Tern-2 Well: Environment Plan Summary

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ABBREVIATIONS AND ACRONYMS

ADIOS	Automated Data Inquiry for Oil Spills
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environmental Conservation Council
API	American Petroleum Institute
BIA	Biologically Important Areas
BRUV	Baited Remote Underwater Video
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CE	Critically Endangered (under the EPBC Act)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWR	Department of Aquiculture, Water and Resources
DEE	Department of Environment and Energy
DIIS	Department of Industry, Innovation and Science
DO	Dissolved Oxygen
DoE	Department of Environment
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
E	Endangered (under the EPBC Act)
EMBA	Environment that May Be Affected
EP	Environmental Plan
EPBC	Environment Protection and Biodiversity Conservation
ERM	Environmental Resource Management
ESD	Ecologically Sustainable Development
f	Foraging BIA (under the EPBC Act)
GHG	Global greenhouse gas
IAP	Incident Action Plan
IAPP	International Air Pollution Prevention
IEE	International energy efficiency
IMCRA	Integrated Marine and Costal Regionalisation of Australia
IMO	International Maritime Organisation
IMP	Invasive Marine Pests
IMT	Incident Management Team
ISPP	International Sewage Pollution Prevention Certificates
JRCC	Joint Rescue Coordination Centre
KEF	Key Ecological Features
KO	Species of species habitat known to occur within the area (under the EPBC Act)
LO	Species or species habitat likely to occur within area
LOC	Loss of Control
LOR	Limit of reporting

M	Marine (under the EPBC Act)
MARPOL	International Convention for the Prevention of Pollution from Ships
MARS	Maritime Arrivals Reporting System
MDO	Marine Diesel Oil
MES	Monitoring, Evaluation and Surveillance
MNES	Matters of National Environmental Significance
MO	Marine Orders
MO	Species of species habitat may occur within area (under the EPBC Act)
MOC	Management of Change
MODU	Mobile offshore Drilling Unit
MSL	Mean Sea Level
NEBA	Net Environmental Benefit Analysis
NEPM	National Centre for Environmental Prediction
NES	National Ecological Significance
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Authority
NT	Northern Territory
OGUK	Oil and Gas UK
OPEP	Oil Pollution Emergency Plan
OPGGS	Offshore Petroleum and Greenhouse Gas Storage
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations
OSMP	Operational and Scientific Monitoring Plan
OSPAR	Oil Spill Prevention, Administration and Response Fund
OSRL	Oil Spill Response Ltd
OWR	Oiled Wildlife Response
PAH	Polyaromatic hydrocarbons
PMS	Planned Maintenance System
PNEC	Predicted no effect concentration
PPE	Personal protective equipment
PSZ	Petroleum Safety Zone
PTS	Permanent Threshold Shift
RAMSAR	Convention on Wetlands of International Importance especially as Waterfowl Habitat
RKB	Rotary Kelly bushing
ROV	Remotely Operated Vehicle
SEEMP	Ship Energy Efficiency Management Plan
SOPEP	Ship Oil Pollution Emergency Plan
SPL	Sound Pressure Level
STP	Sewage treatment plant
TPH	Total Petroleum Hydrocarbons

TSS	Total suspended solids
TSSC	Threatened Species Scientific Committee
UK	United Kingdom
V	Vulnerable (under the EPBC Act)
W	Wetland (under the EPBC Act)
WA	Western Australia
WOMP	Well Operations Management Plans

UNITS OF MEASUREMENT

°C	Degrees centigrade
dB	Decibels
Hz	Hertz
km	Kilometre (1,000 metres)
m	Metre (100 cm)
mg/L	Milligrams per litre
mm	Millimetre
nm	Nautical mile (1.856 km)
ppb	Parts per billion
ppm	Parts per million

1. INTRODUCTION

1.1 Scope

Santos Limited (Santos) is the titleholder and operator of the Tern field within permit WA-27-R, in the Bonaparte Basin. The Tern field is approximately 300 km west-southwest of Darwin, and approximately 100 km offshore from the Western Australian coast (Figure 1-1).

This five-year Environment Plan (EP) covers the following petroleum activities:

- the ongoing temporary abandonment of the Tern-2 well; and
- periodic seabed equipment surveillance surveys.

Planned activities covered under this EP are limited to the wellhead and a 500 m buffer around the wellhead; within the EP this is referred to as the operational area.

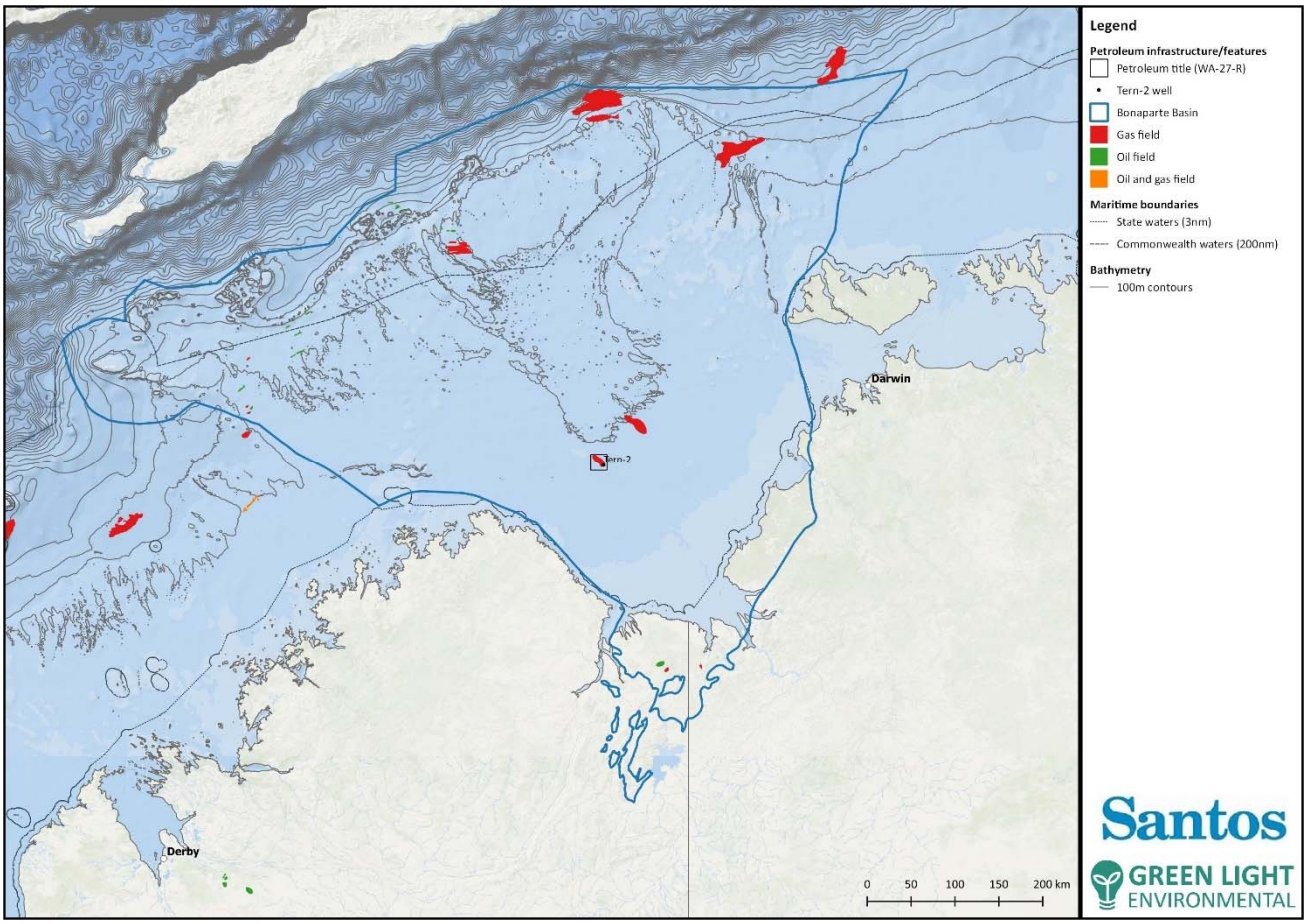


Figure 1-1: Location of Tern field in Bonaparte Basin

1.2 Details of the titleholder

The nominated liaison person for the activity are as follows:

Name:	Joe Ariyaratnam (General Manger Offshore Development)
Business address:	Level 7, 100 St Georges Terrace Perth WA 6000
Phone:	08 6218 7100
Email:	joe.ariyaratnam@santos.com

2. ACTIVITY DESCRIPTION

2.1 General details

Within the WA-27-R permit, the Tern-2 well has been identified as plugged and temporarily abandoned since the 1980's, with the wellhead remaining in-situ. The well is being managed in accordance with the Tern-2 Well Operations Management Plan (WOMP) (DR-91-BW-20003). Table 2-1 contains the location and other well details specific to the Tern-2 well.

As part of the ongoing management of the well, infrequent ROV inspections of the subsea equipment will be undertaken from contracted vessels. These surveys will be short in duration (i.e. days).

A survey is expected to occur at least once during the five-year period this EP is in-force. Since the actual timing of the surveys is dependent on a number of factors including vessel availability and weather conditions, this EP has accounted for activities potentially occurring in any season.

No new well activities are planned within the permit area, and no work on the existing well (Tern-2) is planned.

Table 2-1: Tern-2 Well Information

Well Designation	Appraisal
Permit	WA-27-R
Spud Date	16 November 1982
Original Operator	Australian Aquitaine Petroleum Pty Ltd
Current Interest Holders	Bonaparte Gas & Oil Pty Ltd (65%), Santos Limited (35%).
Lat-MSL	-2.37m
Tidal Range	0.00m to 4.21m
Water Depth	83 m (MSL)
Geographic Surface Location	Datum: GDA94
	Lat: 13º 16' 42.97" S Long: 128º 07' 58.04" E
	Projection: MGA 94 UTM Zone 52
	Easting: 406,193.5 m E Northing: 8,532,017 m N
Well Depth (TD)	3140m MDRT (RKB Elevation on original well 10m)
Max BHT (ºC)	Not reported
Max BHP	3661 psi at 2546 m MDRT
Well Status	Temporarily abandoned gas producer

2.2 Planned seabed equipment surveillance survey

2.2.1 Vessel operations

The activity is to be undertaken using a contracted vessel. The vessel will be primarily used to transport equipment and personnel to the operational area. The vessel will also be used as a platform on which to undertake subsea activities including ROV operations. The vessels are not likely to anchor on location during the activity but will use dynamic positioning or similar station keeping systems to maintain their position while undertaking the activities.

It is anticipated that for the planned activities, vessel operations will take place within an approximately 24-hour period, and have been notionally scheduled to occur at least once during the period that the WOMP (Doc: DR-91-BW-20003) and this EP are in-force. All vessels are likely to mobilise out of

Darwin Harbour in the Northern Territory. In most instances, only one vessel will be mobilised to undertake the activity.

Vessels will be fuelled by marine diesel oil. All vessel fuelling is proposed to take place within the nearest suitable harbour (likely Darwin). There is no planned vessel refuelling to take place in the operational area. There will be no operational discharges (such as chemicals, inhibited seawater, control fluid) associated with planned activities.

At this time, the vessels that will be used to undertake the activity have not been identified, however they are typically less than 30 m in length and support a crew of 15 persons.

2.2.2 ROV operations

ROV operations are proposed to support the seabed equipment surveillance survey. Fisheye ROV surveys, or inspection ROV surveys, are proposed to be undertaken to provide a means to visually monitor to confirm no changes in the condition of the seabed equipment left in place when the well was temporarily abandoned. For these surveys, the ROV will likely be deployed and operated from a small utility vessel.

The planned seabed equipment surveillance survey will not comprise side-scan sonar or any other geophysical survey methods that generates underwater sound.

3. EXISTING ENVIRONMENT DESCRIPTION

3.1 Overview

This EP assesses environmental impacts and risks (Section 5) associated with the ongoing temporary abandonment and periodic seabed equipment surveillance surveys of the Tern-2 well (as described in Section 2). In determining the spatial extent of the environmental sensitivities that may be affected by the activity, Santos considered both the defined area for planned events and unplanned events as well as the area that may be affected by credible worst-case hydrocarbon spills.

3.2 Physical environment

The Tern field is approximately 300 km west-southwest of Darwin, and approximately 100 km offshore from the Western Australian coast, in 80–100 m water depth. The Tern field occurs within the Northwest Shelf Transition IMCRA provincial bioregion, and the Bonaparte Gulf meso-scale bioregion.

3.2.1 Bathymetry and seabed morphology

The majority of the Northwest Shelf Transition is located on the continental shelf, with only a small area extending onto the continental slope. The bioregion is characterised by complex geomorphology, including shelves, shoals, banks and terraces.

The Tern field is located on one of the prominent geomorphic features of the bioregion, the Sahul Shelf (Baker et al. 2008). The seabed within the Tern field is generally smooth and flat, sloping down to the north-west with gradient less than 1:2,000 (0.03°). The seabed is punctuated by numerous isolated pockmarks up to 25 m in diameter and 0.5 m deep (ERM 2011).

3.2.2 Climate and meteorology

The climate over the region is characterised by seasonal reversals of the prevailing winds. During the wet season (November to April) northwest winds bring moisture from the Timor Sea and generate regular thunderstorm activity and high rainfall. During the dry season (May to October) easterly winds generated over inland Australia, result in dry and warm conditions, with little rainfall and low relative humidity. Tropical cyclones can develop off the northern Australian coast during the wet season which is often associated with heavy rain and strong winds, sometimes of destructive strength (RPS 2011).

3.2.3 Hydrography and oceanography

The oceanographic environment of the Joseph Bonaparte Gulf region is dominated by diurnal and semi-diurnal tides featuring some of the largest tidal energies observed anywhere in the world, with tidal sea level ranges exceeding 8 m along the western side of the Gulf during the spring tide (CSIRO 2005). There is a well-defined spring-neap lunar cycle, with spring tides occurring two days after the new and full moon.

Superimposed on the astronomical tide are ‘meteorological’ tides resulting from changes in atmospheric pressure and strong onshore or offshore winds. Seasonal changes of mean sea level in Darwin are only ~0.15 m, and offshore the changes will be considerably less and quite insignificant (i.e. maybe ±0.05 m) (RPS 2011).

Mean monthly surface temperatures in the Joseph Bonaparte Gulf region vary between about 23°C in winter months and 33°C in summer months (RPS 2011). The water column is well mixed all year round with respect to temperature, due to the large tidal range and strength of currents.

Surveys carried out in 2010 and 2011 showed that seawater temperature was consistent across the area. Temperature gradients throughout the water column did not display a thermocline, instead a vertical gradient in seawater temperature was observed across all fields in which temperature decreased progressively from the surface to the bottom ranging from 32.08°C to 25.3°C. Temperature was around 2°C greater in the second survey, attributed by the warmer and calmer conditions at the end of summer, when survey two was completed (ERM 2011).

3.2.4 Water quality

Surface seawater salinities in the tropics are generally 34–35 and vary little between seasons (Middleton 1995 in Shell 2009). Modelled seawater salinity profiles in the Tern field indicated that there is little variation in salinity through the water column, monthly or seasonally with values ranging 33.9–35.5 (RPS 2011). This is supported by field data showing that salinity and specific conductivity were similar across the Tern field (ERM 2011). There is a small variation in salinity and specific conductivity between seasonal surveys with a slight increase in both parameters in the dry season (ERM 2011).

Dissolved oxygen (DO) concentration ranged from a minimum of 3.64 mg/L (49.8%) near the seabed to 7.80 mg/L (117.2%) at the sea surface. DO was found to decrease with depth consistently across all fields. Such variation is often linked to higher photosynthetic activity at the seawater surface and wave and wind generated mixing. These values are typical of unpolluted seawater (ERM 2011).

Total suspended solids (TSS) were largely not detected across the area during the time of sampling. The samples that did report detections, had concentrations marginally above the laboratory LOR of 5 mg/L with no differences observed between surface and bottom measurements. These data represent relatively low suspended solid values as would be expected for offshore waters in the region (ERM 2011).

Surveys completed in 2010 and 2011 showed that water quality within the Tern field is relatively pristine with results typical of nutrient poor (oligotrophic) offshore northern Australian waters (ERM 2011).

3.2.5 Sediment quality

Sediments in the Tern field were dominated by sand, with silt and clay sized particles also present (ERM 2011).

Surveys completed in 2010 and 2011 showed that sediment quality within the Tern field is relatively pristine with no metal concentrations above the trigger values defined in the ANZECC guidelines (ANZECC/ARMCANZ 2000) an TPH, BTEX, PAH or tributyltin detected in any samples

3.3 Ecological environment

3.3.1 Soft sediment

Sediments of the Bonaparte Gulf are dominated by biogenic gravels and sands, grading to muds offshore (IMCRA Technical Group, 1998). Benthic habitat surveys indicated that the soft sediment seabed comprised of primarily of sand, coarse shell fragment and silt. The Tern seabed sediment contained predominantly sand, with a proportion of silt and clay (ERM 2011).

3.3.1 Plankton

3.3.1.1 Phytoplankton

Phytoplankton assemblages recorded across the Tern fields were characteristic of offshore tropical waters. Phytoplankton assemblages were dominated by the cyanobacteria during the 2010 wet season survey, which comprised 99.7% of identified algal cells. During 2011 dry season survey, the phytoplankton assemblage was largely dominated by the diatoms (Bacillariophyceae).

The phytoplankton cell densities were typical of offshore oceanic waters and indicative of a classically oligotrophic (low nutrient) system as is the case across offshore Western Australia and indeed the Timor Sea which feeds the Leeuwin Circulation in the north-west Bioregion.

3.3.1.2 Zooplankton

Sampling during 2010 and 2011 indicated that larval fishes during both seasons were found to be dominated by the Serranidae (cods) and Lutjanidae (snappers), both of which are species of interest targeted by commercial fisheries in the region. Larval fish density also varied seasonally with the 2011 dry season recording highest densities of larval fishes in the zooplankton. This seasonal effect is consistent with the notion of an extended spawning season (and possibly planktonic larval duration) of the reef species dominating the larval fish assemblage in the study area at this time (ERM 2011).

Zooplankton sampling indicated that copepods represented the most dominant group within the macro-zooplankton assemblage in both the 2010 wet season and 2011 dry season. The density of these macro-zooplankton varied significantly among seasons, with an overall greater density of these animals recorded during 2010 wet season. The greater density of macro-zooplankton may be indicative of higher primary productivity in the summer months fuelling population increases of the zooplankton (secondary productivity) at this time. Overall zooplankton density varied at the level of the assemblage with statistically distinct assemblages found within both the 2010 wet season and 2011 dry season.

3.3.2 Marine invertebrates

A survey conducted in November 2010 recorded benthic infauna assemblages across the Tern field similar to the results of other studies in the bio-region in terms of the species, diversity and biomass. Infauna is documented to occur in coastal waters to depths of approximately 200 m, and are widely distributed through subtropical and tropical waters of Western Australia (Jones and Morgan 1994).

A total of 18 benthic habitat sites were sampled in November 2011 with depths ranging from 85-99 m. Benthic habitat mapping found that generally the seabed composition was similar, with sparse sessile benthos except for an unidentified white colonial organism (presently recorded as a hydrozoan) across all sampled fields. Estimated percentage cover was low for octocorals and sponges (~2% for each) while the unidentified hydroid comprised between 11-30% at all sites.

3.3.3 Seabirds and shorebirds

There are 11 seabird and shorebird species (or species habitat) classified as threatened, migratory or listed marine that may occur within the EMBA (Table 3-1). The type of presence varies between species, but is predominantly may or likely to occur, with no important behaviours (e.g. foraging, roosting, breeding) recorded within the EMBA (Table 3-1). No Biologically Important Areas (BIAs) for any seabird or shorebird species intersects with the EMBA (Table 3-1).

Given the various species distributions, habitat preferences, breeding patterns and/or foraging characteristics, any occurrence within the EMBA is likely to be of a transient nature only.

Table 3-1: Seabird and shorebird species or species habitat that may occur within the EMBA

Species (Scientific)	Species (Common)	Threatened Species	Migratory Species	Listed Marine Species	Type of Presence	BIA
Actitis hypoluecos	Common Sandpiper		✓(W)	✓	MO	–
Anous stolidus	Common Noddy		✓(M)	✓	MO	–
Calidris acuminate	Sharp-tailed Sandpiper		✓(W)	✓	MO	–
Calidris canutus	Red Knot	E	✓(W)	✓	MO	–
Calidris ferruginea	Curlew Sandpiper	CE	✓(W)	✓	MO	–
Calidris melanotos	Pectoral Sandpiper		✓(W)	✓	MO	–
Calonectris leucomelas	Streaked Shearwater		✓(M)	✓	LO	–
Fregata ariel	Lesser Frigatebird		✓(M)	✓	LO	–
Fregata minor	Greater Frigatebird		✓(M)	✓	MO	–
Numenius madagascariensis	Eastern Curlew	CE	✓(W)	✓	MO	–
Pandion haliaetus	Osprey		✓(W)	✓	MO	–

Threatened Species:
E Endangered
CE Critically Endangered
Migratory Species:
(M) Marine
(W) Wetland

Biologically Important Area:
– No BIA Present
Type of Presence:
MO Species of species habitat may occur within area
LO Species or species habitat likely to occur within area

3.3.4 Fish

There are 11 shark and ray species (or species habitat) classified as threatened or migratory and 24 syngnathid species (or species habitat) that may occur within the EMBA (Table 3-2). The type of presence varies between species, but is predominantly may, likely or known to occur, with no important behaviours (e.g. aggregating, breeding) recorded within the EMBA (Table 3-2). No Biologically Important Areas (BIAs) for any fish species intersect with the EMBA (Table 3-2).

3.3.4.1 Sharks and rays

Given the various species habitat preferences, predominant range and/or migratory patterns, occurrence of these species within the EMBA is considered unlikely or of a transient nature only.

3.3.4.2 Syngnathids

Given the habitat within the EMBA is expected to be predominantly bare sediment with occasional low density of epifauna (e.g. sponges), occurrence of these species within the EMBA is considered unlikely.

Table 3-2: Fish species or species habitat that may occur within the EMBA

Species (Scientific)	Species (Common)	Threatened Species	Migratory Species	Listed Marine Species	Type of Presence	BIA
Sharks and Rays						
Anoxypristis cuspidata	Narrow Sawfish		✓		MO	–
Carcharodon carcharias	Great White Shark	V	✓		MO	–
Glyphis garricki	Northern River Shark	E			MO	–
Isurus oxyrinchus	Shortfin Mako		✓		LO	–

Species (Scientific)	Species (Common)	Threatened Species	Migratory Species	Listed Marine Species	Type of Presence	BIA
Isurus paucus	Longfin Mako		✓		LO	–
Manta alfredi	Reef Manta Ray		✓		LO	–
Manta birostris	Giant Manta Ray		✓		LO	–
Pristis clavate	Dwarf Sawfish	V	✓		MO	–
Pristis pristis	Freshwater Sawfish	V	✓		KO	–
Pristis zijsron	Green Sawfish	V	✓		KO	–
Rhincodon typus	Whale Shark	V	✓		MO	–
Syngnathids						
Campichthys tricarinatus	Three-keel Pipefish			✓	MO	–
Choeroichthys brachysoma	Pacific Short-bodied Pipefish			✓	MO	–
Choeroichthys suillus	Pig-snouted Pipefish			✓	MO	–
Corythoichthys amplexus	Fijian Banded Pipefish			✓	MO	–
Corythoichthys flavofasciatus	Reticulate Pipefish			✓	MO	–
Corythoichthys schultzi	Schultz's Pipefish			✓	MO	–
Doryrhamphus excisus	Bluestripe Pipefish			✓	MO	–
Doryrhamphus janssi	Cleaner Pipefish			✓	MO	–
Halicampus brocki	Brock's Pipefish			✓	MO	–
Halicampus grayi	Mud Pipefish			✓	MO	–
Halicampus spinirostris	Spiny-snout Pipefish			✓	MO	–
Haliichthys taeniophorus	Ribboned Pipehorse			✓	MO	–
Hippichthys penicillus	Beady Pipefish			✓	MO	–
Hippocampus histrix	Spiny Seahorse			✓	MO	–
Hippocampus kuda	Spotted Seahorse			✓	MO	–
Hippocampus planifrons	Flat-face Seahorse			✓	MO	–
Hippocampus spinosissimus	Hedgehog Seahorse			✓	MO	–
Micrognathus micronotopterus	Tidepool Pipefish			✓	MO	–
Solegnathus hardwickii	Pallid Pipehorse			✓	MO	–
Solegnathus lettiensis	Gunther's Pipehorse			✓	MO	–
Solenostomus cyanopterus	Robust Ghostpipefish			✓	MO	–
Syngnathoides biaculeatus	Double-end Pipehorse			✓	MO	–
Trachyrhamphus bicoarctatus	Bentstick Pipefish			✓	MO	–
Trachyrhamphus longirostris	Straightstick Pipefish			✓	MO	–

Threatened Species:
V Vulnerable
E Endangered
Biologically Important Area:
– No BIA Present

Type of Presence:
MO Species of species habitat may occur within area LO Species or species habitat likely to occur within area
KO Species or species habitat known to occur within the area

3.3.4.3 Observed fish assemblages

Analysis of the 36 Baited Remote Underwater Video (BRUV) samples from the 2010 wet season survey recorded a total of 22 genera representing 17 families (positive identification was made for 33 species plus three unidentified records) for the deep waters of both the Petrel and Tern fields as well as a proposed pipeline route, that was being planned as part of a previously scoped project. The most common families by density were Terapontidae (grunters) Nemipteridae (threadfin breams), and Lutjanidae (snappers).

3.3.5 Marine reptiles

There are six marine turtles, 17 sea snakes, and one crocodile species (or species habitat) classified as threatened, migratory or listed marine that may occur within the EMBA (Table 3-3). The type of presence varies between species, but is predominantly may occur, with no important behaviours (e.g. aggregating, breeding) recorded within the EMBA (Table 3-3). Foraging BIAs for four marine turtle species intersect with the EMBA (Table 3-3). No known habitat critical for the survival of marine turtles (DEE 2017a) occurs within the EMBA.

3.3.5.1 Marine turtles

Any occurrence within the EMBA is likely to be of a transient nature only; however, it is possible that some species (e.g. Loggerhead, Green, Olive Ridley and Flatback) may use the area for foraging.

3.3.5.2 Sea snakes

Given their primarily nearshore and shallow water distribution, occurrence within the EMBA is considered unlikely and would likely be of a transient nature only.

3.3.5.3 Crocodiles

Given their primarily coastal distribution, occurrence within the EMBA is considered unlikely and if it did occur would likely be of a transient nature only.

Table 3-3: Marine reptile species or species habitat that may occur within the EMBA

Species (Scientific)	Species (Common)	Threatened Species	Migratory Species	Listed Marine Species	Type of Presence	BIA
Marine Turtles						
Caretta caretta	Loggerhead Turtle	E	✓	✓	LO	✓(f)
Chelonia mydas	Green Turtle	V	✓	✓	LO	✓(f)
Dermochelys coriacea	Leatherback Turtle	E	✓	✓	LO	–
Eretmochelys imbricata	Hawksbill Turtle	V	✓	✓	LO	–
Lepidochelys olivacea	Olive Ridley Turtle	E	✓	✓	LO	✓(f)
Natator depressus	Flatback Turtle	V	✓	✓	KO	✓(f)
Sea Snakes						
Acalyptophis peronii	Horned Sea Snake			✓	MO	–
Aipysurus duboisii	Dubois' Sea Snake			✓	MO	–
Aipysurus eydouxii	Spine-tailed Sea Snake			✓	MO	–
Aipysurus laevis	Olive Sea Snake			✓	MO	–
Astrotia stokesii	Stokes' Sea Snake			✓	MO	–
Disteira kingii	Spectacled Sea Snake			✓	MO	–
Disteira major	Olive-headed Sea Snake			✓	MO	–
Enhydrina schistosa	Beaked Sea Snake			✓	MO	–

Species (Scientific)	Species (Common)	Threatened Species	Migratory Species	Listed Marine Species	Type of Presence	BIA
Hydrelaps darwiniensis	Black-ringed Sea Snake			✓	MO	–
Hydrophis atriceps	Black-headed Sea Snake			✓	MO	–
Hydrophis coggeri	Slender-necked Sea Snake			✓	MO	–
Hydrophis elegans	Elegant Sea Snake			✓	MO	–
Hydrophis inornatus	Plain Sea Snake			✓	MO	–
Hydrophis mcdowelli	Small-headed Sea Snake			✓	MO	–
Hydrophis ornatus	Spotted Sea Snake			✓	MO	–
Lapemis hardwickii	Spine-bellied Sea Snake			✓	MO	–
Pelamis platurus	Yellow-bellied Sea Snake			✓	MO	–
Crocodiles						
Crocodylus porosus	Saltwater Crocodile		✓	✓	LO	–

Threatened Species:
V Vulnerable
E Endangered
Biologically Important Area:
– No BIA Present
(f) Foraging BIA

Type of Presence:
MO Species of species habitat may occur within area LO Species or species habitat likely to occur within area
KO Species of species habitat known to occur within area

3.3.6 Marine mammals

There are five whale and eight dolphin species (or species habitat) classified as threatened, migratory or a listed cetacean species that may occur within the EMBA (Table 3-4). The type of presence varies between species, but is predominantly may occur, with no important behaviours (e.g. aggregating, breeding) recorded within the EMBA. No BIAs for marine mammals have been identified within the EMBA (Table 3-4).

3.3.6.1 Whales

Given the various species predominant range, migratory patterns, and/or known aggregation areas, occurrence of these species within the EMBA is considered unlikely or of a transient nature only.

Analysis of six months of noise logger data (September 2010 to March 2011) did not provide evidence of any Blue Whales being present in the area. The noise logger data also did not provide evidence of Humpback Whale feeding, breeding or resting areas in the vicinity of the Petrel and Tern fields. During two marine surveys, November 2010 and May 2011, no Blue Whales or Humpback Whales were sighted from the survey vessel in the area.

3.3.6.2 Dolphins

Occurrence of some dolphins species (e.g. Spotted, Indian Ocean Bottlenose, Spotted Bottlenose) within the EMBA was considered possible, however if it did occur would likely be of a transient nature only.

Table 3-4: Marine Mammal Species or Species Habitat that may occur within the EMBA

Species (Scientific)	Species (Common)	Threatened Species	Migratory Species	Listed Marine Species	Type of Presence	BIA
Whales						
Balaenoptera borealis	Sei Whale	V	✓		MO	–
Balaenoptera edeni	Bryde's Whale		✓		MO	–

Species (Scientific)	Species (Common)	Threatened Species	Migratory Species	Listed Marine Species	Type of Presence	BIA
Balaenoptera musculus	Blue Whale	E	✓		LO	–
Balaenoptera physalus	Fin Whale	V	✓		MO	–
Megaptera novaeangliae	Humpback Whale	V	✓		LO	–
Dolphins						
Delphinus delphis	Common Dolphin				MO	–
Grampus griseus	Risso's Dolphin				MO	–
Orcinus orca	Killer Whale		✓		MO	–
Pseudorca crassidens	False Killer Whale				LO	–
Stenella attenuata	Spotted Dolphin				MO	–
Tursiops aduncus	Indian Ocean Bottlenose Dolphin				MO	–
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)		✓		MO	–
Tursiops truncatus s. str.	Bottlenose Dolphin				MO	–

Threatened Species:
V Vulnerable
E Endangered
Biologically Important Area:
– No BIA Present

Type of Presence:
MO Species of species habitat may occur within area LO Species or species habitat likely to occur within area

3.4 Social Environment

There are no Commonwealth or State marine protected areas, wetlands of international or national importance, World, National or Commonwealth heritage properties or places, Indigenous Protected Areas, maritime heritage (i.e. shipwrecks) that intersect with the EMBA. Due to the distance offshore, it is also not expected that tourism and recreation activities are likely to occur within the vicinity of the EMBA.

3.4.1 Commonwealth marine regions

Six marine regions have been identified in Commonwealth waters around Australia; the EMBA interests with two of these regions: North-west and North. Key conservation values for each of the marine regions are described online (DEE 2017b).

3.4.1.1 Key Ecological Features

Two KEFs occur within the EMBA: carbonate bank and terrace system of the Sahul Shelf; and the pinnacles of the Bonaparte Basin (Table 3-5).

Table 3-5: Key Ecological Features present within the EMBA

KEF	Values and Description[1]
Carbonate bank and terrace system of the Sahul Shelf	• Unique seafloor feature with ecological properties of regional significance • Little is known about the bank and terrace system of the Sahul Shelf but it is regionally important because of its likely ecological role in enhancing biodiversity and local productivity relative to its surrounds. The banks are thought to support a high diversity of organisms including reef fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter feeders. The banks are known to be foraging areas for loggerhead, olive ridley

KEF	Values and Description[1]
	and flatback turtles. Cetaceans and green and freshwater sawfish are likely to occur in the area
Pinnacles of the Bonaparte Basin	• Unique seafloor feature with ecological properties of regional significance • As they provide areas of hard substrate in an otherwise relatively featureless environment, the pinnacles are likely to support a high number of species, although a better understanding of the species richness and diversity associated with these structures is required

Notes:
1. Values and description as provided in DSEWPaC 2012.

3.4.2 Commercial Fisheries

3.4.2.1 Commonwealth Fisheries

Four Commonwealth-managed commercial fisheries have management areas that intersect with the EMBA. One of these, the Skipjack Tuna Fishery, has been inactive since the 2008-2009 fishing season; and two fisheries (Southern Bluefin Tuna, and Western Tuna and Billfish) have their catch from areas well outside the EMBA.

The Northern Prawn Fishery is the only Commonwealth-managed fishery that may have activity within the vicinity of the EMBA, however this is considered unlikely. The highest catches are taken offshore from mangrove forests, which are the juvenile nursery areas (Patterson et al. 2018).

3.4.2.2 State Fisheries

Fishing activity in the vicinity of the EMBA is expected to be low, with only one of the State-managed fisheries (the offshore Demersal Fishery and Licences) identified as potentially having active fishing effort in the general region; however, no trawling fishing is undertaken in the area.

3.4.1 Industry

3.4.1.1 Shipping

There are no known recognised major shipping routes within the immediate vicinity of the Tern field, however vessels may pass through the general area. The temporarily abandoned wells have been in-situ since the 1980's, and also appear on navigation charts.

3.4.1.2 Petroleum Exploration and Production

Petroleum exploration in the Bonaparte Basin commenced in the late 1940's. Gas in the Bonaparte Basin is currently produced from the Bayu-Undan and Blacktip fields; and oil is produced from the Laminaria-Corallina and greater Montara fields (DIIS 2019). Currently there are five gas (Sunrise/Sunset/Troubadour, Barossa/Caldita, Petrel/Tern/Frigate, Cash/Maple, and Evans Shoals) and one oil (Buffalo) fields being considered for development (DIIS 2019).

3.4.1.3 Military

The Tern field is located within a military exercise zone, the Northern Australia Exercise Area. The zone incorporates the majority of the Northern Territories portion of the Bonaparte Basin, and is mainly utilised for activities associated with border protection including surveillance, illegal immigration and illegal fishing. Consultation with the Department of Defence indicated that unexploded ordnance may be present on and in the seafloor.

4. STAKEHOLDER CONSULTATION

4.1 Overview

Santos is committed to consulting with relevant stakeholders to ensure concerns associated with the Tern-2 temporarily abandoned well and associated surveillance survey are incorporated into the management of the activity wherever practicable.

Santos acknowledges that stakeholder consultation to-date has been undertaken by the previous operator. As there are no new or different significant risks or impacts associated with the activities covered by this EP, the stakeholder engagement process supporting the previous operator's EP (Neptune Energy 2018) is considered appropriate for use, and the outcomes of that engagement remain applicable.

Santos has notified relevant stakeholders of the change in operators (see Section 4.2), and all ongoing stakeholder consultation regarding the activities under this EP will be led by Santos (see Section 4.3).

4.2 Summary of stakeholder consultation

4.2.1 Identification of relevant stakeholders

The requirements in the OPGGS(E) Regulations were used to identify a relevant person for activities under this EP (Table 4-1).

Table 4-1: Relevant stakeholders for the activity

Commonwealth department or agency	Australian Fisheries Management Authority (AFMA) Australian Hydrological Office (AHO) Australian Maritime Safety Authority (AMSA) Department of Defence (DoD)
State department or agency	NT Department of Primary Industry and Resources
Persons or organisations	**Fisheries:** Northern Territory Seafood Council Offshore Demersal Fishery and Licences Commonwealth Fisheries Association Amateur Fisherman's Association of the Northern Territory Northern Prawn Fishery Western Australian Fishing Industry Council Inc (WAFIC)
	Oil spill preparedness and response agencies: Australian Marine Oil Spill Centre (AMOSC)
Other	None identified given the location of the activity

4.2.2 Consultation outcomes

A summary of the consultation undertaken by Santos is provided in Table 4-2.

From the stakeholder consultation undertaken by the previous operator, no claims or objections were raised. The requests for notification prior to activity being undertaken from AMSA, AHO and DoD have been carried across to commitments under this EP as per Section 4.3.

Table 4-2: Summary of stakeholder consultation

Stakeholder	Relevance to Activity	Information provided	Summary of Response
Commonwealth department or agency			
Australian Fisheries Management Authority (AFMA)	Management of Commonwealth commercial fisheries from 3 nm to 200 nm (EEZ)	February 2019: notification of change of operator	No response is required
Australian Hydrological Office (AHO)	Commonwealth agency responsible for hydrographic services such as Notice to Mariners Details of infrastructure placed on Navigation Charts Charting and Information Management		
Australian Maritime Safety Authority (AMSA)	Safety Regulator for Marine Safety and Vessel-based Oil Spill Response in Commonwealth Waters Impacts on Shipping Routes & Navigation Warnings Marine Pollution Controller in Commonwealth Waters for Vessels		
Department of Defence (DoD)	Potential for interaction between vessels and DoD activities		
State department or agency			
NT Department of Primary Industry and Resources	Petroleum activity regulation	February 2019: notification of change of operator	No response is required
Persons or organisations			
Northern Territory Seafood Council	Relevance due to for coexistence with commercial fisheries	February 2019: notification of change of operator	No response is required
Offshore Demersal Fishery and Licences	Relevant based on potential for coexistence.		
Commonwealth Fisheries Association	Peak body for commercial fisheries. Relevant based on potential for coexistence.		
Amateur Fisherman's Association of the Northern Territory	Unlikely to be relevant due to location of activity offshore, flyer was provided for information		
Northern Prawn Fishery	Relevant based on potential for coexistence.		
Western Australian Fishing Industry Council Inc (WAFIC)	Relevant based on potential for coexistence.		
Australian Marine Oil Spill Centre (AMOSC)	Oil Spill Response Organisation		

4.3 Ongoing stakeholder consultation

From the stakeholder consultation undertaken, the notifications and ongoing consultation outlined in Table 4-3 will be undertaken by Santos.

In addition, if any changes to relevant stakeholders are identified Santos will consult with them prior to the seabed surveillance survey taking place. Santos will assess any feedback received, including

any future stakeholder objections or claims about the proposed activity, and take appropriate action where it considers it necessary to do so, which may include amendment to the EP. Santos will advise stakeholders of its response to feedback provided and any resultant action taken.

If an additional control measure, or change to an existing control measure, is considered necessary as an outcome of stakeholder feedback, this will be managed as per the management of change (MoC) process (Section 6.3) and in accordance with regulatory requirements.

Table 4-3: Notifications and ongoing consultation requirements

Stakeholder	Notification / Ongoing Consultation Requirement	Timing	Objective	Frequency
DoD	Advanced notification of the activity	Two weeks before commencing seabed equipment surveillance survey	Location, start and finish dates	Once
AHO	Advanced notification of the activity for: • Notice to Mariners	Three weeks before commencing seabed equipment surveillance survey	Notice to Mariners	Once
AMSA JRCC	Advanced notification of the activity for: • AUSCOAST Warnings	24–48 hours before commencing seabed equipment surveillance survey	AUSCOAST Warning	Once
Interested parties Potentially affected parties Government agencies	Advise of any new or significant changes to activities or impacts/risks within the scope of this EP	Prior to new or significant changes to activities or impacts/risks occurring	Location, start and finish dates	As required

5. ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

5.1 Risk assessment method

Santos has undertaken an environmental impact and risk assessment for the activity in accordance with OPGGS(E) Regulations. The environmental risk assessment process undertaken for the activity comprised of the following components:

1. Identification of environmental hazards;
2. Identification of the environment that may be affected;
3. Description of the environment that may be affected;
4. Identification of the particular values and sensitivities;
5. Identification and evaluation of potential environmental impacts;
6. Control measure identification and ALARP decision framework;
7. Determine severity of consequence;
8. Determine likelihood (for unplanned events);
9. Determine residual risk ranking; and
10. Determination of Acceptability.

Once the potential hazards and environmental values and sensitivities were identified, the potential level of impact (consequence) was assessed and assigned. Consequence is defined using the Santos Environmental Consequence Classification Guide (Table 5-1).

For planned events, the final ranking directly reflects the consequence level assigned by evaluation of impacts as shown in Table 5-2.

For unplanned risks, a likelihood and risk evaluation are also undertaken. Likelihood is defined using the Santos Likelihood Descriptors (Table 5-3) from the Santos Operational Risk Matrix. Risk is expressed in terms of a combination of the consequence of an impact and the likelihood of the consequence occurring. Santos uses a Corporate Risk Matrix (Table 5-4) to plot the consequence and likelihood to determine the level of risk.

Once the level of risk is determined, Santos uses a Risk Significance Rating (Table 5-5) to determine the magnitude of the risk and if further action is required to reduce the level of risk using the process described in Section 5.1.2.

Table 5-1: Santos environmental consequence classification

Consequence Classification	Indicative Impact		
	Ecosystems	**Flora and Fauna Conservation Value**	**Land/Water/Air**
Critical (VI)	Regional and long-term impact on an area of significant environmental value.	Destruction of / or extensive and long-term impact to an important population of plants and animals with recognised conservation value.	Regional and long-term impact to land or surface or groundwater or air quality. Complete remediation impossible.
Severe (V)	Regional and medium-term impact on an area of significant environmental value.	Destruction of an important population of plants and animals of recognised environmental value.	Regional and medium-term impact to land or surface or groundwater or air quality. Complete remediation not practical or impossible.
Major (IV)	Extensive and medium-term impact or localised and long-term impact to areas of significant environmental value. Extensive and medium-term impact or localised and long-term impact to an ecosystem.	Extensive and medium-term impact or localised and long-term impact to plants or animals with recognised conservation value.	Extensive and medium-term impact or localised and long-term impact to land or surface or groundwater or air quality. Remediation possible but may be difficult or expensive.
Moderate (III)	Localised and medium-term impact or extensive and short-term impact to areas of significant environmental value. Localised and medium-term impact or extensive and short-term impact to an ecosystem	Localised and medium-term impact or extensive and short-term impact to plants or animals of significant environmental value.	Localised and medium-term impact or extensive and short-term impact to land or surface or groundwater or air quality. Remediation may be difficult or expensive.
Minor (II)	Localised and short-term impact to areas of environmental value. Localised and short-term impact to an ecosystem.	Localised and short-term impact to plants or animals with environmental value	Localised and short-term impact to land or surface or groundwater or air quality. Readily treated.
Negligible (I)	Negligible/localised and short-term impact to an ecosystem/community.	Localised and short-term impact to plants of animals.	Negligible/localised and short-term impact to land or surface or groundwater or air quality. Readily treated.

Definitions	
Duration of Potential Impact	**Extent of Impact**
Short-term: days or weeks	**Localised**: within the operational area
Medium-term: les than 12 months	**Extensive**: within the EMBA
Long-term: greater than 12 months	**Regional**: outside of the EMBA

Table 5-2: Planned event ranking

Impact Consequence Ranking	Final Ranking (for planned events)	Treatment Guide
Critical (VI)	Very High (5)	**Intolerable**
Severe (V)	Very High (5)	
Major (IV)	High (4)	**May be tolerable subject to ALARP**
Moderate (III)	Medium (3)	
Minor (II)	Low (2)	
Negligible (I)	Very Low (1)	**Tolerable**

Table 5-3: Santos likelihood descriptions

Level		Criteria
Almost certain	**f**	Occurs in almost all circumstances or could occur within days to weeks
Likely	**e**	Occurs in most circumstances or could occur within weeks to months
Occasional	**d**	Has occurred before in Santos or could occur within months to years
Possible	**c**	Has occurred before in the industry or could occur within the next few years
Unlikely	**b**	Has occurred elsewhere or could occur within decades
Remote	**a**	Requires exceptional circumstances and is unlikely even in the long-term or only occurs as a "100 year event"

Table 5-4: Santos risk matrix

		Consequence					
		I	**II**	**III**	**IV**	**V**	**VI**
Likelihood	**f**	**2**	**3**	**4**	**5**	**5**	**5**
	e	**2**	**3**	**4**	**4**	**5**	**5**
	d	**2**	**2**	**3**	**4**	**4**	**5**
	c	**1**	**2**	**2**	**3**	**4**	**5**
	b	**1**	**1**	**2**	**2**	**3**	**4**
	a	**1**	**1**	**1**	**2**	**3**	**3**

Table 5-5: Santos risk significance rating

Risk Level	Mitigation / Investigation Focus
5	Intolerable risk level Following verification of the residual risk at Level 5, activity must stop Activity cannot recommence until controls implemented to reduce residual risk to Level 4 or lower Dedicated multi-disciplinary incident investigation team Management involvement in the investigation
4	Assess risk to determine if ALARP If ALARP, activities related to maintenance of controls/barriers prioritised and managed If not ALARP, improve existing controls and/or implement new controls Dedicated multi-disciplinary incident investigation team
3	Assess risk to determine if ALARP If ALARP, activities related to maintenance of controls/barriers prioritised and managed If not ALARP, improve existing controls and/or implement new controls Full incident investigation
2	Assess risk to determine if ALARP If ALARP, activities related to maintenance of controls/barriers prioritised and managed If not ALARP, improve existing controls and/or implement new controls Incident investigations using simple tools
1	Managed as stipulated by the related work processes No incident investigation required

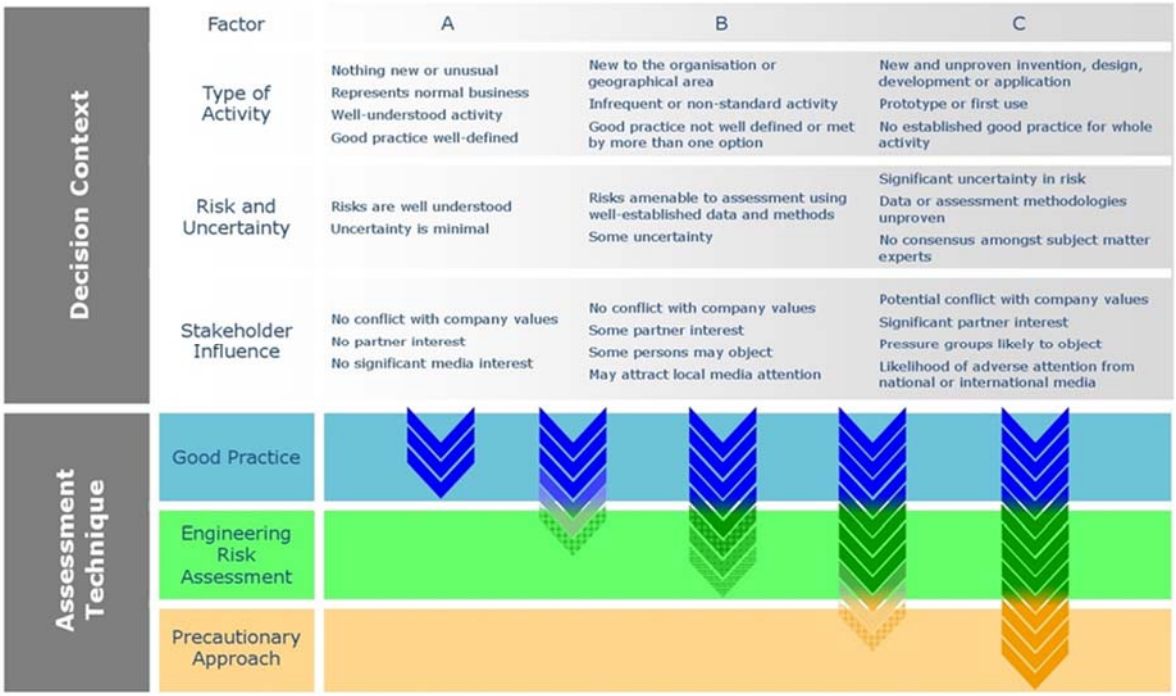
5.1.1 ALARP decision framework

In alignment with NOPSEMA's ALARP Guidance Note (GN0166), Santos have adapted the approach developed by Oil and Gas UK (OGUK) (formerly UKOOA) for use in an environmental context to determine the assessment technique required to demonstrate that potential impacts and risks are ALARP (Figure 5-1).

Specifically, the framework considers impact severity and several guiding factors:

- activity type;
- risk and uncertainty; and
- stakeholder influence.

This framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the impact or risk (referred to as the Decision Type A, B or C). Decision types and methodologies to establish ALARP are outlined in Table 5-6.



(Source: NOPSEMA Guidance Note. N-04300-GN0166, Rev 6, June 2015)

Figure 5-1: Impact and risk 'uncertainty' decision making framework

Table 5-6: ALARP decision making based upon level of uncertainty

Decision Type	Description	Decision Making Tools
A	Risks classified as a Decision Type A are well understood and established practice.	Good Practice Control Measures are considered to be: • Legislation, codes and standards: Identifies the requirements of legislation, codes and standards that are to be complied with for the activity. • Good Industry Practice: Identifies further engineering control standards and guidelines that may be applied over and above that required to meet the legislation, codes and standards. • Professional Judgement: Uses relevant personnel with the knowledge and experience to identify alternative controls. When formulating control measures for each environmental impact or risk, the 'Hierarchy of Controls' philosophy, which is a system used in the industry to identify effective controls to minimise or eliminate exposure to impacts or risks, is applied.
B	Risks classified as a Decision Type B are typically in areas of increased environmental sensitivity with some stakeholder concerns.	Risk-based tools such as cost based analysis or modelling: Assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the risk assessment process.
C	Risks classified as a Decision Type C will typically involve sufficient complexity, high potential impact, uncertainty or stakeholder interest.	Precautionary Approach: OGUK (2014) state that if the assessment, taking account of all available engineering and scientific evidence, is insufficient, inconclusive or uncertain, then a precautionary approach to hazard management is needed. A precautionary approach will mean that uncertain analysis is replaced by conservative assumptions that will result in control measures being more likely to be implemented.

5.1.2 Determination of impact and risk acceptability

The model Santos used for determining acceptance of residual risk is detailed in Figure 5-2. In summary:

- A Level 5 residual risk is intolerable and must not be accepted or approved by management;
- A Level 2–4 residual risk is acceptable provided that ALARP has been achieved and demonstrated;
- A Level 1 residual risk is acceptable and it is assumed that ALARP has been achieved.

In addition to the requirements detailed above, for the purposes of offshore petroleum activities, impacts and risk to the environment are considered broadly acceptable if:

- The residual risk is determined to be Level 1 (and ALARP Decision Type A selected and good practice control measures applied), or
- The residual risk is determined between Level 2–4 and ALARP can be demonstrated; and the following have been met:
  - Principles of ecologically sustainable development;
  - Legal and other requirements;
  - Santos policies and standards; and
  - Stakeholder expectations.

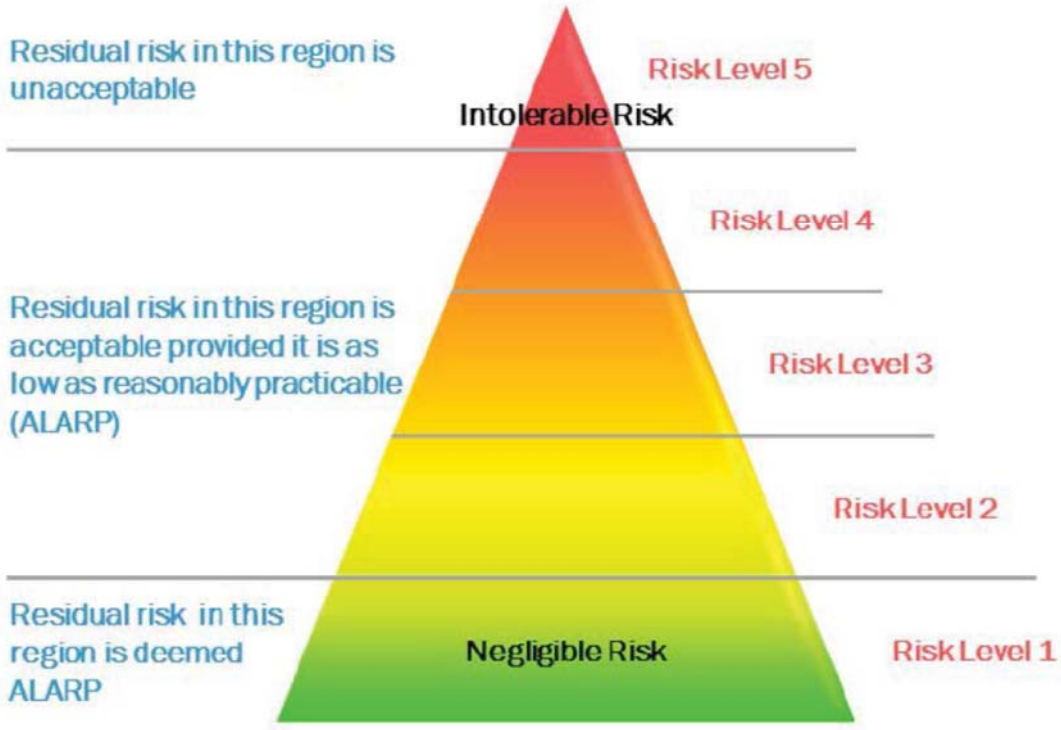


Figure 5-2: Santos residual risk acceptance model

5.2 Summary of environmental impact assessments for planned events

The below tables summarise the potential impacts and consequence evaluations, and the associated control measures applied to reduce these to ALARP and an acceptable level for each environmental aspect.

Table 5-7: Summary of environmental impact assessment – Physical Interaction (Other Marine Users)

Hazard	The presence of the wellheads on the seabed has the potential to result in interactions with other marine users. In addition, the presence of moving vessels within the operational area during the seabed equipment surveillance survey has the potential to result in interactions with other marine users. Note that interactions with divers and swimmers have not been considered, due to lack of appropriate sites within the operational area and distance from shore.
Known or potential environmental impacts	Interaction with other marine users has the potential to result in the: • disruption to commercial activities.
Evaluation of environmental impacts	
Several commercial fisheries have management areas that overlap the operational area associated with this EP. Fisheries which may be active within the vicinity of the operational area include the Commonwealth Northern Prawn Fishery and the State Offshore Demersal Fishery and Licence. The temporarily abandoned wellhead protrudes approximately 2-3 m above the seabed, so are ~80 m below the sea surface. Demersal trawling consists of towing a net across the seabed to catch fish that are generally within 2-3 m of the seabed (Baker 2003). Protruding wellheads or other structures may potentially snag fishing nets. Based on the management framework where trawl gear is permitted in the Demersal Fishery, these areas do not appear to intersect with the operational area (DPIRD 2012). Engagement with relevant stakeholders did not raise any concern or objection over the activities proposed in the EP. It is noted that the well has been temporarily abandoned since the 1980's (with location shown on existing navigation charts), and as such the continued presence of the wellhead is not a new aspect for marine users. Therefore, the proposed	

activities are not expected to result in an impact to commercial operations (via loss of catches or damage to fishing equipment) from the presence of a wellhead on the seabed given the existing long-term presence of this feature. The most credible impact to other marine users would be the minor deviation of commercial vessels around the seabed equipment surveillance survey small utility vessel during integrity monitoring activities. Any deviation would be minor and given the duration of the integrity monitoring, are not expected to effect travel times or fuel use of these vessels. There is no exclusion zone (Petroleum Safety Zone) currently in force around the temporarily abandoned well, and nor is one required during the seabed equipment surveillance survey. Although the wellhead is expected to remain in-situ for the duration of this EP, the seabed equipment surveillance survey is only expected to take approximately four hours on site at the well. Consequently, any impacts would be Negligible (I), with no measurable little to no potential impacts to, or concerns from, affected external stakeholders.

Control Measure Identification	
Control Measure	**Description**
Pre-start notifications	Under the Navigation Act 2012, the Australasian Hydrographic Office is responsible for maintaining and disseminating hydrographic and other nautical information and nautical publications including: • Notices to Mariners • AUSCOAST warnings. It is unlikely that a Notice to Mariners will be issued, given the short-term nature of the seabed equipment surveillance survey. However, this will be considered in the planning of and prior to a seabed equipment surveillance survey and should it be determined as a possible mitigation details of the vessel movements will be published in Notices to Mariners, thus enabling other marine users to plan their activities, and minimising disruption to exclusion zones. Relevant details will be provided to the Joint Rescue Coordination Centre (JRCC) to enable AUSCOAST warnings to be disseminated.
Watch-keeping	All contracted vessels will have radar capability and 24-hour watch capability.

Environmental Impact Assessment		
Impact	**Consequence Ranking**	**Final Ranking**
Physical interaction with other marine users causing a disruption to commercial activities	Negligible (I)	Very Low (1)
ALARP Decision Context	A	
Acceptability Evaluation	With the controls proposed, the impacts associated with physical interaction with other marine users were assessed to be 'Very Low' (1). Therefore, the impacts from interaction with marine users are considered to be acceptable.	

Table 5-8: Summary of environmental impact assessment – Physical Interaction (Seabed Disturbance)

Hazard	During the seabed equipment surveillance survey, the ROV operates close to the seabed, and may temporarily come into direct contact with the seabed. The ROV's thrusters may also result in the suspension of seabed material. Seabed disturbance from the physical presence of the wells is not considered within the scope of this EP, as the wells were drilled in the 1980's and the wellheads have been in-situ since then.
Known or potential environmental impacts	Seabed disturbance has the potential to impact on receptors, including benthic habitats and assemblages, through: • smothering and alteration of benthic habitats; and • localised and temporary increase in turbidity near the seabed.
Evaluation of environmental impacts	
Smothering and alternation of benthic habitats The area of benthic habitat expected to be disturbed by the ROV coming into direct contact with seabed is approximately 1.5 m^2. Any impact will be limited to the immediate vicinity of the well head, and thus the extent of potential impact is considered to be very localised. The benthic habitat within the Tern field is characterised by primarily sand and silt; with infauna assemblages and sparse coverage of sessile epibenthic organisms. The benthic area within the field is not dissimilar to the wider Sahul Shelf.	

Given the lack of sensitive benthic receptors, and that damage would only occur within a small area, it is expected that any localised impacts from the ROV contacting the seabed would rapidly recolonise and recover from any disturbance. Therefore, the potential impact has been determined as Negligible (I).

Localised and temporary increase in turbidity near the seabed

Benthic habitat may be disturbed through the temporary increase in turbidity near the seafloor when the thrusters are used to raise the ROV off the seafloor. Note, ROV activities that interact with the seabed are not constant through the activities for this EP; that is, there is a single event that may result in a once-off increase in local turbidity.

The impact from the thrusters is not expected to cause the suspension of a large volume of material. In addition, the high settling velocity of sand (and coarser) material would ensure that the particles do not remain in suspension for an extended period of time.

The location of the wells within a homogenous seabed area, and lack of sensitive benthic features, means that turbidity resulting from the described activities is expected to result in only temporary and localised impacts or disturbance, therefore the potential impact has been determined as Negligible (I).

Control Measure Identification	
Control Measure	**Description**
Competence and qualifications	All ROV personnel to have relevant qualifications and/or experience to be competent to carry out survey tasks as per IMCA C005 Guidance on Competence Assurance and Assessment.
Operating procedures	IMCA R004 Code of Practice for the Safe and Efficient Operation of Remotely Operated Vehicles refers to having operating procedures in place that include standard procedures and any site-specific requirements. This operational procedure should be available and maintained.

Environmental Impact Assessment		
Impact	**Consequence Ranking**	**Final Ranking**
Seabed disturbance causing smothering and alteration of benthic habitats	Negligible (I)	Very Low (1)
Seabed disturbance causing localised and temporary increase in turbidity near the seabed	Negligible (I)	Very Low (1)
ALARP Decision Context	A	
Acceptability Evaluation	With the controls proposed, the impacts associated with physical interaction due to seabed disturbance were assessed to be 'Very Low' (1). Therefore, the impacts from physical interaction due to seabed disturbance are considered to be acceptable.	

Table 5-9: Summary of environmental impact assessment – Underwater Sound Emissions

Hazard	Underwater sound emissions will be generated from vessel operations. The noise generated from ROV operations was also considered. However, given this is considerably lower than the noise of the thrusters and propellers from a vessel, the noise from the manoeuvring of the ROV will make minimal difference to the overall noise impacts and associated impacts and as such has not been considered further.
Known or potential environmental impacts	The potential impacts of underwater sound emissions in the marine environment are: • Localised and temporary fauna behavioural disturbance that significantly affects migration or social behaviours; and • Auditory impairment, Permanent Threshold Shift (PTS).
Evaluation of environmental impacts	
Localised and temporary fauna behavioural disturbance *Marine Mammals* Using the National Marine Fisheries Service (NMFS) guidance for non-pulsed sound, such as vessel noise, a behavioural disturbance limit of 120 dB re 1 µPa RMS is adopted (NMFS 2016). Richardson et al. (1995) and Southall et al. (2007) indicate that behavioural avoidance of baleen whales may onset from 140 to 160 dB re 1 µPa or possibly higher. McCauley (1998; 2004) indicates that continuous noise sources from MODU and vessel operations are expected to fall below 120 dB re 1 µPA within 4 km of the MODU / vessel. Hearing damage in marine mammals from shipping noise has not been widely reported (OSPAR 2009). Consequently, the potential impacts and risks from noise emissions on marine mammals are considered to be Minor (II) as this type of event may result in a localised short-term effect to species of recognised conservation value.	

Fish and sharks

Due to a lack of observational data on impacts to fish from continuous underwater sound sources, Popper et al. (2014) proposed qualitative indicators of relative risk of effects indicating that Peak SPL (~207 dB re 1 µPa) has the potential to result in a recoverable injury in fish that have high or medium hearing sensitivity. Temporary behavioural impacts from these sound levels may include initial startle reactions before behaviours either return to normal, or result in fish moving away from the area (Wardle et al. 2001).

Thrusters from vessels have been measured to have a peak output of ~182 dB re 1 µPa (Hannay et al. 2004). As such, underwater sound levels from this activity are expected to be generated that would result in either a recoverable injury, and any impact (behavioural or other) would be temporary.

Consequently, the potential impacts and risks from noise emissions on fish and sharks are considered to be Negligible (II) as this type of event may result in slight effect limited to the immediate area of the vessel which is only expected to be temporary.

Marine reptiles (turtles)

Electro-physical studies have indicated that the best hearing range for marine turtles is in the range of 100-700 Hz, however no definitive thresholds are known for the sensitivity to underwater sounds or the levels required to cause pathological damage (McCauley, 1994). Using the limited information available, it has been reported that behavioural and masking changes are likely to occur at levels above 120 dB re 1 µPa (SVT Engineering Consultants 2009).

Based upon (Hannay et al. 2004), there is the potential for behavioural and masking changes to occur within 4 km of the vessel during the seabed equipment surveillance survey.

Consequently, the potential impacts and risks from noise emissions are considered to be Minor (II) as this type of event may result in a localised short-term effects that is expected to recover immediately upon completion of the activity.

Auditory Impairment, Permanent Threshold Shift (PTS)

The criteria set by Southall et al. (2007) suggests that to cause an instantaneous injury to cetaceans (including porpoises) resulting in a permanent loss in hearing, the sound must exceed 230 dB re 1 µPa (Peak SPL).

Popper et al. (2014) propose qualitative indicators of relative risk of effects indicating that Peak SPL (~207 dB re 1 µPa) has the potential to result in a recoverable injury in fish that have high or medium hearing sensitivity; thus, peak levels would need to be above this to result in auditory impairment.

Using the limited information available, it has been reported that physical injury and/or instantaneous permanent hearing damage to adult turtles is likely to occur at 240 dB re 1 µPa (SVT Engineering Consultants 2009).

No supporting literature is available to determine levels of continuous underwater noise generated from vessel operations would be above those required to cause auditory impairment or PTS impacts on marine mammals, whales and sharks or marine turtles. As such, no further assessment of this impact has been made.

Control Measure Identification	
Control Measure	**Description**
Planned maintenance system (PMS)	It is industry good practice that a PMS is in place to ensure that the generators and thrusters are working efficiently to the required standard.
Vessel Master Fauna observation actions Fauna interaction management actions	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans – The Australian Guidelines for Whale and Dolphin Watching, describes strategies to ensure whales and dolphins are not harmed during offshore interactions with people. These guidelines were developed jointly by all state and territory governments through the Natural Resource Management Ministerial Council and although are more relevant for tourism activities, provide a list of good requirements that are generally adopted by the oil and gas industry to minimise the risk of fauna strike occurring; this also has the effect of ensuring distance from vessel propellers and so on that cause underwater sound. AMSA marine notice 15/2016 Minimizing the risk of collisions with cetaceans; also identifies control measures for vessel operators to minimise interactions with marine fauna which by proxy reduce the potential impact of underwater sound species such as marine mammals and marine turtles. These control measures are the same as those identified within EPBC Regulations 2000 and thus have not been discussed further.

Environmental Impact Assessment		
Impact	**Consequence Ranking**	**Final Ranking**
Behavioural disturbance to marine fauna (reptiles, mammals) from underwater noise	Minor (II)	Low (2)
Behavioural disturbance to marine fauna (fish and sharks) from underwater noise	Negligible (I)	Very Low (1)

ALARP Decision Context	A
Acceptability Evaluation	With the controls proposed, the impacts associated with underwater sound emissions were assessed to be 'Low' (2). No additional reasonably practicable controls were identified (and is

	therefore considered ALARP), and additional principles/expectations met (as per table below), and as such the impacts from underwater sound emissions are considered to be acceptable

Table 5-10: Summary of environmental impact assessment – Atmospheric Emissions

Hazard	The use of fuel by vessels was identified as having the potential to result in air emissions:
Known or potential environmental impacts	Generation of atmospheric emissions has the potential to result in: • chronic effects to sensitive receptors from localised and temporary decrease in air quality from diesel combustion. Given the short duration and minimal fuel usage of vessel(s), the contribution of atmospheric emissions to the global greenhouse gas (GHG) effect is expected to be insignificant and has not been assessed further.

Evaluation of environmental impacts

The use of fuel (specifically marine-grade diesel) to power engines, generators and mobile and fixed plant (e.g. ROV, back-deck crane, generator), will result in gaseous emissions of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), along with non-GHG such as sulphur oxides (SO_X) and nitrous oxides (NO_X).

The quantities of atmospheric emissions and related impacts will be similar to other vessels operating in the region for both petroleum and non-petroleum activities. Emissions from engines, generators and deck equipment may be toxic, odoriferous or aesthetically unpleasing, and will result in a localised, temporary reduction in air quality.

Modelling was undertaken by BP (BP 2013) for a large offshore project (that comprised a MODU, support vessels, helicopters, tug boats etc) to understand the extent of potential impacts associated with offshore atmospheric emissions. NO2 is the focus of the modelling as it is considered the main (non-greenhouse) atmospheric pollutant of concern, with larger predicted emission volumes compared to other pollutants, and the potential for NO_2 to impact on human health (as a proxy for environmental receptors). Results of this modelling indicate that on an hourly average, there is the potential for an increase in ambient NO2 concentrations of 0.0005 ppm within 10 km of the source and an increase of less than 0.1 µg/m3 (0.00005 ppm) in ambient NO2 concentrations more than 40 km away.

The Australian Ambient Air Quality National Environmental Protection (Air Quality) Measures (NEPM) recommends that hourly exposure to NO_2 is <0.12 ppm and annual average exposure is <0.03 ppm.

As this modelling was based upon emissions from a number of different sources including a MODU that generates a significantly higher amount of emissions due to higher diesel consumption, this modelling is very conservative and indicates that exposures above NEPM would not be expected from this activity too distant from the source of emission.

Emissions will be small in quantity and will dissipate quickly into the surrounding atmosphere, therefore any reduction in air quality is not expected to result in any measurable effect and consequently, the potential impacts and risks from atmospheric emissions are evaluated as Negligible (I).

Control Measure Identification

Control Measure	Description
Reduced sulphur content fuel	Sulphur content of diesel/fuel oil complies with Marine Order Part 97 and Regulation 14 of MARPOL 73/78 Annex VI (fuel oil with sulphur content less than 3.50% mass/mass)
Compliance with Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution	• Where applicable, all vessels will comply with Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel, including: o Vessels will hold a valid International Air Pollution Prevention (IAPP) certificate and a current international energy efficiency (IEE) certificate. • All vessels (as appropriate to vessel class) will have a Ship Energy Efficiency Management Plan (SEEMP) as per MARPOL 73/78 Annex VI. • Operation of engines, generators and deck equipment in accordance with manufacturer's instructions and ongoing maintenance to ensure efficient operation.

Environmental Impact Assessment

Impact	Consequence Ranking	Final Ranking
Generation of atmospheric emissions has the potential to result in chronic effects to sensitive receptors from localised and temporary decrease in air quality from diesel combustion.	Negligible (I)	Very Low (1)

ALARP Decision Context	A

Acceptability Evaluation	With the controls proposed, the impacts associated with atmospheric emissions were assessed to be 'Very Low' (1). Therefore, the impacts from atmospheric emissions are considered to be acceptable.

Table 5-11: Summary of environmental impact assessment – Light Emissions

Hazard	During the activity, the vessels will generate light while in the operational area. Lighting is used for marine safety to ensure clear identification of vessels to other marine users and to allow activities to be undertaken safely 24 hours a day. Lighting will typically consist of bright white (i.e. metal halide, halogen, fluorescent) lights, and are not dissimilar to other offshore activities in the region, including fishing and shipping. Spot lighting may also be used on an as-needed basis, such as during ROV deployment and retrieval.
Known or potential environmental impacts	A change in ambient light levels has the potential to result in: • Disorientation, attraction or repulsion; and • Disruption to natural behavioural patterns and cycles.

Evaluation of environmental impacts

Artificial lighting has the potential to affect marine fauna (e.g. seabirds, fish, turtles) that use visual cues for orientation, navigation, or other purposes, resulting in behavioural responses which can subsequently alter foraging and/or breeding activity. These potential impacts are dependent on:

- Density and wavelength of the light and the extent to which light spills into areas that are significant for breeding and foraging;
- Timing of overspill relative to breeding and foraging activity; and
- Resilience of the fauna populations that are affected.

Lighting will be localised to a small radius of light glow around the vessel and temporary in nature as the vessel is on location within the operational area over a short (<1 day) duration.

Seabirds may be attracted to vessels at night due to the light glow. Bright lighting can disorientate birds, thereby increasing the likelihood of seabird injury or mortality through collision with infrastructure, or mortality from starvation due to disrupted foraging at sea (Wiese et al. 2001). However, no foraging BIAs for seabirds have been identified within the area. Therefore, it is not expected that light emissions acting as an attractant to a small number of individual seabirds would result in any significant impact to the individual or to the greater population. Nesting birds may be disorientated where lighting is adjacent to rookeries, however, this is not identified as a potential impact as the operational area is approximately 100 km offshore.

The response of fish and invertebrates to light emissions varies depending on their photosensitivity. For example, species such as squid are known to aggregate under downward facing lights; and a study on artificial lighting associated with offshore oil and gas activities showed an increased abundance of clupeids (herring and sardines) and engraulids (anchovies) (Lindquist et al. 2005). However, it is not expected that light emissions acting as an attractant to a small number of individuals over a short period of time would result in any significant impact to the individual or to the greater population.

Artificial light is identified as a potential threat to marine turtles (DEE 2017a) because it disrupts critical behaviour such as hatchling orientation and females returning to nesting beaches. However, this is not considered a potential impact as the operational area is approximately 100 km offshore and not within the vicinity of critical habitat for turtle nesting.

Light emissions from vessel operations will be of a short duration and limited spatial extent, therefore any disorientation or disruption to marine fauna is expected to be localised and short-term only, and consequently, the potential impacts are evaluated as Negligible (I).

Control Measure Identification

Control Measure	Description
Minimised lighting	• Lighting is kept to a minimum safe operational level in line with AMSA (Marine Order Part 30 – Prevention of Collisions) navigation requirements. • Overside lighting pointing towards the water shall be limited to that required for safe operations (i.e. essential only).

Environmental Impact Assessment

Impact	Consequence Ranking	Final Ranking
A change in ambient light levels has the potential to result in disorientation or disruption to behavioural patterns for marine fauna.	Negligible (I)	Very Low (1)

ALARP Decision Context	A
Acceptability Evaluation	With the controls proposed, the impacts associated with light emissions were assessed to be 'Very Low' (1). Therefore, the impacts from light emissions are considered to be acceptable.

Table 5-12: Summary of environmental impact assessment – Planned Discharges

Hazard	During the seabed equipment surveillance survey, the vessel will make the following planned liquid discharges: • Sewage and grey water • Food / putrescible waste • Brine (from water treatment plant) • Cooling water • Deck drainage and bilge water. As the operational area is located ~300 km from the nearest landfall at Darwin, all of these liquid wastes will be discharged to the marine environment as permitted under MARPOL Annex IV and V.
Known or potential environmental impacts	Planned liquid discharges to the marine environment could affect water quality and marine fauna in surface waters. Changes to water quality may include: • increased water temperature; • increased water salinity; • potential chemical toxicity in the water column. Impacts associated with the planned discharge of food waste, sewage and greywater, including changes to water and sediment quality, are presented in detail in the NERA Reference Case 2017:1001 and have not been discussed further here. No additional impacts from the planned discharge of food waste, sewage and greywater associated with this activity are expected.
Evaluation of environmental impacts	
Increased Temperature Changes in water temperature can result from discharges of cooling water. Modelling of continuous wastewater discharges (including cooling water) undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being <1°C above ambient within 100 m (horizontally) of the discharge point, and 10 m vertically (WEL 2014). Sensitive environmental receptors with the potential to be exposed to an increase in temperature are transient marine fauna, including whales, sharks, fish, and reptiles. Marine mammals and fish passing through the area will be able to actively avoid entrainment in any heated plume (Langford, 1990), and reptiles and sharks would be expected to behave similarly. Acclimation of test organisms at 15, 20 and 25°C allowed them to tolerate temperature increments of 8-9°C without damage (UNEP 1985). Given the open nature of the receiving environment and the short duration of the activity, the impact of increased temperature is expected to be Negligible (I). **Increased salinity** Changes in salinity can result from discharges of brine. Brine water will sink through the water column where it will be rapidly mixed with receiving waters and dispersed by ocean currents. As such, any potential impacts are expected to be limited to the source of the discharge where concentrations are highest. This is confirmed by studies that indicate effects from increased salinity on planktonic communities in areas of high mixing and dispersion are generally limited to the point of discharge only (Azis et al. 2003). Changes in salinity can affect the ecophysiology of marine organisms. Most marine species are able to tolerate short-term fluctuations in salinity in the order of 20% to 30% (Walker and McComb 1990). However, larval stages, which are very crucial transition periods for marine species, are known to be more susceptible to impacts of increased salinity (Neuparth, Costa & Costa 2002). Pelagic species are mobile, it is expected that at worst, they would be subjected to slightly elevated salinity levels (~10-15% higher than seawater) for a very short time which they are expected to be able to tolerate. As such, transient species are not expected to experience chronic or acute effects. Given the open nature of the receiving environment and the short duration of the activity, the impact of increased salinity is expected to be Negligible (I). **Potential Chemical Toxicity** Potential chemical toxicity can result from scale inhibitors and biocides used in the heat exchange and desalination process, and treatment of bilge and deck drainage.	

Scale inhibitors are typically low molecular weight phosphorous compounds that are water-soluble, and only have acute toxicity to marine organisms about two orders of magnitude higher than typically used in the water phase (Black et al. 1994). The biocides typically used in the industry are highly reactive and degrade rapidly (Black et al. 1994).

Scale inhibitors and biocide used in the heat exchange and desalination process to avoid fouling of pipework are inherently safe at the low dosages used; they are usually consumed in the inhibition process, so there is little or no residual chemical concentration remaining upon discharge.

Bilge and deck water may contain small volumes of hydrocarbons. OSPAR (2014) indicates that the predicted no effect concentration (PNEC) for marine organisms exposed to dispersed oil is 70.5 ppb. It should be noted that this PNEC is based upon NOECs after exposure to certain concentrations for an extended period that was greater than seven days (OSPAR 2014).

A discharge of treated bilge is non-continuous and infrequent. Modelling by Shell (2009) indicates that upon discharge, hydrocarbon and other chemical concentrations are rapidly diluted and expected to be below PNEC within a relatively short period of time.

Given the nature of this discharge, marine fauna most susceptible to toxic impacts from chemical discharges are mainly limited to less mobile fish embryo, larvae, and other plankton. Any impact that may occur to plankton or to species that rely on plankton as a food source would be temporary as the duration of exposure would be very limited, and fish larvae and other plankton are expected to rapidly recover as they are known to have high levels of natural mortality and a rapid replacement rate (UNEP 1985). However, as vessel operations within the operational area are only in the order of approximately 4 hours, toxicity impacts are not expected to occur.

Consequently, the potential impacts and risks from planned discharge of treated bilge and other chemicals are considered to be Negligible (I).

Control Measure Identification	
Control Measure	**Description**
MARPOL-approved oil water separator Criteria for approved discharge	AMSA Marine Order Part 91 (Marine Pollution Prevention - Oil) gives effect to parts of MARPOL Annex I. MARPOL is the International Convention for the Prevention of Pollution from Ships and is aimed at preventing both accidental pollution and pollution from routine operations.
Planned maintenance system (PMS)	• Oil water separator will be maintained. • Engines and associated equipment that require cooling by water will be maintained. • Food macerator and MARPOL-approved sewage system will be maintained.
Sewage discharge	• Where appropriate for class, requirements in accordance with Marine Order 96 (Marine pollution prevention – sewage) 2013. This includes: o No discharge of treated or untreated sewage <3 nm from nearest land o Sewage discharged between 3 NM and 12 NM to be treated via an onboard sewage treatment plant (STP) approved by the International Maritime Organisation (IMO) (MARPOL MEPC.2 (IV), or MEPC.159 (55), or MEPC.227 (64)). o Sewage (treated or untreated) originating from holding tanks is discharged at a moderate rate* while the ship is proceeding en route at a speed not less than 4 knots o *The rate of discharge shall be approved by the Administration based upon standards approved by the Organisation (MEPC.157 (55)). Recommended standards for the rate of discharge of sewage from ships can be found in Marine Order 96 • Where appropriate for class, vessels/facilities will have valid International Sewage Pollution Prevention Certificates (ISPP) • STP must be in good working order • Personnel must be appropriately trained in tasks and aware of requirements
Putrescible waste discharge	• Where appropriate for class, requirements in accordance with Marine Order 95 (Marine pollution prevention – garbage) 2013. This includes: o All food wastes discharged >3 NM and <12 NM will be macerated to <25mm o Food waste to be discharged >12 NM but within 500 m of a stationary facility, will be macerated to <25 mm o Processing equipment must be capable of macerating to <25 mm, and be in good working order • Personnel must be appropriately trained in tasks and aware of requirements • Records of food waste disposal to be maintained in a Garbage Record Book • Vessels will maintain a Garbage Management Plan which addresses the requirements for food wastes

	• Vessels of 12 metres in length or over are required to display placards notifying passengers and crew of the disposal requirements, including for food wastes

Environmental Impact Assessment		
Impact	**Consequence Ranking**	**Final Ranking**
Planned liquid discharges to the marine environment could affect water quality (temperature, salinity, toxicity) and marine fauna in surface waters.	Negligible (I)	Very Low (1)
ALARP Decision Context	A	
Acceptability Evaluation	With the controls proposed, the impacts associated with planned discharges were assessed to be 'Very Low' (1). Therefore, the impacts from planned discharges are considered to be acceptable.	

5.3 Summary of environmental risk assessment for unplanned events

The below tables summarise the potential risks and consequence evaluations, and the associated control measures applied to reduce these to ALARP and an acceptable level for each environmental aspect.

Table 5-13: Summary of environmental risk assessment – Physical interaction (collision with marine fauna)

Hazard	The presence of moving and dynamically positioned vessels within the operational area has the potential to result in collision with marine fauna.
Known or potential environmental impacts	Interaction with fauna has the potential to result in: • injury or death of marine fauna.
Evaluation of environmental impacts	
Macrofauna comprising marine mammals, turtles and whale sharks are the species most at risk from this potential impact and thus are the focus of this evaluation. Several marine mammals (whale, dolphin), turtles and sharks listed as threatened, migratory and/or a listed marine species under the EPBC Act have the potential to occur within the operational area. However, the presence of these fauna are expected to be transitory only, with no known aggregation areas within the vicinity. There are foraging BIAs for the Loggerhead, Green, Olive Ridley and Flatback Turtle that do intersect with the operational area; although it is noted that this represents are very small proportion of the entire BIA, and presence is still expected to be transitory only. There is limited data regarding strikes to fauna such as turtles and Whale Sharks, possibly due to lack of collisions being noticed and lack of reporting; however, marks observed on animals show that strikes have occurred (Peel et al. 2016; cited in Commonwealth of Australia 2016). Cetaceans are the focus of this evaluation as they provide a representative case to enable an evaluation of consequence to be undertaken. Cetaceans are naturally inquisitive marine mammals that are often attracted to offshore vessels and facilities. The reaction of whales to the approach of a vessel is quite variable. Some species remain motionless when in the vicinity of a vessel, while others are curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster-moving ships (Richardson et al. 1995). Collisions between larger vessels with reduced manoeuvrability and large, slow-moving cetaceans occur more frequently where high vessel traffic and cetacean habitat occurs (Whale and Dolphin Conservation Society, 2006). Laist et al. (2001) identifies that larger vessels with reduced manoeuvrability moving in excess of 10 knots may cause fatal or severe injuries to cetaceans, with the most severe injuries caused by vessels travelling faster than 14 knots. Vessels typically used to undertake petroleum activities do not have the same limitations on manoeuvrability and would not be moving at these speeds when conducting activities within the scope of this EP, inside the operational area. Peel et al. (2016; cited in Commonwealth of Australia 2016) reviewed vessel strike data from 1997-2015 for marine species in Australian waters and identified the following: • Whales including the humpback, pygmy blue, Antarctic blue, southern right, dwarf minke, Antarctic minke, fin, bryde's, pygmy right, sperm, pygmy sperm and pilot species were identified as having interacted with vessels. The humpback whale exhibited the highest incidence of interaction followed by the southern right whale. A number of these species may migrate through the waters of the operational area. • Dolphins including the Australian humpback, common bottlenose, indo-pacific bottlenose and Risso's dolphin species were also identified as interacting with vessels. The common bottlenose dolphin exhibited the highest incidence of interaction. A number of these species may reside in or pass through the waters of the operational area. The duration of fauna exposure to the risk vessel strike is very limited as vessel operations within the operational area are only in the order of approximately 4 hours. If a fauna strike occurred and resulted in death, it is not expected that it	

would have a detrimental effect on the overall population. Consequently, the potential impacts and risks from fauna strike are considered to be Minor (II) as this type of event may result in a slight effect within the immediate vicinity of the vessel with a temporary impact given a strike resulting in death is not expected to affect the population or local ecosystem function	
Control Measure Identification	
Control Measure	**Description**
Vessel Master Fauna observation actions Fauna interaction management actions	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans – The Australian Guidelines for Whale and Dolphin Watching describes strategies to ensure whales and dolphins are not harmed during offshore interactions with people. These guidelines were developed jointly by all state and territory governments through the Natural Resource Management Ministerial Council and although are more relevant for tourism activities, provide a list of good requirements that are generally adopted by the oil and gas industry to minimise the risk of fauna strike occurring. AMSA Marine Notice 15 / 2016 Minimizing the risk of collisions with cetaceans also identifies control measures for vessel operators to minimise the risk of fauna collisions (AMSA, 2016). These control measures are the same as those identified within EPBC Regulations 2000
Incident reporting	Vessel strikes are required to be reported under the: • Conservation Management Plan for the Blue Whale 2015–2025 (DoE 2015) and • Conservation Advice for the Humpback Whale 2015–2020 (TSSC 2015a); • Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC 2015b); • Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC 2015c).

Environmental Impact Assessment			
Impact	**Consequence Ranking**	**Likelihood Ranking**	**Residual Risk**
Interaction with fauna has the potential to result in injury or death of marine fauna	Minor (II)	Unlikely (b)	Very Low (1)
ALARP Decision Context	A		
Acceptability Evaluation	With the controls proposed, the impacts associated with physical interaction with marine fauna were assessed to be 'Very Low' (1). Therefore, the impacts from physical interaction with marine fauna are considered to be acceptable.		

Table 5-14: Summary of environmental risk assessment – Introduction of marine pests

Hazard	Vessel operations have the potential to result in: • discharge of ballast water within the operational area; and • biofouling. Both these aspects have the potential to result in the introduction of invasive marine pests (IMPs), and therefore they have been assessed together.
Known or potential environmental impacts	The known and potential impacts of IMPs introduction (assuming their survival, colonisation and spread) include: • reduction in native marine species diversity and abundance; • displacement of native marine species; • socio-economic impacts on commercial fisheries; and • changes to conservation values of protected areas. No ballast water discharge or exchange is expected to occur within the territorial sea boundary. Open-ocean ballast water discharge or exchange is considered the best compromise in regard to efficacy, environmental safety and economic practicality to manage the potential risk if IMPs (DoF 2009). The two key assumptions underpinning this are: • Changes in biological condition (including salinity) of source and recipient waters; i.e. coastal or estuarine IMPs are presumed unlikely to survive in ocean waters, and vice versa.

	• The transport of viable released non-indigenous organisms from open-ocean to coastal and estuarine waters, by ocean currents, is considered extremely unlikely.

Evaluation of environmental impacts

Successful IMP invasion requires the following three steps:

- Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
- Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., project area).
- Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

IMP are likely to have little or no natural competition or predators, thus potentially outcompeting native species for food or space, preying on native species, or changing the nature of the environment. It is estimated that Australia has more than 250 established marine pests, and it is estimated that approximately one in six introduced marine species becomes pests (DoE 2015).

Marine pest species can also deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion. Marine pests can also damage marine and industrial infrastructure, such as encrusting jetties and marinas or blocking industrial water intake pipes. By building up on vessel hulls, they can slow the vessels down and increase fuel consumption.

The benthic habitat within the operational area is expected to comprise soft sediment with the occasional hard substrate outcrop, infauna communities, and sparse epibiotic communities. Areas of higher value or sensitivity are not located within the operational area.

Once established, some pests can be difficult to eradicate (Hewitt et al. 2002) and therefore there is the potential for a long-term or persistent change in habitat structure. It has been found that highly disturbed environments (such as marinas) are more susceptible to colonisation than open-water environments, where the number of dilutions and the degree of dispersal are high (Paulay et al 2002).

Successful colonisation in the recipient region would be difficult given the nature of the benthic habitats within the operational area (i.e. predominantly bare sands with patchy occurrences of hard substrate), and lack of light due to deep waters (i.e. approximately 80-100 m). If an IMP was introduced, and if it did colonise an area, it is expected that any colony would remain fragmented and isolated, and only within the vicinity of the wells (i.e. it would not be able to propagate to nearshore environments, and protected marine areas present in the wider region). Given the lack of benthic sensitivities in the operational area, there is the potential for the introduction of an IMP to result in a localised medium-term effect to benthic habitats and as such has been evaluated as a Moderate (II) consequence.

Control Measure Identification

Control Measure	Description
Maritime Arrivals Reporting System (MARS)	Under the Biosecurity Act 2015, pre-arrival information must be reported through MARS before arriving in Australian waters
Exchange of vessel ballast water outside Australian waters	• The Australian Ballast Water Management Requirements (DAWR 2017) describes the management requirements for ballast water exchange. • These also require that if a vessel is mobilised from outside Australian waters; its ballast water will be exchanged before it enters Australian waters.
Report ballast water discharges	
Maintain a ballast water record system	
Anti-fouling certificate	The Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 enacts the Marine Order Part 98 (Marine pollution – anti-fouling systems). This marine order requires that an anti-fouling certificate is in place for vessels.
Biofouling record book	The guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (Biofouling Guidelines) MEPC.207(62)) 2011 (IMO, 2011) specifically requires a record book to be available and maintained.

Environmental Impact Assessment

Impact	Consequence Ranking	Likelihood Ranking	Residual Risk
Introduction and establishment of invasive marine pests	Moderate (III)	Remote (a)	Very Low (1)

ALARP Decision Context	B
Acceptability Evaluation	With the controls proposed, the impacts associated with the introduction of IMPs were assessed to be 'Very Low' (1). No additional reasonably practicable controls were identified (and is therefore

	considered ALARP), and additional principles/expectations met (as per table below), and as such the impacts from the risks of an introduction of IMPs are considered to be acceptable.

Table 5-15: Summary of environmental risk assessment – Accidental release (waste)

Hazard	The handling and storage of materials and waste on board the vessel(s) has the potential for accidental over-boarding of hazardous/non-hazardous materials and waste. The following non-hazardous materials and wastes will be disposed of to shore, but have the potential to be accidentally dropped or disposed overboard due to overfull bins or crane operator error: • paper and cardboard; • aluminium, cans; • glass; and • plastics. The following hazardous materials may be used and waste generated using consumable products and will be disposed to shore, but may be accidentally dropped or disposed overboard: • hydrocarbon-contaminated materials (e.g. oily rags); • batteries, empty paint cans, aerosol cans, fluorescent tubes, printer cartridges; and • contaminated personal protective equipment (PPE).
Known or potential environmental impacts	The potential environmental impacts associated with the accidental release of waste are: • marine pollution (litter and a temporary and localised reduction in water quality); • injury and entanglement of marine fauna and seabirds; and • smothering or pollution of benthic habitats.

Evaluation of environmental impacts

Hazardous Materials and Waste

Hazardous materials and wastes are defined as a substance or object that exhibits hazardous characteristics and are no longer fit for its intended use and requires disposal. Some of these hazardous characteristics (as outlined in Annex III to the Basel Convention) include being toxic, flammable, explosive and poisonous.

Hazardous materials and wastes released to the sea cause pollution and contamination, with either direct or indirect effects on marine organisms. For example, chemical spills can impact on marine life from plankton to pelagic fish communities, causing physiological damage through ingestion or absorption through the skin. Impacts from an accidental release would be limited to the immediate area surrounding the release, prior to the dilution of the chemical with the surrounding seawater. In an open ocean environment such as the operational area, it is expected that any minor release would be rapidly diluted and dispersed, and thus temporary and localised.

Solid hazardous materials, such as paint cans containing paint residue, batteries and so forth, would settle on the seabed if dropped overboard. Over time, this may result in the leaching of hazardous materials to the seabed, which is likely to result in a small area of substrate becoming toxic and unsuitable for colonisation by benthic fauna. Given the size of materials release it is expected that only localised impacts to benthic habitats within the operational area would be affected and unlikely to contribute to a significant loss of benthic habitat or species diversity.

Non-hazardous Materials and Waste

Non-hazardous wastes released overboard can cause smothering of benthic habitats as well as injury or death to marine fauna or seabirds through ingestion or entanglement (e.g., plastics caught around the necks of seals or ingested by seabirds and fish). For example, the TSSC (2015a) reports that there have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998 (humpback whales being the main species).

If dropped objects such as bins are not retrievable by ROV, these items may permanently smother small areas of seabed, resulting in the loss of benthic habitat. However, as with most subsea infrastructure, the items themselves are likely to become colonised by benthic fauna over time (e.g., sponges) and become a focal area for sea life, so the net environmental impact is likely to be neutral. This would affect small areas of seabed and is not expected to contribute to the loss of benthic habitat or species diversity.

Control Measure Identification	
Control Measure	**Description**
Garbage / waste management plan	AMSA Marine Order Part 95 (Marine pollution prevention — garbage) and Marine Order Part 94, (Packaged harmful substance) gives effect to MARPOL Annex V.
Garbage record book	MARPOL is the International Convention for the Prevention of Pollution from Ships and is aimed at preventing both accidental pollution, and pollution from routine operations.

	Specifically, MARPOL Annex V requires that a garbage / waste management plan and garbage record book is in place and implemented.
Waste management training / induction	The Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Part IIIC (Prevention of pollution by garbage) requires garbage to minimised, collected and stored appropriately in accordance with the Garbage Management Plan. Inductions for all Vessel crew provide an opportunity to make personnel aware of the requirements of the Garbage Management Plan during the implementation of the activity.

Environmental Impact Assessment			
Impact	**Consequence Ranking**	**Likelihood Ranking**	**Residual Risk**
Marine pollution from the accidental release of waste materials	Negligible (I)	Possible (c)	Very Low (1)
ALARP Decision Context	A		
Acceptability Evaluation	With the controls proposed, the impacts associated with accidental release of waste materials were assessed to be 'Very Low' (1). Therefore, the impacts from accidental release of waste materials are considered to be acceptable.		

Table 5-16: Summary of environmental risk assessment – LOC (Vessel collision)

Hazard	The following activities have the potential to result in a spill of hydrocarbon to the environment: • a collision between the activity vessel and a third-party vessel that results in tank rupture and loss of 60 m3 MDO. A review of receptors within the operational area did not identify significant shipping or commercial fishing activity thus a vessel collision is unlikely but is classified as a credible scenario. Vessel drift or powered grounding is not considered credible given the distance from shore and the lack of emergent features in the operational area.
Known or potential environmental impacts	The LOC (vessel collision) event has the potential to expose the environment to hydrocarbon with the potential to directly or indirectly result in: • Toxicity or physical oiling to marine habitats or fauna; • Reduction in intrinsic value / visual aesthetics; • Damage to commercial businesses. Results of stochastic oil spill modelling (RPS 2018) for the surface release of MDO have predicted: • Surface exposure above the social impact threshold was predicted to extend a maximum distance of up to 68 km from the release site, depending on the season. • Surface exposure above the sublethal ecological impact threshold was predicted to extend a maximum distance up to 32.5 km from the release site, depending on the season. • Surface exposure above the lethal ecological impact threshold was predicted to extend a maximum distance up to 7 km from the release site, depending on the season • No in-water entrained exposure above the ecological impact thresholds was predicted for any season. • No in-water dissolved exposure above the ecological impact thresholds was predicted during the summer and transitional seasons. During winter, there was a low probability (1%) that the sub-lethal ecological impact threshold would be met in a single isolated cell in the immediate vicinity of the release site. • No shoreline contact was predicted for any season. Therefore, the below consequence evaluation is focused on surface exposure only
Evaluation of environmental impacts	
Seabirds and shorebirds When first released, the MDO has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. out to 32.5 km for potential sublethal toxicity, and 7 km for potential lethal toxicity) may suffer impacts however it is unlikely that a large number of birds will be affected given the rapid natural evaporation and dispersion that is expected to occur. Seabirds rafting, resting, diving or feeding at sea have	

the potential to come into contact with localised areas of sheen, however the time-based exposure requirement for toxicity effects (i.e. 48 hrs) may not occur. It is also noted that the area of exposure is localised and temporary (1-2 days following the release). As such, acute or chronic toxicity impacts (death or long-term poor health) to small numbers of birds are possible, however this is not considered significant at a population level.

Consequently, the potential impacts and risks to seabirds from a vessel collision event are considered to be Minor (II), as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value for a short duration but not expected to affect species populations or general ecosystem functioning.

Marine Reptiles

The number of sea snakes that may be exposed is expected to be low due to the offshore location and the extent of exposure above the threshold, before the hydrocarbon weathered further. Therefore, potential impact would be limited to individuals, with population impacts not anticipated.

Marine turtles are vulnerable to the effects of oil at all life stages. Marine turtles can be exposed to surface oil externally (i.e. swimming through oil slicks) or internally (i.e. swallowing the oil). Ingested oil can harm internal organs and digestive function. Oil on their bodies can cause skin irritation and affect breathing.

Marine turtles have the potential to come into contact with localised areas of MDO, however the time-based exposure requirement for toxicity effects (i.e. 48 hrs) may not occur. It is also noted the area of contact is localised and temporary (1-2 days following the release). Therefore, potential impact would be limited to individuals, with population impacts not anticipated.

Consequently, the potential impacts and risks to marine reptiles from a vessel collision event are considered to be Minor (II), as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value for a short duration but not expected to affect species populations or general ecosystem functioning.

Marine Mammals

Physical contact by individual whales or dolphins of MDO is unlikely to lead to any long-term impacts. Given the mobility of whales, only a small proportion of the migrating population would surface in the affected areas, resulting in short-term and localised consequences, with no long-term population viability effects.

Consequently, the potential impacts and risks to marine mammals from a vessel collision event are considered to be Minor (II), as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value for a short duration but not expected to affect species populations or general ecosystem functioning.

Control Measure Identification	
Control Measure	**Description**
Vessel crew	AMSA Marine Order Part 3 [Seagoing qualifications] requires that crew meet the minimum standards for safely operating a vessel, including watchkeeping requirements.
Navigational equipment	AMSA Marine Order Part 30 [Prevention of collisions] requires that onboard navigation, radar equipment, and lighting meets industry standards
Vessel SOPEP/ emergency management plan	In accordance with MARPOL Annex I and AMSA's Marine Order Part 91, Marine Pollution Prevention – oil, a SOPEP is required to be developed based upon the Guidelines for the Development of Shipboard Oil Pollution Emergency Plans, adopted by IMO as Resolution MEPC.54(32) and approved by AMSA. To prepare for a spill event, the SOPEP details: • response equipment available to control a spill event • review cycle to ensure that the SOPEP is kept up to date • testing requirements, including the frequency and nature of these tests. In the event of a spill, the SOPEP details: • reporting requirements and a list of authorities to be contacted • activities to be undertaken to control the discharge of oil • procedures for coordinating with local officials. AMSA's Marine Order Part 21 [Safety and emergency arrangements] requires vessels to have an emergency management plan which includes recommended actions for dealing with emergencies, including damage to the vessel and pollution from the vessel. The emergency management plan/s must include: • damage control procedures; • a decision support system for emergency management; • Marine Order Part 21 [Safety and emergency arrangements] also requires that the Vessel Master must: • assign the crew duties relating to emergencies that may occur on the vessel; and provide instructions on those duties. • ensure each crewmember is trained in the operation and application of all emergency appliances and equipment of the vessel.

OPEP	Under the OPGGS(E)R, NOPSEMA require that the petroleum activity have an accepted OPEP in place before commencing the activity. In the event of a vessel collision the OPEP will be implemented.
OSMP	Santos' OSMP details the arrangements and capability in place for: • operational monitoring of a hydrocarbon spill to inform response activities • scientific monitoring of environmental impacts of the spill and response activities. Operational monitoring will allow adequate information to be provided to aid decision making to ensure response activities are timely, safe, and appropriate. Scientific monitoring will identify if potential longer-term remediation activities may be required.
Pre-start notifications	It is unlikely that a Notice to Mariners will be issued, given the short-term nature of the activity. However, this will be considered in the planning of and prior to a seabed equipment surveillance survey and should it be determined as a possible mitigation details of the vessel movements will be published in Notices to Mariners, thus enabling other marine users to plan their activities, and minimising disruption to exclusion zones. Relevant details will be provided to the JRCC to enable AUSCOAST warnings to be disseminated.

Environmental Impact Assessment			
Impact	**Consequence Ranking**	**Likelihood Ranking**	**Residual Risk**
Accidental release of MDO causing toxicity effects, physical oiling, and/or reduction in intrinsic values	Minor (II)	Unlikely (b)	Very Low (1)
ALARP Decision Context	A		
Acceptability Evaluation	With the controls proposed, the impacts associated with planned discharges were assessed to be 'Very Low' (1). Therefore, the impacts from planned discharges are considered to be acceptable.		

6. ENVIRONMENTAL PERFORMANCE

6.1 Santos EHS Management System

Santos manages the environmental impacts and risks of its activities through the implementation of the Santos Management System (SMS). The SMS provides a formal and consistent framework for all activities of Santos employees and contractors.

Figure 6-1 summarises the framework for the SMS and includes:

- Constitution, Board Charters, Delegation of Authority – These documents define the purpose and authorities of the Santos Limited Board, Board Committees.
- Code of Conduct and Policies – outline the key requirements and behaviours expected of anyone who works for Santos. The Policies are set and approved by the Board.
- Management Standards – prescribe the minimum performance requirements and expectations in relation to the way we work at Santos (the 'What').
- Processes, procedures and tools – support implementation of the Management Standards and Policy requirements by providing detail of 'How' to achieve performance requirements.

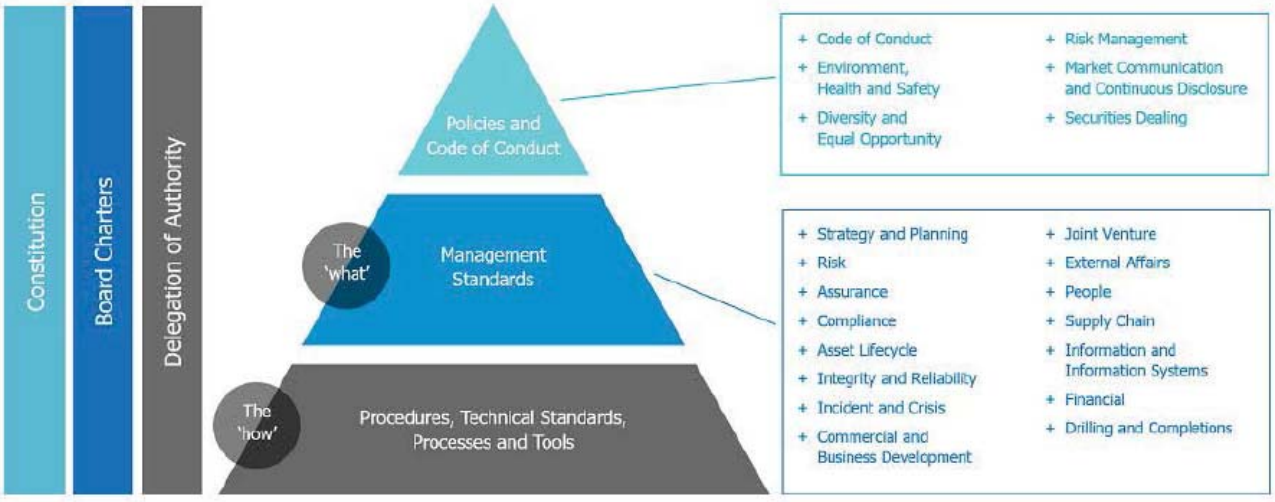


Figure 6-1: Santos management system framework

6.2 Monitoring and reporting

6.2.1 Record management

SMS-MS2 Data and Information Systems detail the requirements to ensure that information is kept current and accurate, stored in a manner to facilitate retrieval, and is accessible to personnel who need it.

Document control and record keeping requirements including record retention periods are specified in the SMS. Where no record retention requirement is specified, the default for physical records is 10 years and 'life of plant' for electronic records.

6.2.2 Emissions and discharges monitoring

Table 6-1 details the monitoring that will be undertaken for planned emissions and discharges associated with the activity.

Table 6-1: Emission and discharge monitoring

Environmental Hazard	Monitoring	Frequency	Reporting
Treated Bilge	Volume Location Vessel Speed	Daily	EP Performance Report
Sewage Discharge	Volume Location	Daily	EP Performance Report
Food-scraps	Volume Location	Daily	EP Performance Report
Fuel Use	Volume	Daily	EP Performance Report
Incinerator (waste)	Volume Flue Temperature	Daily	EP Performance Report
Ballast Water Discharge	Volume	Daily	EP Performance Report
Chemical Inventory	Chemical Type	Weekly	EP Performance Report
Spill	Volume Chemical / Oil Type	By incident event	Incident Report EP Performance Report

6.2.3 Audit

To ensure that the EP requirements have been effectively implemented and that the performance outcomes and standards in the EP have been met, a pre-start audit will be undertaken to ensure the EP requirements can be implemented by the contractor.

SMS–MS15/ST1 Assurance Procedure outlines the audit procedure. Audits findings including actions are communicated to the Santos Asset Manager and Santos Offshore Representative via an audit report. Actions are agreed and assigned an actioner and required completion date. The audit and actions are recorded in the Santos EHS Toolbox Audit and Compliance Manager which notifies the actioner and their manager when actions are due. If actions are not closed within the due date the system has a hierarchy notification system based on the number of days an action is overdue as to the level of manger who receive notification of the overdue action.

6.2.4 Annual performance report

Santos will submit EP Performance Reports to NOPSEMA annually with sufficient information to enable the regulator to determine whether the environmental performance outcomes and standards in the EP have been met. The initial environmental performance report will be submitted to NOPSEMA within one year of acceptance of the EP.

6.2.5 Incident reporting and activity notification

SMS 11/STD2 Incident Reporting, Investigation and Learning sets out the requirements for incident notification, reporting and investigation. Incidents that impact on the environment or have the potential to impact on the environment (near-miss) are to be reported and entered into the EHS Toolbox Incident Management System (IMS).

Table 6-2 details the external incident notification, reporting requirements and timeframes for environmental incidents and activity notifications associated with this EP.

Table 6-2: Incident reporting and activity notification requirements

Requirement	How and by When
Before the activity	
In accordance with Regulation 29, NOPSEMA must be notified that the activity is to commence, through completion of NOPSEMA's Regulation 29 'Start or End of Activity Notification' form.	Written notification to NOPSEMA at least 10 days before the activity commences.
End of activity	
In accordance with Regulation 29, NOPSEMA must be notified that the activity is completed, through completion of NOPSEMA's Regulation 29 'Start or End of Activity Notification' form.	Written notification to NOPSEMA within 10 days after completion.
In accordance with Regulation 25A, NOPSEMA must be notified that the activity has ended and all EP obligations have been completed	Written notification to NOPSEMA within six months of the final Regulation 29(2) notification.
Recordable incident reporting	
Legislative Definition: "means an incident arising from the activity that: (a) breaches a performance objective or standard in the Environment Plan that applies to the activity; and (b) is not a reportable incident."	
Recordable incidents are breaches of environmental performance standards described in this EP examples are, but not limited to: • Spills to the marine environment that are not a reportable incident. • Interference with other marine user As a minimum, the written incident report must include a description of: • The incidents and all material facts and circumstances concerning the incidents. • Any actions taken to avoid or mitigate any adverse environmental impacts. • Any corrective actions that have been taken, or may be taken, to prevent a repeat of similar incidents occurring.	Submit written report to NOPSEMA by 15th of every month
Reportable incident notification	
Definition: "means an incident relating to an activity that has caused, or has the potential to cause, moderate to significant environmental damage." Based on this definition a reportable incident is those that have been identified through the risk assessment process as having a consequence of moderate or above.	
Based on the risk assessment of the activities under the EP the following incidents have been identified as being reportable incidents: • Introduction of an invasive marine pest.	Report verbally to NOPSEMA as soon as practicable within 2 hours and provide written record of notification by email. Ph: 08 6461 7090 Email: submissions@nopsema.gov.au
Reporting Requirements Notify NOPSEMA as soon as practicable, and in any case not less than 2 hours after: • The first occurrence of the reportable incident; or • If the reportable incident was not detected by the operator at the time of the first occurrence – the time the operator becomes aware of the reportable incident. The following information is required: • The incident and all material facts and circumstances concerning the incident that is known at the time. • Any actions taken to avoid or mitigate any adverse environmental impacts. • Any corrective actions that have been taken, or may be taken, to prevent a repeat of similar incidents occurring.	
The verbal notifications must be followed up by a written report as soon as practicable, and not later than 3 days following the incident. At a minimum, the written incident report will include: • The incident and all material facts and circumstances concerning the incident.	As soon as practicable, and not later than 3 days following the incident Email: submissions@nopsema.gov.au Email: info@nopta.gov.au Email: nicholas.papandonakis@nt.gov.au

Requirement	How and by When
• Actions taken to avoid or mitigate any adverse environmental impacts. • Any corrective actions that have been taken, or may be taken, to prevent a recurrence of the incident. • Completion date. The written incident report must be provided to NOPSEMA, the National Offshore Petroleum Titles Authority (NOPTA) and the NT Department of Lands and Planning. If the initial notification of the reportable incident was verbal, the written report is not required to include anything that was not included in the verbal notification	
Other incident reporting requirements	
Oil spills with the potential to impact on territory waters or land must be reported to NT Department of Lands and Planning.	Report verbally or by email if phone contact is not possible to NT DLP as soon as practicable within 2 hours. Phone: 0401 116 097 Email: nicholas.papandonakis@nt.gov.au
Oil spills which occur within AMPs, or are likely to impact AMPs, must be reported to Director of National Parks.	Report verbally to the Marine Park Compliance Duty Office as soon as possible. Phone: 0419 296 465
Ship or non-ship source marine pollution incidents must be reported to AMSA.	Report verbally to AMSA via the RCC immediately. Phone: 02 6230 6811
Impact to a matter of National Environmental Significance	Report verbally or by email if phone contact is not possible to DoE within 2 hours or as soon as practicable Phone: 02 6274 1372 Email: compliance@environment.gov.au
Injury to or mortality of an EPBC Act Listed or Threatened species Injury to or mortality of a cetacean	Report by email or phone to the Department of Environment and Energy within 7 days of observation Phone: (02) 6274 1111 Email: protected.species@environment.gov.au
Suspected or confirmed marine pest / disease	
Department of Primary Industries and Regional Development (DPIRD) is to be notified within 24 hours of a suspected or confirmed presence of any marine pest or disease.	Email: biosecurity@fish.wa.gov.au Pone: Fishwatch 1800 815 507

6.2.6 Management of non-conformance

For the activity a non-conformance is classed as:

- a breach of an environmental performance outcome or environmental performance standard (this triggers the requirement to report as a “recordable incident” as per Section 6.2.5);
- failure to implement a requirement in the implementation strategy.

Non-conformances are identified via:

- emissions and discharge monitoring (Section 6.2.2);
- audits and inspections (Section 6.2.3);
- preparation of the Annual Performance Report (Section 6.2.4); or
- incident reporting and investigations (Section 6.2.5).

Where a non-conformance is identified, actions are implemented to correct the non-conformance and prevent reoccurrence. Effectiveness of the actions is reviewed via auditing (Section 6.2.3) and performance reporting (Section 6.2.4) to ensure that non-conformances are not re-occurring and environmental performance is improving.

To ensure that non-conformances lead to learning and improvements for the survey and on a company-wide basis, non-conformance are:

- Communicated to the Santos General Manager Offshore Development via Santos EHS Toolbox (see below), and the appropriate reports (i.e. audit, performance, incident investigation) to ensure personnel are made aware of nonconformances and corrective actions to help prevent recurrence of similar incidents.
- Communicated to vessels and vessel crews at pre-start meeting via the Santos Offshore Representative to ensure personnel are made aware of non-conformances and corrective actions to help prevent recurrence of similar incidents.
- Communicated internally within Santos as per the Santos Internal Incident Notification Guide and where there are lessons learnt that are applicable to other areas of the business a Flash Notification is issued.
- Agreed with the Santos General Manager Offshore Development and actions assigned an actioner and required completion date.
- Recorded in Santos EHS Toolbox and actions tracked to completion.
- Reviewed by the actioner's manager prior to being closed to ensure actions are completed and implemented.
- Reported externally as per the requirements are detailed in Section 6.2.5.

The Santos EHS Toolbox consists of modules for recording audits, incidents, emergency response exercises, obligations, and actions. The toolbox includes initial notification of non-conformances to be sent at a minimum to the responsible manager though other personnel can be selected as required. The toolbox also has an action tracking and reporting component which notifies the actioner and their manager when actions are due. If actions are not closed within the due date the system has a hierarchy notification system based on the number of days an action is overdue as to the level of manger who receive notification of the overdue action.

For incidents a companywide daily report is sent to registered personnel which for the survey would be at a minimum the Santos General Manager Offshore Development and Environment Manager. This allows for the sharing of incidents and lesson learned between different parts of the business. Any incidents raised from other parts of the business applicable to the survey will be communicated to the Santos Offshore Representative to discuss at the prestart meeting.

The Santos General Manager Offshore Development, Environment Manager and Public Affairs Manager receive formal and informal information via industry associations, engagement with stakeholders including community, other oil and gas companies, regulators and Joint Ventures. Where information is received from external sources in regards to lessons learnt and non-conformances, relevant to the activity, these will be discussed by the asset team to identify if there are actions relevant to the survey. If actions are relevant, they will be implemented as per Santos non-conformance process detailed in this Section 6.2.6.

6.3 Management of change

The SMS-MS1 Risk Management Standard/ST4 Management of Change Procedure establishes the processes required to ensure that when changes are made to a project, control systems, an

organisational structure or to personnel, the EHS risks and other impacts of such changes are identified and appropriately managed.

The SMS requires that all environmentally relevant changes must obtain environmental approval (internal i.e. within Santos and/or external i.e. regulatory) prior to undertaking any activity.

6.3.1 EP review

In order to ensure that impacts and risks are continually reduced to ALARP and acceptable levels and the requirements of legislation will continue to be met, Santos will review the environmental inputs used to inform the evaluation of impacts and risks in the EP, including identifying updates to legislative requirements and environmental information prior to the commencement of each offshore campaign.

6.3.2 Environmental relevant changes

For the purposes of this EP, environmentally relevant changes are as follows:

(a) The commencement of any new activity, or any significant modification, change, or new stage of an existing activity, not provided for in this EP.
(b) New activities, assets, equipment, processes or procedures proposed to be undertaken or implemented that have potential to impact on the environment and have not been:
    (i) assessed for environmental impact previously, in accordance with the requirements of the Offshore Environment Management of Change (MoC) process; and
    (ii) authorised in the existing management plans, procedures, work instructions, or maintenance plans.
(c) The introduction of any new legislative requirements that apply to the activity and are relevant to the environmental management of the activity, or amendments to the existing legislative requirements.
(d) Any significant change to the receiving physical, biological or socio-economic environment within, or immediately adjacent to, the operational area.
(e) The identification of any:
    (i) KEF not already described in this EP;
    (ii) threatened species of cetacean, marine reptile, sharks and ray-finned fish and seabirds not already described in this EP;
    (iii) listed marine species not already described in this EP; and
    (iv) critical habitat/BIA for threatened species not already described in this EP, which has spatial overlap with the operational area.
(f) New information or changes of information from research, stakeholders, legal and other requirements, and any other sources used to inform the EP.
(g) Identification of new relevant stakeholders.

6.3.3 EP revision and resubmission

In the event that the proposed change represents a new activity, a significant modification or new stage of the activity, or introduces a significant new environmental impact or risk, results in a significant increase to an existing environmental impact or risk, or, as a cumulative effect results in an increase in environmental impact or risk, this EP will be revised and submitted for re-assessment and acceptance by NOPSEMA.

7. EMERGENCY RESPONSE OVERVIEW

7.1 Emergency response

7.1.1 Source of risk

This EP has identified the credible and worst-case hydrocarbon spill scenario as:

- Level 2: Unplanned MDO spill from a vessel collision from a ruptured fuel tank of 60 m^3.

7.1.2 Oil pollution emergency plan

As required by Regulation 14(8AA) of the OPGGS(E) Regulations, Santos has prepared an Oil Pollution Emergency Plan (OPEP) (Doc: TRN-1000-PLN-0002). The OPEP is the primary reference document and key control measure to implement in the event of an oil spill over the in-force period of this EP. The OPEP establishes the processes and procedures to ensure that Santos maintains readiness to prevent and, if required, respond to and effectively manage oil spill incidents that may occur over the cessation of production phase.

The OPEP will be updated as and when required if new threats are identified through exercises or changes to industry guidance or best practice, or if there are significant changes to any of the spill response arrangements.

Santos and the vessel contractors maintain company emergency response plans that cover inspection/maintenance activities. These documents supplement the OPEP (Doc: TRN-1000-PLN-0002), which will serve as a stand-alone interface between both companies' spill response plans and with relevant state (WA, NT) and national plans.

7.1.3 Response testing arrangements

Santos' spill response testing arrangements for the OPEP are provided in Table 7-1. Findings from the exercise will be recorded and tracked to closure to ensure continual improvement.

Table 7-1: Testing arrangements for the OPEP

Test	Objective	Schedule	Mechanisms to assess effectiveness	Mechanisms to address recommendations arising from the test
OPEP desk-based emergency exercise	Scenario will include an oil spill. • Adequacy of the IMT to facilitate a credible spill response • Adequacy of the OPEP and associated linkages • Notification and communication arrangements. • Engagement of external parties identified to support the response • Media and/or external affairs management	Annual	• Feedback from external observers • Feedback from exercise participants • Written report incorporating feedback by exercise facilitator	• Tracking through EHS Toolbox • Document updates as required • Additional training if required
General equipment availability	Test that suppliers identified in the EP/OPEP who provide critical equipment have sufficient[1] equipment available for immediate response.	At least 10 days prior to activity	Email confirmation from suppliers of their current stock levels along with details of time to mobilise.	Tracking through EHS Toolbox
EP audit	Ensure that the commitments relevant to spill response made in the EP are being carried out as planned. Confirm	Prior to activity	• Review of commitments	• Tracking through EHS Toolbox

Test	Objective	Schedule	Mechanisms to assess effectiveness	Mechanisms to address recommendations arising from the test
	communications of all relevant offshore and onshore support personnel are undertaken.		made in EP and OPEP • Written report.	• Document updates as required • Additional training if required

Notes:

1. The term "sufficient" is aimed at AMOSC and OSRL. Sufficient is defined that the equipment providers have equipment availability to meet twice Santos' immediate need to allow for response to other spills. For example, are sufficient booms available to meet Santos' initial needs and 1 other customer with a similar-sized spill (200% of Santos' immediate need). For aviation resources Santos will accept 100%. These resources have been confirmed through development of the OPEP and EP, but will be re-confirmed during the exercise.

7.1.4 Management of spill response providers

In the event of an oil spill, a number of contractors will be mobilised to provide a range of required services. Santos has a comprehensive strategy to implement a local, national and international spill response network of third-party service providers. Table 7-2 summarises contracts for key services needed to ensure an effective and proportionate response to a potential spill.

Table 7-2: Santos contracting strategy

Resource Type	Resource Purpose	Key Contracts
Aerial support observation	Provision of aircraft for aerial observation and potentially for freight and personnel transport	Santos will maintain a contract with AVMIN (or equivalent) during the period of an active seabed equipment surveillance survey
Marine services	Vessels for oil spill observation (MES, operational monitoring), and scientific monitoring.	Santos will maintain a contract with Mermaid Marine (or equivalent) during the period of an active seabed equipment surveillance survey
Operational monitoring	Trained observers and sampling of spilled oil and water column. Provision of OSTM.	Santos will maintain a membership with AMOSC (or equivalent) during the period of an active seabed equipment surveillance survey Santos will maintain a contract with SGS (or equivalent during the period of an active seabed equipment surveillance survey. Santos will maintain a contract with RPS (or equivalent) during the period of an active seabed equipment surveillance survey.
Scientific monitoring	Support selection of indicator species for monitoring following receipt of OSTM. Development of detailed scientific monitoring plan. Design and implement scientific monitoring to close data gaps. Development of metadata manual including data location and notification of data owners. Set up standby teams for field monitoring and environmental baseline development	Santos will maintain a contract with GHD (or equivalent) during the period of an active seabed equipment surveillance survey

7.2 Net Environmental Benefit Analysis of response strategies

The overall aim of a spill response is to mitigate further damage to the environment. There are a number of available spill response strategies; however, not all may be effective to protect the environment.

Net Environmental Benefit Analysis (NEBA) is the process of considering advantages and disadvantages of different spill response options (including no response) to arrive at a spill response decision resulting in the lowest overall environmental and social impacts. NEBA is undertaken at a

strategic level to identify pre-determined recommended response strategies, and an operational NEBA is undertaken throughout the emergency response.

Table 7-3 provides an assessment of the available oil spill response options, their suitability to MDO and their recommended adoption for the identified source of risk. As there is no shoreline contact predicted for the spill scenario, nearshore and shoreline response is not required. The response techniques considered appropriate for this EP include:

- Natural Recovery;
- Monitoring, Evaluation, and Surveillance (MES); and
- Vessel Source Control

Natural recovery is not discussed further as specific tasks are not required to be implemented. Should natural recovery be considered an appropriate response option, continual MES and NEBA will be undertaken, as per the overarching response implementation process.

Table 7-3: Suitability of response options

Response Option	Viable Response	Strategic Net Benefit
Natural Recovery	✓	✓
Monitor & Evaluate	✓	✓
Vessel Source Control	✓	✓
Dispersant Application	X	X
Contain & Recover	X	X
Protect & Deflect	X	X
Shoreline Clean-up	X	X
Oiled wildlife Response (OWR)	X	X

7.3 Response strategy overview

7.3.1 Monitoring, evaluation, and surveillance

7.3.1.1 Activity overview

MES will apply to all marine spills. Higher levels of surveillance such as vessel/aerial surveillance, and oil spill trajectory modelling will only be undertaken for Level 2/3 spills given the nature and scale of the spill risk.

It is the responsibility of the Control Agency to undertake MES during the spill event to inform the operational response. MES may include the following:

- Aerial observation;
- Vessel-based observation;
- Computer-based tools:
- Oil spill trajectory modelling;
- Automated Data Inquiry for Oil Spills (ADIOS) (a spill weathering model); or
- Utilisation of satellite tracking buoys.

For vessel-based spills, the responsibility for MES lies with AMSA (Commonwealth waters).

7.3.1.2 Needs analysis and capability

MES should be conducted throughout the response duration, potentially along with other response options. Table 7-4 details the required capability and evaluates the effectiveness and feasibility of the response option.

Table 7-4: MES capability, effectives and feasibility

Response Capability	MES should be conducted throughout the response duration, potentially along with other response options. Scientific monitoring may continue after the response has been terminated. **Service Providers:** Santos have access to vessels and aircraft providers, which are detailed the OPEP. This includes: • Contract in place with RPS to provide spill trajectory modelling. • Suitable aircraft is available for hire in NT (including contract with AVMIN). • Access to vessels or aircraft (including contract with Mermaid Marine). • Third-party environmental support. **Specialist Contractors:** As the control agency, AMSA provide support tools including: • Trajectory modelling • Response phase monitoring • GIS mapping Santos have access to RPS for soil spill trajectory modelling, directly and via AMSA.
Effectiveness and Feasibility	Based on the modelling for an MDO spill, the worst-case radius of actionable oil is a surface expression of <7 km. Additional vessels could be mobilised from Darwin or offshore under existing contracts. Vessel steam times from Darwin are in the order of 36 hours. In addition to this Santos can contract aircraft to conduct aerial observation with fast-tracked contracts available to be in place, and aircraft mobilised to location within 24-48 hours of activation of the IMT. Based on this availability, Santos considers that the existing capability is appropriate, and there are no other practicable controls, appropriate to the nature and scale of the oil spill risk, which could be implemented to affect more timely response activities.

7.3.2 Vessel source control

7.3.2.1 Activity overview

Source control arrangements for an accidental release from vessel failures includes:

- closing water tight doors;
- checking bulkheads;
- determining whether vessel separation will increase spillage;
- isolating penetrated tanks;
- tank lightening, etc.

Implementation of source control for vessels is detailed within the below documents:

- SOPEP/Vessel emergency management plan/s (as required by AMSA Marine Orders Part 21 and/or 91)
- National Plan for Maritime Environmental Emergencies (NatPlan).

7.3.2.2 Needs analysis and capability

Source control for vessel failure does not rely on additional capability, resources or equipment to be mobilised to the spill location; rather it is actions taken onboard the vessel to minimise the loss of MDO and make the vessel safe. There is not necessarily any specific equipment required; and no external services providers. Therefore, response capability, effectiveness and feasibility is not discussed further in this EP.

7.4 Environmental impact and risk assessment for spill response activities

Typically, environmental risks that arise from conducting emergency response activities are similar to those already described; specifically, aspects generated by using offshore vessels are not included here as they are considered to be appropriately covered under various impact and risk evaluations in Section 5.

Source control for vessels is implemented onboard the vessels, by closing valves, transferring fuel between tanks, patching and so on. These activities don't present any different risks to those of vessel operations (Section 5), therefore are no additional risk assessment is necessary. Table 7-5 provides a summary of the environmental risk assessment associated with the MES response strategy.

Table 7-5: Summary of environmental risk assessment – MES

Hazard	The following hazards associated with MES have been identified: • additional vessel activity (over a greater area); and • aircraft use for aerial surveillance (fixed wing or helicopter). The potential impacts associated with vessel activities have been evaluated in Section 5. Based upon the nature and scale of the activities, the evaluation is considered appropriate for any marine surveillance undertaken and thus has not been considered further. As aircraft operations have not been previously evaluated, they are the focus of this risk assessment.
Known or potential environmental impacts	The potential impacts of underwater sound emissions in the marine environment are: • localised and temporary fauna behavioural disturbance that significantly affects migration or social behaviours; and • auditory impairment, Permanent Threshold Shift (PTS).

Evaluation of environmental impacts

Underwater sound emissions literature has been used in Table 5-9 to determine the impact thresholds for fauna behavioural disturbance to be 120 dB re 1 µPa for marine turtles, 140–160 dB re 1 µPa for marine mammals and ~207 dB re 1 µPa for fish.

A helicopter flyover at 305 m was measured at 108 dB re 1 µPa at 45 to 70,000 Hz (Simmonds et al. 2004). Under calm sea conditions, airborne sound is totally reflected and does not enter the water; however rough seas may provide suitable angles for airborne sound to penetrate the water surface (Richardson et al. 1985).

Consequently, the potential impacts and risks from noise emissions on marine mammals, turtles, fish and sharks are considered to be Minor (II) as this type of event may result in temporary localised impact or disturbance to animals.

Similar to underwater noise (Table 5-9), no auditory impairment (PTS) is expected from aircraft activities, and no further assessment of this impact has been made.

Control Measure Identification

Control Measure	Description
Fauna observation actions	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans – The Australian Guidelines for Whale and Dolphin Watching, describes strategies to ensure whales and dolphins are not harmed during offshore interactions with people. These guidelines were developed jointly by all state and territory governments through the Natural Resource Management Ministerial Council and although are more relevant for tourism activities, provide a list of good requirements that are generally adopted by the oil and gas industry to minimise the risk of fauna strike occurring; this also has the effect of ensuring distance from aircraft and so on that cause underwater sound.
Fauna interaction management actions	

Environmental Impact Assessment

Impact	Consequence Ranking	Likelihood Ranking	Residual Risk
Behavioural disturbance to marine fauna from underwater noise	Minor (II)	Remote (a)	Very Low (1)

ALARP Decision Context	A
Acceptability Evaluation	With the controls proposed, the impacts associated with aircraft use for MES were assessed to be 'Very Low' (1). Therefore, the impacts from aircraft use for MES are considered to be acceptable.

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