmore Reef, Cartier Island and Browse Island, have the potential to be exposed to entrained/dissolved hydrocarbons above the 100 ppb and 50 ppb impact thresholds. Whereas demersal fish communities (such as the continental slope demersal fish community KEF which intersects WA-50-L) and fish associated with other KEFs or deeper benthic habitats are less likely to be exposed above impact thresholds in deeper waters. As such, the consequence of entrained/dissolved hydrocarbons on fisheries (commercial, recreational and traditional), fish and shark populations, including whale sharks (foraging BIA approximately 15 km south-east from WA-50-L) is considered to be Significant (C). Benthic communities in the EMBA, including benthic primary producers, such as coral reefs, seagrass and mangroves, and deeper water filter-feeding communities could be exposed to entrained hydrocarbons above impact thresholds (down to 30 m depth) and dissolved aromatic hydrocarbons (down to 130 m depth). As described in Table 8-7 this could result in a number of lethal or sub-lethal effects on these values and sensitivities. Browse Island, as the closest receptor to WA-50-L, is predicted to receive the highest concentrations of entrained (2,851 ppb) and dissolved aromatic hydrocarbons (3,376 ppb) although concentrations were predicted to be higher at the release location in WA-50-L. Due to the proximity of some deep-water filter-feeding communities, such as the 125 m ancient coastline KEF, Echuca Shoal and Heyward Shoal, and the prolonged exposure above impact thresholds that may be received at these locations, the potential consequence for coral reefs is considered to be Significant (C). The majority of seagrass locations within the EMBA are distant from WA-50-L, therefore the associated received concentrations of entrained and dissolved oils will be lower; however, may still be above the threshold that could cause impact and the consequence is considered to be Minor (E) based on rapid expected recovery. Mangrove communities within the EMBA, present along WA, NT and international coastlines are also susceptible to entrained/dissolved oil exposure, with potential impacts, including defoliation and mortality. 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-50-L therefore, the associated received concentrations will be lower; however, still above the threshold that could cause impacts. Therefore, the consequence is considered to be Moderate (D). As described in Table 8-7, impacts to planktonic communities from exposure to entrained/dissolved oils has been well studied. If the entrained/dissolved plume reached a coral-spawning location, such as Browse Island or Scott Reef during a spawning event, localized short-to-medium term impacts could occur (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 (WA DoT 2018). There are no known BIAs or aggregation areas within WA-50-L. However, the EMBA overlaps two Ramsar sites (Ashmore Reef and Coburg Peninsula) and several nationally important wetland sites at Mermaid Reef and along the Kimberley coastline. Additionally, the PEZ includes other Ramsar sites and nationally important wetlands (Section 4.6), these sites provide important habitat for marine avifauna. Small proportions of populations of protected species could be impacted, therefore the consequence is considered to be Moderate (D).	

In summary, the potential extent of entrained/dissolved hydrocarbons with a concentration above impact threshold values may result in widespread exposure to identified values and sensitivities. There would likely also be cumulative impacts through bioaccumulation up the food chain. On this basis, the potential consequence associated with entrained/dissolved plumes from the worst-case loss of containment from a production well is considered to be Significant (C).	
Potential consequence – shoreline hydrocarbons	Severity
As presented in Table 8-10, shoreline contact and accumulation of oil on shorelines was predicted at multiple locations within the EMBA at concentrations in excess of the 100 g/m^2 impact threshold. Indicative quantities of oil that could potentially accumulate on shorelines within the EMBA included but were not limited to: • Browse Island (433 m^3) • Ashmore Reef (207 m^3) • shorelines in the Kimberley MP (198 m^3) • Cassini Island (106 m^3) • Sandy Islet (62 m^3) • Cartier Island (55 m^3) • Bonaparte Archipelago (30 m^3). The minimum predicted time for shoreline contact was 68 hours (3 days) at Browse Island. In general, time to contact for other shorelines was in the order of 9 to 59 days. Given this time to reach shorelines, any surface release is expected to have weathered due to several physical and biological processes, such as evaporation of volatile/toxic components, 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 2018). 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) • EPBC-listed species (BIAs - turtles and avifauna). Impacts to benthic primary producer habitats/shoreline habitats from shoreline accumulation of oil are described in Table 8-7. Based on the predicted times to contact and significant expected weathering of any hydrocarbons accumulating on shorelines, any impacts to benthic primary producer or intertidal habitats are expected to be localised and of short-to-medium term with a consequence of Moderate (D). Impacts to EPBC-listed species from shoreline accumulation of oil are described in Table 8-7. In the event of a shoreline contact following loss of containment event from a production well in WA-50-L, there is the potential for short–to-medium-term impacts on the environment while local populations recover. It is not expected that the overall population viability for any protected species would be threatened.	Moderate (D)

Therefore, the potential consequence associated with shoreline hydrocarbon exposure for EPBC-listed species 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 potentially impacting a small portion of a population of protected species. On this basis, the potential consequence associated with shoreline accumulation from the worst-case loss of containment from a production well is considered to be Moderate (D).	

Identify existing controls

- Conduct inspections and testing of the subsea infrastructure during operations in accordance with the Subsea Integrity Monitoring and Management Plan and Subsea Inspection Management System (COABIS)
- Perform tests and verification of well barriers on handover of wells from drilling to operations
- Inspection and maintenance of CPF and FPSO moorings
- Leak testing of SPS following introduction of hydrocarbons
- Function testing of SPS isolation valves (SSSVs, XTVs, SSIVs and RESDVs)
- Validation of functionality of SSSVs, XTVs, SSIVs and RESDVs and validate automated alarms and automated shutdowns of SPS
- Verification of competency (VOC) of CPF and FPSO CCR operators
- Plan and control all pigging and IMR activities in the Ichthys Field to avoid damage to SPS from over pressurisation or isolation issues
- Implement field management plan
- INPEX lifting standard
- PSZ maintained around the CPF, FPSO, drill centres and CRM and flash fuel gas lines
- Implementation of Incident Management Guides contained in CPF and FPSO Emergency Management Plans.

Propose additional safeguards/control measures (ALARP evaluation)

Hierarchy of control	Control measure	Used?	Justification
Elimination	None identified	N/A	N/A
Substitution	None identified	N/A	N/A
Engineering	None identified	N/A	N/A
Procedures and administration	Implement Browse Regional Oil Pollution Emergency Plan	Yes	The INPEX BROPEP defines the processes that will be used to maintain oil spill preparedness and implement effective response measures, in the event of a spill.

<table>
<tr><td></td><td colspan="2">Implementation of the INPEX Loss of Well Integrity Response Plan (WIRP)</td><td>Yes</td><td colspan="2">The objective of the WIRP is to provide an action plan to be followed in the case of a loss of well integrity with the intent to prevent escalation of any loss of well integrity and establish 2 (or more) barriers. The WIRP, referenced in the Well Operations Management Plan, is a requirement of the Well Integrity Manual and describes the interface between the drilling and operations teams to ensure preparedness at all times. The Source Control Emergency Response Plan (SCERP) is a subset of the WIRP.</td></tr>
<tr><td colspan="6">Identify the likelihood</td></tr>
<tr><td>Likelihood</td><td colspan="5">In the case of the Ichthys Field, all production wells are fitted with SSSVs located 500 m below mud line. SSSVs are designed to fail into a closed position. The SSSVs are held open with hydraulic pressure continuously applied to the spring, to keep the valve in an open position during production from the well. In the event of a catastrophic failure of the xmas tree connector, hydraulic pressure in the SSSV control line will be lost and cause the SSSV to close, thereby preventing a well blowout. SSSVs are factory-acceptance tested to confirm they close within three seconds of loss of hydraulic pressure in the control line.

Calculations considering the back-pressure of the reservoir against the bottom side of the SSSV, demonstrate that a solid steel object, of approximately 5.34 inches in diameter, and greater than 15 feet in length would need to be falling perfectly vertically aligned through 500 m of well production tubing, without any obstructions, at terminal velocity, before it could potentially open the SSSV.

A review of all subsea components located around the Ichthys Field was conducted in an attempt to identify a solid cylinder steel object, that is approximately 5.34 inches in diameter and 15 feet or greater in length. The review did not identify any such objects in the Ichthys Field.

In the hypothetical scenario of a xmas tree being completely sheared off, it is expected that metal debris, such as a bolt or gasket material from around the tree are the only objects which could possibly make their way downhole; however, these objects could not physically open the SSSV. As such, this proposed scenario is not seen as a credible scenario. Therefore, the likelihood is considered beyond remote. However, for the purposes of conducting this risk assessment, the likelihood has been classified as Remote (6).

Given the design controls in place, preventative and mitigation controls that have been identified to minimise the potential exposure to particular values and sensitivities, the likelihood of this consequence occurring is considered Remote (6).</td></tr>
<tr><td>Residual risk</td><td colspan="5">Based on a consequence of Significant (C) and likelihood of Remote (6) the residual risk is Moderate (8).</td></tr>
<tr><td colspan="6">Residual risk summary</td></tr>
<tr><td colspan="2">Consequence</td><td colspan="3">Likelihood</td><td>Residual risk</td></tr>
<tr><td colspan="2">Significant (C)</td><td colspan="3">Remote (6)</td><td>Moderate (8)</td></tr>
<tr><td colspan="6">Assess residual risk acceptability</td></tr>
</table>

Legislative requirements All reasonable means to minimise loss of containment events occurring from integrity failures have been taken during the design, route selection and installation of the subsea infrastructure. The Project has been developed in accordance with the relevant Australian standards and codes of practice to ensure integrity and minimise the potential for integrity failures in the hydrocarbon processing system. The preventative and mitigation measures are typical for the proposed activities and are appropriate for the North West Shelf region. Stakeholder consultation Stakeholders have been engaged throughout the development of the EP. Where relevant, the controls in place have been developed in consultation with relevant stakeholders (e.g. WA DoT, AMSA). Conservation management plans / threat abatement plans Several conservation management plans (refer Appendix B) identify oil spills as a key threatening process, through both direct/acute impacts of oil, as well as indirect impacts through habitat degradation (which is a potential consequence of an oil spill). The prevention of loss of containment events from the subsea production system and reducing impacts to the marine environment through oil spill response preparedness and response (refer INPEX *Browse Regional OPEP*), demonstrates alignment with the various conservation management plans. ALARP summary Given the level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No other additional controls have been identified that can reasonably be implemented to further reduce the risk of impact. Acceptability summary Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because: • the activity demonstrates compliance with legislative requirements/industry standards • the activity takes into account stakeholder feedback • the activity is managed in a manner that is consistent with the intent of conservation management documents • the activity does not compromise the relevant principles of ESD • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "moderate", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.		
Environmental performance outcomes	**Environmental performance standards**	**Measurement criteria**
Prevent impacts to the marine environment from a loss of containment due to a structural integrity failure.	Subsea integrity inspections of the subsea production system implemented in accordance with the Subsea Integrity Maintenance Management Plan (SIMMP), specifically the frequency specified in risk-based inspection schedule.	Risk-based inspection schedule records confirm subsea production system inspections conducted in accordance with the risk-based inspection schedule specified in the SIMMP.

	Conduct maintenance of the subsea production system in accordance with the findings of the subsea Inspection Management System.	SAP records confirm maintenance of the subsea production system was conducted in accordance with the subsea Inspection Management System.
	Prior to handover to Operations, tests and verification of well barriers will be conducted in accordance with the INPEX Well Acceptance Criteria.	Well handover documents
	Conduct inspections and maintenance of the CPF/FPSO moorings, in accordance with the Mooring IMM Plan; specifically, the frequency specified in risk-based inspection schedule.	Records confirm that inspection have been completed in accordance with the Mooring IMM Plan and the risk-based inspection schedule.
	Prior to operation of new SPS infrastructure, a leak-test will be conducted of all interconnections/connections of the subsea production system, in accordance with DNV-OS-F101, and will be verified by a third party.	Third-party verification of DNV leak-test certificates.
	Prior to the introduction of hydrocarbons in new SPS infrastructure, validate the functionality of the SSSVs, XTVs, SSIVs and RESDVs, and validate the automated alarms and automated shutdowns related to the subsea production system, in accordance with the RFSU dossier.	RFSU certificates Records of verification of readiness process
	During operations, SPS isolation valves will be function tested in accordance with their relevant performance standards; specifically: • SSSVs, XTVs and SSIVs – Subsea IMM Plan • RESDVs – Actuated Valves Strategy for Availability Assurance.	Records of tests in accordance with the Subsea IMM Plan and Actuated Valves Strategy for Availability Assurance.
	All CPF/FPSO CCR Operators will demonstrate verification of competency in accordance with the INPEX Operations Assessment Strategy Specification.	Records of VOC for CPF/FPSO CCR Operators.

	All pigging, subsea infrastructure IMR activities conducted in accordance with a permit to work, issued in accordance with the Field Management Plan.	Permit to work documentation related to subsea production system pigging and IMR activities.
	A Field Management Plan will be implemented; specifically: • The INPEX field manager will identify, coordinate and manage activities which are deemed to constitute SIMOPS and CONOPS associated with the subsea production system infrastructure.	500 m checklists for any vessel activities interacting with the subsea production system infrastructure. SIMOPs documentation for any MODU movements within the Ichthys Field.
	Any vessel-based lifting for large infrastructure ('critical lifts') will be managed under a permit to work issued in accordance with the INPEX *Lifting Standard*.	Records of permit to work for all critical lifts.
	A 500 m PSZ, issued by NOPSEMA, will be maintained around Project infrastructure.	Gazette notice of PSZ. 500 m checklists issued under the Field Management Plan, for authorised entry into the PSZ. Records of reporting of unauthorised entry into the PSZ.
	Incident Management Guides, contained within the CPF/FPSO Emergency Management Plans will be implemented, in the event of a loss of containment from the SPS	Records demonstrate Incident Management Guides were implemented following a loss of containment from the SPS.
	Regain control of production well within 80 days (Brewster) and 108 days (Plover) through implementation of the INPEX *Well Integrity Response Plan.*	Documentation demonstrates that the control of the production well was regained within 80/108 days, following a loss of containment event.
Refer to the INPEX *Browse Regional OPEP* for environmental performance outcomes, standards and measurement criteria related to mitigative controls.		

8.4 Oil spill response and capability

INPEX has developed a regional OPEP for the Browse Basin which applies to the petroleum activity described in this EP. The INPEX *Browse Regional OPEP* (BROPEP) consists of a suite of documents as shown in Figure 8-4 and described in Table 8-12. The BROPEP covers all INPEX Australia's exploration and production activities in the Browse Basin.

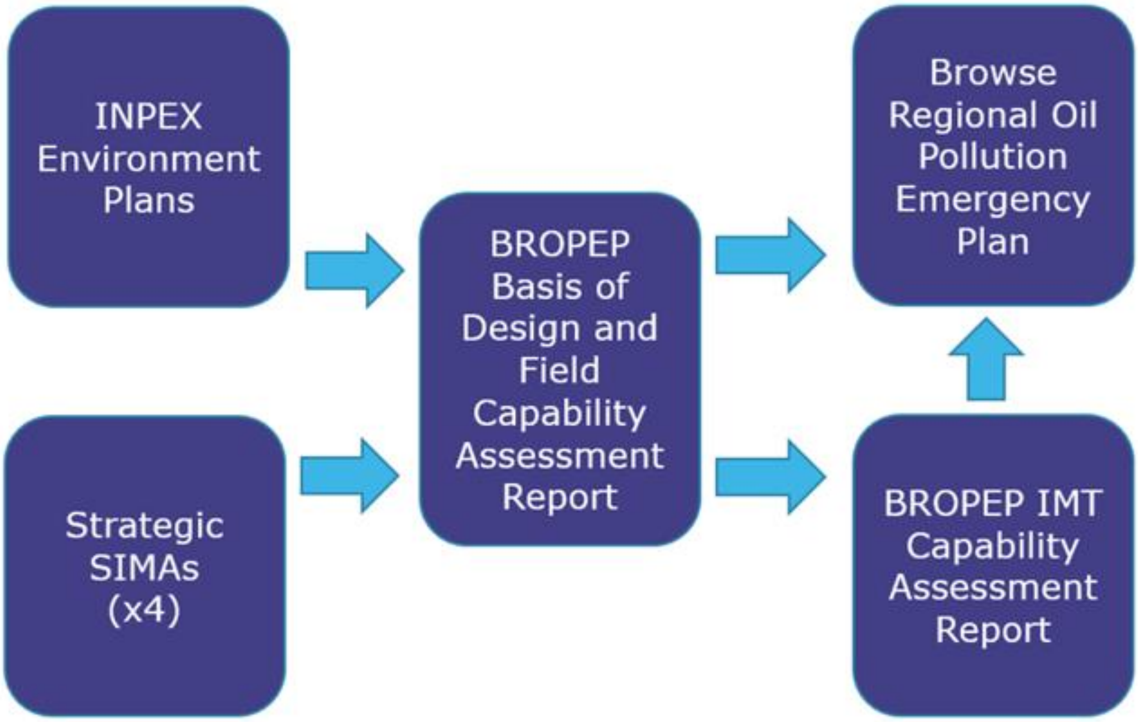


Figure 8-4: Browse regional OPEP document structure

Table 8-12: Browse regional OPEP documentation overview

Document title	Document number	Purpose
INPEX Environment Plans	N/A	All INPEX EPs contain a detailed activity description and activity-specific oil spill scenarios. Specifically, INPEX EPs include the following: • a description of the activity-specific spill scenarios (including the potential release rates, volumes, locations, hydrocarbon types, etc.) • activity-specific oil spill modelling (used to inform environmental risk assessments) • an assessment of oil spills risks/impacts on environmental values and sensitivities • evaluations of controls to prevent oil pollution from the specific activity.

Document title	**Document number**	**Purpose**
		• The WCSS from all INPEX EPs are included in the INPEX Australia - Browse Regional Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment.
Strategic Spill Impact Mitigation Assessments (SIMAs): • Condensate spill – instantaneous surface release • Marine gas oil/diesel spill – instantaneous surface release • Intermediate fuel oil/heavy fuel oil (HFO) spill – instantaneous surface release • Condensate/gas well or pipeline blowout – long duration subsea release.	X060-AH-LIS-60031 X060-AH-LIS-60032 X060-AH-LIS-60033 X060-AH-LIS-60034	The four INPEX Strategic SIMA documents are pre-spill planning tools. These are used to facilitate response option selection by identifying and comparing the potential effectiveness and impacts of the various oil spill response strategies on a range of environmental values and sensitivities. The Strategic SIMAs utilise a semi-quantitative process to evaluate the impact mitigation potential of each response strategy. This method provides a transparent decision-making process for determining which response strategies are most likely to be effective at minimising oil spill impacts. The SIMA process includes environmental considerations as well as a range of shared values such as ecological, socio-economic and cultural aspects.
INPEX Australia - Browse Regional Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment (BROPEP BOD/FCA)	X060-AH-REP-70016	The BROPEP BOD/FCA presents an overview of all of INPEX Australia's offshore petroleum exploration and production activities and associated oil spill risks. It includes an evaluation of modelling outcomes from a series of selected WCSSs and presents an oil spill response field capability analysis. The BROPEP BOD/FCA includes the EPOs and EPSs relevant to the preparedness and environmental risk assessment of field response capability and arrangements and the broader BROPEP implementation strategy (i.e. reviews, management of change process, etc.).
INPEX Australia - Browse Regional Oil Pollution Emergency Plan – Incident Management Team Capability Assessment (BROPEP IMTCA)	X060-AH-REP-70015	The BROPEP IMTCA utilises the field capability assessments as inputs to evaluate the size and structure of the INPEX IMT necessary to mobilise and maintain the field capability. The BROPEP IMTCA outlines the EPOs and EPSs relevant to INPEX IMT capability and arrangements.

Document title	Document number	Purpose
INPEX Australia - Browse Regional Oil Pollution Emergency Plan (BROPEP)	X060-AH-PLN-70009	The BROPEP is the tool which will be utilised by the INPEX IMT during any impending/actual oil spill event. This document assists/guides the IMT through the process of notifications, gaining/maintaining situational awareness, response strategy evaluation and incident action plan (IAP) development, and mobilisation of field response capabilities. The BROPEP outlines the EPOs and EPSs related to the implementation of response strategies.

The various applicable WCSS used as the basis of design for the BROPEP are based on the same predictive oil spill modelling outputs as described in Section 8.1. However, where Table 8-2 describes thresholds for impact that have been used to define the PEZ and EMBA, the BROPEP has used thresholds appropriate for spill response planning and field/IMT capability assessments. Therefore, all the controls that relate to spill response planning and field/IMT capability elements are described in the suite of BROPEP documents, not in this EP.

9 ENVIRONMENTAL MANAGEMENT IMPLEMENTATION STRATEGY

This section provides a description of the INPEX Australia Business Management System (BMS) which captures the HSE requirements to manage HSE risks and meet legislative and corporate obligations, as applicable to the implementation of this EP and its associated performance outcomes and standards.

9.1 Overview

The BMS is a comprehensive, integrated system that includes standards and procedures necessary for the management of HSE risks. Activities to manage HSE risks are planned, implemented, verified and reviewed under an iterative "plan, do, check, act" (PDCA) cycle. The PDCA cycle enables INPEX to ensure that processes are adequately resourced and managed and that opportunities for improvement are determined and acted on.

INPEX HSE requirements are designed to meet the in-principle expectation of several standards, international management frameworks, guidelines and legislation. Of particular relevance to this EP includes the following:

- Commonwealth of Australia, Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
- National Offshore Petroleum Safety and Environmental Management Authority Guidance note N04750-N1344, Environment plan content requirements
- IOGP 510 Operating Management System Framework for controlling risk and delivering high performance in the oil and gas industry
- IOGP 511 Operating Management System in practice
- International Standards Organisation (ISO) 9001 Quality Management Systems
- ISO 14001 Environmental Management Systems.

The components of the BMS relevant to HSE are grouped into 13 external elements (Figure 9-1). These elements must be managed and implemented properly in order to achieve the desired HSE performance and reflect a PDCA cycle, which is applied to every aspect of the 13 elements.

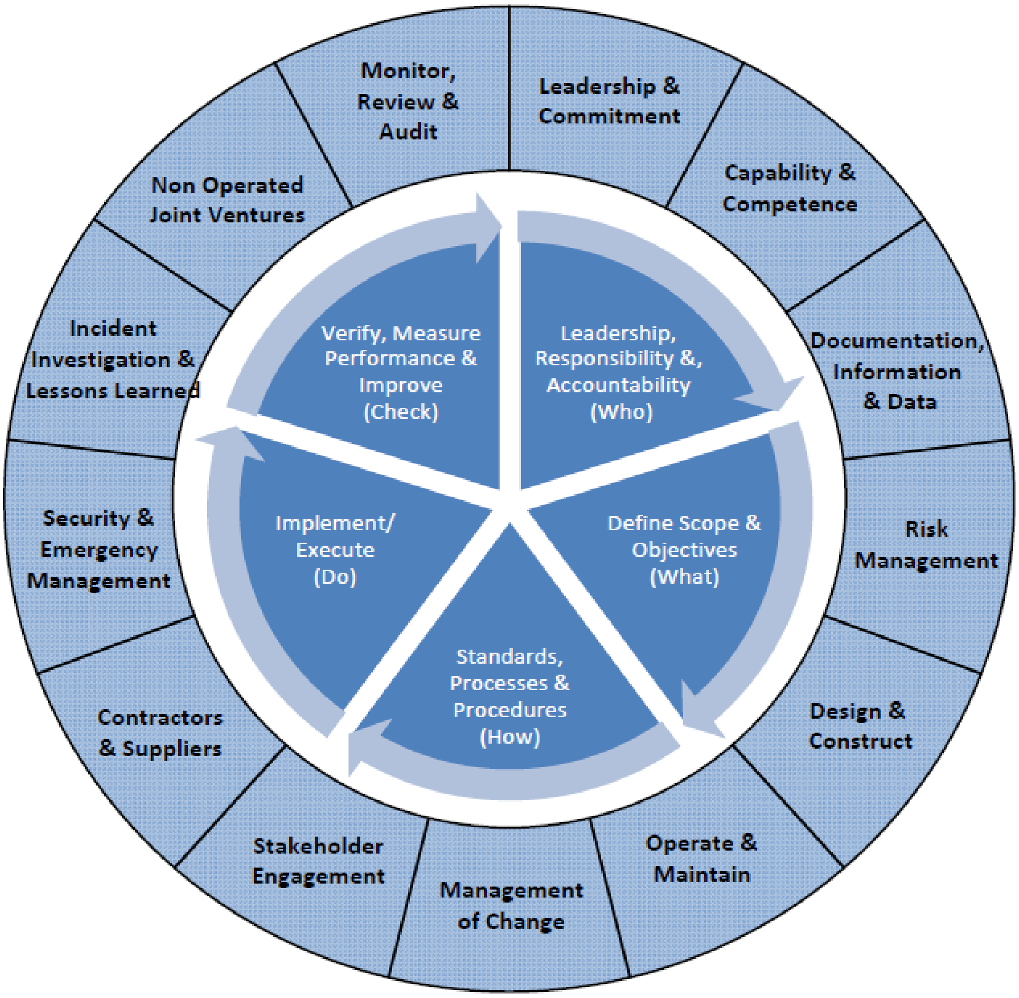


Figure 9-1: INPEX BMS: HSE requirements

9.2 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. Achieving high levels of HSE performance is defined within the highest levels of management system documents (policies) and is cascaded through subsidiary documents.

The INPEX Environmental Policy (as amended from time to time) (Figure 9-2) solidifies this commitment and states the minimum expectations for environmental performance. The policy applies to all INPEX controlled activities in Australia. All personnel, including contractors, are required to comply with the policy.

The policy (as amended) is available on the INPEX intranet and displayed at all INPEX workplaces. It is communicated to personnel involved in the activities, including contractors, through inductions.

INPEX

Environmental Policy

Objective

INPEX is a worldwide oil and gas exploration, development and production company committed to conducting each of its activities in a manner that is environmentally responsible.

Our objective is to develop an environment culture that is recognised as amongst "best in industry" that will exceed the performance expectations of our stakeholders.

We recognise our responsibility to adhere to the principles of sustainable development and we acknowledge that we owe a duty of care to both the natural environment and the communities in which we operate.

Strategy

To accomplish this, INPEX will:

- comply with applicable laws and regulations, environmental plans and commitments and apply appropriate INPEX standards
- maintain a culture where people are empowered to intervene to prevent environmental harm
- set, measure and review environmental performance objectives and targets and ensure appropriate management of change processes are followed
- ensure our personnel have the necessary awareness, training, knowledge, resources and support, to meet environmental objectives and targets
- identify, manage and review environmental hazards and risks associated with our current and future business activities and manage these to levels that are 'as low as reasonably practicable' (ALARP)
- implement, maintain and regularly test control measures associated with major environmental events
- maintain and regularly test emergency management processes and procedures, including with industry and government emergency response partners
- engage with and communicate openly on environmental issues with internal and external stakeholders
- provide clearly defined environmental performance expectations for our contractors and suppliers, and work collaboratively with them to attain these
- endeavour to prevent pollution and seek continual improvement with respect to emissions, discharges, wastes, energy efficiency and resource consumption
- actively promote the reduction of greenhouse gas emissions across our operations in a safe, technically and commercially viable manner
- endeavour to protect biodiversity and to contribute to increased understanding of our natural environment
- drive continual improvement in environmental performance through monitoring, auditing and reviews.

Application

This policy applies to all INPEX controlled activities in Australia and related project locations. It will be displayed at all company workplaces and on the company's intranet and it will be reviewed regularly.

Hitoshi Okawa
President Director, Australia

Rev: 3
April 2019

Figure 9-2: INPEX Environmental Policy

9.3 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 individual competencies established in position descriptions and competency plans that set expectations, track progress and monitor results. It also applies to the overall capability of the organisation through well-defined organisational structures and provision of resources.

9.3.1 Organisation

Responsibility for the offshore assets rests with the Vice-president (VP) Operations who is based onshore, together with a support team. The VP Operations consults the HSE and logistics support teams for all aspects relating to implementation of the BMS HSE requirements in the field.

Offshore responsibility for HSE within the operational area (and the field management area) rests with the field manager. The field manager maintains a functional reporting line to the VP Operations/Offshore Operations General Manager.

The CPF and FPSO each have an OIM and they are supported by a team of people to ensure safe operation. When providing support, the ASV vessel masters report to the OIM of the facility they are attached to.

On entry to the field management area, vessel masters are coordinated via direction from the field manager. Once vessels are within 500 m of a facility, they are directed by the OIM of that facility.

A company representative (offshore or onshore) will be assigned to manage the scope and ensure implementation of INPEX BMS HSE requirements for any contractor vessels required to perform work under this EP.

The proposed organisational structure is shown in Figure 9-3.

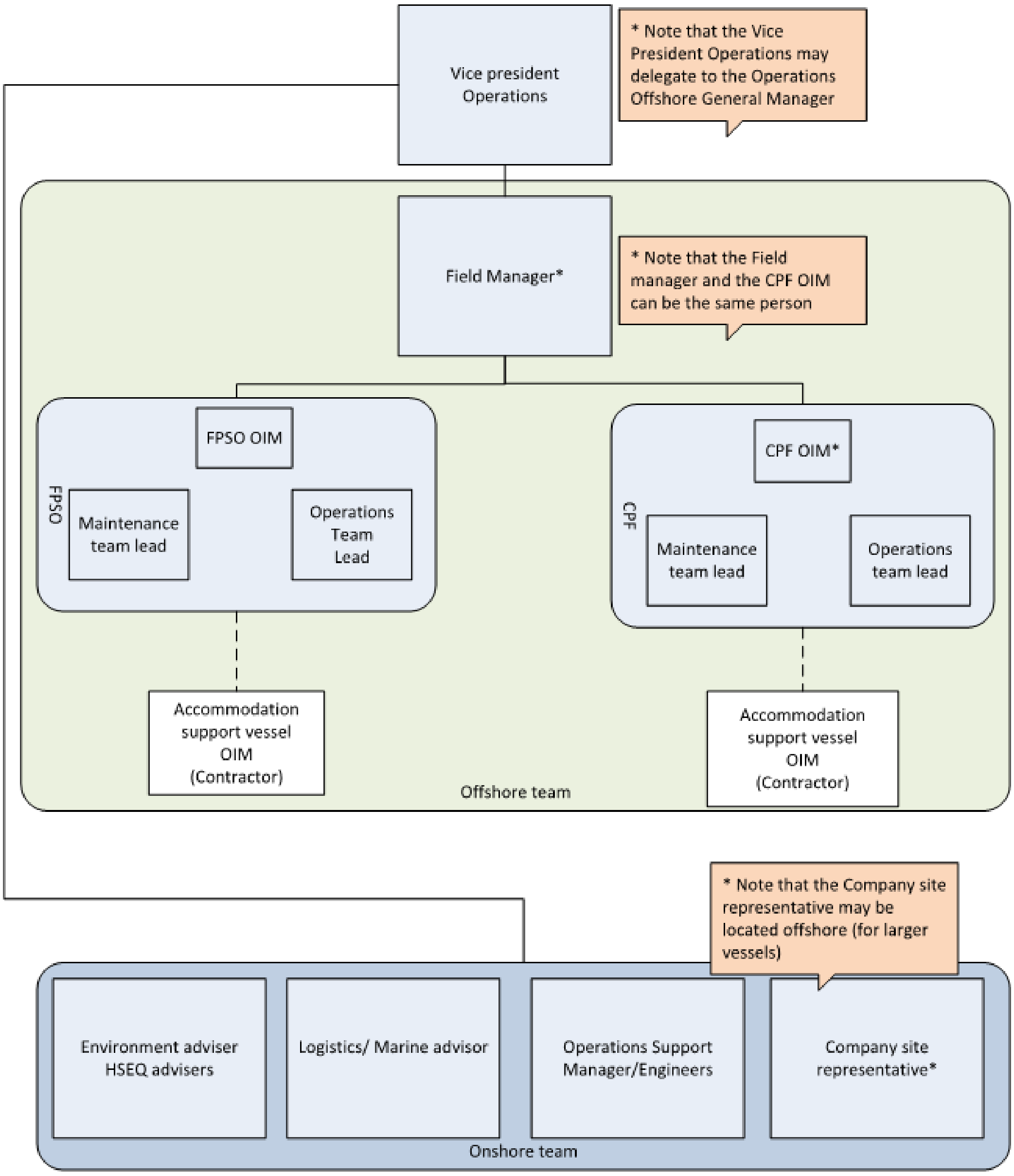


Figure 9-3: Organisational structure

9.3.2 Roles and responsibilities

INPEX has established and implements standards, procedures and systems to build and maintain a trained and competent workforce capable of fulfilling its assigned roles and responsibilities, as well as meeting its legislative and regulatory requirements. The selection process for the key INPEX personnel identified in Table 9-1 includes consideration of their previous work experience and recognised qualifications when compared with the INPEX minimum competency standards. Key personnel are provided with a position description to formalise their role and define their responsibilities.

The key roles in Table 9-1 are responsible for collecting and maintaining the required evidence and monitoring data as specified in the environmental performance standards detailed in sections 7, 8 and 9 of this EP.

INPEX conducts training-needs analysis for each of the key roles listed in Table 9-1 in order to define minimum training requirements. The analysis is used to develop training plans which document, schedule and record completion of specific HSE training for individuals.

Key responsibilities in respect of environmental performance outcomes described in this EP are listed in the tables in sections 7, 8 and 9. Additional roles and responsibilities related to the implementation of HSE requirements are also listed in Table 9-1.

Table 9-1: Key personnel and support roles and responsibilities

Key role	Responsibilities
Vice-president Operations (may delegate to Offshore Operations General Manager or Drilling VP)	Accountable to ensure INPEX BMS HSE requirements are monitored and implemented, and participates in management reviews and as per relevant performance standards stated within this EP.
Field manager	Maintains records of communications between vessels and the INPEX field manager (or delegate) when vessels arrive within the field management area. Ensures that task-specific risk assessments are recorded and maintained for all vessels working close to each other. Ensures compliance with INPEX and regulatory health, safety and environmental requirements for all activities conducted within the field management area. Manages emergency response operations in the event of an incident within the field management area.
Facility OIMs	• Responsible for the day to day safe operation of the CPF/FPSO. • Implements relevant performance standards stated within this EP.
Maintenance team lead	• Implements relevant performance standards stated within this EP.
Operations team lead	• Implements relevant performance standards stated within this EP.

Environmental adviser	• Implements relevant performance standards stated within this EP.
	• Implements the HSE requirements of the BMS, specifically:
	  ◦ ensure events are recorded and reported in accordance with Section 9.11.3
	  ◦ ensure that the contractor selection process is completed in accordance with INPEX standards
	  ◦ audit compliance against the INPEX BMS HSE requirements
	  ◦ participate in review of recordable/reportable events
	  ◦ participate in assessments/management of change.

Logistics/marine adviser and Company representative (contractors)	Supports activities through provision of vessels that comply with the relevant performance standards stated within this EP.

Key role	Responsibilities
Vessel masters/company representatives (contractors)	Implements relevant performance standards stated within this EP.
Support role	Responsibilities
HSE advisers	Implements the HSE requirements of the BMS, specifically: • ensure events are recorded and reported in accordance with Section 9.11.3 • ensures the contractor selection process is completed in accordance with INPEX standards • audits compliance against the INPEX BMS HSE requirements • provides technical support to the environmental adviser • participates in review of recordable events • participates in assessments of change • coordinates environmental approvals for the whole of the Ichthys Project, including other petroleum titles.

9.3.3 Training and inductions

Inductions are conducted for all personnel (including INPEX representatives, contractors, subcontractors and visitors) before they start work at any of the vessels described in this EP. Inductions cover the HSE requirements under the INPEX BMS, including information about the commitments contained in this EP. A summary of the inductions and training programs in place to ensure relevant personnel are aware of their responsibilities under accepted EPs is presented in Table 9-2. In addition, environmental awareness is communicated to all personnel through a number of different mechanisms including environmental alerts, environmental bulletin posts on INPEX intranet site and posters displayed at work locations.

Table 9-2: Induction and training course summary

Induction/training course	Target audience	EP relevant content
INPEX Australia HSE Induction	All new INPEX Australia employees	Overview of INPEX Environment Policy, OPGGS (E) Regulations and requirement to adhere to EP commitments.
Offshore Induction	All new personnel (staff, contractors and visitors) attending the CPF/FPSO	Overview of Offshore Facility EP and GEP EP including: • environmental values and sensitivities • environmental aspects/risk from offshore activities • controls to manage emissions, discharges and wastes • reporting requirements • management measures to avoid harm to marine fauna including EPBC Regulations 2000.

Induction/training course	Target audience	EP relevant content
Offshore Leadership EP/OPEP Awareness Training	All CPF/FPSO senior leadership personnel including OIMs, Superintendents, OTLs and MTLs.	Comprehensive training in the Offshore Facility and GEP Operations EPs, including: • environmental values and sensitivities • environmental aspects/risk from offshore activities • controls associated with managing all emissions, discharges and wastes • management of change • reporting requirements • spill response leadership/command & control requirements from offshore and interface with the INPEX IMT.
Oil Spill Monitoring Training	CPF and FPSO HSE personnel	Overview of the INPEX Oil Spill and Dispersant Application Guide and INPEX Australia Spill Volume Calculator, to enable offshore HSE personnel to accurately report visual estimates of surface oil slicks to the IMT.
INPEX Australia Dispersant Application Training	FPSO HSE, Service Technicians and Aft Storage/Offtake personnel	Overview of the INPEX Oil Spill Observation and Dispersant Application Guide, FPSO AFEDO dispersant spray system and associated AFEDO unit operating procedure and job hazard analysis.
INPEX Australia Browse Basin Environment Plans Support Vessels Induction	All personnel working onboard a support vessel in the Ichthys Field	Overview of the management controls for emissions, discharges and wastes from support vessels (which are consistent throughout INPEX EPs).
INPEX Australia Browse Regional Oil Pollution Emergency Plans Induction	All support vessel ERT personnel working in the Ichthys Field	Overview of the BROPEP requirements related to support vessels (which are consistent throughout INPEX EPs).
INPEX Australia Support Vessels Marine Fauna Awareness Training	All support vessel bridge personnel working in the Ichthys Field	Overview of the marine fauna management requirements (which are consistent throughout INPEX EPs).
INPEX Australia Support Vessel Spill Observation and Dispersant Training	All support vessel personnel, working on a support vessel equipped with dispersant spray capability.	Overview of the INPEX Australia Oil Spill Observation and Dispersant Application Guide, use of the INPEX dispersant stockpile onboard a support vessel, and communication protocols between Support Vessels, Field Manager and the INPEX IMT during any dispersant operations.

Table 9-3: Environmental performance outcome, standards and measurement criteria for induction and training

Environmental performance outcome	Environmental performance standard	Measurement criteria
INPEX personnel including staff, contractors and visitors are aware of their responsibilities under this EP.	The training and awareness material described in Table 9-2 is delivered.	Records that inductions, training and awareness material has been provided.

9.4 Documentation, information and data

INPEX implements and maintains document and records management procedures and systems. These are in place to ensure that the information required to support safe and reliable operations, is current, reliable and available to those who need it. It also ensures that organisational knowledge and learning is captured and preserved to enable the effective operations of processes to maintain compliant management of HSE information.

Documents and records are stored electronically in INPEX document management systems and databases such as Plant Historian (Pi), Energy Components (EC) and Laboratory Information Management System (LIMS). This EP and associated documentation are maintained within a database, with current versions also available via the controlled document repository.

Records to demonstrate implementation of the INPEX BMS HSE requirements and compliance with legislative requirements and other obligations are identified and maintained for at least five years. These records include:

- written reports – including risk assessment reports, hazard and risk registers, monitoring reports, ALARP demonstrations and audit and review reports– about environmental performance or implementation strategies
- records relating to environmental performance or the implementation strategies
- records of environmental emissions and discharges
- management of change records
- incident and/or near miss investigation reports
- lessons learned records
- improvement plans (corrective actions, key performance indicators)
- records relating to training and competency in accordance with this EP.

9.5 Risk management

A robust, structured process is applied by INPEX to identify hazards and ensure that HSE risks arising from assets and operations are systematically identified, assessed, evaluated and controlled to levels as low as reasonably practicable.

The risks and impacts associated with operation and maintenance of the offshore facility are detailed in Section 7 and Section 8. Additional risk assessments are undertaken on an ongoing basis when triggered by any of the following circumstances:

- when there is a proposed change to the design or method of operation and maintenance to the offshore facility, as identified by an INPEX new information assessment or 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.

The risk assessments are carried out in line with the assessment process described in Section 6 and are aligned to the HSE requirements of the INPEX BMS. This ensures that risks related to the operation of the offshore facility are systematically identified, assessed, evaluated and controlled.

An environmental risk register for the petroleum activity is reviewed on a quarterly basis. The review includes assessment of any new information and other changes that have been recorded throughout the previous quarter. Where this review results in a change, the changes are documented and communicated.

9.6 Operate and maintain

9.6.1 Chemical assessment and approval

The purpose of the *INPEX Chemical Assessment and Approval Procedure* is to establish and communicate the process for the assessment and approval of chemicals for use on INPEX sites or facilities. The procedure has been developed to ensure compliance with relevant Australian legislation and to assess chemicals based on toxicity, bioaccumulation and biodegradation potential. By implementing the procedure, exposure to chemicals by personnel and/or the environment resulting from INPEX activities are assessed and controlled. This procedure promotes the use of chemicals that present low health and/or environmental hazard levels.

All operational chemicals discharged into the marine environment must undergo an environmental assessment. The assessment considers the following:

- chemical’s toxicity, bioaccumulation, and biodegradation potentials
- discharge concentration
- frequency of discharge
- maximum credible volume of chemical anticipated to be discharged in 24 hours
- if the chemical is listed on the AICS
- if the chemical contains ozone-depleting substances or synthetic greenhouse gases
- if the chemical or component of the chemical is registered on either the OSPAR priority action or possible concerns lists.

As part of the above assessment, a chemical assessment tool is used (Table 9-4) to determine the chemicals’ inherent environmental hazard potential, which can be determined by considering toxicity in conjunction with bioaccumulation and biodegradation potentials. Chemicals falling within the “Green” range are considered to present a low inherent hazard potential.

Table 9-4: Chemical assessment tool

		Bioaccumulation					
		$LogP_{ow}$[1] <3 or BCF[2] ≤100 and with a molecular weight ≥700			$LogP_{ow}$[1] ≥3 or BCF[2] >100 and with a molecular weight <700		
Toxicity (ppm)		Biodegradation (in 28 days)					
Aquatic	Sediment	≥60%	≥20% to <60%	<20%	≥60%	≥20% to <60%	<20%
<1	<10						
1≤ to <10	10≤ to <100						
10≤ to <100	100≤ to <1000						
100≤ to <1000	1000≤ to <10000						
≥1000	≥10000						

Cells highlighted in green represent chemical characteristics associated with low environmental hazard levels.

1 Octanol–water partition coefficient.

2 Bioconcentration factor.

Category 3 chemicals in the *INPEX Chemical Assessment and Approval Procedure*, are considered to present a low environmental hazard if they meet all of the following criteria:

- they are listed on AICS
- they do not contain ozone-depleting substances or synthetic greenhouse gases for which a license is required
- they are not registered on either the OSPAR priority action or possible concerns lists
- they are in the "green" range (Table 9-4)
- the maximum credible discharge volume is less than 10 m^3 a day.

Chemicals regarded as Category 3 are considered to present inherently low potential environmental harm, and therefore are regarded as ALARP and acceptable and do not require further environmental assessment.

Category 1 chemicals, with regards to liquid effluent discharges, are chemicals which are not listed on the AICS, and therefore cannot be used in Australia. As such, the use of Category 1 chemicals is not permitted by INPEX. Category 1 chemicals are not acceptable but may be ALARP. Should a Category 1 chemical be required, the chemical vendor must have the chemical listed on AICS before INPEX considers its use. Once a Category 1 chemical is listed on AICS, it is reclassified as a Category 2 or 3 depending on its characteristics and maximum daily discharge volumes.

Category 2 chemicals are those which are neither, Category 1 or Category 3 chemicals. Category 2 chemicals are required to undergo an additional environmental assessment to ensure they are ALARP and acceptable. The additional environmental assessment incorporates five criteria:

1. Potential environmental consequence of the discharge:
   - the potential environmental hazard and impact pathways based on the chemical's fate, toxicity, bioaccumulation and biodegradation potential (chemical characteristics provided by the chemical vendor)
   - comparison of the proposed chemical discharge concentration against the Safety Data Sheet (SDS) toxicity value and adjusted NEC to obtain the severity of the potential hazard

- use of the SDS toxicity data and adjusted NEC to predict distances for the chemical to reach threshold dilutions (if not already reached at the point of discharge)

2. Potential likelihood of the negative environmental consequence occurring:
   - Whether the chemical will be spent (i.e. partially/completely used in the process) before discharge, neutralised and or have no potential to reach the marine environment (e.g. does not partition with the water during processing) and the likelihood of the identified environmental consequences being realised.
3. Risk level (using the INPEX risk matrix in Figure 6-1) based on the consequence and likelihood determined above
4. Alternative chemicals:
   - the identification of viable alternative options
   - identification of the reasons why the alternatives were not selected (such as environmental characteristics, fate, volume and concentration of discharges, overall efficacy, practicality of use/storage, compatibility with other chemicals, health and safety risks, and costs)
5. Alternative techniques:
   - identification of other non-chemical (engineering) solutions considered
   - identification of the reasons why other alternative techniques were not selected (such as environmental costs/benefits, practicality of implementation, track record – proven and/or efficient technology, health and safety risks, and costs).

An EPO and EPS related to the implementation of the chemical assessment procedure is presented in Table 9-5.

Table 9-5: Environmental performance outcome, standards and measurement criteria for implementation of chemical assessment and approval procedure

Environmental performance outcome	Environmental performance standard	Measurement criteria
No discharge of unapproved chemicals.	All chemicals assessed in accordance with the procedure.	Chemical assessments recorded and retained in a database.

9.6.2 Liquid effluent management plan

The LEMP has been designed and implemented to monitor for potential contaminants in the liquid effluent streams from the facility (CPF and FPSO). These streams and their discharge points are described in Section 7.1.3.

The framework of the LEMP is summarised here, with the full program detailed in the Offshore Facility Liquid Effluent Management Plan (X060-AH-PLN-60033). An EPO and EPS related to the implementation of the LEMP is presented in Table 9-13. The review and update of the LEMP is detailed in Section 9.12.3 of this EP.

The objectives of the LEMP are to:

1. provide an indicator of potential impacts from liquid effluent discharges to the marine environment
2. confirm, with field-based monitoring of water and sediment quality, that the risk from liquid effluent discharges from the operations of the Ichthys offshore facility is as predicted and acceptable

3. provide a framework to manage risk from liquid effluent discharges to the environment through adaptive management based on an integrated monitoring program so risks are managed to ALARP.

Monitoring design including adaptive management

The LEMP is premised on an adaptive management framework that is integrated so that facility-based monitoring and sampling acts as an indicator to inform potential risks to the receiving environment along the risk to impact continuum (Figure 9-4). This integrated monitoring program is an iterative process to ensure risks are managed to ALARP. The adaptive management process as it relates to the individual monitoring components is illustrated in Figure 9-5.

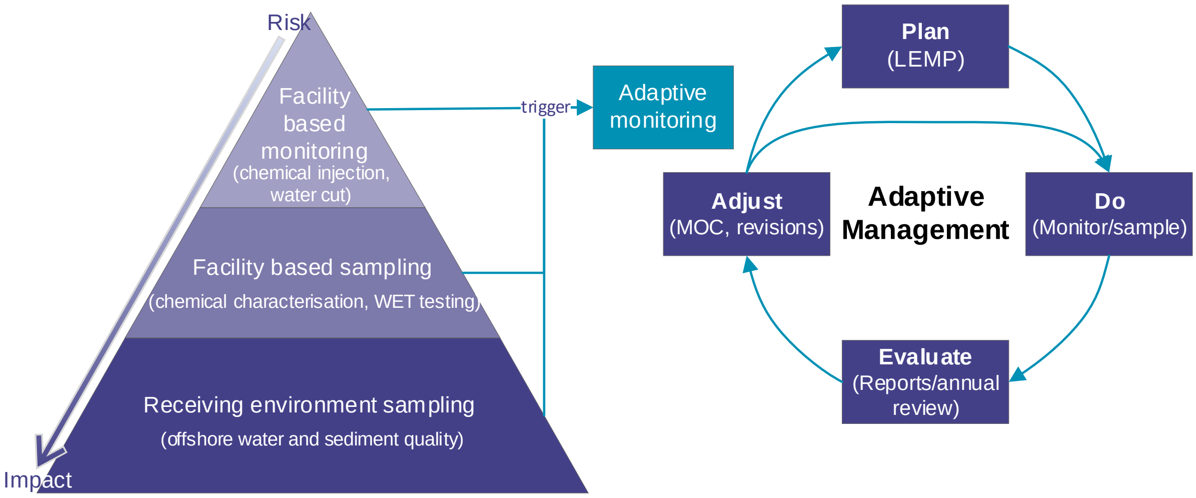


Figure 9-4: LEMP monitoring design

Facility based monitoring and sampling is underpinned by the adaptive management framework which supports additional monitoring and testing, on an as determined basis linked to triggers and the management response hierarchy described below and detailed in Figure 9-5 and Table 9-6. A multiple lines of evidence approach is used to assess and interpret results as recommended in ANZG (2018).

Implementation of the LEMP commenced in 2018, upon first introduction of reservoir hydrocarbons. Since that time, an array of information and data regarding the reservoir constituents and other factors that influence the nature and behaviour of the liquid effluent discharge streams has been collected and analysed. This data has been reviewed and summarised in an annual report (as per Section 9.12.3), which has led to numerous recommendations and updates to ensure the LEMP remains up to date, aligned with the programs objectives and to ensure risks are managed to ALARP. This data has been used to support the impact assessment for liquid effluent discharges presented in this EP.

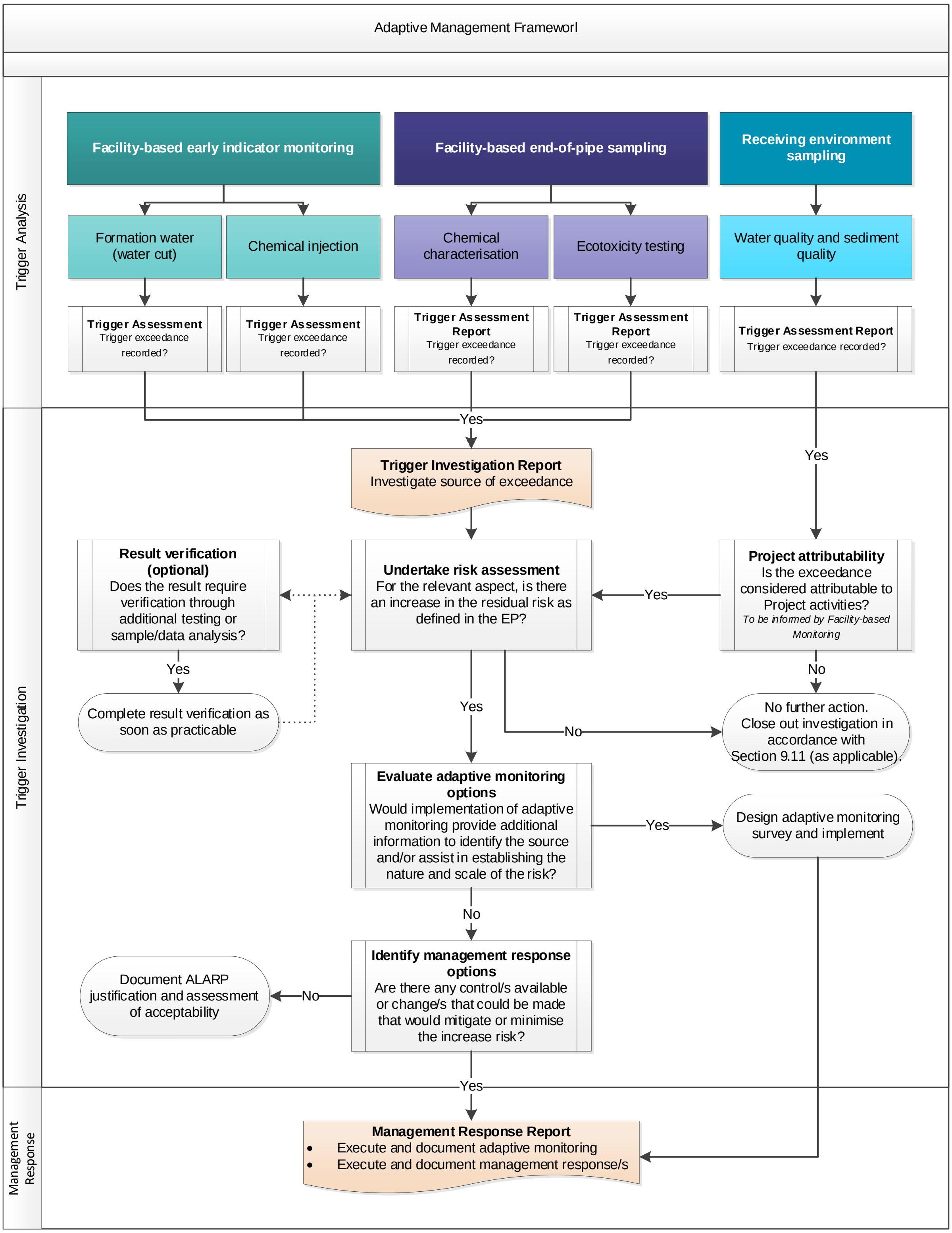


Figure 9-5: Adaptive management framework for liquid effluent monitoring

Triggers

The LEMP utilises triggers to identify changes in monitoring parameters which may indicate a potential risk to the environment. Two types of triggers are included in the LEMP, routine and proactive.

Routine triggers are designed around the planned liquid effluent discharge streams. Routine triggers are exceeded if measured analytes exceed threshold values for particular programs. For example, if chemical characterisation shows that an analyte in the comingled stream has a greater concentration than predicted in Table 7-16, then the management response hierarchy is initiated (see Table 9-6).

As routine triggers are based on the outcome of sampling results, they represent lag indicators. Therefore, management response actions are implemented following collection, analysis and reporting of results (e.g. trigger assessment report). Trigger assessment reports are completed within five (5) business days following receipt of laboratory results to enable sufficient time for trigger assessment.

To allow for earlier management intervention, proactive triggers are also used. These are based on monitoring the risk of parameters relating to the toxicity of the effluent stream (i.e. water cut from the wells and the injection of production chemicals). Sampling is conducted early in the gas production process, which provides for the earliest indication of potential changes to the toxicity of discharges along the cause–effect pathway.

Parameters that are routinely monitored in order to enable environmental performance outcomes (EPOs) and environmental performance standards (EPSs), as detailed in Section 7.1.3 of this EP, to be achieved are not included as triggers in the LEMP. These include the EPSs in relation to the following:

- PW OIW (30 mg/L)
- open drains OIW (15 ppm(v))
- CW inlet concentration of NaClO (3.5 ppm).

The EPS for cumulative impacts from liquid effluent discharges, as outlined in Table 9-13 ensures that any trigger exceedance detailed in the LEMP will initiate the management response hierarchy in accordance with Table 9-6.

Management response

Management actions in response to trigger exceedances are designed to follow a hierarchy as illustrated in Figure 9-5 and detailed in Table 9-6. Triggers will follow a hierarchy of investigations that may lead to further investigation and field studies and ultimately project controls if the exceedance is serious. In the most serious circumstances project controls could be considered as soon as a trigger is exceeded, depending on the nature and the scale of the event.

Table 9-6: Management response hierarchy for trigger exceedances

Deliverables	Description	Timing
Result verification	Optional – result verification Criteria: Does the result require verification through additional testing or sample/data analysis? • If yes: complete result verification as soon as practicable to inform Step 1 and/or Step 2. • If no: move onto Step 1. Example scenario: In the event of an analyte trigger exceedance is there any potential for a type 1 error (false positive) that can be readily substantiated.	If desired, commenced as soon as practicable following receipt of trigger assessment report.
	1.1 Determine the risk of the trigger exceedance to the environment.	

Deliverables	Description	Timing
1. Trigger investigation report	Criteria: For the relevant aspect, is there an increase in the residual risk as defined in the Offshore Facility EP? Note the risk assessment process will follow the requirements set out in Section 9.5 (Risk management) of this EP. • If no: then no further assessment required under the management response hierarchy. Any further investigation will be followed up and recorded in accordance with Section 9.11 (Incident investigation and lessons learned) of this EP. • If uncertain/yes: then continue to Step 1.2. Example scenario: In the event of an analyte trigger exceedance, is the increase in size of mixing zone (based on number of additional dilutions required to meet safe dilution) likely to lead to an increased residual risk.	If triggered, within 20 business days of receipt of trigger assessment report.
	1.2 Evaluate adaptive monitoring options Criteria: Would implementation of adaptive monitoring provide additional information to identify the source and/or assist in establishing the nature and scale of the risk? • If yes: design adaptive monitoring survey, then execute and describe results in Step 2 deliverable. • If no: continue to Step 1.3. Example scenario: In the event of an analyte trigger exceedance that has been verified, targeted testing in various part of the system may be required to assist in identifying the source of contamination.	
	1.3 Identify available management response options Criteria: Are there any control/s available or change/s that could be made that would mitigate or minimise the increased risk, described in Step 1.1? • If yes: list potential management response options for assessment in Step 2. • If no: continue to Step 2 and provide ALARP justification and assessment of acceptability. Example scenario: In the event of an analyte trigger exceedance where the concentration is deemed to be linked to dosage rates, potential control/s or changes include review and adjust chemical dosage rates, review and adjust chemical discharge frequency or chemical substitution.	
2. Management response report	2.0 Implement management response Criteria: Complete assessment, execute and document adaptive monitoring identified in Step 1.2 and/or management response options identified in Step 1.3. Termination: The management response is considered to be completed when the relevant trigger is no longer exceeded and/or the control/action implemented has been confirmed as effective. Adaptive monitoring Execute and document results for any adaptive monitoring surveys described in Step 1.2 and state how the outcomes were used to inform the assessment. Assessment of control proposed	If initiated, within 40 business days of receipt of pertinent information identified in the trigger investigation report.

Deliverables	Description	Timing
	From the list of possible controls presented in Step 1.3, identify the most suitable control/s, including ALARP assessment. Where no control/s are available provide ALARP justification and assessment of acceptability. The preferred approach will be to first enhance current controls as described in Section 7.1.3 and then assess requirements for further controls. The criteria upon which the selection of specific project controls and actions will include the balanced consideration of a number of elements to ensure impacts are managed to ALARP and acceptable levels. Effectiveness of control/s implemented Review and document the effectiveness of the control/s implemented or change made to mitigate or minimise the risk.	

Facility-based programs

Facility-based programs are integral to the LEMP as they describe the potential risk of the discharge stream before it enters the receiving environment. Understanding the nature of the discharge allows for cause-and-effect relationships to be investigated if impacts are observed in the receiving environment.

The facility-based programs consist of the following:

- Early indicators of risk:
  - formation water (water cut) monitoring
  - chemical injection monitoring
- End of pipe sampling:
  - chemical characterisation
  - whole effluent toxicity (WET) testing.

Early indicators of risk

Facility-based monitoring on the FPSO and CPF is routinely conducted early in the gas production process and targeted, to assess whether changing conditions may increase the potential for environmental harm. This may be related to either a change in the reservoir formation water production and/or changes in chemical injection and dosing, in response to gas processing demands. Measurements are taken regularly to track plant operations and thus risk monitoring is embedded within INPEX systems and operating procedures.

Formation water (water cut)

There are primarily two types of produced water[4], condensed water which is pure water (water from water vapour) and formation water which is saline water from the underlying aquifer. Formation water monitoring is included to identify when formation water (free) is detected. This is because only formation water is expected to contain increased levels of salinity, total dissolved solids and contaminants (e.g. NORMS, metals etc.) (Neff et al. 2011) that may contribute to the overall toxicity of the produced water discharge stream. Therefore, an increase in formation water not only reflects a greater risk from the produced water in terms of volume, but also greater risk in toxicity. However, water vapour produced along with the hydrocarbon gas is the condensed water, which is a pure form of water having salinities less than 1,000 ppm and is non-toxic. The volume of condensed water is linked to the volume of gas produced and does not have contaminant issues or create any issues with environmental harm.

The Brewster formation is considered to be a depletion drive reservoir, formation water (free) is therefore unlikely to be produced from the Brewster reservoir. The maximum quantity of produced water is expected to occur with the switch to the Plover reservoir. This has been reflected in monitoring with low water-gas ratios (WGRs) measured for the Brewster reservoir to date. Further, chemical characterisation sampling of the produced water stream has reported salinity and most metal and metalloid concentrations below laboratory limits of reporting, indicating produced water to date is likely to be condensed water.

The formation water (water cut) framework is summarised in Table 9-7.

Table 9-7: Formation water (water cut) framework

Aspect	Description
Program	Water cut
Monitoring frequency	Measured/calculated continuously via online meters and recorded in plant historian. Reviewed and trended monthly.
Sampling location	Online instrumentation (e.g. wet gas flow meters) used to determine WGR.
Parameters	Water cut (amount of formation water in the system).
Trigger	Significant and sustained rise in individual well WGR.
Term	For the life of the EP.

[4] It is noted that mud filtrate may also contribute to produced water. Mud filtrate are mud losses from the drilling of the well (which are eventually removed after continuous production of the well)

Chemical injection

Production chemicals are required to maintain the integrity and the efficient operation of the CPF, FPSO and the subsea production system. Production chemicals are dosed into the required process streams neat or diluted. For the most part, the dosing of production chemicals is done via a dedicated pump system for each chemical. Each pump system has two 100% duty/standby chemical specific dedicated pumps. Ad-hoc chemical dosing can also be undertaken manually, if required. Many of the chemicals are added specifically to remove components from the process waters and will be spent (e.g. scavengers), neutralised and decomposed with their risk to the environment decreasing at discharge.

Chemical injection rates are measured as they are dosed into the system and records retained in a database (Section 9.4). To date all chemicals have been injected as required with the exception of TEG corrosion inhibitor, which has been removed from the CPF as it is not required. Since start-up, no chemicals have required continuous injection into produced fluids, and instead have only required intermittent use.

The chemical injection framework is summarised in Table 9-8.

Table 9-8: Chemical injection analysis framework

Aspect	Description
Program	Chemical injection.
Monitoring frequency	Measured/calculated daily via online meters and recorded in Energy Component (EC) software. Reviewed monthly.
Sampling location	Online database.
Parameters	All production chemicals
Trigger	Increase in production chemical maximum “end-of-pipe” discharge concentration as outlined in Table 7-16.
Term	For the life of the EP.

End-of-pipe monitoring

Obtaining representative samples of the liquid effluent discharge streams, as they leave the facility (CPF and FPSO) provide the greatest level of certainty with respect to sampling for potential additive or synergistic effects between the different effluent streams. However, obtaining a representative sample directly from the FPSO moonpool or within discharge caissons on the CPF is not practicable. This is because obtaining samples for testing from confined spaces with limited accessibility and high velocity discharge streams presents health and safety risks to personnel and potential for damage to sampling equipment. Additionally, based on the continuous and intermittent nature of the streams, obtaining a representative sample is not possible or repeatable due to a high level of variability based on flow rates (i.e. continuous and intermittent flows).

In order to obtain repeatable, representative liquid effluent discharge samples for testing, samples will be collected of the liquid effluent streams leaving the CPF and FPSO before they commingle/combine and enter the marine environment via the moon pool (FPSO) or discharge caissons (CPF). The three discharge points are:

- streams entering the FPSO moon pool (i.e. PW, CW, ballast, open drains, gas scrubbing water and degasser fluid)
- streams entering the CPF seawater dump caisson (i.e. CW, ballast and brine)
- streams entering the CPF open drains caisson (i.e. open drains).

Representative samples of the CPF and FPSO streams (described in Table 7-9 and Table 7-15 respectively) will be characterised to determine concentrations of individual analytes and production chemicals. A representative composite sample for ecotoxicity testing of each of the three discharge points will also be mixed in a laboratory in the correct ratio to accurately represent and reflect the combined discharges.

Chemical characterisation

Chemical characterisation of the liquid effluent discharge streams verifies discharges are as expected and provides information about the composition of the streams so that any changing conditions can be identified. While contaminants from all streams are expected to be minimal, the chemical characterisation of the discharge will test for all contaminants that may be present. Most importantly those that are most likely to be toxic in the marine environment in high concentrations (i.e. hydrocarbons and metals in PW (Neff et al. 2011)), as well as production chemicals expected to be present in the discharge streams.

Results from the first three years of operations were as expected. Minimal contaminants were reported in the PW stream and the FPSO representative sample as a whole. The only reported trigger exceedances for the FPSO (diesel biocide and process biocide (THPS-based)) were investigated and considered to be false-positive trigger exceedances based on multiple lines of evidence.

Similarly, low levels of contaminants were reported for the CPF seawater dump caisson and open drains caisson. The only exceptions for the CPF were copper in the seawater dump caisson, and diesel biocide in the open drains caisson. Elevated levels of copper were routinely reported in the seawater dump caisson due to the corrosion of the coarse seawater filters, which are a copper nickel alloy. While the single diesel biocide trigger exceedance was considered to be a false-positive based on multiple lines of evidence.

The chemical characterisation framework is summarised in Table 9-9.

Table 9-9: Chemical characterisation framework

Aspect	Description
Program	Chemical characterisation
Monitoring frequency	• Routine - annually; and • When determined, through management response (Table 9-6) and in accordance with Section 9.12.3.
Sampling location	• Laboratory analysis of end-of-pipe samples representing all of the effluent discharge streams, namely: o streams entering the FPSO moon pool (PW, CW, ballast, open drains, gas scrubbing water and degasser fluid) o streams entering the CPF seawater dump caisson (CW, ballast, brine) o streams entering the CPF open drains caisson (open drains).

Aspect	Description	
Parameters	Analytes: • pH • electrical conductivity • total suspended solids (TSS) • total organic carbon (TOC) • nutrients • heavy metals • speciated phenols • total recoverable hydrocarbons (TRH) • benzene, toluene, ethyl benzene, xylene (BTEX) • polycyclic aromatic hydrocarbons (PAH).	Production chemicals: • MEG • TEG • oxygen scavenger • scale inhibitors • TEG pH control • TEG antifoam • diesel biocide • process biocide (glutaraldehyde-based) • process biocide (THPS-based) • H_2S scavenger • citric acid (50 wt.%) • sodium carbonate (20 wt.%) • chlorine scavenger • HCl (5 wt.%) • NaClO • Sodium metabisulfite • Anti-scale.
Trigger	Chemical composition of the waste discharge streams indicates there is a potential increase in its toxicity. An increase in the toxicity of the discharge stream is defined as having one or more of the analyte or production chemical concentrations above in-pipe discharge concentrations as listed in Table 7-16 that may exceed safe dilution requirements at the edge of the mixing zone. Safe dilution is defined as meeting: • the 99% species protection guidelines as outlined in ANZG (2018) and background levels • OR • adjusted NECs (for production chemicals).	
Term	For the life of the EP.	

Whole effluent toxicity testing

Chemical characterisation is complimented by whole effluent toxicity (WET) testing, which provides an indicative toxicity value for the discharge streams from the FPSO and CPF. Results can be used to verify that the safe dilutions predicted in Table 7-28 are being reached within the modelled mixing zone.

Results from the first three years of operations (i.e. six sampling events) indicated safe dilutions (i.e. 99% species protection) were typically being reached within the modelled mixing zones. On the CPF, safe dilutions were reported for the open drains caisson in all samples, while the seawater dump caisson reported consistent dilution requirements with the exception of one sample. Seawater dump caisson dilution requirements increased by 20 times in one sample, resulting in a trigger exceedance. Investigation into this trigger exceedance identified that inclusion of a new species in the WET testing was the primary driver. This was also coupled with a low reliability species sensitivity distribution (SSD) outcome and large toxicity data range, which cause uncertainty and lead to conservatism when generating an SSD. Review of chemical characterisation data also showed that there had been little to no change between surveys. Based on multiple lines of evidence the trigger exceedance was not considered a true exceedance (i.e. there was not a true increase in toxicity resulting in safe dilutions not being met at the edge of the modelled mixing zone). WET testing results for the FPSO showed some variability between sampling events with increased toxicity in sampling events 2 and 3. Investigation into both results using multiple lines of evidence could not identify drivers of increased toxicity and residual risk assessment showed no change in risk rating in accordance with management response hierarchy (see Table 9-6).

Sampling to date has shown that WET testing results should be interpreted with a level of caution and collected in parallel with other data (i.e. chemical characterisation). Toxicity results for 99% species protection also have a large degree of uncertainty and associated conservatism, as outputs are from the extremes of the modelled SSD. It is also important to minimise variability between sampling events (e.g. change in test species), as this can cause false-positive or perceived increases in toxicity.

The WET testing framework is summarised in Table 9-10.

Table 9-10: Ecotoxicity testing framework

Aspect	Description
Program	WET testing
Monitoring frequency	• Routine - annually; and • When determined, through management response (Table 9-6) and in accordance with 9.12.3. • On the FPSO within three months of a new reservoir being brought online WET testing and chemical characterisation samples will be collected at the same time to maximise comparisons.
Sampling location	• Laboratory analysis of end-of-pipe samples representing all of the effluent discharge streams, namely: o streams entering the FPSO moon pool (PW, CW ballast, open drains and gas scrubbing water) o streams entering the CPF seawater dump caisson (CW, ballast, brine) o streams entering the CPF open drains caisson (open drains).
Parameters	A number of lethal and sublethal tests will be undertaken on a range of marine organisms covering at least five species from four different taxonomic groups as per ANZG (2018) recommendations.
Trigger	Ecotoxicity testing shows that the comingled stream has a greater toxicity than predicted.

Aspect	Description
	For example, WET testing dilution requirements is greater than modelled mixing zone dilutions as shown in Table 7-28).
Term	For the life of the EP.

Receiving environment monitoring

Receiving environment monitoring of water and sediment quality is designed to monitor for potential short- (i.e. water) and long-term (i.e. sediment) impacts in the marine environment from facility liquid effluent discharges. If triggers are exceeded, this represents the potential for environmental harm further down the cause and effect pathway, so receiving environment monitoring may default directly to project controls, depending on the potential for environmental harm as determined through the management response hierarchy (Figure 9-5 and Table 9-6).

Water and sediment samples are to be collected once during the life of this EP. This frequency is considered appropriate because of the leading, and end of pipe indicators in place through implementation of routine facility-based monitoring and sampling that supports this entire LEMP. This enables management responses to be implemented prior to environmental harm or impact occurring.

Water quality

Water quality monitoring is proposed to measure any potential short-term changes in the receiving environment from exposure to the liquid effluent streams.

Samples will be collected at multiple depths along a gradient from the point of discharge, taking into consideration the prevailing hydrodynamics as well as sites perpendicular to the prevailing hydrodynamics. Gradient design for the PW monitoring program is described in Holdway & Heggie (2000), where sampling is more concentrated closer to the plume where the greatest exposure to higher concentrations of the contaminant occurs. This sampling design was completed in 2019 and included the establishment of fixed sites, along and perpendicular to, the prevailing hydrodynamics for long-term monitoring. Graduated mobile sites were also sampled in proximity (e.g. 50 m) and downstream of the CPF and FPSO based on hydrodynamics at the time of sampling. No discernible changes to water quality were reported at either fixed or mobile sites in 2019, providing a reference point for future comparison.

Results will be compared to benchmark levels outside of the mixing zone. Benchmarks include water quality guidelines values as provided in ANZG (2018), published literature, and/or other reference material, where applicable, in addition to available background data (i.e. baseline and previous surveys).

Table 9-11: Water quality monitoring framework

Aspect	Description
Program	Water quality including ecotoxicity.
Monitoring frequency	• Routine - once in every five (5) year period. • Adaptive monitoring when determined, through management response (Table 9-6) and in accordance with Section 9.12.3.

Aspect	Description
Sampling location	Laboratory analysis of water samples collected in the receiving environment following a gradient design (dose/response) from the discharge point.
Parameters	As per chemical characterisation (see Table 9-9).
Trigger	Any measured analyte or production chemical exceeds safe dilution at the edge of the predicted mixing zone. Safe dilution is defined as meeting: • the 99% species protection guidelines as outlined in ANZG 2018), and background levels; • OR • adjusted NECs (for production chemicals). Water quality results will be assessed in context of the facility-based monitoring. A management action is only triggered when the trigger exceedance is found to be attributable to operations activities.
Term	For the life of the EP.

Sediment quality

Sediment sampling is proposed to monitor the potential for particulates, including PW precipitates or other particulates formed by flocculation or oxidation reactions upon discharge, to settle and accumulate on the seabed. Regular in-pipe monitoring of OIW and chemical characterisation will inform the likely nature of any PW constituents and their potential to precipitate and accumulate on the seabed (i.e. attributable to the petroleum activity).

Sediment samples will be collected at fixed sites established as part of the 2019 survey as described in the above water quality program. To maximise comparison and provide multiple lines of evidence, water and sediment samples are collected from the same locations. Similar to the water quality program, no discernible changes to sediment quality were reported in 2019, providing a reference point for future comparison.

Results will be compared to benchmark levels outside of the modelled mixing zone. Benchmarks include sediment quality guidelines values as provided in ANZG (2018), published literature, and/or other reference material, where applicable, in addition to available background data (i.e. baseline and previous surveys).

Table 9-12: Sediment quality monitoring framework

Aspect	Description
Program	Sediment quality
Monitoring frequency	• Routine – once in every five (5) year period. • Adaptive monitoring as determined, through management response (Table 9-6) and in accordance with Section 9.12.3.
Sampling location	Laboratory analysis of sediment samples collected in the receiving environment following a gradient design (dose/response) from the discharge point out to 10 km from the FPSO discharge point. Sampling sites were established in 2019 based on the aforementioned will be resampled in future sampling events.

Aspect	Description
Parameters	As per chemical characterisation (see Table 9-9) with the exception of pH, electrical conductivity and TSS. Particle size distribution and NORMS will also be included in analysis.
Trigger	When any measured analytes exceeds benchmark levels. An exceedance of a benchmark level occurs when: • a measured analyte exceeds a sediment quality guideline values described in ANZG (2018) AND • a measured analyte exceeds background levels. Sediment quality results will be assessed in context of the facility-based monitoring. A management action is only triggered when the exceedance is found to be attributable to Project activities.
Term	For the life of the EP.

Adaptive monitoring

As shown in Figure 9-4, routine monitoring will be supplemented with adaptive monitoring in the event that any of the identified triggers are exceeded. Adaptive monitoring will be implemented following the management response hierarchy described in Table 9-6. Adaptive monitoring will continue throughout the management response to confirm that any project controls have been successfully implemented in order to enable EPSs to be met Table 9-13.

Table 9-13: Environmental performance outcome, standards and measurement criteria for implementation of the LEMP

Environmental performance outcome	Environmental performance standard	Measurement criteria
No impact to identified values and sensitivities from planned liquid discharges outside the predicted CPF and FPSO mixing zone.	Within the LEMP, facility-based monitoring (which includes taking representative samples from the facility discharge streams) predicts that no analyte or production chemical will exceed safe dilution at the edge of the predicted mixing zone. Safe dilution is defined as meeting: • the 99% species protection guidelines as outlined in ANZG (2018) and background levels; OR • adjusted NECS (for production chemicals); OR • overall stream dilution at the edge of the mixing zone, as determined through WET testing.	Results of chemical characterisation and WET testing will be used to estimate the safe dilution for the discharge. This concentration will be related back to the modelling results to determine the potential mixing zone size for the comingled discharge and confirms that safe dilution is not being exceeded more than 5% of the time.

Environmental performance outcome	Environmental performance standard	Measurement criteria
	Within the LEMP, water quality monitoring in the receiving environment confirms edge of mixing zone meets benchmark levels (i.e. as provided in ANZG (2018), published literature, and/or other reference material, where applicable, in addition to available background data).	Records of water quality monitoring can be related back to the modelling to confirm that water quality benchmark levels are reached at the edge of the mixing zone.
	Within the LEMP, sediment quality monitoring in the receiving environment confirms edge of mixing zone meets benchmark levels (i.e. as provided in ANZG (2018), published literature and/or other reference material where applicable, in addition to available background data).	Records of sediment quality monitoring confirm that sediment quality benchmark levels are reached at the edge of the mixing zone.
	Any exceedance of triggers detailed in the LEMP will initiate the management response (that includes adaptive monitoring) hierarchy in accordance with Table 9-6.	Records from the implementation of the management response hierarchy in accordance with Table 9-6.

9.6.3 Air emissions management program

Corporate GHG governance and targets

Climate change, and appropriate action with regard to long-term decarbonisation, is a key global challenge. INPEX recognises that a global response to climate change requires action by all members of the international community, governments, businesses and civil society. At a corporate level, INPEX is committed to fulfilling its role in addressing climate change as a responsible member of the oil and gas industry.

INPEX Corporation has an ongoing program to assess climate change risk as part of strategic efforts to respond to climate change (Figure 9-6). As with many corporate climate strategy programs, ultimate accountability for climate change strategy sits with the Board of Directors, with specific responsibility for development and execution of climate change strategy being held by the Climate Change Strategy Group – within the Corporate Strategy and Planning Unit.

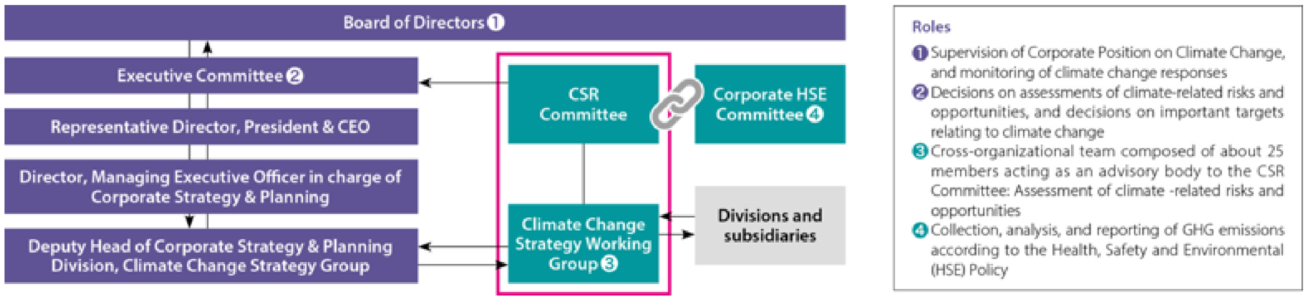


Figure 9-6: Climate change governance at INPEX Corporation

INPEX Australia participates in this process via the Climate Change Strategy Working Group (CCSWG) – in addition to providing detail on GHG emissions via monthly reporting to the Corporate HSE Committee.

The CCSWG has an annual process of analysing and responding to the risks of climate change (primarily transition risk but physical risks are also examined) that informs annual action plans regarding climate change. As per the framework developed by the Taskforce on Climate Related Financial Disclosure, the risk assessment process considers transition risks in the following areas:

- Policy risk – risks associated with acceleration in climate and decarbonisation policy in the areas where INPEX operates that may involve an implicit or explicit cost on carbon
- Reputational risk – risks associated with social license to operate that may be realised as a result of the company's direct and indirect emissions
- Technology risk – risks associated with new technologies being developed that could reduce future demand for INPEX's products
- Market risk – risks associated with decreasing market share long-term as global decarbonisation proceeds
- Legal – risks associated with legal action arising from climate change
- Finance – risks associated with an inability to access debt or equity when required as a result of the company's direct and indirect emissions.

This process is also the basis for the emissions reduction targets that apply company wide – with specific targets at 2030 and 2050.

Figure 9-7 summarises the process used as the framework by which corporate emissions reduction targets have been set for the company.

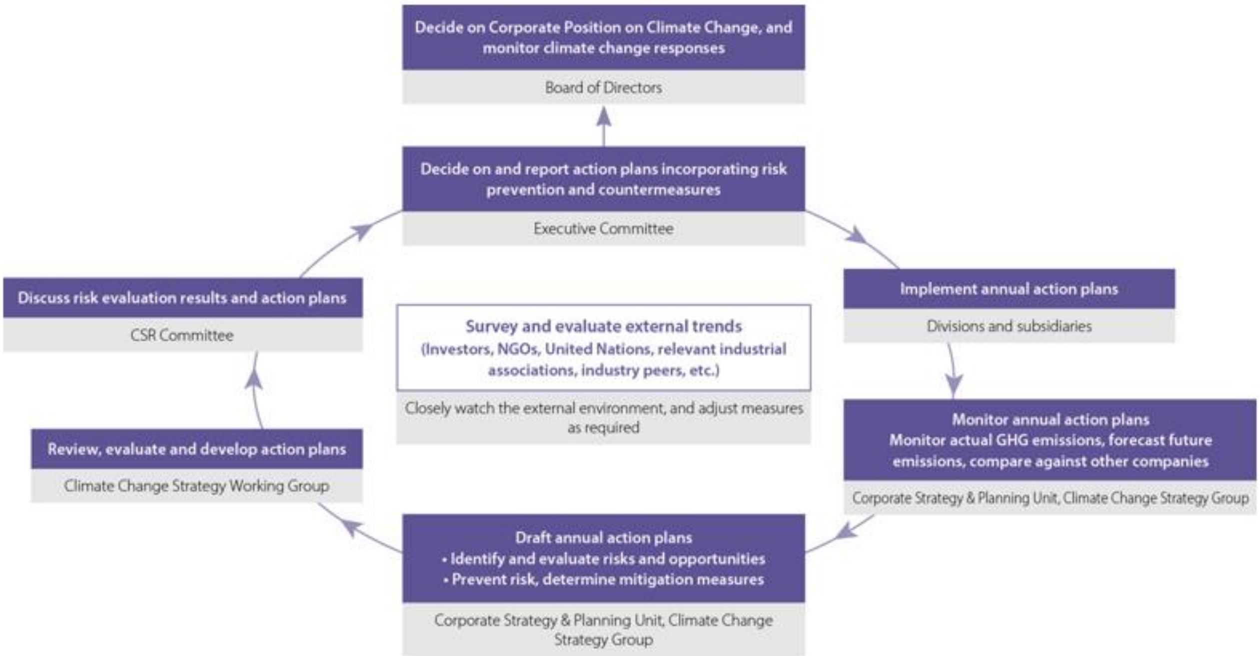


Figure 9-7: INPEX Corporation emission reduction framework

The corporate emissions reduction framework detailed in Figure 9-7 generates an action plan that is managed at INPEX Corporation level but filters through the entire organisation – including INPEX Australia. The boundaries and scope of the assessment and action plan include all INPEX operations globally.

Outcomes from the development of the action plan are discussed and developed by the Climate Change Strategy Working Group (of which INPEX Australia is a participant). The Working Group screens all potential actions and applies a decision-making process to finalise the action plan. The action plan is then submitted to the executive committee for approval and the board for endorsement. This decision-making process takes into account the company's exposure the climate risk, the costs of implementing actions, the benefits of those actions on climate risk and how they support overall decarbonisation efforts in the company. INPEX Australia targets are a reflection of these corporate level targets. INPEX Australia also, being the largest contributor to corporate emissions, will play a significant role in the achievement of these targets – and has the same target set.

Although ultimate responsibility for achieving the action plan sits with INPEX Corporation, the different business units in the company, including INPEX Australia, have a responsibility for supporting the achievement of the goals.

Corporate goals for INPEX Corporation are:

- 30% (or greater) reduction in Scope 1 and 2 emissions[5] intensity by 2030 – compared to 2019 intensity
- achieve net zero emissions on an absolute basis for INPEX Corporation's equity share emissions footprint by 2050
- work with stakeholders to reduce emissions across the company's entire value chain.

In addition, INPEX Corporation has set supporting targets to maintain the current methane emissions intensity of approximately 0.1% of total gas sold and to eliminate routine flaring by 2030 in INPEX operated projects. There are no Scope 2 emissions associated with the petroleum activity in WA-50-L.

National and global decarbonisation efforts

As previously mentioned, INPEX Corporation has an ongoing program to monitor and manage climate change risk. This incorporates ongoing analysis of policy frameworks governing climate change and decarbonisation in countries in which the company operates, as well as countries and customers to whom the company exports products. One key purpose of the company analysing climate change risk is to inform ongoing business strategy and ultimately minimise risk exposure. INPEX Corporation has a documented action plan that consists of actively monitoring carbon policy frameworks in the countries where the company operates. Supplementing this, INPEX has an internal carbon price of \$40 USD/t CO_2-e applied to decision making. As part of this process, emissions reduction targets are also set for the company as detailed above.

It is recognised that countries, including Australia are increasingly setting net zero emissions targets. Over 130 countries have currently indicated long-term net zero targets later in this century. With respect to Australia's net zero aspirations by 2050, this is completely aligned with INPEX Corporation's target for net zero emissions by 2050. INPEX's operations will follow an overall decarbonisation pathway that is aligned with the 30% reduction in intensity by 2030 and continue that path to achieve net zero emissions by 2050.

With respect to the decarbonisation efforts of countries and companies that INPEX sells product to, this is a key consideration of the INPEX CCSWG Group. The results of this process are summarised in INPEX's corporate climate change response[6].

INPEX Corporation, via the program for monitoring climate change risk sets targets and identifies opportunities to minimise exposure to climate change risk. These are managed by the corporate group in Japan though INPEX Australia does contribute to the process. INPEX Australia is also held to the achievement of these overall corporate goals. The climate risk management process has identified a number of areas where value chain emissions are the focus and organisational goals have been set accordingly.

As part of INPEX Corporation's climate change commitments, the company will work with relevant stakeholders across its value chain to address challenges relating to climate change. The overall aim of this is to reduce Scope 3 emissions over time. Underneath this overall commitment are specific goals and opportunities in the following areas:

- Build on trades of carbon-neutral cargoes of LNG (and other products such as condensate and LPG) and work to scale these up in the future. These cargoes offset the GHG emissions across the entire process from production to consumption.

[5] Scope 1 GHG emissions are the emissions released to the atmosphere as a direct result of an activity, or a series of activities at a facility level. Scope 2 GHG emissions are the indirect emissions from the consumption of purchased energy. Scope 3 emissions are indirect GHG emissions other than scope 2 emissions that are generated in the wider community.

[6] https://www.inpex.co.jp/english/csr/climatechange/

- Work with contractors and suppliers to support emissions reduction efforts across the supply chain.
- Consideration of portfolio diversification into renewable energy, clean hydrogen and ammonia and carbon recycling – providing cleaner energy for use by INPEX customers.

An EPO and EPSs for the management of indirect and direct GHG emissions is presented in Table 9-14.

Table 9-14: Environmental performance outcome, standards and measurement criteria for the management of indirect and direct emissions

Environmental performance outcome	Environmental performance standard	Measurement criteria
Achieve INPEX's corporate goal of net zero direct GHG emissions by 2050	Ichthys supply forecast of GHG emissions and production to INPEX corporation CCSWG on an annual basis	Annual emissions forecasts records
	INPEX Australia to contribute to the decision-making process on annual INPEX corporate targets and climate change action plan by participating in the annual climate change risk workshop	Workshop records
	The outcomes of the CCSWG action plan are adopted as the INPEX Australia annual direct GHG emissions targets	Action plan and INPEX Australia annual direct GHG emissions targets
	INPEX Australia implements the air emissions management program (Table 9-18, Table 9-20, Table 9-21, Table 9-22 and Table 9-23) in order to achieve the annual targets	Measurement criteria as per Table 9-18, Table 9-20, Table 9-21, Table 9-22 and Table 9-23
Reduce contractor and supplier emissions across the supply chain	INPEX Australia will provide GHG emissions allocation for any particular product cargo for sale by INPEX Corporation, to enable trade of carbon-neutral cargoes	Records of GHG emissions allocation data for cargo sold by INPEX Corporation
	INPEX Australia will work with contractors and suppliers to establish a baseline position and undertake annual reviews opportunities that when implemented will reduce emissions	Contractor emissions reduction program

INPEX Australia

INPEX Australia, and the Ichthys Project, are currently the largest contributors to INPEX Corporation's overall emissions. As such, the actions of INPEX Australia will have a significant impact on INPEX Corporation's ability to meet these corporate targets. From a compliance point of view, INPEX Australia will continue to abide by the legal requirements set out in the *National Greenhouse and Energy Reporting* (NGER) *Act* – and supporting regulations – including the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule.

The NGER Act provides a single, national framework for reporting and disclosure of information relating to GHG emissions and energy consumption in Australia. INPEX has an obligation to report emissions to the Clean Energy Regulator under the NGER Act as a result of having emissions above both the facility and corporate thresholds under the NGER Act. INPEX is required to have the systems and processes in place to measure key production parameters that are then used to estimate GHG emissions and report those in the annual NGER report. INPEX also completes external third-party assurance of the NGER report prior to submission to the Clean Energy Regulator.

The Safeguard Mechanism provides a framework for large emitters in Australia (greater than 100,000 t CO_2-e/a) to manage their emissions. This is done through requiring large emitters to have an emissions baseline set for their facilities. For the purposes of NGER reporting and the Safeguard Mechanism, the Ichthys Project is considered to be a single facility comprising offshore and onshore plant and equipment.

The baseline number is determined by developing both a production and an emissions forecast for the facility. The baseline is set using the forecast emissions intensity for the year of highest production during the calculated baseline period. Ichthys is permitted to use a calculated emissions intensity for this purpose. The calculation of the relevant emissions intensities for the different production variables in use for the operation is completed using industry standard practice for forecasting of production and emissions and following INPEX internal processes for these forecasts. Prior to being set, the baseline, calculations, processes, governance and the basis of preparation for the data undergoes external third-party assurance and is reviewed by the Clean Energy Regulator.

If emissions for a facility are in excess of the baseline that is set, companies must procure and surrender Australian Carbon Credit Units (ACCUs) to reduce the emissions number for the facility to the level of the baseline.

The Safeguard Mechanism can be considered to be the Australian Government's framework for managing GHG emissions at a national level. The baseline is generated as a realistic forecast of actual emissions and it has been developed from both historical operational data (for fuel consumption) and estimates of future reliability and maintenance (flaring). Under the Safeguard Mechanism, the baselines are set as an effective limit to emissions that is ultimately set by the Australian Government; the Clean Energy Regulator is responsible for making the baseline determination for a facility.

Given the requirement to procure and surrender ACCUs in the event of emissions exceedance above the baseline, there is an incentive to keep GHG emissions below the level of the baseline. However, INPEX does recognise that the Safeguard Mechanism may be interpreted as an accounting approach to emissions management and acknowledge that in and of itself, the Safeguard Mechanism may not necessarily deliver emissions reduction.

An EPO and EPS for the reporting of GHG emissions is presented in Table 9-15.

Table 9-15: Environmental performance outcome, standard and measurement criteria for external GHG reporting

Environmental performance outcome	Environmental performance standard	Measurement criteria
Air emissions management program, starting with proper measurement and monitoring of GHG emissions, contributes to reduction of emissions and INPEX's corporate goals including net zero emissions by 2050	INPEX will meet the legislative reporting requirements for the NGER Act in relation to the Ichthys Project.	NGER reporting to the Clean Energy Regulator

Measurement and forecasting of emissions

INPEX has a dedicated system for reporting GHG emissions, with data collated on a monthly basis. The reporting system in use imports information directly from production reporting systems, using data on fuel gas, diesel, flared gas and other relevant flows to calculate emissions. This system has been the subject of reasonable assurance audits since start-up and has been deemed to be fully aligned to the requirements of the NGER Act and NGER (Measurement) Determination. Key data that is used to estimate GHG emissions is approved and verified prior to being used for the calculation of GHG emissions within the emissions reporting system – and emissions data is reviewed prior to being issued for use within the company.

Monthly data is collated into a number of monthly and annual reports that are used for various purposes – including forming the basis of the annual NGER report to the Clean Energy Regulator.

There is an internal process of forecasting of GHG emissions also that is used for multiple purposes within INPEX. This process is linked to the process for production forecasting as the expected production informs the future GHG emissions. The GHG emissions forecast uses production forecast models, historical emissions intensity performance and estimates of timing of shutdowns. This same method of GHG forecasting has been utilised to generate the emissions baseline under the Safeguard Mechanism and, as per requirements, has undergone successful reasonable assurance by a third-party, independent assurance provider.

The GHG emissions forecast has a key role in estimating the potential for an emissions exceedance situation with respect to the Safeguard Mechanism baseline and to ensure an adequate supply of ACCUs is obtained in the event that they are required.

In the event that ACCUs are not required in a particular reporting year as a result of the facility emissions remaining under the baseline, INPEX may choose to retire voluntary offsets to meet corporate decarbonisation goals and other decarbonisation efforts for the offshore facility. These credits will be eligible credits under the Climate Active Carbon Neutral Standard for Organisations.

Overall GHG emissions targets

The emissions forecasting process provides the expected emissions for each forthcoming year. The forecast is generally high fidelity, using a dedicated modelling platform that has been tuned to actual plant conditions. The emissions forecast takes into account operational considerations such as number and duration of shutdowns and other key operational events that may impact GHG emissions. The emissions forecast includes estimation of all emissions sources on the offshore facilities – primarily fuel combustion and flaring.

The overall emissions forecast for offshore will form the basis of an annual GHG emissions target for the CPF and FPSO. For the purpose of target setting, only Scope 1 (direct) emissions from the facility will be considered. INPEX has systems and processes for monitoring GHG emissions using daily data that is compiled and approved on a monthly basis. This monitoring is completed on an equipment level and rolled up to the individual facilities prior to being compiled and reported under the NGER scheme on an annual basis. Cumulative monthly emissions performance is monitored against targets.

Emissions vary from year to year due to the dynamic nature of operations, routine maintenance, and planned shutdowns (e.g. for booster compression module installation in FY 24/25 (refer Figure 3-11, Figure 3-12 and Figure 3-13). As a result, setting a single target to cover all years to which this EP applies is problematic. Setting an annual target, which takes into account expected operational conditions during a particular year, as well as the expected impact of any identified emissions reduction opportunities, is more appropriate for this facility and allows for continual improvement. The indicative figures presented in Table 9-16 include the NGER safeguard mechanism baseline and allowance for known activities such as the commissioning of the booster compression module in FY 25/26.

Through the implementation of the controls described in Table 3-11 and Table 7-2, during normal operations there will be no routine flaring offshore. The Ichthys Project has been designed to produce LNG and LPG for export. Therefore, there is commercial incentive to avoid flaring where practicable and this is reflected in the GHG emissions targets (Table 9-16). The direct GHG emissions targets are based on forecast production rates and do not contain any margin for contingency. They are set on an annual basis to remain ALARP based on the premise that there is no routine flaring during normal operations. An EPO and EPS in relation to direct GHG emissions targets is presented in Table 9-17.

Table 9-16: Indicative direct GHG emissions targets (5 year lookahead)

	FY 21/22	FY 22/23	FY 23/24	FY 24/25	FY 25/26
Offshore emissions (CPF and FPSO)	956,728 tCO_2-e	758,740 tCO_2-e	811,805 tCO_2-e	753,214 tCO_2-e	998,033 tCO_2-e

Table 9-17: Environmental performance outcome, standard and measurement criteria for direct GHG emissions targets

Environmental performance outcome	Environmental performance standard	Measurement criteria
Air emissions management program will result in a reduction of direct GHG emissions contributing to INPEX's corporate goals including net	Annual direct GHG emissions target will be set each year using INPEX's GHG emissions forecasting process and the in-house models used to estimate future emissions.	Annual target. Ongoing tracking and analysis of actual direct GHG emissions against targets.

Environmental performance outcome	Environmental performance standard	Measurement criteria
zero emissions by 2050.	Annual direct GHG emissions targets will be met.	Annual target report(s) which consider the following: Actual GHG emissions, estimated in line with the NGER framework Monthly production flaring reports Fuel combustion records

Key emissions reduction equipment reliability and management

The ability to meet emissions targets is dependent on the reliability of key emissions reduction equipment as described in Table 3-11.

Reliability targets

As detailed in Table 7-2, reliability targets have been set for the FGC system, the OGR system and the VOC system. The implementation of reliability targets for key emissions reduction equipment contributes towards INPEX achieving its corporate emissions reduction goals including net zero emissions by 2050.

Reliability improvement plans

Reliability improvement plans are developed for problematic systems and equipment, that demonstrate poor reliability.

Root Cause Analysis (RCA) allows INPEX to be proactive and mindful so that that once a problem is identified a clear process is followed to document and investigate problems and failures. Similar to HSE, events that are managed in the HSE incident reporting system, production and equipment failures are managed within the failure elimination module within the proact module and RCA analysis features within.

There are many root cause analysis methodologies that can be used to analyse an event. The criteria for determining which RCA methodology is used is based on individual circumstances, impact, criticality and complexity. Examples of methodologies used include:

- 5 whys: The 5 Whys methodology is primarily used for initial frontline information and brainstorming recording. This methodology is an effective and efficient tool for all disciplines to get people involved in the process for problem solving and solution implementation. The methodology is a cause-and-effect type of analysis and requires few resources and inexpensive to conduct. The 5 whys template documents the sequence of events and key corrective actions for further review and analysis.
- PROACT: PROACT is the preferred methodology used for production and equipment related events. The structured process can be broken down into the following:
    - Preserve: Team members gather and record information (i.e., failure data) about a piece of equipment's or location's failure.
    - Order: The Principal Analyst: Defines the goals of the RCA Analysis. Assembles the team members who will conduct the RCA Analysis.

- Analyse: Team members review and analyse the available information and then record any conclusions. Communicate: Team members submit to the decision makers in the organisation their hypotheses about the cause of the failure and their recommendations for solutions to the failure.
- Track: Team members track the success of the solutions that were implemented. A re-evaluation can be performed, if necessary.

An EPO and EPSs for the performance of key emissions reduction equipment is presented in Table 9-18.

Table 9-18: Environmental performance outcome, standards and measurement criteria for emissions reduction equipment performance

Environmental performance outcome	Environmental performance standard	Measurement criteria
Air emissions management program will result in a reduction of emissions contributing to INPEX's corporate goals including net zero emissions by 2050.	Monthly reliability target of 90% for the OGR system is met	Record of OGR system performance (%)
	Monthly reliability target of 95% for the FGC system is met	Record of FGC system performance (%)
	Monthly reliability target of 95% for the VOC system is met	Record of VOC system performance (%)
	Implementation of reliability improvement plans for key emissions reduction equipment	Records of reliability improvement plans

Flaring management plan

The FMP is implemented to reduce the amount of flared gas from the Ichthys offshore facility. This will reduce the INPEX contribution to global GHG emissions in line with the corporate goal to be net zero by 2050.

A key element of the FMP is the use of an adaptive management program. This program will be used to develop, monitor, and continuously improve on:

- monthly leading indicators which will be used to drive performance
- annual flaring target which the facilities will reported on and be assessed against
- flaring guidelines for operations for specific identified events.

Flaring targets

Regular reports against the monthly flaring targets (Table 9-19) will provide lead indicators of flaring performance, for internal review and management by INPEX. Exceedance of monthly flare targets will be discussed in a multidisciplinary review to determine if further actions are required.

Flaring guidelines

In general, the intent is to provide the facilities with the flexibility to manage the assets as best possible in line with the flaring targets. However, it is recognised that there will be unplanned events which may require some flaring.

The FMP provides guidance as to the volume and expected duration for different unplanned flaring events, the corrective action to be taken and the responsible owner of the event.

Restriction on continuous operational flaring

There is a restriction on any continuous operational flaring for more than 72 hours without assessment of the risk and the written approval of the Offshore Operations General Manager. Along with approval, exceedances beyond 72 hours require an assessment of corrective actions (alternate and /or additional mitigations) to be considered to reduce emissions.

Notwithstanding the 72-hour restriction, the OIM takes all reasonable steps to minimize flaring. Along with approval, exceedances beyond 72 hours require an assessment of corrective actions (alternate and /or additional mitigations) to be considered to reduce emissions. Corrective actions can include a range of responses from escalating repair of key emission reduction equipment to consideration to ramp down production.

A summary of the requirements of the FMP and compliance records are presented in Table 9-19 and an EPO and EPSs presented in Table 9-20.

Table 9-19: Flaring monitoring and reporting requirements

Requirement	Compliance record
Continuously monitor flaring levels	Daily production reports KPI dashboard
Review actual flaring performance	Weekly asset planning and offshore production optimisation meetings/reports
Review flaring targets monthly	Monthly production flaring reports Offshore production optimisation meetings/reports
Provide annual flaring targets to contribute to direct GHG emissions target	Direct GHG emissions annual targets include predicted flaring emissions
No continuous operational flaring for more than 72 hours	Written approval from the Offshore Operations General Manager and documentation confirming expected flow rates and durations and an assessment of corrective actions

Table 9-20: Environmental performance outcome, standards and measurement criteria for implementation of air emissions management program

Environmental performance outcome	Environmental performance standard	Measurement criteria
Air emissions management program will result in a reduction of emissions contributing to INPEX's corporate goals including net zero emissions by 2050.	Monitoring and reporting requirements for flaring will be undertaken in accordance with Table 9-19.	Daily production reports KPI dashboard Weekly asset planning and offshore production optimisation records Monthly production flaring reports Offshore production optimisation records Direct GHG emissions annual targets include predicted flaring emissions Records of flaring > 72 hours approved by Offshore Operations General Manager

Environmental performance outcome	Environmental performance standard	Measurement criteria
	Annual flaring targets established in accordance with the FMP will be met.	EP annual performance reporting EP recordable incident report

Offsets

INPEX proposes a voluntary offset for offshore emissions if emissions on the offshore facility (CPF and FPSO) during a reporting year (NGER compliance year basis) exceeds the annual target. INPEX will acquire and surrender carbon credits equivalent to any excess emissions for that year. This arrangement is subject to the following conditions:

- Acceptable carbon credits include any eligible offset units under the Australian Government's Climate Active Program (Climate Active Carbon Neutral Standard for Products and Services). These currently include ACCUs, certified emission reductions, removal units, verified emission reductions, and verified carbon units.
- For a particular compliance year, should the Ichthys Project also exceed its Safeguard Mechanism baseline and choose to surrender ACCUs to resolve an excess emissions situation, then any such surrender will also count towards offsetting exceedance of the offshore emissions target.

An EPO and EPS in relation to offsets is presented in Table 9-21.

Table 9-21: Environmental performance outcome, standard and measurement criteria for offsets

Environmental performance outcome	Environmental performance standard	Measurement criteria
Air emissions management program will result in a reduction of emissions contributing to INPEX's corporate goals including net zero emissions by 2050.	In the event that the annual offshore direct GHG emissions target is exceeded an offset* will be purchased equivalent to any excess emissions for that year. *Acceptable carbon credits include any eligible offset units under the Australian Government's Climate Active Program (Climate Active Carbon Neutral Standard for Products and Services). These currently include ACCUs, certified emission reductions, removal units, verified emission reductions, and verified carbon units.	Records of actual performance against annual target Offset purchase records

Leak detection and repair program

INPEX has a LDAR program in place to allow continual improvement, reduce methane emissions and operate more efficiently (Table 7-2). An EPO and EPS in relation to the LDAR program is presented in Table 9-22.

Table 9-22: Environmental performance outcome, standard and measurement criteria for LDAR program

Environmental performance outcome	Environmental performance standard	Measurement criteria
Air emissions management program will result in a reduction of emissions contributing to INPEX's corporate goals including net zero emissions by 2050.	Methane emissions management will be implemented through a leak detection and repair (LDAR) program which includes: • inspections undertaken at a minimum of once annually for each component on the CPF and FPSO • tiered leak classification system based on thresholds of flammable gas or flammable liquid mass detected. • leak response and investigation including risk assessments of weeps and seeps • corrective repair work orders for leaks, monitoring records and action plans.	Records of LDAR program including leak size, risk assessment, corrective repair work orders, monitoring records and action plans.

Energy efficiency program

As part of INPEX Operations' Continuous Improvement operating model, INPEX has established an Energy Efficiency Program (EEP). The EEP is linked to the FMP, as the aim of EEP is to identify, assess and execute design modifications which result in a reduction of all GHG emissions, including those associated with offshore flaring.

The EEP is a continuous improvement initiative funded by INPEX with the intention to reduce GHG emissions in line with corporate targets. The aim of EEP is to identify, assess and execute design modifications which result in a reduction in GHG emissions associated with offshore fuel use, offshore flaring, onshore fuel use and onshore flaring. The program also aims to continuously review future opportunities and conduct preliminary studies to understand their GHG reduction potential. Examples of these preliminary studies include:

- optimisation of facilities restart time to reduce flaring during start-up
- investigation of potential to reduce fuel gas demand to offshore heating medium
- investigation of potential to reduce FPSO and CPF diesel usage
- onshore battery storage.

There is an ongoing budget commitment to assist in implementing energy efficiency projects. Projects are investigated based on best practices and industry standard as well as a collaborative knowledge transfer between key JV partners.

Projects are assessed based on a marginal abatement curve, which plots the cost of abatement ($/T CO_2e) vs cumulative CO_2 reduction over project life. Opportunities are assessed and implemented where feasible – taking into account the limitations of working with the existing facility.

Projects to be implemented include:

- Offshore heating medium heater system surveillance

- Interconnector cable optimisation to allow operation to change from 4 MPG online, to 3 MPG online. This change will result in more efficient offshore fuel gas usage.
- Implement offshore advanced process control to improve stability, reduce flaring and increase fuel efficiency.
- Improve flare metering on the CPF and FPSO to improve low range accuracy.

GHG emissions reductions resulting from implementation of the EEP are reported to INPEX corporation on a quarterly basis to centralise the data so that performance against corporate emissions reduction targets can be measured. An EPO and EPS in relation to the EEP is presented in Table 9-23.

Table 9-23: Environmental performance outcome, standard and measurement criteria for implementation of the EEP

Environmental performance outcome	Environmental performance standard	Measurement criteria
Air emissions management program will result in a reduction of emissions contributing to INPEX's corporate goals including net zero emissions by 2050.	Implementation of the INPEX Operations EEP/continuous improvement framework which includes: • Projects investigated based on best practices and industry standard using collaborative knowledge transfer between joint venture partners. • Projects assessed based on a marginal abatement curve. • Projects implemented where feasible – taking into account the limitations of working with the existing facility.	Emissions reduction options analysis in engineering assessments and studies.
	GHG emissions reductions resulting from implementation of the EEP are reported to INPEX corporation on a quarterly basis so that performance against corporate emissions reduction targets can be measured.	Quarterly reporting of GHG emissions reductions resulting from implementation of the EEP.

9.6.4 Adaptive IMS monitoring program

INPEX's IMS monitoring program (IMSMP) has been implemented since 2018. It was developed in consultation with relevant stakeholders (DPIRD, NT DITT and DAWE) and in the context of the facility's low risk status and management controls. The IMSMP is an adaptive process that employs routine and risk-based monitoring to identify potential/confirmed increases in IMS risk, and where applicable leads to the initiation of appropriate response actions.

The process recognises that every scenario is different and as such will be treated on a case-by-case basis to determine the most appropriate response action, whether that may be additional monitoring/inspection and/or management controls. An overview of the proposed process is shown in Figure 9-8, and includes consultation with IMS experts and commitments to consult with stakeholders as a key component of any response.

An EPS related to the ongoing monitoring and adaptive management of IMS is presented in Table 9-24.

Aspects and triggers

The IMSMP relies on routine and risk-based monitoring aspects and associated triggers for the facility, support vessels and the relevant operating ports (Broome/Darwin) as illustrated in Figure 9-8. Facility-based risks are associated with a potential increase in the IMS risk profile related to the occurrence of a specific incident. This includes the discharge of high-risk ballast water within the PSZ or a high-risk vessel (with regards to biofouling risk) enters the PSZ. Conversely, port-based risks are associated with the IMS status of the port and may instigate a response where the regulator/port authority has provided an alert regarding the confirmed establishment of a new IMS of concern.

Responses

In the event of a trigger breach as stated Figure 9-8, a response will be initiated. As each scenario is different, the appropriate response actions to be implemented will be treated on a case-by-case basis.

Where there is a "suspected" presence of IMS or a "potential" for a change in risk profile, additional monitoring and/or inspection will be implemented to confirm the "actual" risk as part of the response. Examples of additional monitoring/inspections may include a dedicated survey for the collection of samples for genetic analysis/taxonomic identification or DNA water sampling to confirm the identification of suspected IMS. During this process, IMS experts and relevant stakeholders will be consulted with regard to the sampling design of any additional monitoring to ensure it is appropriately robust and fit-for-purpose.

Where an increase in IMS risk is confirmed, a review of the adequacy and efficacy of the existing controls will be completed in consultation with independent IMS experts. Any additional controls deemed necessary, in context of the IMS risk status and ALARP, will be identified discussed with relevant stakeholders. Examples of additional controls may range from increased personnel training in environmental awareness to vessel cleaning.

Implementation timeframes

In the event a trigger has been breached, an IMS expert and relevant stakeholders will consulted within three business days. Following initial notification, an event specific action plan will be developed in consultation with the IMS expert, following the process outlined in Figure 9-8. The relevant response will then be implemented, with the timing for the implementation being event dependant, as guided by IMS experts. Relevant stakeholders will be consulted and kept informed of the status throughout the investigation and response.

Table 9-24: Environmental performance outcome, standards and measurement criteria for implementation of adaptive IMS monitoring program

Environmental performance outcome	Environmental performance standard	Measurement criteria
No establishment of IMS of concern in the Commonwealth Marine Area or coastal waters via ballast water or biofouling attributable to the petroleum activity.	Any breach of triggers detailed in the IMSMP will initiate the adaptive management response	Records of IMSMP implementation.

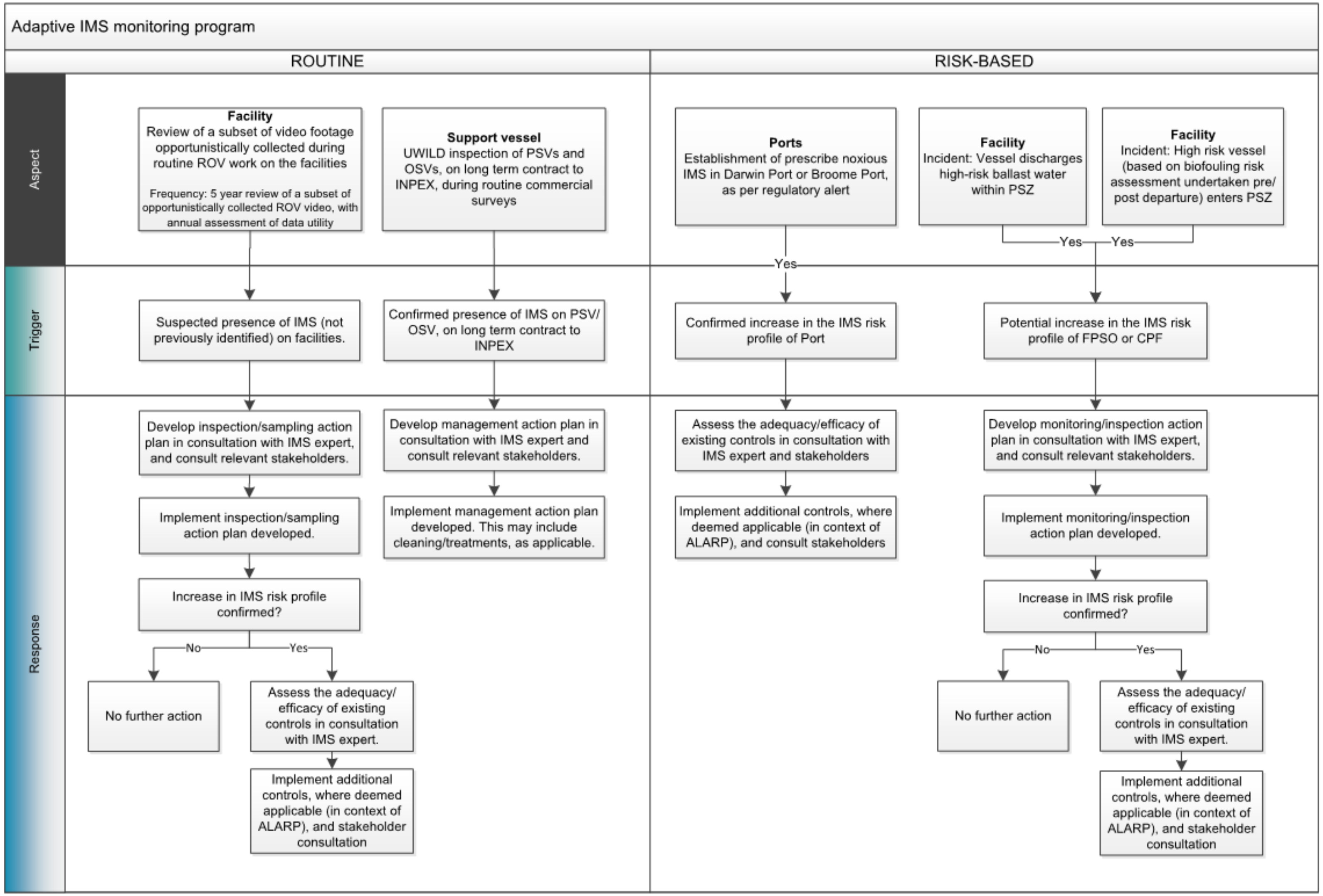


Figure 9-8: Adaptive IMS monitoring program

9.6.5 Biofouling risk assessment for domestic movements

The biofouling risk assessment process for domestic vessel movements includes aspects of the vessels history with respect to IMS risk e.g. vessels origin from within Australian waters and previous locations of operation (including whether these Australian locations have reported IMS occurrences), periods out-of-water and inspections/cleaning undertaken, age of anti-fouling coatings, presence and condition of internal treatment systems etc.

While undertaking the INPEX biofouling risk assessment for domestic movements (Figure 9-9), in any instances where potential risks are identified e.g. no anti-fouling coating or extended stays in Port, the process requires INPEX to engage an independent IMS expert and if required a further risk assessment may be undertaken.

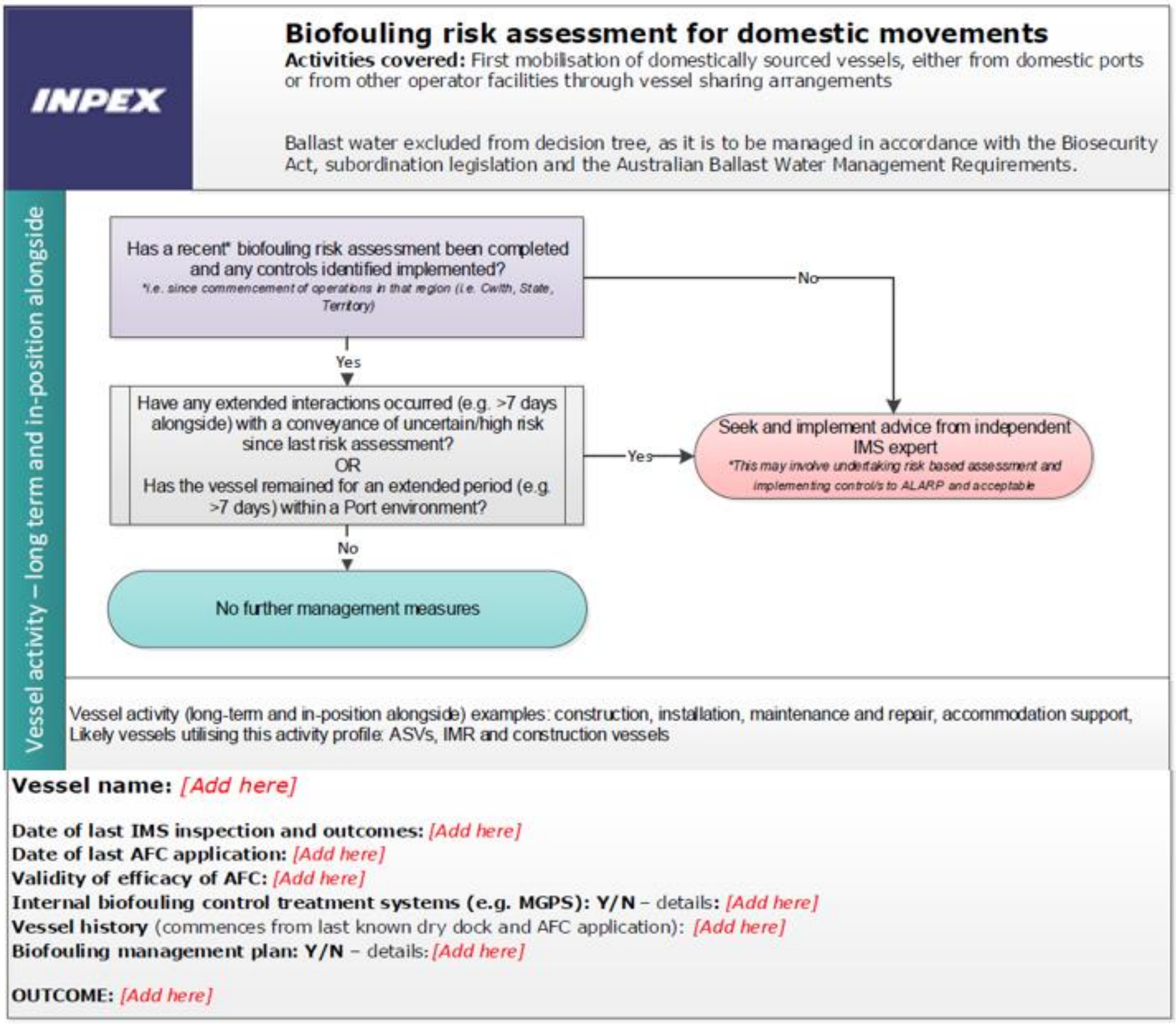


Figure 9-9: INPEX biofouling risk assessment for domestic movements

9.6.6 OIW measurement

Online measurement systems on the CPF and FPSO are used to monitor oil levels within effluent streams to ensure they meet specified environmental discharge limits. The OIW Measurement, Calibration, Correlation and Validation Strategy defines how to correlate and validate the Ichthys offshore OIW measurement systems including the online analysers and the laboratory handheld instruments.

The three effluent streams monitored along with their treatment method and OIW limits are:

- CPF open drains 15ppm (v)
- FPSO open drains 15ppm (v)
- FPSO produced water 30 mg/L

In order to ensure the defined limits are accurately measured by the online analysers, a method of verifying and correlating the analysers against a reference method is required. Given the remote location of the Ichthys assets, a primary reference method performed in an onshore laboratory has been selected to verify the online analyser results while a secondary reference method, performed offshore, has been selected to ensure the online analysers maintain a strict correlation requirement.

The primary reference method selected by INPEX to measure OIW is Gas Chromatography - Mass Spectrometry (GC-MS). The method is referred to as the '3rd party laboratory method'. The 3rd party method utilises dichloromethane to extract the oil components out of the effluent stream followed by GC-MS separation and detection. As such, the 3rd party method provides a more extensive analysis of hydrocarbon impurities and is expected to be more sensitive, with higher readings than the lab-based method. The 3rd party method is therefore considered a verification to confirm OIW results as measured by the online analysers (which in turn is correlated against the secondary reference method) do not exceed the specified limit at the time of sampling.

The secondary reference method is performed by a Turner TD560 handheld analyser in the offshore laboratories and is referred to as the 'offshore laboratory method'.

Calibration

Calibration is defined as the act of ensuring that an instrument used in measurement will produce accurate results.

The online analysers will be calibrated using procedures based on manufacturer instrument manuals against standards that have been prepared using the specified lab instrument. The FPSO open drains and produced water analysers will be calibrated according to INPEX procedures, while the CPF open drain analyser will be calibrated using third party procedures as per an IMO directive. The frequency of calibration is presented in Table 9-25.

Online analysers can be calibrated either directly using a known calibrant or indirectly where a measured reading is forced to read a result calculated from the secondary reference method.

For the CPF, in addition to the calibration a solid point check is performed as part of regular maintenance (3 – 6 weekly). This is an optic check against a calibrated light source with an allowable tolerance limit of 10% as set by the vendor.

Table 9-25: Laboratory (TD 560) and online OIW analyser calibration frequency

Stream	Frequency
CPF open drains	2 yearly
FPSO open drains	2 yearly
FPSO produced water	6 monthly

Correlation

Correlation is the statistical process of establishing a relationship exists between two or more things. When referring to the Ichthys OIW measuring system, the online analyser is correlated against the secondary reference method.

Correlation of the online analysers against the offshore laboratory method will be performed on a routine basis due the following benefits:

- It provides assurance regarding reliability and accuracy of online results.
- Correlation with laboratory measurements limits step changes in results when online systems are offline and laboratory measurements are required.
- It provides system variance limits between online and laboratory measurements for ongoing routine monitoring.

Any correlation must only be performed when there is confidence in both the online analyser performance, and laboratory method. If either set of results are impacted by performance issues, then the correlation results will be invalid, and conclusions cannot be drawn in terms of system performance.

A linear correlation between online and laboratory results should be developed to evaluate the performance of the online analysis system. Development of this linear relationship will be impacted by:

- Sampling method – the use of averaged results vs single point comparisons.
- Span of results – a set of results that covers a wide concentration range will provide an improved correlation.
- Number of results – increasing the number of results will improve the overall correlation as the impact of outliers is minimised.
- Process conditions – ideally, the process should be sampled under steady state conditions.

A minimum of 10 correlation points sampled over the period of 5 – 10 days to ensure variance in results is achieved, are used to build an initial correlation chart. The number of points and sampling interval should be modified on the basis of meeting the above criteria for improving the overall correlation.

Samples are taken in triplicate and analysed by the approved laboratory method to achieve an average value. The average result of the three laboratory results is then compared to the average online analyser value reported over the time period during which each set of triplicate samples were taken. This approach limits the influence of single point outliers on the overall correlation.

Validation

Validation is the routine process of checking the validity or accuracy of a measuring device. When referring to the Ichthys OIW measuring system, the online analyser is validated against the secondary reference method.

A weekly validation check is carried out on the online analysers by taking three samples and analysing them on the laboratory instrument. An average reading is then obtained from the online monitor during the period when the corresponding samples were taken. The results are then plotted onto the original correlation graph with the coefficient of determination (r2) recalculated using the new data point. Should the correlation results still fall within desired results then validation is achieved.

In the event the first validation does not fall within the correlation, sampling and testing can be repeated to produce a second averaged validation point. If this point passes, the first point can be treated as an outlier and the verification can be considered a pass. If both fail, a new correlation graph must be established.

Verification

Verification is the act or process of confirming or checking the accuracy of one result against known or standard results.

When referring to the Ichthys OIW measuring system, a monthly verification shall be performed by engaging a 3rd party laboratory to test a sample of effluent water using the primary reference method. This verification is used to confirm OIW results as measured by the online analyser (which in turn is correlated against the lab method) did not exceed the specified limit at the time of sampling.

Contingency

Online analysers are an effective way to monitor oily water discharges in real time. However, there are periods when the online analysers may not be switched on or they are not functioning or may be expected to be impacted by infrequent, unexpected process changes. This occurs during periods of exceptional process conditions, maintenance or for calibration. If discharges need to occur during this time (i.e. when the analysers are offline) an alternative measurement is required to ensure discharges remain under the relative discharge limits i.e. 15ppm(v) or 30 mg/l specification.

In the event the online analysers fail (or they are offline in “Lab test” mode for maintenance purposes), INPEX will undertake sampling and analysis in the offshore laboratory, to confirm OIW concentrations are below 15 ppm(v) for the CPF and FPSO open drains and 30 mg/l for the FPSO produced water, on a 6-hourly basis. The overboard discharge valves will be closed manually when a reading above 15ppm(v) or 30 mg/l is observed.

An EPO and EPSs related to OIW measurement calibration, correlation, validation and verification including contingency measures are presented in Table 9-26.

Table 9-26: Environmental performance outcome, standards and measurement criteria for implementation of OIW measurement

Environmental performance outcome	Environmental performance standard	Measurement criteria
Impacts to identified values and	Gas Chromatography - Mass Spectrometry (GC-MS) is used as the primary reference method	

sensitivities from planned liquid discharges associated with the offshore facility are limited to a localised area.	A secondary reference method is performed by a (Turner TD560) handheld analyser in the offshore laboratories	Records of laboratory analysis and correlation.
	OIW analysers will be calibrated in accordance with Table 9-25	
	CPF open drains analyser calibration solid point check is performed in accordance with a routine maintenance schedule every ~3-6 weeks	
	A minimum of 10 correlation points sampled over the period of 5 – 10 days	
	Samples for correlation will be taken in triplicate	
	A weekly validation check is carried out on the online analysers by taking three samples and analysing them on the laboratory instrument.	
	A monthly verification shall be performed by engaging a 3rd party laboratory to test a sample of effluent water using the primary reference method	
	In the event the online analysers fail (or they are offline in “Lab test” mode for maintenance purposes), INPEX will undertake sampling and analysis in the offshore laboratory, to confirm OIW concentrations at least 6 hourly and close the overboard discharge valves if a reading is observed above 15ppm(v) (open drains); or 12 hourly and close the overboard discharge values if a reading is observed above 30 mg/l (PW)	Discharge records

9.6.7 Asset integrity

INPEX defines asset integrity as the ability of an asset to perform its required functions effectively and efficiently whilst protecting health, safety and the environment. Asset integrity is described in the INPEX Asset Integrity Standard which provides for the development of suitable operating manuals and procedures to ensure that the safe operating parameters and limits of all control measures, the steps required to prevent any excursion from these limits and the actions to be taken upon an excursion from these limits are clearly defined.

Asset integrity management (AIM) is the means of ensuring that the people, systems, processes and resources which deliver asset integrity are in place, fit for purpose and measurable over the whole lifecycle of the asset. INPEX recognises that AIM does not only relate to the physical condition of facilities, but also to elements involving people, activities or business processes and AIM is a key contributor to managing the risk of incidents to ALARP.

An asset integrity management plan is developed covering the facility, which is reviewed by INPEX technical authorities and approved by the VP Operations. The AIM plan defines the objectives, requirements and techniques for ensuring the through-life integrity of the facility's structure and equipment and demonstrating compliance with the business rules defined in the Asset Integrity Standard.

An operations assurance plan is developed on an annual basis in accordance with the operations assurance strategy. The operations assurance plan incorporates activities addressing requirements of the AIM plan. To achieve this, the operations assurance plan establishes a program of periodic reviews, self-assessment processes, and peer reviews by relevant discipline personnel.

In the case of proposed further development (brownfield & greenfield), AIM plans are prepared to identify the activities required during project execution to enable and demonstrate appropriate AIM, in compliance with the Asset Integrity Standard.

Maintenance and inspection

The strategies, methodologies and work instructions for the inspection, testing and maintenance of the facility plant and equipment are developed, reviewed and approved / endorsed in accordance with the AIM Plan.

The inspection, testing and maintenance regimes are developed using a risk-based approach, drawing upon the requirements of a range of Australian and International Codes and Standards, in conjunction with Risk Based Inspection Methodologies and industry best practices.

Inspection, maintenance and repair tasks and activities are developed from the basis of the AIM plans and strategies along with good industry practices. The INPEX Maintenance System is effectively implemented through the Computerised Maintenance Management System (CMMS), where planned and corrective maintenance is programmed and recorded. All maintenance scheduling and recording is in undertaken in SAP. The CMMS is subject to periodic audits and monitoring.

An EPS related to the ongoing inspection and maintenance is presented in Table 9-27.

Table 9-27: Environmental performance outcome, standards and measurement criteria for implementation of INPEX maintenance system

Environmental performance outcome	Environmental performance standard	Measurement criteria
Equipment will be maintained to ensure efficiency and reduce impacts to identified values and sensitivities.	Equipment will be inspected and maintained in accordance with preventative maintenance plans at the frequencies outlined in the risk-based inspection schedule in the INPEX Maintenance Management System.	Records confirm inspections and preventative maintenance of equipment is implemented in accordance with preventative maintenance plans at the frequencies outlined in SAP.

9.7 Management of change

Changes to this EP will be managed in accordance with an INPEX Australia 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 management of change (MoC) request. The request will identify the proposed change(s) along with the underlying reasons and highlight potential areas of risk or impact. In accordance with the INPEX business rules, it is mandatory to undertake an environmental risk assessment in every case for changes that could affect the environment. The MoC request will be managed by an environmental adviser who will then determine the necessary approval/endorsement pathway, in consultation with the environmental approvals coordinator. Minor changes (such as updating a document or process) that do not invoke a revision trigger are endorsed by the VP (or relevant Facility OIM) and the change is implemented.

In accordance with Regulation 17 of the OPGGS (E) Regulations 2009, a revision of this EP will be submitted to NOPSEMA where:

a change is considered to represent a new activity

a change is considered to represent a significant modification to, or a new stage of, an existing activity

a change will create a significant new environmental impact or risk that is not provided for in the current EP

a change will result in a series of new (or increased) environmental impacts or risks that, together, will result in a significant new environmental impact or risk, or a significant increase in an existing environmental impact or risk.

The MoC request process is periodically checked against NOPSEMA guidance to ensure ongoing compliance. This is undertaken as part of the management review process described in Section 9.13.

9.8 Stakeholder engagement

Communications with stakeholders are inclusive and effective, to facilitate the controlled transfer of relevant and appropriate HSE information. Stakeholders include INPEX Corporation, INPEX employees, contractors, regulators, external industry bodies, shareholders, joint venture participants, suppliers, customers, non-government organisations, indigenous groups, financiers and members of the community.

9.8.1 Legislative and other requirements

INPEX maintains an approvals and compliance tracking system which identifies future approval requirements and when they must be in place, as well as compliance with existing approvals. Through this system, responsible persons are provided with alerts for required actions and time frames to avoid non-compliance and ensure there are no gaps in approvals.

In addition, INPEX personnel participate in industry and regulator forums, as well as maintain up-to-date knowledge of industry practices and proposed regulatory changes. Changes to legislative and other requirements are reviewed for potential impacts to business operations and communicated, as required, to personnel managing potentially affected activities.

Updates to matters relating to the EPBC Act, including policy statements and conservation management documentation is achieved through subscription to automated email notifications provided by the DAWE. In addition, updates following the Government's independent Australian Marine Parks review, such as AMP management plans will also be reviewed for relevance against this EP. Where required, updates to this EP will be conducted in accordance with the MoC process described in Section 9.7.

9.8.2 Communication

INPEX HSE requirements and matters are communicated throughout the organisation. This facilitates the cascading and implementation of business policies and standards through the business, and on to contractors who work on behalf of INPEX.

INPEX and its contractors adopt a number of methods to ensure that information relating to HSE risks and impacts are communicated to personnel, including:

daily toolbox meetings

use of noticeboards, HSE alerts and newsflashes e.g. environmental aspects and events

internal and external reporting.

9.8.3 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. In addition to the Ichthys Project webpage (http://www.inpex.com.au) that provides project information, the mechanisms that provide ongoing opportunities for consultation in relation to the implementation of this EP are summarised in Table 9-28.

Table 9-28: Ongoing stakeholder consultation

Stakeholder	Information supply	Frequency
AMSA – Nautical Advice	Provide updates to both AHO and the JRCC on progress and any changes to the intended operations.	As required
DAWE– Fisheries, AFMA and relevant fishing representatives	Provide updates on future developments relating to the project.	As required
WA DPIRD – Biosecurity Section	DPIRD will be consulted in relation to any change in IMS risk identified over time as described in the IMSMP (Section 9.6.4).	As required
NT DITT (NT Aquatic Biosecurity Unit)	NT DITT Aquatic Biosecurity Unit will be consulted in relation to any change in IMS risk identified over time as described in the IMSMP (Section 9.6.4).	As required
Department of Mines, Industry Regulation and Safety (DMIRS)	Provide updates on any changes to the intended operations.	As required

Stakeholder	Information supply	Frequency
AMOSC	Provide updates on future drilling programs/schedules that extend beyond 2023.	Prior to next drilling campaign

Table 9-29: Environmental performance outcome, standards and measurement criteria for implementation of ongoing stakeholder consultation

Environmental performance outcome	Environmental performance standard	Measurement criteria
Where requested, relevant stakeholders will be kept informed of Project activities.	Ongoing stakeholder consultation with relevant stakeholders undertaken in accordance with Table 9-28.	Stakeholder consultation records.

9.9 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 HSE and risk management.

Contractors and suppliers are selected based on their capabilities and managed throughout the scope of works to deliver on HSE and process safety performance expectations.

The processes for pre-qualification, selection and management of suppliers and contractors are detailed within the INPEX BMS such that:

- HSE and process safety risks associated with the scope of works are identified and known
- contractors and suppliers are selected based on their organisational capability and personnel competence to execute the scope of work, including effective management of HSE and process safety risks
- roles and responsibilities, and minimum performance expectations are communicated to contractors and suppliers, and form part of contractual obligations
- contractors are partnered to deliver desired HSE and process safety performance targets, and monitored for compliance with contractual requirements
- lessons learnt from each scope of work are applied to future activities.

9.10 Security and emergency management

Regulation 14(8) of the OPGGS (E) Regulations 2009 requires the implementation strategy to contain an OPEP and the provision for the OPEP to be updated. In accordance with Regulation 14 (8AA)) the OPEP must include arrangements to respond to and monitor oil pollution, including:

- the control measures necessary for a timely response to an oil pollution emergency
- the arrangements and response capability to implement a timely implementation of those controls, including ongoing maintenance of that capability

- the arrangements and capability for monitoring the effectiveness of the controls and ensuring that performance standards for those controls are met
- the arrangements and capability for monitoring oil pollution to inform response activities
- the provision for the OPEP to be updated.

These requirements are addressed through the INPEX *Browse Regional OPEP*, a summary of which is provided in Section 8.4 and Table 8-12 of this EP.

9.11 Incident investigation and lessons learned

HSE and process safety incidents and high potential hazards must be reported and investigated to identify and address the root causes, and apply lessons learned to improve designs, systems and work practices.

9.11.1 HSE performance measurement and reporting

HSE performance data is monitored in accordance with the INPEX BMS. This enables the status of conformance with HSE obligations and goals to be determined, and also ensures HSE risks are being effectively managed to support continuous improvement. HSE performance is regularly reviewed by senior management.

9.11.2 Environmental incident reporting – internal

INPEX refers to environmental incidents and hazards as "environmental events", which all personnel, including contractors, are required to report as soon as is reasonably practicable. Reporting must be in accordance with the INPEX *Incident Reporting and Investigation Standard* and associated procedure.

All events will be documented and reviewed for their actual and potential consequence severity levels and investigated as appropriate. Corrective or preventative actions will be identified and documented, and their completion verified in an action register. These actions may include changes to the risk registers, standards, or procedures, or the need for training, different tools or equipment. Any actions will be recorded and tracked.

9.11.3 Environmental incident reporting - external

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.

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 (Figure 6-1).

Based on the consequence assessments described in sections 7 and 8 of this EP, 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 vessel collision resulting in a spill
- structural integrity failure (production well loss of containment) resulting in a subsea condensate release.

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 this EP, it is a breach of the performance standards and outcomes listed in Section 7, 8 or Section 9 of this EP and the *Browse Regional OPEP*.

For the purposes of regulatory reporting to DAWE, any significant impact to matters of national environmental significance (MNES), as classified using the INPEX Risk Matrix, will be reported to DAWE. 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 (refer to INPEX *Browse Regional OPEP*).

Reportable incidents

Initial verbal notification

In the event of a reportable incident, INPEX will give NOPSEMA an initial verbal notification of the occurrence as soon as is practicable; and in any case, not later than two hours after the first occurrence of the reportable incident; or if it is not detected at the time of the first occurrence, within two hours of the time that INPEX becomes aware of the incident.

The initial verbal notification will contain:

- all material facts and circumstances concerning the reportable incident that are known or can, by reasonable search or enquiry, be found out
- any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.

Written notification

As soon as possible after an initial verbal notification of a reportable incident, INPEX will provide a written record of the notification to:

- NOPSEMA
- the National Offshore Petroleum Titles Authority (Cwlth)
- the Department of Mines, Industry Regulation and Safety (WA) or the Department of Infrastructure, Planning and Logistics (NT), depending on the jurisdiction.

In the event of a significant impact to MNES, INPEX will provide an initial notification to DAWE within 24 hours of becoming aware of the event.

In the event of a reportable incident, INPEX will provide a written report to NOPSEMA as soon as is practicable; and in any case, not later than three days after the first occurrence of the incident. If, within the three-day period, NOPSEMA specifies an alternative reporting period, INPEX will report accordingly. The report will contain:

- all material facts and circumstances concerning the reportable incident that are known or can, by reasonable search or enquiry, be found out
- any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

Within seven days of giving a written report of a reportable incident to NOPSEMA, INPEX will provide a copy of the report to:

- the National Offshore Petroleum Titles Authority (Cwlth)
- the Department of Mines, Industry Regulation and Safety (WA) or Department of Infrastructure, Planning and Logistics (NT), depending on the jurisdiction.

Following submission of the above, NOPSEMA may, by notice in writing, request INPEX to submit an additional report(s) of the incident. Where this is the case, NOPSEMA will identify the information to be contained in the report(s) or the matters to be addressed and will specify the submission date for the report(s). INPEX will prepare and submit the report(s) in accordance with the notice given.

In the event of a significant impact to MNES, INPEX will provide a written notification to DAWE (Cwlth) within three days of becoming aware of the event, and provide additional information as available, if requested.

This includes reporting any vessel strike incidents to the National Ship Strike Database at <https://data.marinemammals.gov.au/report/shipstrike>.

Suspected or confirmed presence of any marine pest or disease will be reported to DPIRD within 24 hours by email (biosecurity@fish.wa.gov.au) or telephone. This includes any organism listed in the WA prevention list for introduced marine pests and any other non-indigenous organism that demonstrates invasive characteristics.

Recordable incidents

Reporting

In the event of a recordable incident, INPEX will report the occurrence to NOPSEMA as soon as is practicable after the end of the calendar month in which it occurs; and in any case, not later than 15 days after the end of the calendar month. The report will contain:

- a record of all the recordable incidents that occurred during the calendar month
- all material facts and circumstances concerning the recordable incidents that are known or can, by reasonable search or enquiry, be found out
- any action taken to avoid or mitigate any adverse environmental impacts of the recordable incidents
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the recordable incident
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

9.11.4 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 January 1 to December 31, to NOPSEMA on an annual basis, as agreed with NOPSEMA. The annual submission date for the environmental performance report will be April 1 of each year.

9.12 Monitor, review and audit

HSE performance must be monitored through audits, reviews, validation, verification and assurance checks, to correct at risk situations and deliver improved performance.

9.12.1 Management system audit

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 HSE audits against the INPEX BMS
- regular inspections of workplace equipment and activities
- INPEX HSE audit on Ichthys operations every two years to confirm alignment with and implementation of the HSE requirements of the INPEX BMS
- 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.

Audit teams will be appropriately qualified, experienced and competent in auditing techniques. They will include relevant technical expertise, as required, and the audit team structure will be commensurate with the scope of the audit. HSE audit and inspection findings will be summarised in a report. Non-conformances, actions and improvement plans resulting from audits will be managed in an action tracking system.

9.12.2 Inspections

Inspections are undertaken to ensure that the environmental performance outcomes and standards documented in this EP are likely to be achieved. The inspections are conducted prior to mobilisation of vessels to the operational area. Findings during the inspections will be converted into actions that will be tracked within an action tracking database until closed.

Based on the intermittent and infrequent nature of the IMR activities described in this EP, the duration of a vessel’s scope of work is unknown however is estimated to range from 5-60 days per year. Should an IMR vessel's scope of work extend beyond 60 days, an additional environmental inspection, to confirm compliance with this EP, will be conducted. Following the completion of an IMR vessel scope of work, a report on EP compliance will be prepared.

9.12.3 Liquid effluent management plan revision

The LEMP will be reviewed annually, with a view to adapting the program using the multiple lines of evidence approach. The review will include:

- summary of the adaptive management implemented, including the number of triggers exceeded and if any action was taken to address the trigger exceedances. It will also include an assessment of how lessons from trigger exceedances have been incorporated into the LEMP and/or facility management.
- whether adjustments to the frequency of chemical characterisation and WET testing are appropriate, based on the results obtained. Should the chemical characterisation and/or ecotoxicity results confirm the conclusions reached in this EP, the frequencies may be reduced to biennial. Should biennial results reach the same conclusions, the frequency may be reduced further (e.g. triennial).
- the water and sediment quality program will be reviewed after the next survey is completed and analysed, and adaptations made based on the results (e.g. one survey in every five-year period).
- other amendments to the LEMP may be made based on outcomes of the annual review. Amendments may include but are not limited to review of the statistical power of the program to determine an effect size, the gradient design in terms of the dose-

response to the plume, as well as precision and replication as appropriate, to detect cause and effect pathways.

Outcomes of the LEMP annual review will be included in the annual compliance report described in Section 9.11.4.

9.13 Management review

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 HSE requirements as per the INPEX BMS are performed by senior management on a periodic basis. Learnings from this process, and iterative decision-making will then be used as feedback to improve future management.

Together with the annual environmental performance reporting described in Section 9.11.4, EP management reviews will enable the review of environmental performance, as well the efficacy of the implementation strategy used during the petroleum activity.

Management reviews of this EP shall assess whether:

- the environmental impacts and risks of the petroleum activity continue to be identified and reduced to a level that is ALARP
- control measures detailed in this EP are effective in reducing the environmental impacts and risks of the petroleum activity to ALARP and an acceptable level
- implementation of the management of change (MoC) process has remained consistent with the commitment to ensuring impacts and risks are reduced to ALARP and are acceptable
- any changes in legislation, or matters relating to the EPBC Act, including policy statements and conservation management documentation, have occurred which affect or need to be taken into consideration in relation to this EP
- any changes in NOPSEMA guidance which may affect or need to be taken into consideration in relation to this EP
- the Operational and Scientific Monitoring Program (within the INPEX *Browse Regional OPEP*) remains fit for purpose
- lessons learned have been communicated and, where applicable, applied across all titleholder activities, as relevant.

Where the documented findings of the management reviews have implications for this 5-year EP revision, the EP will be updated in accordance with the EP MoC process.

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Appendix A-
EPBC MINISTERIAL CONDITIONS

On 27 May 2015, INPEX received revised conditions for Approval Decision EPBC 2008/4208 from DAWE, to reflect the outcomes of the Commonwealth Government's regulatory streamlining process. Condition 19 was added as a new condition and it requires INPEX to ensure elements of conditions which are no longer required to be implemented are included in Environment Plans submitted to NOPSEMA for assessment. This Appendix demonstrates how Condition 19 has been met.

Relevant EPBC 2008/4208 Ministerial Conditions	Location in Environment Plan submission
19. A plan, strategy or program (however described) required by conditions 1, 2, 5, 7, 8, 9 or 15 is automatically deemed to have been submitted to, and approved by, the Minister if the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that:	This EP includes the elements of relevant conditions, as cross-referenced below.
a) was submitted to NOPSEMA after 27 February 2014; and	
b) either: i. is in force under the OPGGS Environment Regulations; or ii. has ended in accordance with Regulation 25A of the OPGGS Environment Regulations.	
19B. Where an environment plan which includes measures specified in the conditions referred to in conditions 19 and 19A above, is in force under the OPGGS Environment Regulations that relates to the taking of the action, the person taking the action must comply with those measures as specified in that environment plan.	This EP
1. Oil Spill Contingency Plan The person taking the action must develop and submit to the Minister for approval, an Oil Spill Contingency Plan that demonstrates the response preparedness of the person taking the action for any hydrocarbon spills, including the capacity to respond to a spill and mitigate the environmental impacts on the Commonwealth marine area and listed species habitat within offshore areas and Darwin Harbour. The Plan must include, but is not limited to:	This EP
a) Oil spill trajectory modelling for potential spills from the action. This should include consideration of a well blow out or uncontrolled release. The modelling should be specific to the characteristics of the hydrocarbons contained in the Ichthys gas field, the likely volumes released in a worst-case scenario spill, and the potential time over which the oil may be released in a worst-case scenario spill, including a scenario of a minimum eleven (11) week uncontained spill;	Section 8.1, Section 8.2 and Section 8.3 Table 8-5, Table 8-6, Table 8-9 and Table 8-10

Relevant EPBC 2008/4208 Ministerial Conditions	**Location in Environment Plan submission**
b) A description of resources available for use in containing and minimising impacts in the event of a spill and arrangements for accessing them;	INPEX Browse Regional OPEP
c) A demonstrated capacity to respond to a spill at the site, including application of dispersants, if required and appropriate, and measures that can feasibly be applied within the first 12 hours of a spill occurring;	INPEX Browse Regional OPEP
d) Identification of sensitive areas that may be impacted by a potential spill, in particular, Browse Island, specific response measures for those areas and prioritisation of those areas during a response;	Section 4, Section 8.2.5 and Section 8.3.5 of this EP and INPEX Browse Regional OPEP
e) Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program required under condition 2 and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program;	Section 1.8 of this EP
f) Training of staff in spill response measures and identifying roles and responsibilities of personnel during a spill response; and	INPEX Browse Regional OPEP
g) Procedures for reporting oil spill incidents to the Department.	Section 9.11.3 and INPEX Browse Regional OPEP
The person taking the action must not commence drilling activities until the Oil Spill Contingency Plan is approved. The approved Oil Spill Contingency Plan must be implemented.	The accepted EP revision will be implemented as required under the OPGGS Act and OPGGS (E) Regulations.
2. Operational and Scientific Monitoring Program The person taking the action must develop and submit to the Minister for approval, an Operational and Scientific Monitoring Program that will be implemented in the event of an oil spill to determine the potential extent and ecosystem consequences of such a spill, including, but not limited to:	INPEX Browse Regional OPEP
a) Triggers for the initiation and termination of the Operational and Scientific Monitoring Program, including, but not limited to, spill volume, composition, extent, duration and detection of impacts;	INPEX Browse Regional OPEP

Relevant EPBC 2008/4208 Ministerial Conditions	**Location in Environment Plan submission**
b) A description of the studies that will be undertaken to determine the operational response, potential extent of impacts, ecosystem consequences and potential environmental reparations required as a result of the oil spill.	INPEX Browse Regional OPEP
c) Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program, and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program;	Section 1.8 of this EP
d) Inclusion of sufficient baseline information on the biota and the environment that may be impacted by a potential hydrocarbon spill, to enable an assessment of the impacts of such a spill;	Section 4, Table 8-7 and Table 8-11 and INPEX Browse Regional OPEP
e) A strategy to implement the Operational and Scientific Monitoring Program, including timelines for delivery of results and mechanisms for the timely peer review of studies;	INPEX Browse Regional OPEP
f) In the event of an oil spill the person taking the action must pay all costs associated with all operational and scientific monitoring undertaken in response to the spill, as outlined in the approved Operational and Scientific Monitoring Program and any environmental remediation determined necessary by the results of the approved Operational and Scientific Monitoring Program; and	Section 1.8 of this EP
g) Provision for periodic review of the program.	Section 9.13 of this EP and INPEX Browse Regional OPEP
The Operational and Scientific Monitoring Program must be submitted at least three months prior to the commencement of drilling activities. The person taking the action must not commence drilling activities until the Operational and Scientific Monitoring Program is approved. The approved Operational and Scientific Monitoring Program must be implemented.	The accepted EP revision will be implemented as required under the OPGGS Act and OPGGS (E) Regulations.
7. Offshore Waste Management Plan The person taking the action must submit for the Minister's approval an Offshore Waste Management Plan or plans to mitigate the environmental effects of any wastes generated from the proposal within the Commonwealth marine area. The Offshore Waste Management Plan(s) must address the following:	

Relevant EPBC 2008/4208 Ministerial Conditions	Location in Environment Plan submission
a) identify all sources of waste;	Table 3-6 and Section 7.2 of this EP
b) describe any impacts associated with disposal of these wastes;	Table 7-31 of this EP
c) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these;	Table 7-31 of this EP
d) outline measures to avoid impacts;	Table 7-31 of this EP
e) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts;	Section 7.2 of this EP
f) identify all regulatory requirements relating to the disposal of waste and how these will be met;	Table 2-1 and Table 7-31 of this EP
g) include a monitoring regime to determine achievement of objectives and success of measures used;	Table 7-31 of this EP and Section 9.12 of this EP
h) outline reporting and auditing arrangements; and	Section 9.11 and Section 9.12 of this EP
i) describe how the plan will apply the principles of adaptive management.	Section 9.13 of this EP
The plan(s) must be submitted prior to the commencement of the relevant activity to which they apply. The relevant activity may not commence until the plan is approved. The approved plan(s) must be implemented.	The accepted EP revision will be implemented as required under the OPGGS Act and OPGGS (E) Regulations.
8. Liquid Discharge Management Plan The person taking the action must submit for the Minister's approval a Liquid Discharge Management Plan or plans to mitigate the environmental effects of any liquid discharge from the proposal, including sewerage and surface water runoff. The Liquid Discharge Management Plan(s) must be for the protection of the Commonwealth marine area and habitat for listed species in Darwin Harbour and must:	This EP
a) identify all sources of liquid discharge;	Table 3-6 and Section 7.1.3 of this EP

Relevant EPBC 2008/4208 Ministerial Conditions	Location in Environment Plan submission
b) describe any impacts associated with the discharge of liquids, including the cumulative impacts associated with the discharge of sewerage;	Section 7.1.3 of this EP
c) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these;	Section 7.1.3 of this EP
d) outline measures to avoid impacts;	
e) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts;	
f) demonstrate how any discharges into Darwin Harbour are consistent with the guidelines for discharges, and the water quality objectives for Darwin Harbour, developed under the National Water Quality Management Strategy;	N/A
g) identify all regulatory requirements relating to the discharge of liquids and how these will be met;	Table 2-1 and Section 7.1.3 of this EP
h) include a monitoring regime to determine achievement of objectives and success of measures used;	Section 7.1.3 and Sections 9.12 of this EP
i) outline reporting and auditing arrangements; and	Section 9.11 and Section 9.12 of this EP
j) describe how the plan will apply the principles of adaptive management.	Section 9.13 of this EP
The plan(s) must be submitted prior to the commencement of the relevant activity to which they apply. The relevant activity may not commence until the plan is approved. Separate Liquid Discharge Management plans can be submitted for the management of liquid discharges in the Commonwealth Marine Area and Darwin Harbour. The approved plan(s) must be implemented.	The accepted EP revision will be implemented as required under the OPGGS Act and OPGGS (E) Regulations.

Appendix B-
EPBC Protected Matters Search Report and Species Risk Evaluation

APPENDIX B: EPBC ACT PROTECTED MATTERS REPORTS AND SPECIES RISK EVALUATION

B.1 EPBC Act protected matters report –WA-50-L and PEZ

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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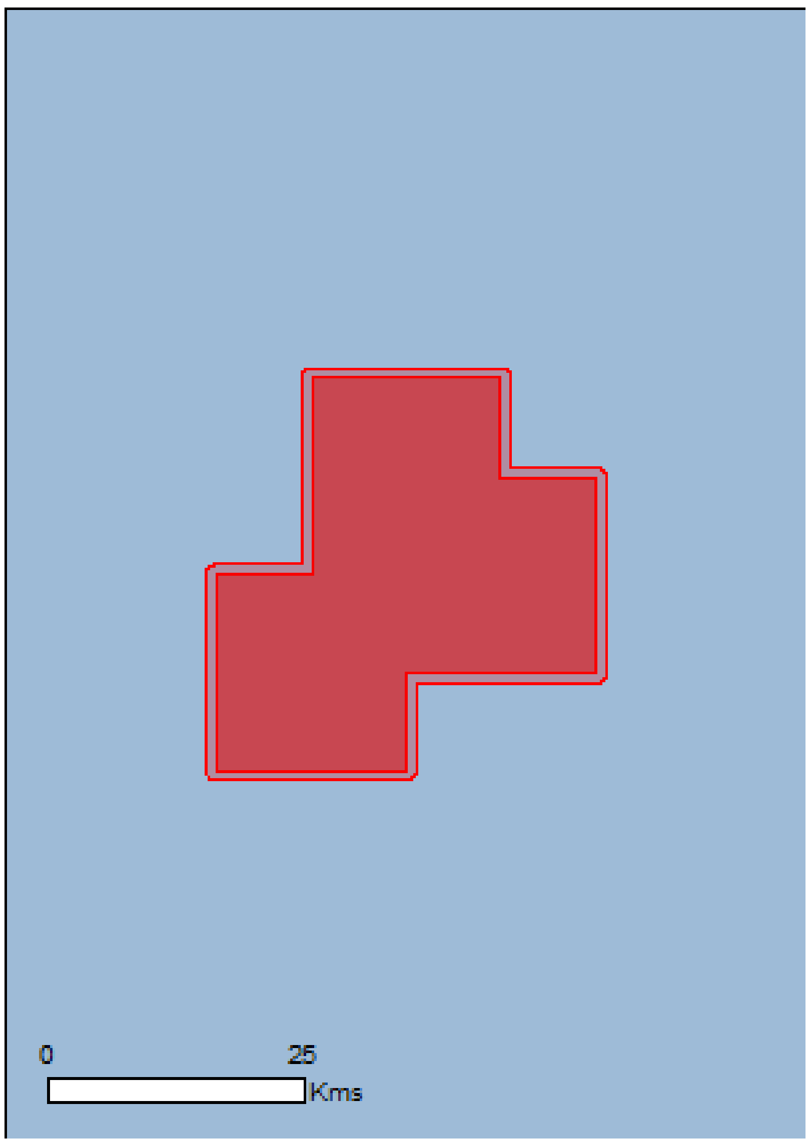

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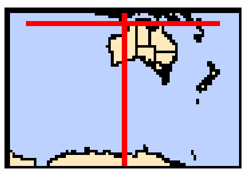

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	19
Listed Migratory Species:	32

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	61
Whales and Other Cetaceans:	22
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	1

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Foraging, feeding or related behaviour likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Continental Slope Demersal Fish Communities	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-13.747 123.085,-13.747 123.251,-13.832 123.251,-13.832 123.335,-13.999 123.335,-13.999 123.168,-14.082 123.168,-14.082 123.001,-13.915 123.001,-13.915 123.085,-13.747 123.085

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government

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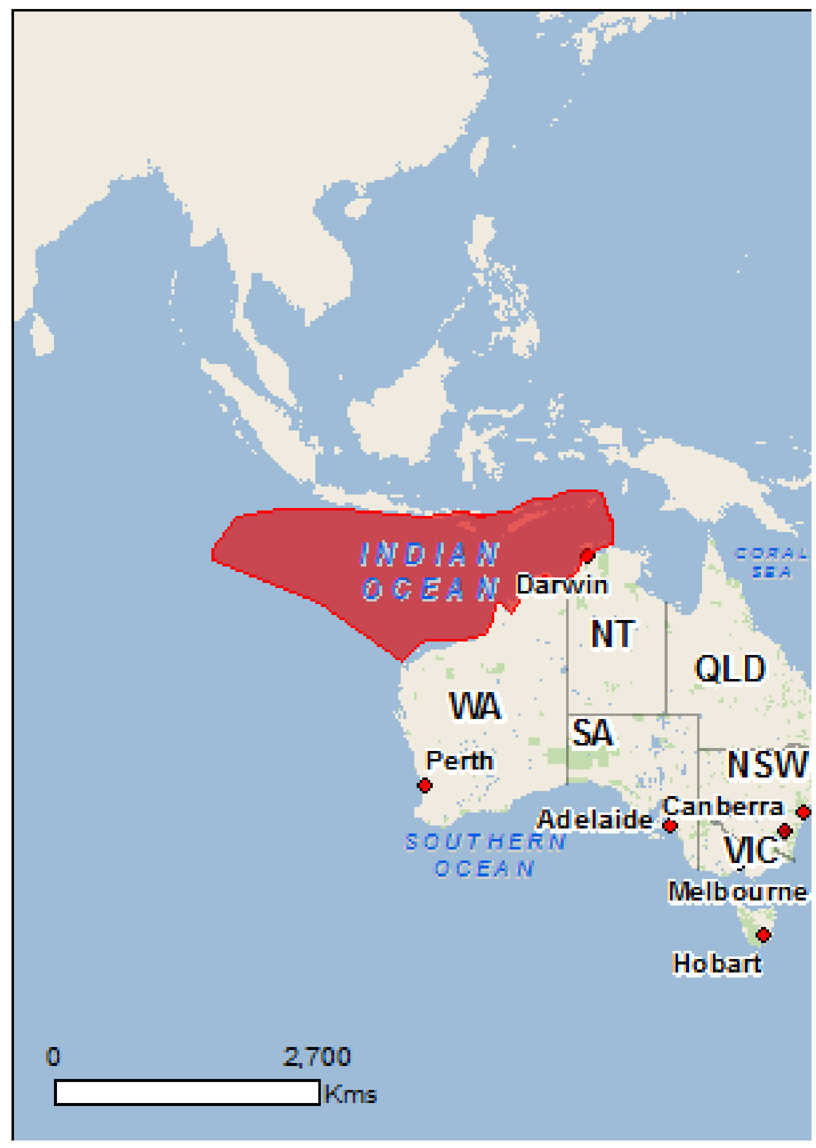
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

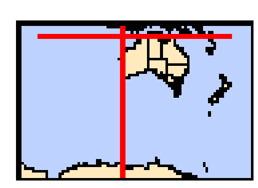
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 28/06/21 16:31:18



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	7
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	91
Listed Migratory Species:	93

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	8
Commonwealth Heritage Places:	37
Listed Marine Species:	167
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	2
Australian Marine Parks:	22

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	36
Regional Forest Agreements:	None
Invasive Species:	43
Nationally Important Wetlands:	13
Key Ecological Features (Marine)	15

Details

Matters of National Environmental Significance

National Heritage Properties
[Resource Information]

Name	State	Status
Natural		
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar)
[Resource Information]

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site
Cobourg peninsula	Within Ramsar site
Eighty-mile beach	Within Ramsar site
Hosnies spring	Within Ramsar site
Pulu keeling national park	Within Ramsar site
Roebuck bay	Within Ramsar site
The dales	Within Ramsar site

Commonwealth Marine Area
[Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions
[Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North
North-west

Listed Threatened Ecological Communities
[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area

Listed Threatened Species
[Resource Information]

Name	Status	Type of Presence
Birds		
Accipiter hiogaster natalis		
Christmas Island Goshawk [82408]	Endangered	Species or species habitat known to occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Chalcophaps indica natalis Christmas Island Emerald Dove, Emerald Dove (Christmas Island) [67030]	Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Epthianura crocea tunneyi Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat known to occur within area
Hypotaenidia philippensis andrewsi Buff-banded Rail (Cocos (Keeling) Islands), Ayam Hutan [88994]	Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092]	Critically Endangered	Species or species habitat known to occur within area
Mirafra javanica melvillensis Horsfield's Bushlark (Tiwi Islands) [81011]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Ninox natalis Christmas Island Hawk-Owl, Christmas Boobook [66671]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Breeding likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat known to occur within area
Pterodroma arminjoniana Round Island Petrel, Trinidade Petrel [89284]	Critically Endangered	Breeding likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Turdus poliocephalus erythropleurus Christmas Island Thrush [67122]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat known to occur within area
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat known to occur within area
Mammals		
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Crocidura trichura Christmas Island Shrew [86568]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesembriomys gouldii gouldii Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat known to occur within area
Mesembriomys gouldii melvillensis Black-footed Tree-rat (Melville Island) [87619]	Vulnerable	Species or species habitat known to occur within area
Petrogale concinna canescens Nabarlek (Top End) [87606]	Endangered	Species or species habitat may occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	Vulnerable	Species or species habitat known to occur within area
Pteropus natalis Christmas Island Flying-fox, Christmas Island Fruit-bat [87611]	Critically Endangered	Roosting known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Sminthopsis butleri Butler's Dunnart [302]	Vulnerable	Species or species habitat known to occur within area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat known to occur within area
Plants		
Asplenium listeri Christmas Island Spleenwort [65865]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Burmannia sp. Bathurst Island (R.Fensham 1021) [82017]	Endangered	Species or species habitat likely to occur within area
Eucalyptus ceracea Seppelt Range Gum [3889]	Vulnerable	Species or species habitat known to occur within area
Hoya australis subsp. oramicola a vine [55436]	Vulnerable	Species or species habitat known to occur within area
Mitrella tiwiensis a vine [82029]	Vulnerable	Species or species habitat likely to occur within area
Pneumatopteris truncata fern [68812]	Critically Endangered	Species or species habitat known to occur within area
Seringia exastia Fringed Fire-bush [88920]	Critically Endangered	Species or species habitat known to occur within area
Tectaria devexa [14767]	Endangered	Species or species habitat likely to occur within area
Typhonium jonesii a herb [62412]	Endangered	Species or species habitat known to occur within area
Typhonium mirabile a herb [79227]	Endangered	Species or species habitat known to occur within area
Xylopia monosperma a shrub [82030]	Endangered	Species or species habitat known to occur within area
Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Cryptoblepharus egeriae Christmas Island Blue-tailed Skink, Blue-tailed Snake-eyed Skink [1526]	Critically Endangered	Species or species habitat likely to occur within area
Cryptoblepharus gurrmul Arafura Snake-eyed Skink [83106]	Endangered	Species or species habitat known to occur within area
Cyrtodactylus sadleiri Christmas Island Giant Gecko [86865]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Lepidodactylus listeri		
Christmas Island Gecko, Lister's Gecko [1711]	Critically Endangered	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Ramphotyphlops exocoeti		
Christmas Island Blind Snake, Christmas Island Pink Blind Snake [1262]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Breeding likely to occur within area
Glyphis glyphis		
Speartooth Shark [82453]	Critically Endangered	Species or species habitat known to occur within area
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Breeding known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat may occur within area
Ardenna pacifica		
Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	Breeding known to occur

Name	Threatened	Type of Presence
[68442]		within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica		
Red-rumped Swallow [80610]		Species or species habitat known to occur within area
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta		
Long-toed Stint [861]		Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Charadrius dubius Little Ringed Plover [896]		Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa incana Wandering Tattler [831]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Government Solicitor
Commonwealth Land - Christmas Island National Park
Commonwealth Land - Pulu Keeling National Park
Defence - MT GOODWIN RADAR SITE
Defence - NORFORCE DEPOT - DERBY
Defence - QUAIL ISLAND BOMBING RANGE
Defence - YAMPI SOUND TRAINING AREA

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Christmas Island Natural Areas	EXT	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
North Keeling Island	EXT	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place
Yampi Defence Area	WA	Listed place
Indigenous		
Boulder Hill West Area	WA	Within listed place
Oombalai Area	WA	Within listed place
Historic		
Administration Building Forecourt	EXT	Listed place
Administrators House Precinct	EXT	Listed place
Bungalow 702	EXT	Listed place
Captain Ballards Grave	EXT	Listed place
Direction Island (DI) Houses	EXT	Listed place
Drumsite Industrial Area	EXT	Listed place
Early Settlers Graves	EXT	Listed place
Government House	EXT	Listed place
Home Island Cemetery	EXT	Listed place
Home Island Foreshore	EXT	Listed place
Home Island Industrial Precinct	EXT	Listed place
Industrial and Administrative Group	EXT	Listed place
Malay Kampong Group	EXT	Listed place
Malay Kampong Precinct	EXT	Listed place
Oceania House and Surrounds	EXT	Listed place

Name	State	Status
Old Co-op Shop (Canteen)	EXT	Listed place
Phosphate Hill Historic Area	EXT	Listed place
Poon Saan Group	EXT	Listed place
Qantas Huts (former)	EXT	Listed place
RAAF Memorial	EXT	Listed place
Settlement Christmas Island	EXT	Listed place
Six Inch Guns	EXT	Listed place
Slipway and Tank	EXT	Listed place
South Point Settlement Remains	EXT	Listed place
Type 2 Residences	EXT	Listed place
Type T Houses Precinct	EXT	Listed place
West Island Elevated Houses	EXT	Listed place
West Island Housing Precinct	EXT	Listed place
West Island Mosque	EXT	Listed place

Listed Marine Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous minutus		
Black Noddy [824]		Breeding known to occur within area
Anous stolidus		
Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Calidris subminuta Long-toed Stint [861]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Charadrius dubius Little Ringed Plover [896]		Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Foraging, feeding or related behaviour known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area

Name	Threatened	Type of Presence
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Roosting known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area

Name	Threatened	Type of Presence
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys sculptus Sculptured Pipefish [66197]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish [66209]		Species or species habitat may occur within area
Doryrhamphus baldwini Redstripe Pipefish [66718]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish [66222]		Species or species habitat may occur within area
Halicampus mataafae Samoan Pipefish [66223]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish [66232]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		

Name	Threatened	Type of Presence
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus fuscus Dusky Seasnake [1119]		Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
[Hydrelaps darwiniensis](#) Black-ringed Seasnake [1100]		Species or species habitat may occur within area
[Hydrophis atriceps](#) Black-headed Seasnake [1101]		Species or species habitat may occur within area
[Hydrophis coggeri](#) Slender-necked Seasnake [25925]		Species or species habitat may occur within area
[Hydrophis czeblukovi](#) Fine-spined Seasnake [59233]		Species or species habitat may occur within area
[Hydrophis elegans](#) Elegant Seasnake [1104]		Species or species habitat may occur within area
[Hydrophis inornatus](#) Plain Seasnake [1107]		Species or species habitat may occur within area
[Hydrophis mcdowelli](#) null [25926]		Species or species habitat may occur within area
[Hydrophis ornatus](#) Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
[Hydrophis pacificus](#) Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
[Lapemis hardwickii](#) Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
[Lepidochelys olivacea](#) Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
[Parahydrophis mertoni](#) Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
[Pelamis platurus](#) Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
[Balaenoptera acutorostrata](#) Minke Whale [33]		Species or species habitat may occur within area
[Balaenoptera bonaerensis](#) Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Foraging, feeding or

Name	Status	Type of Presence
		related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area

Name	Status	Type of Presence
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Commonwealth ReservesTerrestrial [Resource Information]

Name	State	Type
Christmas Island	EXT	National Park (Commonwealth)
Pulu Keeling	EXT	National Park (Commonwealth)

Australian Marine Parks [Resource Information]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Arafura	Special Purpose Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Multiple Use Zone (IUCN VI)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Kimberley	Habitat Protection Zone (IUCN IV)
Kimberley	Multiple Use Zone (IUCN VI)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)

Name	Label
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)
Roebuck	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Adele Island	WA
Balanggarra	WA
Bardi Jawi	WA
Bedout Island	WA
Browse Island	WA
Channel Point	NT
Coulomb Point	WA
Dambimangari	WA
Garig Gunak Barlu	NT
Jinmarnkur	WA
Jinmarnkur Kulja	WA
Karajarri	WA
Lacepede Islands	WA
Lawley River	WA
Lesueur Island	WA
Low Rocks	WA
Marri-Jabin (Thamurrurr - Stage 1)	NT
Mitchell River	WA
Niiwalarra Islands	WA
Prince Regent	WA
Swan Island	WA
Tanner Island	WA
Unnamed WA28968	WA
Unnamed WA37168	WA
Unnamed WA41775	WA
Unnamed WA44669	WA
Unnamed WA44672	WA
Unnamed WA44673	WA
Unnamed WA44677	WA
Unnamed WA51162	WA
Unnamed WA51932	WA
Unnamed WA52354	WA
Unnamed WA53015	WA
Uunguu	WA
Yampi	WA
Yawuru	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		

Name	Status	Type of Presence
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Gallus gallus Red Junglefowl, Feral Chicken, Domestic Fowl [917]		Species or species habitat likely to occur within area
Gallus varius Green Junglefowl [81207]		Species or species habitat likely to occur within area
Lonchura oryzivora Java Sparrow [59586]		Species or species habitat likely to occur within area
Meleagris gallopavo Wild Turkey [64380]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos javanicus Banteng, Bali Cattle [15]		Species or species habitat likely to occur within area
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Rattus exulans Pacific Rat, Polynesian Rat [79]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Mimosa pigra Mimosa, Giant Mimosa, Giant Sensitive Plant, ThornySensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pennisetum polystachyon Mission Grass, Perennial Mission Grass,		Species or species

Name	Status	Type of Presence
Missiongrass, Feathery Pennisetum, Feather Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194]		habitat likely to occur within area
Prosopis spp.		
Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lepidodactylus lugubris		
Mourning Gecko [1712]		Species or species habitat likely to occur within area
Lycodon aulicus		
Wolf Snake, Common Wolf Snake, Asian Wolf Snake [83178]		Species or species habitat likely to occur within area
Lygosoma bowringii		
Christmas Island Grass-skink [1312]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat known to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
"The Dales", Christmas Island	EXT
Ashmore Reef	EXT
Big Springs	WA
Bunda-Bunda Mound Springs	WA
Cobourg Peninsula System	NT
Finniss Floodplain and Fog Bay Systems	NT
Hosine's Spring, Christmas Island	EXT
Mermaid Reef	EXT
Mitchell River System	WA
Prince Regent River System	WA
Pulu Keeling National Park	EXT
Willie Creek Wetlands	WA
Yampi Sound Training Area	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North
Tributary Canyons of the Arafura Depression	North
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Carbonate bank and terrace system of the Sahul	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Pinnacles of the Bonaparte Basin	North-west

Name	Region
Seringapatam Reef and Commonwealth waters in	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-21.56 113.66,-16.49 106.049,-12.655 96.3927,-11.818 96.323,-8.715 98.4496,-8.088 102.563,-8.123 108.559,-8.332 110.337,-8.692 113.421,-8.742 115.839,-8.572 117.378,-8.309 119.513,-8.703 120.79,-8.626 122.266,-8.453 122.759,-8.376 123.192,-8.4 123.423,-8.352 123.651,-8.243 123.814,-8.086 124.085,-7.664 125.142,-7.151 125.745,-7.125 127.172,-6.425 129.314,-6.483 131.413,-6.726 132.113,-7.297 132.384,-9.368 133.182,-11.184 133.152,-11.78 131.67,-12.106 131.078,-12.471 130.483,-12.628 130.417,-12.658 130.372,-12.661 130.337,-12.919 130.203,-12.962 130.176,-13.07 130.165,-13.186 130.143,-13.581 129.915,-13.886 129.68,-14.289 129.06,-14.36 127.793,-14.211 126.851,-14.876 125.6,-17.4368 123.754,-16.497 122.822,-16.834 122.403,-18.232 122.151,-19.388 121.337,-19.807 119.387,-19.682 117.525,-19.682 116.879,-19.747 116.574,-20.087 115.4,-20.732 114.718,-21.284 114.046,-21.56 113.66

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- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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B.2 EPBC-listed species risk evaluation table

This table was developed by:

- Searching the Species Profile and Threats Database (SPRAT) (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl) for every species identified in the EPBC Act Protected Matters searches related to this EP (WA-50-L and PEZ).
- Through the SPRAT database, identifying the relevant conservation management documents.
- Determining the relevant aspects / threats from the conservation management documents related to the activity
- Listing where the aspect / threat has been addressed in the EP.

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
EPBC-listed fishes and sharks	Whale shark management. 2013. Wildlife management program no. 57. Department of Parks and Wildlife. State of Western Australia. Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Rhincodon typus (whale shark). Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities. 2013. Recovery Plan for the White Shark (Carcharodon carcharias). Commonwealth of Australia. Threatened Species Scientific Committee. 2014. Approved Conservation Advice for Glyphis garricki (northern river shark). Commonwealth of Australia. Threatened Species Scientific Committee. 2009. Commonwealth Conservation Advice on Pristis clavata (Dwarf Sawfish). Commonwealth of Australia. Threatened Species Scientific Committee. 2008. Approved Conservation Advice for Pristis zijsron (Green Sawfish). Commonwealth of Australia. Department of the Environment. 2015. Sawfish and River Sharks - Multispecies Recovery Plan. Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. Threatened Species Scientific Committee. 2014. Approved Conservation Advice for Glyphis glyphis (speartooth shark). Commonwealth of Australia. Recovery Plan for the Grey Nurse Shark (Carcharias taurus) (2014)	• Waste / marine debris • Noise and vibration • Introduced Marine Species • Vessel strike • Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill	• Identify populations and areas of high conservation priority (sawfishes). • Ensure there is no anthropogenic disturbance / implement measures to reduce adverse impacts of habitat degradation and/or modification (northern river shark). • Ensure all future developments will not significantly impact upon sawfish and river shark habitats critical to the survival of the species or impede upon the migration of individual sawfish or river sharks. Implement measures to reduce adverse impacts of habitat degradation and/or modification. • Review and assess the potential threat of introduced species, pathogens and pollutants. • Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations (Ningaloo Reef,) and along the northward migration route that follows the northern WA coastline along the 200 m isobath. • Contribute to the long-term prevention of the incidence of harmful marine debris.	• EP Section 7.2 – Waste management • EP Section 7.3 - Noise and vibration • EP Section 7.4.1 - Introduction of invasive marine species • EP Section 7.4.2 - Interaction with marine fauna • EP Section 7.5 - Seabed disturbance • EP Section 7.1.3 - Routine discharges • EP Section 8 - Emergency conditions (oil spills).

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
EPBC-listed marine reptiles	Department of the Environment and Energy 2017. Recovery Plan for Marine Turtles in Australia, Commonwealth of Australia 2017. Threatened Species Scientific Committee. 2011. Commonwealth Conservation Advice on Aipysurus apraefrontalis (Short-nosed Seasnake). Commonwealth of Australia. Threatened Species Scientific Committee. 2011. Commonwealth Conservation Advice on Aipysurus foliosquama (Leaf-scaled Seasnake). Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. Department of the Environment and Energy. 2020. Light pollution guidelines – National light pollution guidelines for wildlife: Including marine turtles, seabirds and migratory shorebirds. Commonwealth of Australia, Canberra, ACT. Department of the Environment and Energy. 2017. National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Fauna. Commonwealth of Australia, Canberra, ACT.	• Waste / marine debris • Noise and vibration • Introduced Marine Species • Vessel strike • Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill • Light emissions	• Manage artificial light from onshore and offshore sources to ensure biologically important behaviours of nesting adults and dispersing hatchlings can continue. • Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats and implementation of best practice light management guidelines for developments adjacent to marine turtle nesting beaches. • Identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution. • Support retrofitting of lighting at coastal communities and industrial developments, including imposing restrictions around nesting seasons. • Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical for survival. • Contribute to the reduction in the source of marine debris. • Ensure that spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to slow to recover habitats, e.g. seagrass meadows or corals. • Implement best practices to minimise impacts to turtle health and habitats from chemical discharges. • Identify populations and areas of high conservation priority (sea snakes). • Ensure there is no anthropogenic disturbance / implement measures to reduce adverse impacts of habitat degradation and/or modification (sea snakes). • Increased reporting of vessel collision (a requirement of the EPBC Act). • Reduce risk of collision with cetaceans (and turtles) such as maintaining look out, consider reducing vessel speed and course alterations away from sightings.	• EP Section 7.1.2 - Light emissions • EP Section 7.2 – Waste management • EP Section 7.3 - Noise and vibration • EP Section 7.4.1 - Introduction of invasive marine species • EP Section 7.4.2 - Interaction with marine fauna • EP Section 7.5 - Seabed disturbance • EP Section 7.1.3 - Routine discharges • EP Section 8 - Emergency conditions (oil spills).
EPBC-listed seabirds and	Department of the Environment. 2015. EPBC Act Policy Statement 3.21 - Industry guidelines for	• Waste / marine debris • Noise and vibration	• Reduce risk of rodents gaining access to key vessels at key ports	• EP Section 7.1.1 - Emissions to air • EP Section 7.1.2 - Light emissions • EP Section 7.2. – Waste management

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
shorebirds	avoiding, assessing and mitigating impacts on EPBC listed migratory shorebird species. Department of the Environment. 2015. Wildlife conservation plan for migratory shorebirds. Commonwealth of Australia. Department of the Environment. 2015. Draft referral guideline for 14 birds listed as migratory under the EPBC Act. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities. 2012. Species group report card - seabirds and migratory shorebirds. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia. Department of the Environment, Water, Heritage and the Arts. 2009. Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares. Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. Threatened Species Scientific Committee. 2016. *Calidris tenuirostris* (Great Knot) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. *Calidris canutus* (Red Knot) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. *Charadrius leschenaultii* (Greater Sand Plover)	• Introduced Marine Species • Introduced Terrestrial Pests (rodents) • Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill • Light emissions	• Contribute to the long-term prevention of the incidence of harmful marine debris • Identify threats to important (migratory shorebird) habitat and develop conservation measures for managing them. • Avoid degradation of migratory shorebird habitat that may occur through the introduction of exotic species, changes to hydrology or water quality (including toxic inflows), fragmentation of habitat or exposure to litter, pollutants and acid sulphate soils. Minimise human disturbance, a major threat to migratory shorebirds • Best practice waste management should be implemented.	• EP Section 7.3 - Noise and vibration • EP Section 7.4.1 - Introduction of invasive marine species • EP Section 8 - Emergency conditions (oil spills) • EP Section 7.1.3 - Routine discharges.

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
	Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. *Charadrius mongolus* (Lesser Sand Plover) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. *Fregata andrewsi* (Christmas Island Frigatebird) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. *Hypotaenidia philippensis andrewsi* (Buff-banded Rail) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2016. *Limosa lapponica menzbieri* — Northern Siberian Bar-tailed Godwit. Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2015. *Calidris ferruginea* (Curlew Sandpiper) Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2001. Commonwealth listing advice on *Macronectes giganteus.* Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Papasula abbotti — Abbott's Booby. Approved Conservation Advice. Commonwealth of Australia. Department of the Environment. 2015. Conservation advice *Numenius madagascariensis* (eastern curlew). Commonwealth of Australia. Department of the Environment. 2014. Conservation Advice *Phaethon lepturus fulvus* white-tailed tropicbird (Christmas Island) Commonwealth of Australia. Threatened Species Scientific Committee. 2015. *Pterodroma arminjoniana* — Round IslandPetrel. Approved Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2015. *Pterodroma mollis* — Soft-plumaged petrel. Approved Conservation Advice. Commonwealth of Australia.			

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
	Threatened Species Scientific Committee. 2015. Approved Conservation Advice for *Anous tenuirostris melanops* (Australian lesser noddy). Commonwealth of Australia. Threatened Species Scientific Committee. 2002. Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (western Pacific)). Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities. 2013. Approved Conservation Advice for *Rostratula australis* (Australian painted snipe). Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities. 2011. Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern). Canberra, ACT. Department of the Environment and Energy. 2020. Light pollution guidelines – National light pollution guidelines for wildlife: Including marine turtles, seabirds and migratory shorebirds. Commonwealth of Australia, Canberra, ACT. Draft National Recovery Plan for albatrosses and petrels. 2021. Commonwealth of Australia.			
EPBC-listed cetaceans	Department of the Environment. 2015. Conservation Management Plan for the Blue Whales - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 (2015-2025). Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Balaenoptera borealis (Sei Whale) Conservation Advice. Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Megaptera novaeangliae (humpback whale). Commonwealth of Australia. Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Balaenoptera physalus — Fin Whale. Commonwealth of Australia. EPBC Act Regulations 2000. Part 8 Interacting with cetaceans and whale watching. Division 8.1	• Waste / marine debris • Noise and vibration • Introduced Marine Species • Vessel strike • Benthic habitat degradation / seabed disturbance • Emissions and discharges • Oil spill	• Ensure all vessel strike incidents are reported in the National Ship Strike Database. • Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented. • Protect habitat important to the survival of the species (humpback whales); assess and manage physical disturbance and development activities (such as ship-strike and pollution). • Ensure the risk of vessel strike on humpback whales is considered when assessing actions that increase vessel traffic in areas where humpback whales occur and, if required appropriate mitigation measures are implemented to reduce the risk of vessel strike.	• EP Section 7.2 – Waste Management • EP Section 7.3 - Noise and Vibration • EP Section 7.4.1 - Introduction of invasive marine species • EP Section 7.4.2 - Interaction with marine fauna • EP Section 7.5 - Seabed disturbance • EP Section 7.1.3 - Routine discharges • EP Section 8 - Emergency conditions (oil spills).

Fauna Type	Conservation management documents	Summary of relevant aspects/threats identified from conservation management documents	Summary of relevant actions from conservation management documents	Relevant exposure / risk evaluation section of EP
	Interacting with cetaceans. Commonwealth of Australia. Department of the Environment and Heritage, 2005. Australian National Guidelines for Whale and Dolphin Watching - Information Sheet. Commonwealth of Australia. Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT. Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. Department of the Environment and Energy. 2017. National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Fauna. Commonwealth of Australia, Canberra, ACT.		• Environmental assessment processes must ensure that existing information about coastal habitat requirements of humpback whales, environmental suitability of coastal locations, historic high use and emerging areas are taken into consideration. • Contribute to the long-term prevention of the incidence of harmful marine debris . • if a whale or dolphin surfaces in the vicinity of a vessel travelling for a purpose other than whale and dolphin watching, take all care necessary to avoid collisions. This may include stopping, slowing down and/or steering away from the animal. • Increased reporting of vessel collision (a requirement of the EPBC Act). • Reduce risk of collision with cetaceans (and turtles) such as maintaining look out, consider reducing vessel speed and course alterations away from sightings.	

Appendix C-
Stakeholder consultation log

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Authorities					
Australian Border Force (ABF), Broome and Darwin Offices (Cwth)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Australian Border Force (ABF), Canberra Office (Cwth)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Australian Fisheries Management Authority (AFMA) (Cwth)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Australian Hydrographic Office (AHO)- Department of Defence	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Australian Maritime Safety Authority (AMSA) - Nautical Advice (Cwth)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	11/03/2021	Email / letter from stakeholder	Response received from officer at AMSA Connect confirming receipt. Confirmed AMSA has no concerns with the proposed activity. Requested that INPEX ensure timely and relevant Maritime Safety Information, including: (1) Contact AHO no less than four working weeks before operations for promulgation of the appropriate Notice to Mariners. (2) Notify AMSA's Join Rescue Coordination Centre (JRCC) by email or phone for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. (3) INPEX should plan to provide updates to both AHO and the JRCC on progress and any changes to the intended operations. Reminded INPEX to exhibit appropriate lights and shapes to reflect the nature of operations in accordance with COLREGS requirements.	Yes - activity fact sheet	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. Note the operations of the Facility are ongoing and AHO and JRCC notifications were notified when the activity commenced in 2017, and as such are not applicable. If there are any changes to intended operations INPEX will notify JRCC and AHO. Vessel light navigation lighting is managed in accordance with the Navigation Act and associated Marine Orders, which align with COLREGS requirements. This information has been incorporated into Table 7-5, Table 7-35, Table 8-7 and Section 9.8.3 of the EP. The stakeholder raised no concerns or objections regarding the activity.
	11/03/2021	Email / letter to stakeholder from INPEX	INPEX thanked stakeholder for feedback and ensured the relevant notifications will be made at the appropriate times to conduct work safely in the area.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Australian Maritime Safety Authority (AMSA) - Marine Environment Pollution Response (Cwth)	11/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Department of Agriculture, Water and Environment (DAWE) – Biosecurity (Marine Pests) (Vessels, aircraft and personnel) (Cwth)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Authorities					
Department of Agriculture, Water and Environment (DAWE) – Ichthys Project officer	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Department of Agriculture, Water and Environment (DAWE) Fisheries	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	31/03/2021	Email / letter from stakeholder	The Department of Agriculture, Water and the Environment's Petroleum & Fisheries noted consultation required by the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009. The Department requested to be informed of future developments relating to this project. The Department requested that future developments be communicated with the Australian Fisheries Management Authority at petroleum@afma.gov.au and the relevant fishing industry representation organisations in that region.	No	Relevant matter - stakeholder has requested to remain informed of other project activities. The stakeholder raised no concerns or objections regarding the activity.
	31/03/2021	Email / letter to stakeholder from INPEX	INPEX confirmed that a similar communication was sent to Petroleum@afma.gov.au, and engaged with WAFIC for support with required consultation of the relevant fishery industry representation.	No	N/A - consultation sent by INPEX
Department of Biodiversity Conservation and Attractions (DBCA) - Environmental Management Branch (WA)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	23/03/2021	Email / letter from stakeholder	Thanked INPEX for providing the Department of Biodiversity, Conservation and Attractions (DBCA) with the attached information in relation to INPEX's upcoming activities in WA-50-L within Commonwealth waters. Advised that DBCA has undertaken a review of the documentation provided and other readily available information, and provides the following comments in relation to its responsibilities under the Conservation and Land Management Act 1984 and Biodiversity Conservation Act 2016. Advised that there are a number of ecologically important areas including marine parks and island/coastal conservation reserves located in the vicinity of the proposed operations, including the Browse Island Nature Reserve and the Scott Reef Nature Reserve. Based on the information provided it appears that there is potential for these areas to be affected by INPEX's operations if there is a substantial hydrocarbon release and subject to particular weather or other environmental conditions. Given the ecological importance of areas potentially affected by a hydrocarbon release from the proposed activities, it is considered important that the baseline values and state of the potentially affected environment are appropriately understood and documented prior to any operations commencing that pose a significant risk of impacting these areas. DBCA advised it would like to have confidence that INPEX maintains appropriate baseline survey data on the important ecological values of these areas and any current contamination if present within the area of potential impact of spills (as identified through INPEX's modelling). Following a desktop review and risk assessment, INPEX should also collect appropriate baseline abundance and distribution data for any threatened and specially protected marine fauna species in the area of potential impact, including information on the key habitats these species use for activities like foraging, breeding and aggregating. If baseline information is not available, INPEX should thoroughly assess what baseline information is required commensurate with the level of risk associated with the proposed activities, and identify suitable sources/methods to attain that information such that INPEX can ensure that any impacts on ecological values and recovery of these values can be monitored and remediated. DBCA advised it undertakes monitoring in marine parks and reserves and publishes monitoring reports which are available on the department's website. However, INPEX should be aware that this monitoring is targeted to inform DBCA's values and objectives relating to marine park management and is not necessarily suitable to provide all baseline information required for oil spill risk assessment and management planning. DBCA encouraged INPEX to ensure it attains all information required to implement a Before-After, Control-Impact (BACI) framework in planning its management response. This may include independently monitoring and collecting data where required or identifying other data sources. In reviewing its Environmental Plan/s, DBCA recommended that INPEX refer to the Commonwealth Department of Agriculture, Water and the Environment's National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds as a best-practice industry standard for managing potential impacts of light pollution on marine fauna (https://www.environment.gov.au/biodiversity/publications/national-light-pollution-guidelines-wildlife). INCIDENTS AND EMERGENCY RESPONSE In the event of a hydrocarbon release, DBCA requested that INPEX notify DBCA's Kimberley regional office as soon as practicable on (08) 9195 5500. DBCA noted that it will not implement an oiled wildlife management response on behalf of a petroleum operator except as part of a whole of government response mandated by regulatory decision makers, and any advice or assistance from DBCA, at any scale, will occur on a full cost recovery basis. Advised that INPEX should also commit to the monitoring and clean-up of any DBCA interests affected by an oil spill in consultation with DBCA. Noting the above, DBCA confirmed understanding that INPEX maintains Oil Pollution Emergency Plans developed in consultation with the Department of Transport and reviewed by NOPSEMA. Requested that INPEX continue to provide all future notifications to EMBAdmin@dbca.wa.gov.au.	No	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into Section 4 (Existing environment), Table 7-4 and Table 7-5 (light emissions) of the EP; and the BROPEP (Notifications, Section 4.5.2 - OWR and Section 4.7 - BROPEP). The stakeholder raised no concerns or objections regarding the activity.
	1/04/2021	Email / letter to stakeholder from INPEX	INPEX requested to meet with stakeholder to provide detail in relation to INPEX's Environmental management capabilities	No	N/A - consultation sent by INPEX
	15/04/2021	Email / letter to stakeholder from INPEX	INPEX provided the following summary of INPEX capabilities in relation to stakeholder feedback: **Topic 1 – baseline data** The INPEX facility (comprising the FPSO, CPF and subsea gathering system) have been connected in the Ichthys Field, Browse Basin since 2017 and in operations since July 2018. In 2014, prior to the arrival of the facility, a tri-party agreement known as the Applied Research Program (ARP) between INPEX, Shell and Australian Institute of Marine Science (AIMS) was signed specifically for the collection of baseline data to ensure sufficient data was available to quantify potential impacts should a significant hydrocarbon release occur. Over a six year period AIMS and its specialist subcontractors (Commonwealth Scientific and Industrial Research Organisation, Curtin University, Monash University, University of Western Australia, ChemCentre) undertook desktop reviews as well as designed and executed baseline monitoring programs specifically for assessing potential impacts of hydrocarbons, should a spill occur. This included more 20 field surveys to a range of ecological important areas such as Browse Island, Lacepede Islands, Adele Islands, Echuca Shoal and Heywood Shoal. The baseline data collected by the ARP is included in the existing environment section of the revised Offshore Facility (Operations) Environment Plan. As part of the Offshore Facility (Operations) Environment Plan revision, INPEX will also undertake a literature review for new information that can be included in the existing environment section and potential sources of baseline data. Since 2014 INPEX has maintained an Operational and Scientific Monitoring Program (OSMP) contract for its activities in the Browse Basin. This contract allows for the rapid deployment of scientific personnel to undertake a range of monitoring programs. Monitoring programs include: • Oil spill surveillance and trajectory modelling • Water and sediment quality, including ecotoxicity • Shoreline and intertidal benthos • Subtidal benthos • Plankton • Seabirds and shorebirds • Non-avian megafauna • Commercial, traditional and recreational fisheries	No	N/A - consultation sent by INPEX

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Authorities					
			Under the OSMP contract, a suite of method statements have been developed that identify methods and techniques that may be used in the event of a hydrocarbon spill to monitor hydrocarbons and detect potential impacts. However it is worth noting exact methods and program designs will be dependent on the nature and scale of the spill. Objectives, activation and termination criteria for each OSMP are detailed in the Offshore Facility (Operations) Oil Pollution Emergency Plan (OPEP). The OPEP also contains details of INPEX's other standby service arrangements including oil spill clean up and oiled wildlife response. Given the proximity to Browse Island, INPEX in consultation with WA DoT has also developed the Browse Island Oil Spill Incident Management Guide (Browse Island IMG). The Browse Island IMG includes assessment of response activities on the island and responsibilities for a cross jurisdictional response with WA DoT, as WA DoT are the control agency for responses in state waters (e.g. Browse Island). Topic 2 – Light pollution guideline INPEX has considered the guideline in the EP revision and makes reference to them in the ALARP assessments of light emissions in relation to marine fauna. Topic 3 – Notification process and oiled wildlife response INPEX will include the DBCA Kimberley office phone number on the INPEX Australia Emergency contacts list. INPEX will include this notification requirement within the Notifications section of INPEX's revised OPEP In all of INPEX's OPEPs, it is acknowledged that any spill/impact to WA waters/shorelines is managed under the WA State Hazard Plan – Maritime Environmental Emergencies, with the WA DoT currently nominated as the Control Agency. Therefore, any DBCA involvement in oiled wildlife response within WA waters/shorelines will only be under the direction of the WA DoT, as Control Agency. As required under the OPGGS Act and associated regulations, INPEX maintains financial assurance against oil spill events, ensuring adequate cost-recovery associated with oil spill response. INPEX includes monitoring of impacts, and determination of secondary response actions including shoreline clean-up and oiled wildlife response, and ongoing scientific monitoring post response termination, as part of all INPEX OPEPs. This includes all potentially impacted WA waters/shorelines, including all DBCA interests.		
	27/04/2021	Email / letter from stakeholder	Stakeholder thanked INPEX for providing required information and confirmed that they will contact environment team, or refer to EP, if further information is required.	No	Not a relevant matter - general correspondence only.
Department of Defence – Northern Command (DoD)	10/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Department of Foreign Affairs and Trade (DFAT)	10/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Department of Industry, Science, Energy and Resources (DISER)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Department of Mines, Industry Regulation and Safety (DMIRS) (WA)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	26/03/2021	Email / letter from stakeholder	Advised that DMIRS has reviewed the information provided relating to operations in the Ichthys field over the next five years and acknowledged that the matters will be regulated by NOPSEMA under the provisions of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009. Advised no further information is required at this stage but requested DMIRS is informed of any relevant updates.	No	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into Section 9.8.3 of the EP. The stakeholder raised no concerns or objections regarding the activity.
Department of Primary Industries and Regional Development (DPIRD) - Aquatic Environment section (WA)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	8/03/2021	Email / letter from stakeholder	Automatic email response advising stakeholder is not currently in Perth (returning soon); provided alternative contact number.	No	Not a relevant matter - general correspondence only.
Department of Primary Industries and Regional Development (DPIRD) - Biosecurity section formerly Department of Fisheries	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Inquired whether DPIRD would be interested in having a discussion to confirm that the text INPEX includes in the EP revision remains ALARP and acceptable to DPIRD. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Authorities					
	8/03/2021	Email / letter from stakeholder	DPIRD responded to confirm interest in discussing above mentioned biosecurity matters.	No	Not a relevant matter - general correspondence only. Note refer to ongoing specific activity/aspect engagement undertaken for the domestic biofouling risk assessment.
Department of Transport (WA DoT) – Marine Safety	11/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility:	Yes - activity fact sheet	N/A - consultation sent by INPEX
	11/03/2021	Email / letter from stakeholder	Stakeholder thanked INPEX for the notification.	No	Not a relevant matter - general correspondence only.
	12/03/2021	Email / letter from stakeholder	Stakeholder thanked INPEX for the notification in regards to the proposed Ichthys LNG field development activities. Stakeholder requested that if there are any changes to the corresponding Oil Pollution Emergency Plans or changes to the spill risk that may impact on State waters, for INPEX to please ensure that the Department of Transport is consulted in accordance with the requirements outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020).	No	Relevant matter - stakeholder has requested to be notified of activity commencement or other project activities. The stakeholder raised no concerns or objections regarding the activity.
	12/03/2021	Email / letter to stakeholder from INPEX	INPEX informed stakeholder that there are no changes to spill risks from our activities, or associated changes associated with risks to WA State Waters. INPEX advised it will be in touch as the OPEPs are updated for its Offshore Facility EP/OPEP and GEP EP/OPEP 5 year revision submissions to NOPSEMA later this year.	No	N/A - consultation sent by INPEX. Note refer to ongoing specific activity/aspect engagement undertaken for the BROPEP development.
	18/03/2021	Email / letter from stakeholder	Stakeholder thanked INPEX for response.	No	Not a relevant matter - general correspondence only.
Department of Water and Environmental Regulation (DWER) Hazard Management Branch Contaminated Sites Branch	11/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Indigenous Land and Sea Corporation (ILSC)	10/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Indonesian Ministry for Marine Affairs and Fisheries (MMAF)	10/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Kimberley Land Council (KLC)	10/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	10/03/2021	Email / letter from stakeholder	KLC confirmed internal lead for the activity/future correspondence.	No	Not a relevant matter - general correspondence only.
	11/03/2021	Email / letter to stakeholder from INPEX	INPEX confirmed receipt.	No	Not a relevant matter - general correspondence only.
NT Department of Industry, Tourism and Trade (DITT) - Fisheries	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
NT Department of Environment, Parks and Water Security (EPaWS) - NT EPA	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	8/03/2021	Email / letter from stakeholder	Automatic email confirming receipt.	N/A	Not a relevant matter - general correspondence only.

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Authorities					
NT Department of Industry, Tourism and Trade (DITT) - Mining and Energy	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
NT Department of Infrastructure, Planning and Logistics - Transport - Marine Safety Branch (DIPL)	11/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
National Native Title Tribunal (NNTT) (Cwth)	10/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
National Offshore Petroleum Titles Administrator (NOPTA)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	8/03/2021	Email / letter to stakeholder from INPEX	NOPTA responded confirming receipt of email and advised INPEX that NOPTA would discuss internally and follow up with any queries or other feedback.	No	Not a relevant matter - general correspondence only.
Northern Land Council (NLC)	10/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Office of the Director of National Parks (Cwth)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	12/03/2021	Email / letter from stakeholder	DNP thanked INPEX for providing the factsheet about Ichthys LNG offshore activities update from 2021 to 2025 for WA-50-L. Based on the factsheet provided and information contained in the existing WA-50-L environmental plan, DNP noted that the planned activities do not overlap any Australian Marine Parks and confirmed are no authorisation requirements from the DNP. DNP informed INPEX that to assist in the preparation of an EP for petroleum activities that may affect Australian marine parks, NOPSEMA has worked closely with Parks Australia to develop and publish a guidance note that outlines what titleholders need to consider and evaluate. DNP advised that when preparing the EP, INPEX should consider the Australian marine parks and their representativeness. DNP advised that in the context of the management plan objectives and values, INPEX should ensure that the EP: • identifies and manages all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level and has considered all options to avoid or reduce them to as low as reasonably practicable. • clearly demonstrates that the activity will not be inconsistent with the management plan. DNP advised that the North-west Marine Parks Network Management Plan 2018 (management plan) came into effect on 1 July 2018 and provides further information on values Ashmore Reef, Cartier Island and other Marine Parks located nearby or within potential any potential exposure zones. Australian marine park values are broadly defined into four categories: natural (including ecosystems), cultural, heritage and socio-economic. Information on the values for the marine parks is also located on the Australian Marine Parks Science Atlas. The DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24 hour Marine Compliance Duty Officer on 0419 293 465. The notification should include: • titleholder details • time and location of the incident (including name of marine park likely to be effected) • proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.) • confirmation of providing access to relevant monitoring and evaluation reports when available; and • contact details for the response coordinator. Noted that the DNP may request daily or weekly Situation Reports, depending on the scale and severity of the pollution incident.	No	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into Section 4 (Existing environment), Section 7 (Risk and impact evaluation) and Section 8 (Emergency conditions) of the EP, and oil/gas pollution notifications have been included in the BROPEP. The stakeholder raised no concerns or objections regarding the activity.
Business					

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Authorities					
Australian Marine Oil Spill Centre (AMOSC)	11/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	11/03/2021	Email / letter from stakeholder	Confirmed receipt. AMOSC noted the drilling of 15 planned wells from Q3 2020 through to 2023, and confirmed this will be noted by our Duty Officers. Requested INPEX inform AMOSC each time a new well is drilled, then AMOSC can focus the Duty Officers information for the timings that the well enters and then seals the reservoir(s).	No	Relevant matter - stakeholder has requested to be notified of activity commencement or other project activities. The stakeholder raised no concerns or objections regarding the activity.
	15/07/2021	Email / letter to stakeholder from INPEX	INPEX requested that AMOSC is just provided with our overall drilling program timeframes, instead of individual status of depths and risks for well. Awaiting response.	No	N/A - consultation sent by INPEX
	27/07/2021	Email / letter from stakeholder	AMOSC agreed that the simplest notification to AMOSC should be on the overall drilling program.	No	Relevant matter - stakeholder has requested to be notified of activity commencement or other project activities. Refer to Section 9.8.3 of the EP, where this notification has been included.
	28/07/2021	Email / letter to stakeholder from INPEX	INPEX thanked AMOSC and noted it would provide updates on drilling program schedules. INPEX noted that production drilling was continuing for the next two years through to 2023 at this stage.	No	N/A - consultation sent by INPEX
Darwin Port Operations Pty Ltd (a Landbridge company)	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
DNV GL Australia Pty Ltd.	25/05/2021	Email / letter from stakeholder	Following email exchange with DAWE - Biosecurity (Marine Pests), stakeholders shared with INPEX DNV checklists including fuel change over procedure and fuel change over record, stating that checklists are generic and may not be application to one or both of the facilities.	No	Not a relevant matter - general correspondence only.
	28/05/2021	Email / letter to stakeholder from INPEX	INPEX representative responded with complete feedback for both facilities (CFP and FPSO), and requested a call to discuss merging ideas into the equivalence 288 application and taking stakeholder through INPEX existing records.	No	N/A - consultation sent by INPEX
	2/06/2021	Email / letter to stakeholder from INPEX	INPEX representative followed up on meeting request.	No	N/A - consultation sent by INPEX
	3/06/2021	Email / letter from stakeholder	Stakeholder suggested time for meeting.	No	Not a relevant matter - general correspondence only.
	3/06/2021	Email / letter to stakeholder from INPEX	INPEX representative confirmed meeting date and time.	No	N/A - consultation sent by INPEX
	3/06/2021	Email / letter from stakeholder	Stakeholder added comments in preparation to scheduled meeting.	No	Not a relevant matter - general correspondence only.
	4/06/2021	Email / letter to stakeholder from INPEX	INPEX thanked stakeholder for their time at the meeting and recapped action item by providing Form 228 for review.	No	N/A - consultation sent by INPEX
	14/06/2021	Email / letter from stakeholder	Stakeholder provided recommendation and changes to reflect on From 288.	No	Not a relevant matter - general correspondence only.
	29/06/2021	Email / letter to stakeholder from INPEX	INPEX representative responded with Form 288 reflecting advised changes and confirming that INPEX reviewed documents.	Yes - 288 exemption FPSO (& CPF) Equivalence	N/A - consultation sent by INPEX
RPS Asia-Pacific Applied Science Associates (APASA)	11/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Oil Spill Response Limited (OSRL)	11/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Northern Territory Seafood Council (NTSC), represents: • Coastal Line Fishery • Demersal Fishery • Mud Crab Fishery • Offshore Net and Line Fishery • Spanish Mackerel Fishery • Trepang Fishery • Pearl Oyster Fishery • Squid Jigging Fishery • Northern Prawn Fishery (Cwth)	30/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
Pearl Producers Association of WA (PPAWA)	9/03/2021	Email / letter to stakeholder from WAFIC	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by WAFIC on behalf on INPEX

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Authorities					
Western Australian Fishing Industry Council (WAFIC) Represents stakeholders in: WA fisheries • Mackerel Managed Fishery • Northern Demersal Scalefish Fishery • West Coast Deep Sea Crustacean Managed Fishery • Northern Shark Fishery • Pearl Oyster Managed Fishery • Kimberley Prawn Managed Fishery Cwth fisheries • North West Slope Trawl Fishery • Western Tuna and Billfish Fisheries	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
WA Fisheries					
North West Slope Trawl Fishery	9/03/2021	Email / letter to stakeholders from WAFIC	Correspondence sent to 4 licence holders by WAFIC on behalf of INPEX.	Yes - activity fact sheet	N/A - consultation sent by WAFIC on behalf on INPEX
Northern Demersal Scalefish Managed Fishery	9/03/2021	Email / letter to stakeholders from WAFIC	Correspondence sent to 11 licence holders by WAFIC on behalf of INPEX.	Yes - activity fact sheet	N/A - consultation sent by WAFIC on behalf on INPEX
Pearl Oyster Managed Fishery	9/03/2021	Email / letter to stakeholders from WAFIC	Correspondence sent to 4 licence holders by WAFIC on behalf of INPEX.	Yes - activity fact sheet	N/A - consultation sent by WAFIC on behalf on INPEX
West Coast Deep Sea Crustacean	9/03/2021	Email / letter to stakeholders from WAFIC	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by WAFIC on behalf on INPEX
Joint Authority Fisheries					
Joint Authority Northern Shark Fishery (Cwth/WA) and North Coast Shark Fishery (WA)	9/03/2021	Email / letter to stakeholder from WAFIC	Correspondence sent to one licence holder by WAFIC on behalf of INPEX	Yes - activity fact sheet	N/A - consultation sent by WAFIC on behalf on INPEX
Joint Authority Northern Shark Fishery (Cwth/WA) and North Coast Shark Fishery (WA)	9/03/2021	Email / letter to WAFIC	Licence holder requested WAFIC fix the problem that they cant fish first.	No	Not a relevant matter - general correspondence only / not relevant to the activity.

SPECIFIC ACTIVITY/ASPECT ENGAGEMENT - INPEX BROWSE REGION OIL POLLUTION EMERGENCY PLAN

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
			Ashmore Reef / Cartier Island Control Agency Clarifications		
Australian Maritime Safety Authority (AMSA) - Marine Environment Pollution Response (Cwth) & Department of Transport (WA DoT) – Marine Safety *Subject - Ashmore/Cartier Island oil spill response*	29/06/2021	Email / letter to stakeholder from INPEX	Stakeholder sent email as part of INPEX's formal consultation under the OPGGS E Regulations, in relation to the Browse Regional OPEP which is being prepared to cover petroleum activities in the Timor Sea. INPEX's query relates specifically to oil spill response at Ashmore Reef and Cartier Island. INPEX advised that both these locations have been identified as locations in which INPEX's activities (as well as many other TH's activities) present a spill risk, possibly requiring shoreline / wildlife response under a worst-credible case scenario. INPEX's understanding is that these locations are both "Commonwealth Lands", and not clearly under the jurisdiction of the WA or NT government Control Agency responsibility under the WA SHP MEE, or NT OSCP. Advised that the in force OPEPs are somewhat confusing, in some spots stating that INPEX would/could be the Control Agency for shoreline response activities (e.g. SCAT, shoreline clean-up, Oiled Wildlife Response etc), or it could be delegated to other agencies, or conducted in parallel with AMSA. Advised that previous stakeholder consultation INPEX conducted has resulted in a range of statements regarding Ashmore Reef / Cartier Island – and INPEX is now trying to clearly understand the spill response command/control arrangements for Ashmore Reef and Cartier Island. Advised stakeholder of the current arrangements in INPEX's most recently accepted OPEPs. INPEX identified items that were not clear and requested if these could be clarified and a clear command/control agency structure established. INPEX suggested three potential options: 1. INPEX is the Control Agency for Ashmore/Cartier, and conducts shoreline response 'in consultation' with AMSA and or WA DoT/DBCA/DWER 2. INPEX is not the Control Agency, and AMSA takes over Control Agency for all shoreline response at Ashmore/Cartier 3. INPEX is not the Control Agency, and AMSA delegates Control Agency, via the WA DEWR, to WA DoT (and OWR done by WA DBCA, under WA DoT). Or some other combination of the above.	No	N/A - consultation sent by INPEX
	23/07/2021	Email / letter from stakeholder	AMSA consulted DAWE and NOPSEMA. Outcome, advised by AMSA that the Department of Infrastructure, Transport, Regional Development and Communications is responsible for administration of the Indian Ocean Territories, including Ashmore Reef and Cartier Island. In addition, DAWE has responsibility over the marine parks. Titleholder, under the OPGGS Act 2006, is the Control Agency, including for spill response on Commonwealth lands. Therefore, TH must consult with the relevant Cwlth government agencies during spill response at these locations. WA Dot were copied in but did not provide specific response to this item.	No	Relevant matter- outcomes incorporated into the BROPEP documentation.
			Regional OPEP Development		
Department of Biodiversity Conservation and Attractions (DBCA) - Environmental Management Branch (WA) and WA DoT *Subject - INPEX & APPEA OSWG Regional OPEP development and shoreline/oiled wildlife response arrangements within WA waters.*	14/04/2021	Email / letter to stakeholder from INPEX	Initial request sent to stakeholders to establish a time to discuss/workshop a regional OPEP.	No	N/A - consultation sent by INPEX
	23/04/2021	Email / letter from stakeholder	Stakeholder agreed with response received. Stakeholder requested INPEX liaise with relevant Planning Officer to identify a suitable date/time/venue for INPEX to brief other stakeholders.	No	Not a relevant matter - general correspondence only.
	23/04/2021	Email / letter from stakeholder	Stakeholder requested a date to meet as May is a busy month for department. Stakeholder advised they would look at feasibility when they get a response.	No	Not a relevant matter - general correspondence only.
	23/04/2021	Email / letter to stakeholder from INPEX	INPEX responded that June is fine. INPEX requested stakeholder to advise their availability.	No	N/A - consultation sent by INPEX
	17/05/2012	Email / letter to stakeholder from INPEX	INPEX followed up on the previous request to WA DoT to arrange a time to provide the Department with an update on INPEX's Browse Basin Regional OPEP which is under development, covering INPEX's offshore petroleum activities between Broome-Darwin. Reaffirmed that the Regional OPEP process is also being utilised by the APPEA Oil Spill Working Group (OSWG). Advised that the APPEA OSWG, in conjunction with AMOSC and Advisian (service provider), are looking to arrange a workshop in early July with the WA DoT, (and DBCA as relevant), to run through the shoreline contact scenarios for the Exmouth and Kimberley ROPEP scenarios. outlined the desired workshop outcomes: • Agree worst-case SCAT capability requirements and discuss those arrangements, with DoT • Agree worst-case shoreline clean-up capability requirements and discuss those arrangements, with DoT • Agree worst-case OWR capability requirements and discuss those arrangements, with DoT and DBCA, with the revised (or latest draft) DBCA OWR Plan.	No	N/A - consultation sent by INPEX
	14/06/2021	Email / letter to stakeholder from INPEX	INPEX informed it is working with the APPEA Oil Spill Working Group to two 'Regional OPEPs', in an attempt to replace the 10s/100s of individual offshore oil and gas OPEPs currently accepted by NOPSEMA. Specifically, INPEX is preparing a Browse Regional OPEP, covering offshore Broome to offshore Darwin – all petroleum activities in Commonwealth waters in those regions. Advised that this will support INPEX's current operational activities, and will be submitted (first version) 31st August this year. This document will effectively be the 'test-case' for a Regional OPEP – to demonstrate how NOPSEMA and O&G companies can use regional planning, instead of individual plans. Advised that APPEA OSWG are also preparing an Exmouth regional OPEP – for a well blowout from the FPSOs offshore of the Ningaloo reef. This would be a future ROPEP, potentially replacing Woodside, BHP and Santos OPEPs in the future, if we can deliver the entire ROPEP project. Advised that INPEX, as the individual company, and APPEA OSWG working on the above two ROPEPs, are seeking to have meetings and workshops with the DBCA, to bridge the ROPEPs to the revised DBCA WA OWRP. Advised that the schedule is to have some workshops in Q3 of this year. Workshop objectives include: • Provide DoT/DBCA with the understanding of the worst credible shoreline impact scenarios for the regions • Discuss with DoT/DBCA, AMOSC and Industry, how we see the response being managed in terms of: • Command and control & IMT capabilities / expectations • Protection priorities, or ways in which DoT/DBCA wish for industry to discuss protection priorities within the upstream O&G OPEPs (as we are ultimately not the decision maker regarding protection priorities within 3nm during a spill event) • Field capabilities and arrangements - who is bringing what capability? What can industry expect/rely on from DoT/DBCA, and what does DoT/DBCA agree is the capability/arrangements industry should have in place, to support the DoT/DBCA as the Control Agency. Advised that the INPEX Browse ROPEP submission will need to go into NOPSEMA on 31st August, so if possible, INPEX would like to run through the Browse scenarios first. Advised that the Exmouth ROPEP doesn't have a specific submission schedule to NOPSEMA and does not have immediate urgency. Advised that INPEX meeting with DoT on 24th June for an initial Industry/DoT discussion around the ROPEPs, and following that session, it'd be great if Industry, AMOSC, DoT and DBCA can arrange a schedule for some workshops for the Browse shoreline contact scenarios.	No	N/A - consultation sent by INPEX
	17/06/2021	Email / letter from stakeholder	Stakeholder shared the above correspondence from INPEX with a colleague. Stakeholder requested to be informed when INPEX have a proposal for workshops, and expressed interest in continuing to work with INPEX on these processes. Stakeholder suggested input from regional management and those who know the OWR plans at the workshop.	No	Not a relevant matter - general correspondence only.
	18/06/2021	Email / letter to stakeholder from INPEX	Advised stakeholder that the 24th June session is for the APPEA OSWG and AMOSC to provide the DoT, a briefing on the whole Regional OPEP planning process which the upstream industry has developed. Advised stakeholder the session is also a background/overview session to then lead into workshops. Expressed intention for the Browse ROPEP workshop to be run first, mid/late July if possible. Requested stakeholder to reach out to the Kimberley regional DBCA team to identify potential windows of opportunity. Informed stakeholder that a more detailed proposal for the consultation workshops with AMOSC will be developed, and hopefully be available to share shortly.	No.	N/A - consultation sent by INPEX
	23/06/2021	Email / letter to stakeholder from INPEX	INPEX provided a presentation describing the abovementioned ROPEPs for consideration.	Yes - Region Oil Pollution Emergency Plans (ROPEPs) (file name: "BROPEP WA DoT June 2021")	N/A - consultation sent by INPEX
	24/06/2021	Workshop	Meeting held with WA DoT, AMOSC and APPEA oil spill working group members, including INPEX, BHP, Shell. High level presentation of Regional OPEP concepts. WA DoT agreed with processes and agreed to continue consultation with APPEA OSWG member companies regarding development of Regional OPEPs. INPEX committed to sending WA DoT additional information specific to the BROPEP, for their consideration ahead of another BROPEP specific workshop.	Yes - Regional OPEPs presentation - on behalf of INPEX and APPEA OSWG - presented to WA DoT on 24 June 2021.	Relevant matter- workshop/briefing to WA DoT, to request further engagement on Regional OPEP concept. WA DoT agreed to future engagement and collaboration on Regional OPEPs.
	6/07/2021	Email / letter to stakeholder from INPEX	INPEX provided workshop presentation materials (Shoreline Response and Oiled Wildlife Response) ahead of the scheduled workshop.	Yes - Browse Region Oil Pollution Emergency Plan (BROPEP) - Shoreline and OWR Workshop	N/A - consultation sent by INPEX
	7/07/2021	Email / letter from stakeholder	Stakeholder acknowledged receipt of presentation as pre reading material prior scheduled workshop on 27th of July 2021	No.	Not a relevant matter - general correspondence only.
	27/07/2021	Workshop	Workshop on 27 July 2021 with WA DoT and WA DBCA, and APPEA Oil Spill Working Group members (INPEX, BHP and Shell) discussed workshop presentation materials. Key discussion outcomes: - WA DoT SCAT - maximum capability statement - peak of 3 'roving' SCAT teams, and 3 SCAT teams incorporated as part of remote shoreline response units. - WA DoT - maximum capability statement - remote shoreline response - peak of 3 remote shoreline response units (total 44 personnel, including OWR). - WA DBCA - as part of each roving SCAT team, one OWR advisor. As part of each shoreline response unit, 8 OWR personnel including 1 vet. - WA DBCA - Wildlife welfare is the key priority. Based on the species at risk in the Kimberly and their likely ability to survive entire first-aid, OWR cleaning and rehabilitation processes, other wildlife welfare options would be credible. No requirement to plan for large-scale remote OWR capture, cleaning and rehabilitation.	No.	Relevant matter - agreed outcomes incorporated into the BROPEP documentation.
	27/07/2021	Email / letter from stakeholder to INPEX	Following the workshop, 2 emails, from Ray Bukholz (WA DoT) provided outcomes from WA DoT/Shell Browse Island spill response exercise from 2019. Attachments demonstrate the planning and maximum field capability requirements for remote shoreline response units, which are aligned with the outcomes of the 27 July workshop.	Yes.	Relevant matter- agreed outcomes incorporated into the BROPEP documentation.
			Protection Priority Identification		
Subject - WA DoT protection priorities process	28/07/2021	Email / letter to stakeholder from INPEX	INPEX provided wording on to be included in the BROPEP regarding the process WA DoT use to define protection priorities and requested feedback.	No	N/A - consultation sent by INPEX
	28/07/2021	Email / letter from stakeholder	WA DoT advised that they will respond to the query by next week	No	Not a relevant matter - general correspondence only.
	5/08/2021	Email / letter from stakeholder	WA DoT advised INPEX to state "WA State waters, during an incident, it is expected that the protection area priorities will be determined by the Department of Transport as the Controlling Agency".	No	Not a relevant matter - general correspondence only.
	6/08/2021	Email / letter to stakeholder from INPEX	Following telephone discussion with WA DoT, INPEX provided written record of WA DoT process for protection priority identification, for incorporation into the BROPEP.	No	Not a relevant matter - general correspondence only.
	19/08/2021	Email / letter from stakeholder	WA DoT provided a text clarification to the proposed wording	No	Relevant matter - agreed outcomes incorporated into the BROPEP documentation.
			NT OSCP		
NT Department of Environment, Parks and Water Security (EPaWS) - Marine Pollution *Subject - INPEX oil spill consultation with NT government*	17/05/2021	Email / letter to stakeholder from INPEX	Follow up email following conversation confirming understanding that DIPL has a final draft of the revised NT OSCP which is shortly going out for consultation via the APPEA OSWG. Confirmed INPEX representative is heading to Darwin in the last week of June and interested in a meeting to discuss INPEX's oil spill arrangements with relevant members of the NT government, and the way forward for bridging to the new NT OSCP revision. Specifically noted: • INPEX's new Browse Basin Regional OPEP (in draft), covering all of INPEX's offshore activities between Broome and Darwin (Commonwealth waters). • Cross Jurisdictional Arrangements in relation to INPEX Regional OPEP and the NT OSCP. • INPEX's revised IMT operating model with AMOSC. • Provide an update on some new information with demonstrates a revision/downgrading of the oil spill risk associated with the Ichthys Gas Export Pipeline • Bridging the INPEX Nearshore OPEP to the revised NT OSCP and Darwin Port OPEP.	No	N/A - consultation sent by INPEX
	Undated	Email / letter from stakeholder	Stakeholder informed other Department members that an INPEX representative is coming to Darwin to meet with anyone available to provide updates and discuss the following: INPEX's new Browse Basin Regional OPEP (in draft), covering all of INPEX's offshore activities between Broome and Darwin (Commonwealth waters) – this will be part of the formal consultation INPEX must undertake with relevant stakeholders, as part of INPEX's EP submissions/revisions process with NOPSEMA. Identified intention to discuss Cross Jurisdictional Arrangements, in relation to INPEX Regional OPEP and the NT OSCP; in addition to INPEX's revised IMT operating model with AMOSC. INPEX will provide an update on some new information with demonstrates a revision/downgrading of the oil spill risk associated with the Ichthys Gas Export Pipeline. INPEX will also provide information on bridging the INPEX Nearshore OPEP to the revised NT OSCP and Darwin Port OPEP.	No	Not a relevant matter - general correspondence only.
	21/06/2021	Email / letter to stakeholder from INPEX	INPEX provided technical comments on the Draft NT OSCP from the Ichthys LNG perspective and from the offshore / cross-jurisdiction perspective.	No	N/A - consultation sent by INPEX

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
	30/06/2021	Email / letter to stakeholder from INPEX	INPEX provided stakeholder with the key points from the meeting: Confirmation that the current Controlling Authority under the NT OSCP is the NT Dept Environment, Parks and Water Security (DEPAWS). The next meeting with the Territory Emergency Management Council (TEMC) is occurring in August 2021, which will hopefully lead to formalisation/sign-off of new Controlling Authority. Discussion held regarding NT's actual spill response capability. NT Govt identified that the intent for driving improvement/change in the NT spill response capability includes training for a multi-agency team of spill response trained personnel, and also potential for use of NT Rangers for spill response/observations. Stakeholder confirmed intent to include in the NT OSCP, a map of the boundaries of the Local Tactical Plans/ Local OSCPs (aligned with local govt jurisdictions), and confirmed the Local Tactical OSCPs will be bridged to the zones defined in the NT Oiled Wildlife Response Plan. Stakeholder confirmed intent is to include updated organisational charts of the various government/non-government organisations in the revised NT OSCP. Stakeholder confirmed they will clarify with DEPAWS the intent around use of dispersant in NT waters/Darwin Harbour – as this may open up additional first strike response capabilities/options. Discussion held regarding cross-jurisdiction response arrangements – the WA DoT model could be used by the NT Govt, for 'unified command' or alternative models. INPEX to share WA DoT industry guidance note. Discussion held regarding I-LNG first strike capability, and it's integration with the Darwin Port OSCP – It was noted that INPEX prepared the Nearshore OPEP for regulatory approval in 2016, and since then, although some joint work was done around INPEX first strike capability (zoom-boom storage/deployment location), there has been no formal consultation with the Darwin Port following the release of the Darwin Port OSCP in 2018, to confirm integration arrangements between the two documents. INPEX should undertake formal consultation to double-check the alignment / understanding of the INPEX and Darwin Port response capabilities and command/control arrangements and integration, in the respective INPEX NS OPEP & Darwin Port OSCP. Conduct of a joint exercise to confirm arrangements/integration would also be desirable. Ongoing consultation will occur in relation to: • INPEX Offshore OPEPs • INPEX and NT Govt agreed to maintain current 'cross-jurisdictional response arrangements' as per current Drilling / URF OPEPs, within the new INPEX Regional OPEP – for submission to NOPSEMA in August 2021. • INPEX to share the WA DoT cross-jurisdiction response arrangements/industry guidance note with NT Govt, for their consideration/use in the NT OSCP (see attached). INPEX to maintain ongoing consultation regarding cross-jurisdictional response (as per routine INPEX stakeholder consultation as per OPGGS E Reg requirements for EPs/OPEPs). Consultation to include: • DPAWS as the current hazard mgt authority • Territory Emergency Services / Territory Emergency Management Council • INPEX NS OPEP INPEX should conduct direct consultation with Darwin Port to re-confirm the I-LNG first strike capability, arrangements & integration, with Darwin Port OSCP. Regional Harbour Master – Anil Chadha - requested that he is provided the outcome of that consultation	Yes - Offshore Petroleum Industry Guidance Note - Marine Oil Pollution: Response and Consultation Arrangements.	N/A - consultation sent by INPEX
	19/08/2021	Phone call	Phone call between INPEX and Raechel Squired - confirmed no further updates regarding progress on the NT OSCP. Territory Emergency Management Council due to meet late August 2021.	No.	Not a relevant matter - general correspondence only.

SPECIFIC ACTIVITY/ASPECT ENGAGEMENT - DOMESTICALLY SOURCED VESSELS BIOSECURITY RISK ASSESSMENT

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Department of Agriculture, Water and Environment (DAWE) – Biosecurity (Marine Pests) (Vessels, aircraft and personnel) (Cwth)	5/07/2021	Email / letter to stakeholder from INPEX	Follow up email to advise stakeholder that INPEX is planning to amend some of the controls related to Invasive Marine species. Advised that INPEX does not believe the supply/support vessels are acting as a vector for spread of known pests between the facility and the Ports of Broome and Darwin. Requested feedback on INPEX's management of D. perlucidum and whether INPEX might be able to reduce the level of scrutiny applied to support vessels when they come on hire domestically.	Yes - IMS monitoring results.	N/A - consultation sent by INPEX
Department of Primary Industries and Regional Development (DPIRD) - <u>Biosecurity section</u> formerly Department of Fisheries	8/03/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Inquired whether DPIRD would be interested in having a discussion to confirm that the text INPEX includes in the EP revision remains ALARP and acceptable to DPIRD. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder reminded that the Ichthys LNG offshore facilities operations are currently being undertaken in accordance with an environment plan accepted by NOPSEMA in 2016, and informed stakeholder that INPEX now plans to submit revisions of the Ichthys Offshore Facility (Operation) EP to NOPSEMA in Q4 2021. INPEX requested that the stakeholder advise INPEX of any provided information/comments that is not suitable for public disclosure, and advised that such information will be omitted/redacted from the published EP and provided separately and privately to NOPSEMA.	Yes - activity fact sheet	N/A - consultation sent by INPEX
	8/03/2021	Email / letter from stakeholder	DPIRD responded to confirm interest in discussing above mentioned biosecurity matters.	No	Not a relevant matter - general correspondence only.
	10/05/2021	Email / letter to stakeholder from INPEX	INPEX provided an update stating the annual review of opportunistic footage had been completed. INPEX informed stakeholder that an opportunity arose to conduct an IMS survey on the offtake support vessel on June 8-9th. INPEX informed that the vessel had been working alongside the FPSO and CPF for over three years and does supply runs to Broome, and this provided an opportunity to see any growth/IMS that may have developed when the vessel comes out of the water. INPEX requested to discuss findings mid-June.	No	N/A - consultation sent by INPEX
	17/06/2021	Email / letter to stakeholder from INPEX	Follow up email send to advise DPIRD that observations from the last 4 years show no signs of d.perlucidum on any of INPEX's support/supply vessels. Requested a meeting with the stakeholder to discuss implications for INPEX's domestic vessel risk assessment process and understand any new/recent data DBCA may have.	No	N/A - consultation sent by INPEX
	Undated	Email / letter to stakeholder from INPEX	INPEX sent a meeting invite to discuss the data INPEX has gathered over the last 4 years. INPEX informed stakeholder it believes the support vessels that are highly mobile are not a vector for the transport of pests domestically and would like to revise their controls in the EP to reflect this. INPEX advised a summary would be sent prior to the meeting.	No	N/A - consultation sent by INPEX
	28/06/2021	Meeting with stakeholder	Meeting cancelled.	No	Not a relevant matter - general correspondence only.
	29/06/2021	Email / letter to stakeholder from INPEX	INPEX provided stakeholder with a presentation detailing the current status of IMS in relation to project activities, a summary of new data collected and the proposed amendments to controls and frequencey of monitoring.	Yes - Stakeholder consultation- IMS monitoring results	N/A - consultation sent by INPEX
NT Department of Industry, Tourism and Trade (DITT) - Fisheries, Biosecurity Section	5/07/2021	Email / letter to stakeholder from INPEX	Email and fact sheet sent to stakeholder with details on proposed INPEX-operated Ichthys LNG field offshore operations activities from 2021 to 2025, as part of the development of five-year revisions of Offshore Facility (Operation) Environment Plan. Informed stakeholder the key proposed operations activities associated with the offshore facility: - The Maersk Deliverer commenced a second phase of drilling in October 2020. This activity involves drilling 15 new wells and will continue through until 2023. - During the next five years the interlinked facilities will undertake shutdown periods to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. - A booster compression module will be placed on the west side of the CPF main deck to account for the future decline in pressure of reservoirs. - The CPF and FPSO are being supplied by support vessels that transfer goods and waste to and from Darwin and/or Broome approximately twice a week. - In addition to normal operations (i.e. production and processing of gas and offtake operations), during the course of the five years periodic shutdown periods will occur in order to conduct maintenance activities and to allow for the installation and commissioning of new equipment and infrastructure. Stakeholder was provided with specific information on INPEX's management of D. perlucidum.	Yes - activity fact sheet and IMS monitoring results.	N/A - consultation sent by INPEX
NT Department of Industry, Tourism and Trade (DITT) - Fisheries, Biosecurity Section & Department of Primary Industries and Regional Development (DPIRD) - Biosecurity section formerly Department of Fisheries	6/07/2021	Email / letter from stakeholder	NT DITT advised that marine pest ascidian D. perlucidum has spread around the coast of Australia and has been found in multiple locations along the WA, NT, Qld and NSW coast. It is considered not possible to control and to the best of the Department's knowledge all affected jurisdictions are not imposing any controls. Advised that this does not mean that INPEX should remove all biofouling risk management on domestic vessels and movements. A bio-fouled vessel travelling between Darwin, Broome and your gas site is still a potential risk. Advised that there is a national push towards vessels being pro-active and having operational biofouling management plans to help minimise biofouling issues. Advised that there are a range of vessel biofouling management assessment systems available that could be used to help in the assessment of vessel biofouling risks without the need to engage an IMS expert - as long as the vessel comes out with a low risk rating. Advised that there is a program called "Vessel Check" that was initially developed by WA fisheries that is now a commercial product that may be worth considering for this purpose.	No	Relevant matter- Request raised by stakeholder is relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. However, stakeholder copied in WA DPIRD. Ongoing consultation occurred with WA DPIRD and NT DITT collaboratively. Biosecurity matters identified by the stakeholder have been addressed in Section 7.4.1 of the EP. INPEX responded on 06/07/2021 (see below).
	6/07/2021	Email / letter to stakeholder from INPEX	INPEX thanked DITT for the response and provided the following clarifications on what INPEX was proposing: INPEX was hoping to remove the requirement for assessing short term mobile vessels with an IMS expert if they mobilise from within Australian waters, given that we have now done this for four out four of our supply vessels and none have shown any IMS of concern it seems an excessive control when the existing operating profile and antifoul coatings/management plans maintain the vessels' risk status. INPEX still plan to do the following for all our vessels: antifoul coatings, biofouling management plans (based on IMO guidance), and assessing visual observations from subsea footage for indication of IMS on our facilities. Confirmed that INPEX continues to strive toward best practice in relation to Biofouling management controls. INPEX offered to meet to discuss the revised EP and controls in detail, noting the offer has also been extended to DPIRD Biosecurity.	No	N/A - consultation sent by INPEX
	14/07/2021	Email / letter from stakeholder	Stakeholder agreed to remove if "the existing operating profile and antifoul coatings/management plans maintain the vessels' risk status". Stakeholder confirmed that using a program like "Vessel Check" can be considered as it assesses a range of factors including the vessels biofouling management and gives the vessel a risk rating.	No	Not a relevant matter - general correspondence only.
	14/07/2021	Email / letter to stakeholder from INPEX	INPEX contact confirmed that vessels are following 'best practice' set out by the International Maritime Organisation (IMO) guidelines, and suggested a video call to discuss vessel check prior year 5.	No	N/A - consultation sent by INPEX
	16/07/2021	Email / letter to stakeholder from INPEX	INPEX requested confirmation from DITT Fisheries and DPIRD that medium and low risk (as defined by Vessel check) are acceptable to operate within WA/NT waters.	No	N/A - consultation sent by INPEX
	22/07/2021	Email / letter from stakeholder	DITT Fisheries responded noting this was the case (i.e. low and medium risk vessels are acceptable. DITT further noted that the actual marine pest biofouling risk posed by the vessel probably does not change if the vessels are just travelling between Broome – Darwin – and production sites. DITT Fisheries have not detected any marine pest of concern at any of these locations so vessel movement between them is a low risk.	No	Relevant matter- DITT confirmed acceptability and risk of " medium" and "low" risk vessels in vessel check represent a LOW risk in relation to the movements occurring that support the Ichthys Facility. This acknowledgment is incorporated into the stakeholder feedback section regarding the proposed controls in Section 7.4.1 of the EP.
	23/07/2021	Email / letter to stakeholder from INPEX	INPEX contact thanked DITT Fisheries and noted that this would be considered in the EP revision.	No	N/A - consultation sent by INPEX
	28/07/221	Email / letter to stakeholder from INPEX	INPEX followed up with DPIRD to confirm alignment with advice received from DITT (22 July 2021).	No	N/A - consultation sent by INPEX
	28/07/2021	Email / letter from stakeholder	DPIRD confirmed they were aligned/agreed with the response provided by DITT.	No	Relevant matter- WA DPIRD confirmed acceptability and risk of" medium" and "low" risk vessels in vessel check represent a LOW risk in relation to the movements occurring that support the Ichthys Facility. This acknowledgment is incorporated into the stakeholder feedback section regarding the proposed controls in Section 7.4.1 of the EP.
	28/07/2021	Email / letter to stakeholder from INPEX	INPEX responded thanking DPIRD (with DITT in Copy) and provided the text included in the EP in relation to domestic vessel biosecurity risk assessment: *The annual reports and vessel inspection reports were provided to WA DPIRD, DAWR Aquatic Branch and DITT Fisheries, for information. A summary of proposed changes to the IMS monitoring program and domestic risk assessment process were provided for discussion. The stakeholders acknowledged (in the context of the controls applied by INPEX) that actual marine pest biofouling risk posed by support vessels operating vessel between Broome – Darwin – and offshore facilities is a low risk and that no IMS of concern have been identified to date from these activities.*	No	N/A - consultation sent by INPEX

SPECIFIC ACTIVITY/ASPECT ENGAGEMENT - OFFSHORE FACILITY MARPOL REQUIREMENTS AND EXEMPTIONS

STAKEHOLDER	Date of Correspondence	Type of Correspondence	Summary of Correspondence / Objection / Claim / Query	Attachments	Assessment of Merit
Australian Maritime Safety Authority (AMSA) - Ship Inspection and Registration Operations (Cwth)	8/04/2021	Email / letter to stakeholder from INPEX	INPEX requested meeting with stakeholder and relevant participants from DNV on Wednesday 19th May to discuss MARPOL compliance with Annex 1, V and VI in relation to the 5 year revision of INPEX's Environment Plan, on the Ichthys Project Offshore facilities.	No	N/A - consultation sent by INPEX
	8/04/2021	Email / letter from stakeholder	AMSA confirmed interest in meeting and circulated correspondence to relevant officers. AMSA informed INPEX that it had recently updated Marine Order 47 – Offshore industry units (https://www.legislation.gov.au/Series/F2019L01324) which replaced both Marine Order 60 and the 'old' Marine Order 47, that were used as part of the basis for the original AMSA statutory approvals covering the tow down to site of each facility. Other Marine Orders in the series 1 to 98 (https://www.amsa.gov.au/about/regulations-and-standards/index-marine-orders) were also used as relevant in respect of AMSA statutory approvals to cover the tow element of each facility. AMSA confirmed understanding that the meeting will discuss matters relating to compliance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (POTS (PPS). AMSA noted this not disallowed in respect of the application Vol. 2, s.640 (3) of the OPGGS Act, and the elements of which are given effect through the Marine Order 90 series: AMSA Marine Orders 91, 93, 94, 95, 96, 97 for MARPOL: https://www.amsa.gov.au/about/regulations-and-standards/index-marine-orders AMSA also noted that that the OPGGS Act does not disallow the following: Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 (POTS (AFS)). AMSA Marine Order 98 – Covers Anti-fouling systems; https://www.legislation.gov.au/Series/F2013L01422 AMSA suggested meeting times/details.	No	Not a relevant matter - general correspondence only.
Australian Maritime Safety Authority (AMSA) - Ship Inspection and Registration Operations (Cwth) & DNV GL Australia Pty Ltd.	19/05/2021	Meeting with stakeholder	Meeting held between INPEX and AMSA. Minutes summary as follows: Application of Marine Orders INPEX described its current understanding of the legislation, to which AMSA agreed and provided additional clarification around the Protection of the Sea Act (POTSA), noting that the simplest way to comply is to have IOPP and IAPP certificates and surveys for Annex I and Annex VI respectively. AMSA suggested that it could be possible for INPEX to revisit the EP and use MARPOL as applied by POTSA as a means to demonstrate its EP compliance, but not refer to the Marine Orders specifically, given there is no scope to deviate from MARPOL. Opportunities for Operational Efficiency INPEX identified opportunities where it believes there are opportunities to make operational improvements. Compliance with EP instead of MARPOL INPEX asked AMSA if it was possible to comply with NOPSEMA accepted EP in lieu of MARPOL. AMSA stated that it recognised that the Ichthys Explorer and Ichthys Venturer are facilities that are not on international voyages. However, because of POTSA, MARPOL still applies and hence the need to carry out surveys to measure MARPOL compliance requirements because Australia is a signatory to the MARPOL Convention. AMSA advised that it is possible for INPEX to request DNV replace the Annex I and Annex VI certificates with Statements of Compliance. AMSA then explained the details associated with the equivalent means to demonstrate MARPOL compliance. INPEX expressed interest and agreed it would make proposals for equivalency in consultation with DNV. Marpol Annex III Noxious Substances AMSA requested that INPEX review their controls and arrangements in relation to Annex III substances and engage with DNV to ensure current arrangements complies with the Annex	No	Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. Obtaining a 'Statement of compliance' and demonstrating equivalence using a Form 288, rather than certificates issued by third party to demonstrate compliance with the Protection of the Sea Act is a change to interpretation of legal application of the stakeholder. This information has been incorporated into various sections in the EP- Section 2 and 7 of the EP. The stakeholder raised no concerns or objections regarding the activity.
Australian Maritime Safety Authority (AMSA) - Ship Inspection and Registration Operations (Cwth)	28/05/2021	Email / letter to stakeholder from INPEX	INPEX attached minutes of the meeting signed off by DNV and INPEX. INPEX requested a review and sign on behalf of AMSA. INPEX advised a discussion could be arranged with other members of the team if there were any issues.	Yes - 19 May Meeting Minutes	Not a relevant matter - general correspondence only.
	18/06/2021	Email / letter from stakeholder	Stakeholder signed minutes and attached to email.	Yes - 19 May Meeting Minutes	Not a relevant matter - general correspondence only.
DNV GL Australia Pty Ltd.	25/05/2021	Email / letter from stakeholder	DNV sent INPEX checklists including fuel change over procedure and fuel change over record, stating that checklists are generic and may not be application to one or both of the facilities.	No	Not a relevant matter - general correspondence only.
	28/05/2021	Email / letter to stakeholder from INPEX	INPEX representative responded with complete feedback for both facilities (CPF and FPSO), and requested a call to discuss merging ideas into the equivalence Form 288 application and taking stakeholder through INPEX existing records.	No	N/A - consultation sent by INPEX
	2/06/2021	Email / letter to stakeholder from INPEX	INPEX representative followed up on meeting request.	No	N/A - consultation sent by INPEX
	3/06/2021	Email / letter from stakeholder	Stakeholder suggested time for meeting.	No	Not a relevant matter - general correspondence only.
	3/06/2021	Email / letter to stakeholder from INPEX	INPEX representative confirmed meeting date and time.	No	N/A - consultation sent by INPEX
	3/06/2021	Email / letter from stakeholder	Stakeholder added comments in preparation to scheduled meeting.	No	Not a relevant matter - general correspondence only.
	4/06/2021	Email / letter to stakeholder from INPEX	INPEX thanked stakeholder for their time at the meeting and recapped action item by providing Form 228 for review.	No	N/A - consultation sent by INPEX
	14/06/2021	Email / letter from stakeholder	Stakeholder provided recommendation and changes to reflect on From 288.	No	Not a relevant matter - general correspondence only.
	29/06/2021	Email / letter to stakeholder from INPEX	INPEX representative responded with Form 288 reflecting advised changes and confirming that INPEX reviewed documents.	Yes - 288 exemption FPSO (& CPF) Equivalence	N/A - consultation sent by INPEX