Cliff Head Field Offshore Operations Environment Plan Summary

Upstream PS Controlled Document

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Revision 5

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Revision history

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5	-	09/11/2017	Updated to include additional information as per request from NOPSEMA	AB	JH	SG
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1	-	09/12/16	Issued to NOPSEMA	AB	CF	AS
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Approvals

This Cliff Head Field Offshore Operations Environment Plan Summary has been reviewed by Triangle Energy (Operations) Pty Ltd and Triangle Energy (Operations) Pty Ltd and is approved.

Approval: Triangle Energy (Operations) Pty Ltd

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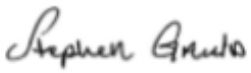
Stephen Gauld General Manager – Production and Asset Development Triangle Energy (Operations) Pty Ltd		09/11/2017

Approval: Triangle Energy (Operations) Pty Ltd

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1 Introduction

On 22nd May 2017, Triangle (Perth Basin) Pty Ltd (TPB) and Royal Energy Pty Ltd officially acquired 100% of Roc Oil (WA) Pty Limited from Roc Oil Company Limited. Subsequently, Roc Oil (WA) Pty Limited was renamed Triangle Energy (Operations) Pty Ltd; the ABN and ACN remain the same. Details of the title holders and their interests are as follows:

+ Triangle Energy (Operations) Pty Ltd (formerly Roc Oil (WA) Pty Limited): 42.5%
+ ACN 008 988 930: 30.0%
+ ACN 008 939 080: 27.5%

Triangle Energy (Operations) Pty Ltd (TEO) as operator on behalf of the Cliff Head Joint Venture in permit WA-31-L holds the petroleum titles and licences (under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act)) associated with the Cliff Head development located off the Western Australian coast, approximately 20 kilometres (km) south of the town of Dongara.

TEO is a titleholder of the Cliff Head development whilst Upstream Production Solutions (Upstream PS) is the nominated operator of the facility. TEO on behalf of the Cliff Head Joint Venture maintain responsibility for compliance with this EP and therefore work as an integrated team with Upstream PS to uphold environmental performance in compliance with this EP, utilising Upstream PS standards and procedures where appropriate to ensure effective EP implementation.

1.1 Details of Titleholders

The Cliff Head Oil Field development (Production Licence Area WA-31-L) lies approximately 11 km off the Western Australian coast.

TEO is the operator on behalf of the Cliff Head Joint Venture Partners (JVP). The JVP consist of:

- Triangle Energy (Operations) Pty Ltd (Operator): 42.5%
- Subsidiaries of Triangle Energy (Global) Limited:
  - A.C.N. 008 988 930 Pty Ltd: 30%
  - A.C.N. 008 939 080 Pty Ltd: 27.5%

The registered offices for the Cliff Head JVPs are:

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Fax Number: +61 8 9385 5184
A.B.N: 32 008 939 080
Email: rtowner@triangleenergy.com.au
Contact person: Robert Towner

Upstream PS is the contract and nominated operator of the Cliff Head Development facilities under the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (OPGGSE). The operations office and address for correspondence for the contract operator is:

Upstream Production Solutions Pty Ltd (ABN 26 166 665 952)

Ground Floor, 100 Havelock Street, West Perth WA 6005 Australia
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ACN: 166 665 952
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1.2 Details of Liaison Person

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Suite 2, Ground floor, 100 Havelock Street, West Perth WA
Telephone Number: +61 8 9219 7111
Email: sgauld@triangleenergy.com.au
Liaison Person: Stephen Gauld

1.3 EP Validity

This EP remains valid for 5 years from date of acceptance by NOPSEMA. During this period, if any changes are required, these will be made pursuant to the process described in Section 5.1. Prior to expiry of the EP, a revision to the EP must be submitted to NOPSEMA if operations will continue. The full field life of the asset is predicted to be go beyond the year 2022 when the EP expires, therefore a revision of the EP is proposed prior to 2022. This EP details ongoing operations at the Cliff Head Platform which has a design life of 23 years (extending from the original design life of 10 years in 2016 as part of the Asset Life Extension) and is therefore expected to remain operating until 2029.

2 Description of Activities

2.1 Location

The Cliff Head oil field is located off the Western Australian coast (Production Licence WA-31-L), west of the Big Horseshoe Reef; approximately 20 km south-southwest of Dongara (

Figure 2-1).

The water depth in the vicinity of the field is approximately 18 m and the closest landfall is 11 km due east. The field itself is approximately 1,260 m below sea level. The wells are tied to the Cliff Head Alpha (CHA) wellhead platform located at 29° 27' 00.4" S 114° 52' 12.1" E. The production and water injection pipelines traverse the seabed within Commonwealth waters, avoiding sensitive areas such as Horseshoe reef. The pipelines cross into State waters at approximately -29° 23' 59.9994" S 114° 54' 0" E.

2.1.1 Operational Area

The operational area includes the CHA platform and the pipeline corridor up to the state waters boundary, including the area within 500m of the pipeline and the 500 m exclusion zone around the platform. A Petroleum Safety Zone (PSZ) of 500m has also been gazetted around the CHA Platform facility. All planned activities described in this EP take place within the operational area.

2.2 Overview of the Cliff Head Oil Field Development

Production from the Cliff Head Oil Field Development involves transferring oil and produced formation water (PFW) from the offshore wellhead to the Arrowsmith Stabilisation Plant (ASP) via the offshore and onshore pipeline. At ASP, the PFW is removed from the product stream, the crude oil is stabilised and then transferred to road tankers and transported for refining.

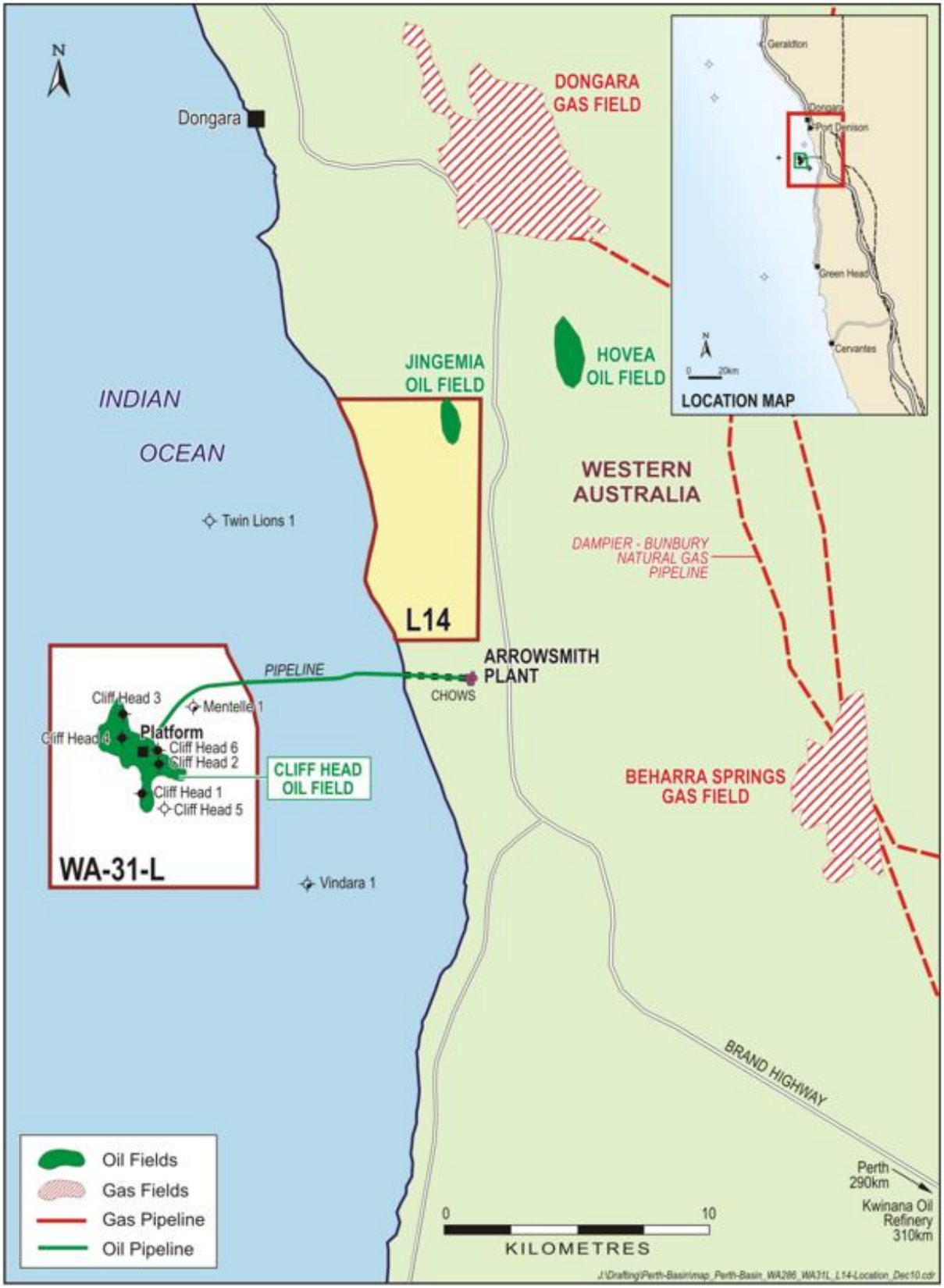
The approved Environment Plan considers only the offshore components of the Cliff Head development, namely those that occur beyond the Commonwealth-State boundaries at 3nm from the coastline, these are:

- An unmanned well head platform, CHA to accommodate the well heads and support equipment;
- Eight well heads with the current arrangement of five production wells with electrical submersible pumps (ESPs) to enable artificial lifting of the produced fluid (i.e. crude oil and water), and three water injection wells;
- An insulated subsea production pipeline, which transports the produced fluids from CHA to the onshore ASP);
- An insulated subsea water injection pipeline from ASP to the three injection wells at CHA; and
- A subsea power and communication cable, and chemical supply umbilical running from ASP to CHA.

The production pipeline transports the produced fluids from the CHA to the ASP where oil is separated from the PFW. The PFW is then transported via the water injection pipeline to the injection wells, where it is then injected into the geological formation that hosts the hydrocarbon reservoir. The offshore components of the pipelines that lie within Commonwealth waters are approximately 4.9 km in length and are operated under pipeline licence WA-12-PL, which is administered by National Offshore Petroleum Titles Administrator (NOPTA). The offshore components of the pipelines that lie within state waters (i.e. between the state waters limit and

the mean low water mark) are approximately 6.9 km in length and are operated under pipeline licence TPL/18, which is administered by DMIRS.

Figure 2-1: Cliff Head Oil Field Location



2.3 Offshore Platform and Wellhead

Extraction of the crude oil from the reservoir occurs at the offshore wellhead platform CHA (

Figure 2-1). The CHA platform is a steel parallel 4-leg jacket complete with drilled and grouted piles through each of the legs. Production and re-injection utilises up to nine well slots, which include the following:

- Three water re-injection wells, which receive injection water from the ASP and inject it into the reservoir to aid oil production;
- Five production wells which produce crude oil and PFW from the reservoir;
- One spare well slot.

The platform operates unmanned except for periodic visits for maintenance and inspection. The platform has four levels: the main deck, mezzanine deck, cellar deck and sub-cellar deck. The platform facilities are spread over the four levels with the helideck located at the east end of the main deck and sized to accommodate a Sikorsky S76 helicopter (with maximum take-off weight of helideck is 5307 kg). A 25 tonne platform crane is located at the North West corner of the main deck and is sized to suit boatlifts and support operations for the ESP's and well workover. A Coil Tubing Unit (CTU) or Hydraulic Workover Unit (HWU) for workovers can be located at this level with access to all wells through deck hatches.

No accommodation or amenities are available on CHA with the exception of a portaloo on the main deck and some chairs in the instrument room. All waste products generated by personnel day visits are transferred onshore for disposal in line with the Prescribed Waste Management Plan (10HSEQENVPC04).

2.3.1 Electric Submersible Pumps

The Cliff Head crude is recovered by the use of ESPs providing artificial lift. Each production well has an ESP located at an average depth of 880 m or 1200 total vertical depth (TVD).

The individual rated flow rate of the ESP's is in the range of 1000 to 10,000 BPD. The normal operating conditions for an ESP are:

- Minimum suction pressure of 2,760kPag (400 psig);
- Discharge pressure of approximately 11,300kPag (1,640 psig) that allows the fluids to arrive at the well head at 2,650kPag to 4,000kPag (400-600 psig);
- The tubing head pressure is maintained above 1000kPag to prevent vapour break-out in the well string.

Oil production from the wells are routed to the 200mm production manifold via individual 100mm flow-lines. Each flow-line is equipped with a choke valve, oil-water flow meter and sample collection point to allow monitoring of each production well.

2.3.2 Workover Activities

Work over activities are typically not a planned activity and are only planned as and when there is reason to carry out a well intervention activity. Historically, this is usually in the event of an Electrical Submersible Pump (ESP) failure. It is then necessary to replace the ESP to allow restoration of production from that well.

Since 2006, ten workover activities have been undertaken, each took approximately 5 weeks with the support of a coiled tubing unit (CTU) or Hydraulic workover unit (HWU); workover

activities are expected to be of similar frequency over the life of this EP. The frequency of workovers is determined by well performance and identification of potential issues.

Normally, a CTU is used given the nature of the workovers, however in the event that CTU operations are not successful, it may be necessary to mobilise a HWU. The primary intent of using the HWU during the well workover is to assist in

- the retrieval of an ESP which has become stuck in a well;
- required well remediation activities, and
- re-completion (if required).

2.4 Offshore Pipeline

The Cliff Head development includes the operation of two pipelines:

- The production pipeline carries the well stream fluids from the wellhead platform (CHA) to the onshore plant (ASP).
- The water injection pipeline transports PFW and additional potential make-up injection water from the ASP to CHA as required.

The two pipelines are essentially identical in size (273.1mm, i.e. 10") and design, they are constructed from steel (wall thickness 14.3mm) and insulated with special high-density polyurethane foam and encased in concrete (concrete thickness is 25-40 mm).

In addition, there is an 80mm integrated power cable complete with fibre optic cables and a 60mm umbilical flat pack for the chemical injection fluids. Both the power cable and umbilical are strapped to the production line.

The pipeline system includes an offshore and onshore component. At CHA the pipeline is tied into the platform riser using flanged connected spool pieces. The offshore pipeline then runs 10.4 km along the seabed from CHA to the shore crossing. The offshore component of the pipeline is unburied and uses the concrete coating weight and rock bolting to provide stability.

2.4.1 Pipeline inspection, maintenance and repair activities

A variety of pipeline inspection, maintenance and repair (IMR) activities may also be undertaken, using a vessel with a fuel tank <500m^3. These methods are well understood and commonly used; they are considered essential for the safe operation of the pipelines and cannot reasonably be avoided. Indicative frequencies and durations are provided for impact and risk assessment context.

2.4.1.1 Freespan Rectification

Freespans are sections of pipework which are unsupported by the seabed, caused by gradual erosion and material removal from natural wave, tide and current movements. Freespan rectification may be undertaken on sections of the pipeline where the seabed has been scoured from below the pipeline, resulting in reduced support for the section of pipeline. The reduced support resulting from a span may increase the mechanical stress on the pipeline, posing a risk to the structural integrity of the pipeline over time. In order to reduce the risk posed by freespans, freespan rectification works may be undertaken to provide additional support to the pipelines. Freespans are identified and surveyed during visual remotely operated vehicle (ROV) inspections.

Freespan rectification works will be undertaken from vessels, with the vessel type and size dependent on the freespan rectification methodology selected. Subsea installation of quarry rock material for the purpose of pipeline freespan rectification and scour protection is planned in Q4 2016. Visual inspection during freespan rectification activities would be carried out by an 'eyeball'

ROV for survey, positioning and as-built records. This type of activity is undertaken as needed on the pipeline.

2.4.1.2 Visual Inspection

Visual inspection of the pipeline will be undertaken to identify any areas that require further attention. Visual inspection will typically be carried out by an observation or micro class ROV deployed from a vessel. Visual inspections may also be carried out by other methods, such as by divers.

2.4.1.3 Time-of-Flight Diffraction Inspection

Time-of-flight diffraction inspection (ToFD) is used to perform measurement of wall thickness externally. ToFD inspections are typically carried out using a tool deployed on an ROV, but may also be carried out by divers.

The tool is attached directly to the pipeline and requires the generation of a temporary span (removal of sediment immediately adjacent and below a short section of the pipeline) to allow the tool to encircle the pipeline. ToFD inspection is carried out from on-board vessels..

2.4.1.4 Marine Growth Removal

A marine growth removal program may be implemented, which entails removing fouling organisms from the pipeline to reduce the hydrodynamic drag the pipeline is subject to. Fouling organisms include a range of biota such as sessile invertebrates (e.g. bivalve molluscs, ascidians etc.) and macroalgae. Marine growth removal will typically be carried out by high pressure water jetting with the water jet mounted onboard an ROV. Other methods may be employed, such as using abrasives to remove marine growth. Marine growth removal may also be carried out by divers, if required.

2.4.1.5 Cathodic Protection (CP) Inspection and Rectification

CP inspection involves using a CP measurement tool to assess electrode potential of anodes. The CP inspection tool is typically mounted on an ROV, however, may also be operated by divers. Replacement of anodes may be carried out using ROV or divers.

2.4.1.6 Emergency Clamping

Emergency clamping is not planned to be carried out routinely during IMR activities. Emergency clamping will only be undertaken in response to a failure, or structural failure, of the pipelines. Emergency clamping will consist of a sleeve that will be mounted around a section of pipeline of concern, which will then be pressed onto the pipeline surface. Emergency clamping will be undertaken by divers or an ROV operating from a vessel.

2.4.1.7 Pipeline, Umbilical or Subsea Cable Repair or Replacement

Where inspections have indicated that it is required, repair or replacement of a section of production pipeline, reinjection pipeline or chemical / electrical umbilical will be carried out. ROV and/or divers may be utilised to undertake repair or replacement of the umbilical, control cables or pipelines. Pipeline repair will depend on the nature of the damage and may consist of deploying a sleeve over a section of pipeline (similar to emergency clamping described above). Pipeline replacement consists of replacing a section of pipeline with a new segment. Pipeline operations will be halted and pipelines flushed prior to commencing pipeline replacement activities.

2.5 Helicopters and Vessels

2.5.1 Helicopter

Personnel and light equipment will be transferred to the platform primarily by dedicated helicopter which is based at Dongara. During normal operations, helicopter visits are approximately fortnightly. During workover operations (see Section 2.3.2 above), there are approximately six trips daily Helicopter refuelling will not be undertaken on CHA.

In addition, a helicopter flies over the pipeline every 21 days undertaking surveillance over the area and detect any leaks to surface (as identified through the presence of a sheen).

2.5.2 Vessels

All vessels will have a maximum credible hydrocarbon spill scenario of <500 m3 as assessed by the largest tank volume size (note that it is expected that all vessels will have considerably smaller maximum credible spill scenarios than this).

2.5.2.1 Support vessels

A Support Vessel will be responsible for the safe transfer of goods, equipment and personnel between the Port Denison Harbour and CHA platform, pipeline corridor and surrounds. At times a Dumb Barge may be used in combination with the support vessel. The support vessel (~18 gross tons) or similar may also jointly function as a Standby Recovery Vessel and be used to conduct or support various asset inspection, survey, environmental monitoring and spill response activities. All goods and equipment transferred from the support vessel and barge to the CHA platform will be transferred using the CHA crane.

All goods and equipment shall be securely fastened to the deck of the support vessel or barge prior to leaving the Port Denison harbour. All goods and equipment manifests shall be checked prior to departure to ensure all required items are on the support vessel, if there are items missing from the manifest then contact shall be made with the ASP Person in Charge (PIC) prior to the support vessel leaving the harbour. Routine activities are undertaken using a small support vessel, as they do not require the use of an Offshore Support Vessel (OSV) as defined by SOLAS and OSV Code (i.e. >500 gross tonnes but <12 passengers). Non-routine activities (e.g. workovers) may require the use of an OSV and if so, that vessel will be required to comply with the OSV Code.

Support vessels will also support pipeline IMR activities where required. Vessels will either be holding station or moored during pipeline IMR activities, depending on the operational requirements of the activity. Moorings are planned to consist of a spread of three moorings consisting of a clump weight with a length of chain attached to a mooring line and buoy. The clump weights intended for use are up to approximately 3 t in weight. Moorings will be installed as required prior to commencing IMR activities and recovered following completion of an IMR activity.

2.5.2.2 Stand-by vessels (SBV)

Marine support is required throughout workover operations at CHA. This support falls into two main categories, namely (i) emergency support provided by the standby vessel (SBV), and (ii) supply operations during the installation, operation and demobilisation of the hydraulic workover unit and substructure. Any vessels selected have fuel tanks with less than 500m^3 The SBV's emergency role is to assist in (i) the collection of liferafts deployed from CHA, (ii) the recovery of personnel from life rafts to the SBV, (iii) the recovery of personnel who have directly entered the sea from CHA, and (iv) the transfer of personnel from the field to shore.

3 Description of the Environment

3.1 Environment That May Be Affected (EMBA)

For the purposes of the EP, the operational area includes the CHA platform and the pipeline up to the state waters boundary, including a 500 m exclusion zone around the platform and 500m operational area either side of the pipeline. The Environment that May Be Affected (EMBA) will encompass the area that could be affected by unplanned events and is derived from modelling worst case hydrocarbon spill scenarios. For conservatism, the worst case scenario, in terms of the extent of area effected, is used to define the EMBA. Three credible spill scenarios were identified to help inform the EMBA as outlined in Table 3-1 below. In this scenario, entrained diesel (exceeding 100 ppb) has a 1% probability of occurring up to 150 km from the source (the CHA platform) and therefore a buffer of 150 km around the CHA platform was used to define the highly conservative EMBA.

Further details of hydrocarbon spill scenarios, including justification of modelling inputs, thresholds, risks and management controls are discussed in Section 7 of the Cliff Head Offshore Operations Environment Plan (10/HSEQ/ENV/PL01, Revision 9).

Table 3-1: Worst case credible hydrocarbon spill scenarios used to define the EMBA

Incident	Substance Type	Worst Case Release	Worst case extent[1]	Section
Pipeline leak (corrosion related - undetected between pipeline surveillance programme every 21 days)	Crude	Crude: 108.4m^3 (0.215m^3/hour over 21 days)	Surface oil may be encountered <15 km from the source	7.3.3
Vessel tank rupture	Diesel	~500m^3 (3 hours)	Entrained oil may be found up to 150 km from the source	7.4.1

3.2 Values and Sensitivities

3.2.1 Key Ecological Features

Key Ecological Features (**KEFs**) are areas of the marine environment that based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity. KEFs that overlap with either the operational area or/and the EMBA are identified in Table 3.2

Table 3-2: Key Ecological Features overlapping the operational area or EMBA

Key Ecological Feature	Distance from Operational Area	Description	Relevant Concerns
Ancient coastline between 90 and 120 m depth	63 km west of Operational Area Within EMBA	Consists of a ridge comprised of a submerged shoreline from a glacial period when sea levels were lower. The ancient coastline between 90 and 120 m may host relatively high benthic biodiversity and be associated with increased productivity (Department of Sustainability, Environment, Water, Population and Communities 2012a)	No relevant pressures of concern / potential concern
Commonwealth marine environment surrounding the	79 km north north-west of Operational Area	The Houtman Abrolhos islands host a unique mix of temperate and tropical species, facilitated by the transport of relatively warm water and tropical larvae southwards by the Leeuwin Current (Department of Sustainability, Environment,	Oil pollution – of potential concern

[1] Distance estimated from figures provided in the Oil Spill Trajectory Modelling Report, see Section 7.3 for more detail

Key Ecological Feature	Distance from Operational Area	Description	Relevant Concerns
Houtman Abrolhos islands	Within EMBA	Water, Population and Communities 2012a). The islands host significant aggregations of breeding seabirds, supporting over one million breeding pairs, and include a range of benthic habitats and associated fisheries resources (Department of Fisheries 2012, Department of Sustainability, Environment, Water, Population and Communities 2012a).	
Commonwealth marine environment within and adjacent to the west coast inshore lagoons	Overlaps Operational Area Within EMBA	The west coast inshore lagoons KEF covers ~1,761 km^2 and includes areas that are important for benthic productivity, and breeding and nursery aggregations for many temperate and tropical marine species (McClatchie *et al*. 2006). The lagoons are dominated by seagrass and epiphytic algae, which provide habitat and food for many marine species (directly and indirectly). Seagrass meadows occur in more sheltered areas and in the inter-reef lagoons along exposed sections of the coast while emergent reefs and small islands create a diverse topography. This mix of sheltered and exposed environments forms a complex mosaic of habitats. The lagoons are also important areas for the recruitment of commercially and recreationally important fishery species, including western rock lobster. Extensive schools of migratory fish visit the area annually, including herring, garfish, tailor and Australian salmon (McClatchie *et al*. 2006).	Oil pollution – of potential concern Invasive marine species – of potential concern
Western demersal slope and associated fish communities	Overlaps Operational Area Within EMBA	Small pelagic fish are an important component of pelagic ecosystems, providing a trophic link between primary production and higher predators, such as other fish, sharks, seabirds, seals and cetaceans. Fluctuations in abundance of small pelagic fish have serious implications for the functioning of pelagic ecosystems of the SWMR (Department of Sustainability, Environment, Water, Population and Communities 2012a). This species group, which includes 10 species (sardine, scaly mackerel, Australian anchovy, round herring, sandy sprat, blue sprat, jack mackerel, blue or slimy mackerel, red bait and saury).	Oil pollution – of potential concern
Western rock lobster	Overlaps Operational Area Within EMBA	Covers a considerable portion (~40,000 km^2) of continental shelf waters on the lower west coast of Western Australia and was established in recognition of the presumed ecological role played by the western rock lobster (*Panulirus cygnus*) in shelf waters (Department of Sustainability, Environment, Water, Population and Communities 2012a, MacArthur *et al*. 2007).	Oil pollution – of potential concern

Table 3-3: Protected areas overlapping the EMBA

Reserve	Distance from Operational Area (km)	IUCN Categories*	Key Values
State			
Abrolhos Fish Habitat Protection Area	100	IV – Fish habitat protection area (245 km^2)	Environmental values within the reserve include (DoF 2012): • high water quality • diverse range of marine habitats, home to tropical and temperate species, including Australian sea lions, western rock lobsters and a number of other species currently listed under State and Commonwealth legislation • variety of terrestrial plant species and communities which are utilised by a diverse range of fauna, including birds. Many of these species are listed under State and Commonwealth legislation and international agreements • wide array of fish and invertebrate species, making it a popular area for commercial and recreational fishing in the Midwest region • proposed aquaculture activities, including a planned strategic environmental assessment within the fish habitat protection area • unique history including, the Batavia and subsequent shipwrecks, evidence of guano mining and commercial fishing all contribute to the heritage values • important socio-economically for the region due to tourism and recreation with a high number of visitors. Activities include boating, fishing, diving, wildlife and heritage photography and appreciation.
Jurien Bay Marine Park	63	Ia – Sanctuary zones (31 km2) II – General use / special purpose (778 km2) IV – Aquaculture / special purpose (14 km2)	Environmental values and sensitivities (Marine Parks and Reserves Authority 2005): Ecological values: • Geomorphology • Intertidal reef platforms • Water and sediment quality • Seagrass meadows • Macroalgal communities • Seabirds • Invertebrate communities • Finfish • Sea lions • Cetaceans and turtles. • Social values: • Indigenous heritage • Maritime heritage • Commercial fishing • Aquaculture • Coastal use

Reserve	Distance from Operational Area (km)	IUCN Categories*	Key Values
			• Seascapes • Recreational fishing • Water sports • Marine nature-based tourism • Petroleum drilling and mineral development • Scientific research • Education.
Commonwealth			
Jurien Commonwealth Marine Reserve	80	II - Marine National Park Zone (31 km^2) VI - Special Purpose Zone (1820 km^2)	Environmental values and sensitivities (Department of the Environment n.d.) a) Important foraging areas for the: • soft-plumaged petrel • Australian sea lion • White shark • roseate tern, bridled tern, wedge-tailed shearwater, and common noddy. b) Important migration habitat for the protected humpback whale c) Examples of the ecosystems of two provincial bioregions: the central part of the South-west Shelf Transition (which includes the Central West Coast meso-scale bioregion) and small parts of the Central Western Province d) One key ecological feature: western rock lobster habitat (species with an important ecological role). e) Heritage values represented by the SS *Cambewarra* historic shipwreck.
Abrolhos Commonwealth Marine Reserve	49	II - Marine National Park Zone (2548 km2) IV - Habitat Protection Zone (23 239 km2) VI - Multiple Use Zone (56 612 km2) VI - Special Purpose Zone (5727 km2)	Environmental values and sensitivities include: Important foraging areas for the: • Australian lesser noddy • northernmost breeding colony of the Australian sea lion • common noddy, wedge-tailed shearwater, bridled tern, Caspian tern and roseate tern. Important migration habitat for the protected humpback whale Second largest canyon on the west coast, the Houtman Canyon Examples of the northernmost ecosystems of the Central Western Province and South-west Shelf Transition (including the Central West Coast meso-scale bioregion) Examples of the deeper ecosystems of the Abrolhos Islands meso-scale bioregion Examples of the shallower, southernmost ecosystems of the Central Western Shelf Province provincial bioregion including the Zuytdorp meso-scale bioregion Examples of the deeper ecosystems of the Central Western Transition provincial bioregion Examples of diversity of seafloor features including: southern most banks and shoals of the North-west region; deep holes and valleys; slope habitats; terrace and shelf environments

Reserve	Distance from Operational Area (km)	IUCN Categories*	Key Values
			Six key ecological features: • Commonwealth marine environment surrounding the Houtman Abrolhos Islands (high biodiversity, breeding and resting aggregations) • Demersal slope and associated fish communities of the Central Western Province (communities with high species diversity) • Meso-scale eddies (high productivity, feeding aggregations) • *West-coast canyons (high productivity, feeding aggregations) • Western rock lobster habitat (species with an important ecological role) • Wallaby Saddle - a unique seafloor feature that supports aggregations of baitfish and attracts large pelagic predators including sperm whales.

*IUCN Categories: Ia – Strict nature reserve, Ib – Wilderness area, II – National Park, III – Natural monument or feature, IV – Habitat / species management area, V – Protected landscape / seascape, VI – Protected are with sustainable use of natural resources

3.2.2 Threatened Ecological Communities

No Threatened Ecological Communities (TECs) occur in the Operational Area; one TEC, *Subtropical and Temperate Coastal Saltmarsh*, was identified as being likely to occur within the EMBA by a search of the EPBC Act Protected Matters Search Tool (PMST). This search encompassed the entire area defined as the EMBA. In Western Australia, this community type is generally encountered on the south-western coastline, with only two locations on the central west coast (Department of the Environment 2015a). This vegetation type is restricted to relatively low energy estuaries. This vegetation type may occur in the Irwin river estuary (25 km north of Operational Area) near Dongara, and the Chapman river estuary (96 km north of Operational Area) near Geraldton. Both of these rivers have sand bars in place at the entrance to the sea, which are closed under most circumstances, although may breach during high river flow periods.

3.3 Habitats

3.3.1 Benthic Habitats

The operational area lies within the 'Central West Coast' meso-scale region according to the IMCRA classification (IMCRA, 1997). The region is characterised by a relatively narrow continental shelf with diverse moderate energy coastal landforms (IMCRA, 1997). The area has a range of temperate species and is also at the southern limit of a suite of sub-tropical and tropical species.

The coast in the operational area is formed over the Perth sedimentary basin. The mainly sandy sediment of the operational area is relatively unproductive.

Surveys of the development area were conducted on three occasions during the construction phase in the operational area, using divers and ROVs to observe any impacts caused by installation activities. Additional, high-resolution, aerial imagery was acquired in 2006 (post-construction) to establish a baseline mapping for subsequent monitoring of seagrass and the seabed (Coffey Natural Systems, 2008).

Net seagrass recovery has been seen over the area impacted during pipeline construction, installation and operation between 2004 and 2006. It is expected that seagrass will recolonise some areas impacted by the activities proposed in this EP – in particular IMR, although will not recolonise areas disturbed by rock placement as seagrass grows in sandy/muddy substrate.

Initial benthic habitat mapping indicate that much of the area in the immediate vicinity of the pipeline is limestone pavement, with some low density seagrass in the vicinity of the platform. Much of the referenced surveys completed by TEO were conducted in State waters to meet Ministerial conditions related to State waters jurisdiction, and therefore less detail is available on the habitats in Commonwealth waters. Along the length of pipeline in Commonwealth waters the benthic habitat is sand veneers with sparse algae and seagrass, with some areas of minor to moderate seagrass coverage.

During the pipeline surveys where a combination of ROV, diver and aerial surveys were conducted post construction (Enesar, 2007). Seagrass in close proximity to the pipeline was observed to be healthy with no significant signs of breakage or stress and no difference was noted from seagrass in neighbouring areas, with no obvious difference in abundance, patchiness or epiphyte cover. During the survey, short spans were observed with *Amphibolis* seagrass growing beneath, however there were no signs of erosion or instability in the surrounding seabed. *Halophila* seagrasses were also identified during the surveys with large areas of bare impacted areas being recolonised by both species. *Posidonia* species were also observed, although they are slower to recolonise bare areas. Fauna were not noted in the Enesar (2007) report.

The planned Q4 2016 IMR activities took place within 1.2 km of the platform in areas of low density seagrass and limestone pavement. No impacts from the proposed IMR would expect to occur on patch reefs or seagrass meadows. A maximum area of 300m^2 is assumed to be impacted by freespan rectification. Given the presence of low density seagrass in the vicinity of the pipeline, a worst case estimated area of up to 300m^2 of low density seagrass could be lost with no prospect for recovery given the change in substrate. This estimate is a worst case estimate as some of the 300m^2 may not support any seagrass and some of the area is directly beneath the pipeline and would not have supported seagrass post installation.

Seagrass density in Australia has been reported, and in 1996 Western Australia was estimated to have approximately 2,200 km^2 of seagrass with 26 different species in the region which are well represented and abundant often covering extensive areas (Kirkman, 1997). Therefore, if these estimates are still reasonably accurate, the area disturbed by the rock placement activities during the planned Q4 2016 IMR activity represents less than 0.000014% of the seagrass in WA.

3.4 Marine Fauna

An EPBC protected matters search was conducted on the 8th June 2016 for the operational area and EMBA. A list of listed threatened and/or migratory marine fauna is given in Table 3-4 below**Error! Reference source not found.**. For each species identified, the extent of likely p resence is provided, including any overlap with designated Biologically Important areas (BIAs) shown in Figure 3-1.

Table 3-4: Protected species in the operational area and EMBA (*CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory)

Value/Sensitivity		EPBC Act Status*	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Fish and Sharks							
Grey nurse shark	*Carcharias taurus*	V	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known to occur within area	Planned • Light emissions • Noise emissions • Planned operational discharges • Spill response operations Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Great white shark	*Carcharodon carcharias*	V, M	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area Overlap with foraging BIA	
Whale shark	*Rhincodon typus*	V, M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Porbeagle	*Lamna nasus*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Reef manta ray	*Manta alfredi*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat known to occur within area	Unplanned events • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Giant manta ray	*Manta birostris*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat known to occur within area	
Shortfin mako	*Isurus oxyrinchus*	M			✓	Species or species habitat likely to occur within area	
Longfin mako	*Isurus paucus*	M			✓	Species or species habitat likely to occur within area	
Marine Mammals							
Blue whale	*Balaenoptera musculus*	E, M	✓	Species or species habitat likely to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	Planned

Value/Sensitivity		EPBC Act Status*	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
						Overlap with migration BIA	• Noise emissions • Planned operational discharges • Spill response operations Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Southern right whale	*Eubalaena australis*	E, M	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	
Humpback whale	*Megaptera novaeangliae*	V, M	✓	Species or species habitat known to occur within area Overlap with migration BIA	✓	Species or species habitat known to occur within area Overlap with migration and resting BIA	
Australian sealion	*Neophoca cinerea*	V	✓	Foraging, feeding or related behaviour likely to occur within area	✓	Breeding known to occur within area Overlap with foraging BIA	
Antarctic minke whale	*Balaenoptera bonaerensis*	M			✓	Species or species habitat may occur within area	
Bryde's whale	*Balaenoptera edeni*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Dusky dolphin	*Lagenorhynchus obscurus*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Orca	*Orcinus orca*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Sperm whale	*Physeter macrocephalus*	M			✓	Species or species habitat may occur within area	Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Pygmy right whale	*Caperea marginata*	M			✓	Species or species habitat may occur within area	
Marine Reptiles							
Loggerhead turtle	*Caretta caretta*	E, M	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	Planned

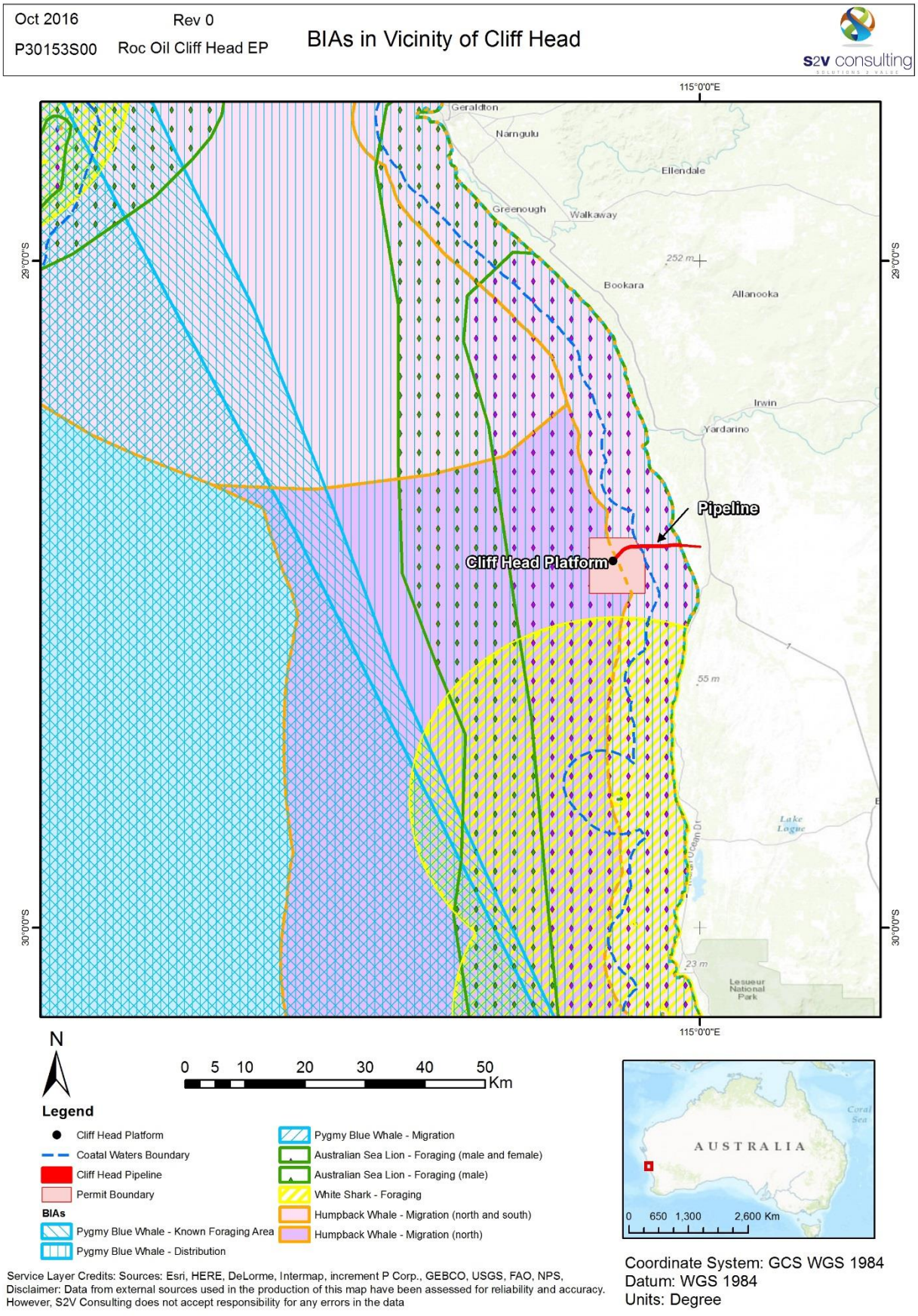
Value/Sensitivity		EPBC Act Status*	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Green turtle	*Chelonia mydas*	V, M	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	• Light emissions • Noise emissions • Planned operational discharges • Spill response operations Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Leatherback turtle	*Dermochelys coriacea*	E, M	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	
Flatback turtle	*Natator depressus*	V, M	✓	Species or species habitat known to occur within area	✓	Foraging, feeding or related behaviour known to occur within area	
Marine Birds							
Australian lesser noddy	*Anous tenuirostris melanops*	V	✓	Species or species habitat may occur within area	✓	Breeding known to occur within area Overlap with foraging BIA	Planned • Light emissions • Noise emissions • Planned operational discharges • Atmospheric emissions • Spill response operations Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases
Amsterdam albatross	*Diomedea amsterdamensis*	E,M	✓	Species or species habitat may occur within area	✓	Breeding known to occur within area	
Southern royal albatross	*Diomedea epomophora*	V, M	✓	Species or species habitat may occur within area	✓	Breeding known to occur within area	
Wandering albatross	*Diomedea exulans*	V, M	✓	Species or species habitat may occur within area	✓	Foraging, feeding or related behaviour likely to occur within area	
Northern royal albatross	*Diomedea sanfordi*	E, M	✓	Species or species habitat may occur within area	✓	Foraging, feeding or related behaviour likely to occur within area	

Value/Sensitivity		EPBC Act Status*	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Southern giant petrel	*Macronectes giganteus*	E, M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Northern giant petrel	*Macronectes halli*	V, M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Soft-plumaged petrel	*Pterodroma mollis*	V	✓	Species or species habitat may occur within area	✓	Foraging, feeding or related behaviour known to occur within area Overlap with foraging BIA	
Australian fairy tern	*Sternula nereis*	V	✓	Foraging, feeding or related behaviour known Overlap with foraging BIA	✓	Foraging, feeding or related behaviour known to occur within area Overlap with foraging BIA	
Indian yellow-nosed albatross	*Thalassarche carteri*	V, M	✓	Foraging, feeding or related behaviour known	✓	Foraging, feeding or related behaviour known to occur within area	
Shy albatross	*Thalassarche cauta*	V, M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
White-capped albatross	*Thalassarche cauta steadi*	V, M	✓	Foraging, feeding or related behaviour known	✓	Foraging, feeding or related behaviour likely to occur within area	
Campbell albatross	*Thalassarche impavida*	V, M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Black-browed albatross	*Thalassarche melanophris*	V, M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Fork-tailed swift	*Apus pacificus*	M	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	

Value/Sensitivity		EPBC Act Status*	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Flesh-footed shearwater	*Puffinus carneipes*	M	✓	Species or species habitat likely to occur within area	✓	Foraging, feeding or related behaviour likely to occur within area	
Bridled tern	*Sterna anaethetus*	M	✓	Foraging, feeding or related behaviour likely to occur within area Overlap with foraging BIA	✓	Breeding known to occur within area Overlap with foraging BIA	
Caspian tern	*Sterna caspia*	M	✓	Foraging, feeding or related behaviour likely to occur within area Overlap with foraging BIA	✓	Breeding known to occur within area Overlap with foraging BIA	
Osprey	*Pandion haliaetus*	M	✓	Species or species habitat may occur within area	✓	Breeding known to occur within area	
Roseate tern	*Sterna dougallii*	M			✓	Breeding known to occur within area Overlap with foraging BIA	Unplanned events • Hydrocarbon spill • Non-hydrocarbon releases
Great egret	*Ardea alba*	M			✓	Species or species habitat known to occur within area	
Cattle egret	*Ardea ibis*	M			✓	Species or species habitat may occur within area	
Bar-tailed godwit	*Limosa lapponica*	M			✓	Species or species habitat known to occur within area	
Common greenshank	*Tringa nebularia*	M			✓	Species or species habitat likely to occur within area	
Sooty albatross	*Phoebetria fusca*	V, M			✓	Species or species habitat may occur within area	
Wedge-tailed shearwater	*Puffinus pacificus*	M			✓	Breeding known to occur within area Overlap with foraging BIA	

Value/Sensitivity		EPBC Act Status*	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Red-tailed tropicbird	*Phaethon rubricauda*	M			✓	Breeding known to occur within area	
Common noddy	*Anous stolidus*	M			✓	Breeding known to occur within area Overlap with foraging BIA	

Figure 3-1: Biologically Important Areas in the vicinity of Cliff Head



3.5 Socio Economic Environment

The operational area is located adjacent to the Shire of Irwin, in the Mid-West region of Western Australia. The twin towns of Dongara and Port Denison are the nearest townships to the development.

3.5.1 Ports and Shipping

Geraldton Port is located in the heart of the city of Geraldton and handles iron ore, grains, fuels, metals, mineral sands, talc, garnet and fertilisers. The harbour in Port Denison is home to one of the state's largest rock lobster fishing fleets, in additional to recreational boating and fishing. The harbour in Port Denison is home to one of the state's largest rock lobster fishing fleets, in additional to recreational boating and fishing. Due to the proximity of the Cliff Head platform to the shoreline (~11 km), high levels of shipping traffic is not expected within the 500 m exclusion zone of Cliff Head platform or along the pipeline.

3.5.2 Commercial Fisheries & Aquaculture

There are a number of Commonwealth and State administered fisheries that are known to have, or may have, fishing permit areas/zones that overlap the location of the CHA platform. The fisheries have differing levels of fishing effort and areas of operations over the year.

3.5.3 Recreational Fishing

The Jurien Bay Marine Park is zoned so that in some areas fishing activities are partially or totally restricted. In the areas where fishing can occur, major forms of recreational fishing include line fishing, rock lobster, abalone, crabbing, spearfishing and octopus, all of which can be collected from the shore or a vessel in particular zones. Netting is also permitted in certain areas from the shore but not from vessels. Cliff Head platform is 68 km from Jurien Bay Marine Park and its proximity to the coastline and high usage may result in recreational fishing vessels passing close to the exclusion zone.

Recreational fishing is a key activity around the Abrolhos Islands, mostly within the islands state waters and charter fishing is a growing activity in the area. A number of fishing regulations apply to the Abrolhos Islands including bag limits for finfish, fishery closures for baldchin groper (*Choerodon rubescens*) and Western rock lobster (*Panulirus Cygnus*), restrictions for certain species including Samson fish (*Seriola hippos*) and yellowtail kingfish (*Seriola lalandi*) and netting is not permitted. The Abrolhos Islands are 112 km from the Cliff Head platform and therefore it is possible that recreational fishing vessels may be present in close proximity to the exclusion zone. However, vessel presence is variable and seasonal peaks will exist.

4 Details of Environmental Impacts & Risks

4.1 Potential Environmental Effects Identification

This section assesses the environmental effects of the production phase of the Cliff Head development activities on the environment, identifies control measures to address and minimise these impacts and assesses the inherent environmental risk with these measures implemented.

Environmental aspects/activities with the potential for impact from the Cliff Head Operations are outlined below.

4.1.1 Planned Activities

- All operational activities (including pipeline maintenance activities)
    - Noise;
    - Artificial light;
    - Seabed disturbance;
    - Interference with other sea users;
    - Physical presence;
    - Atmospheric emissions.
- Vessel based activities;
    - Planned discharges;
- Cliff Head platform operations;
    - Contaminated drainage water and waste oils;
    - Waste management;
    - Workover emissions;

4.1.2 Unplanned Activities

- Introduction of Invasive Marine Species (IMS);
- Vessel collision with marine fauna
- CHA spills;
    - Loss of well control
    - Pipeline leak
    - Chemical/hydrocarbon spills/leaks
    - Workover Chemical spills
    - Produced Formation Water Spills
- Unauthorised access
- Vessel spills
    - Vessel tank rupture
    - Refuelling spill
    - On-board leakage or spillage
- Hydrocarbon spill response

4.2 Risk Assessment Methodology

TEO implements an environmental risk assessment methodology consistent with the approach described in the following documents:

- AN/NZS ISO 31000: Risk management - Principles and guidelines
- AN/NZS ISO 14001: Environmental management systems - Requirements with guidance for use
- HB 203:2012 Managing environment-related risk.

An environmental risk assessment was undertaken in relation to Cliff Head ongoing operations activities which included a number of environmental risk workshops, during which environmental risk management experts identified, analysed, evaluated and treated the credible sources of environmental risk that may arise during operational activities. An initial environmental risk assessment was made in 2006 when the Cliff Head field was being developed and the EP prepared. Since then, the risk assessment has been periodically revisited as circumstance changed and revisions to the EP are made. The most recent review of the risk assessment was conducted in 2016 specific to the additional proposed IMR activities now included in this EP.

4.3 Communication and Consultation

Communication and consultation with internal and external stakeholders is used to inform the risk management process. The OPGGSE require that TEO undertake effective consultation. TEO is committed to consulting with those stakeholders whose functions, interests and activities may be affected by Cliff Head production activities, in order to identify and respond to any concerns, claims or objections raised. The process of stakeholder engagement described in Section 6.1 outlines the consultation undertaken to date, along with the methods by which ongoing consultation will be undertaken.

4.4 Risk Assessment

4.4.1 Consequence, Likelihood and Risk Definitions

The sources of environmental risk, or hazards, assessed in this EP were assessed in accordance with the Risk Management Handbook (00/HSEQ/GEN/MN01) and the Upstream PS Risk Matrix Toolkit (00/HSEQ/GEN/PC01/FM01). This framework defines risk as a combination of consequence (the most reasonably expected worst case scenario) and likelihood (the most reasonable likelihood of the consequence identified occurring). In determining consequence and likelihood rankings, the nature and scale of the activities were a consideration. Consequence rankings considered maximum quantities of planned and unplanned releases, environmental sensitivities, times to exposure and regulatory requirements. Likelihood rankings were based on the operational history of the Cliff Head development, the Titleholder 'operational history on other developments, incidents in the petroleum industry more broadly, and inputs from engineering assessments.

4.5 Risk Analysis and Evaluation

The environmental risk analysis process was undertaken for each identified hazard and comprised the following steps:

(1) identify environmental hazards (i.e. sources of environmental harm)
(2) consider the events by which the hazard may become realised
(3) consider the credible environmental impacts (including the environmental receptors) that may arise if the hazard is realised based on the most reasonably expected worst case scenario
(4) consider the activities or causes that may lead to the event by which the hazard is realised
(5) identify the proactive (i.e. those which reduce likelihood of the event occurring) controls which TEO will implement

(6) consider the reactive (i.e. those which reduce consequence) controls which TEO will implement
(7) determine the credible consequence and likelihood for each of the environmental impacts with proactive (i.e. reduces likelihood) and reactive (i.e. reduces consequence) controls in place
(8) determine the inherent risk ranking for each hazard based on the worst (i.e. highest) consequence and likelihood rankings for each of the credible impacts identified
(9) determine whether the inherent risk ranking is acceptable and reduced to as low as reasonably practicable (ALARP)
(10) consider and apply additional controls as required to manage each hazard to a level that is acceptable and ALARP to determine the residual risk ranking.

4.6 Risk and impact Acceptability and Consideration of ALARP

The ALARP scale employed by TEO represents risk tolerability as an inverted triangle, which is divided into regions corresponding with the risk rankings from the risk matrix. Risks that are deemed to be 'Low' following the application of controls are intrinsically considered to be in the acceptable region. Risks that are deemed to be 'Medium' or 'High' following the application of controls are classified within the ALARP or tolerability region. Risks that are considered to be Very High or Extreme following the application of controls are Unacceptable. Activities associated with Very High or Extreme risk rankings must be stopped immediately and managed such that they are reduced to the ALARP / tolerability or acceptable regions.

The operational and IMR activities considered in the approved EP are considered to be routine; broadly undertaken in the offshore petroleum industry, with well understood methods / procedures and little impacts upon stakeholders. Potential impacts or risks associated with the proposed activity are considered to be acceptable if the following criteria are met:

(1) An assessment has been completed to determine the consequence of the impact or risk to sensitive receptors.
(2) Performance standards and intended outcomes within this EP are consistent with legal and regulatory requirements.
(3) Performance standards and intended outcomes within this EP are consistent with TEO's Environmental Management Policy (Sections 1.4 and 1.5).
(4) Performance standards and intended outcomes within this EP are consistent with stakeholder expectations, and
(5) Performance standards and intended outcomes within this EP have been demonstrated to reduce the impact or risk to ALARP.

4.6.1 Planned Events

Table 4-1summarises the identified hazards and potential impacts associated with the planned activity. Table 4-2 lists the controls to prevent or mitigate impacts such that impacts and risks are reduced to ALARP and are at acceptable levels.

Table 4-1: Summary of Environmental aspects, hazards and potential impacts for Planned Events

Event	Description of Hazard	Potential Impacts
Noise Emissions	During routine operation of the platform and pipeline (i.e. no CTU or HWU activities), noise emissions may be generated by associated vessels and machinery (i.e. helicopters, vessels, submersible pump). Pipeline IMR activities such as rock dumping, high pressure water jetting, abrasive marine growth removal and pipeline repair may generate underwater noise, however these activities occur less frequently and are expected to be of lower intensity than vessel related noise, and a vessel will be required to conduct the activities; as such, the assessment of vessel noise is considered to encompass the risk associated with other sources of underwater noise. Major equipment noise sources during workover activities will stem predominantly from vessel and helicopter activity with lesser noise sources from on board CHA equipment operation (mechanical plant, pumping systems). During CTU or HWU workover: Workover activity on-board CHA may be conducted 24 hours/day; Standby vessels will attend CHA and may operate on a 24 hours/day basis; and Support vessels will service CHA every day and may be required to perform supply runs to the mainland Maintenance visits to the platform are required every fortnight and access will be via a small vessel (rarely) or most frequently by helicopter. During workover activity access to the offshore facility will be by helicopter from Dongara Airport (approximately 6 trips a day). Helicopter operations to CHA Platform are planned at a frequency of two trips per day per shift (four trips per day in total) for shift change with flying time approximately seven minutes each way. The sound levels and frequency characteristics of underwater noise produced by vessels are related to ship size and speed, although there is variation	Ambient ocean noise, resulting from wind and wave action, has been calculated at 90 – 110dB re 1µPa (BHP Billiton, 2006). Avoidance or behavioural changes in marine mammals have been observed when there is continuous industrial noise of 120dB re 1µPa or higher (APPEA, 2005). McCauley (1994) stated that the most sensitive frequency range for toothed cetaceans is between 10-100kHz. Baleen whales are believed to have sensitive hearing at low frequencies, ranging from 12Hz to 8KHz (DoIR, 1997). However, data for baleen whales is sparse and the proposed hearing range for baleen whales should be treated with caution. McCauley (1994) suggests that the auditory thresholds for baleen whales may be comparable to those for toothed cetaceans but with the frequency sensitivity shifted to lower frequencies. Baleen cetaceans identified in the area include blue whale, humpback whale, Southern right whale and Bryde's whale. Mortality or physiological damage from underwater noise, including hearing loss, is only likely to occur in close proximity to high energy sources. While little is known about specific sound levels at which mortality or physical injury occurs in most marine fauna, this threshold is likely to be greater than 200 dB re 1µPa (McCauley, 1994; Richardson et al., 1995). Instantaneous physiological damage is only likely to occur, in particular to cetaceans, if peak sound levels exceed 265 – 275 dB re 1 µPa, and physical injury leading to mortality is only likely to be possible at a peak of 240 dB re 1 µPa (Parvin et al., 2007). Cetaceans have been reported showing behavioural changes in response to underwater noise. However, the distance over which the avoidance occurs seems to be highly variable between species and even within species (Richardson et al., 1995; McCauley et al., 1998), depending upon the activity of the individual. Migrating individuals have been seen to adjust course and speed when received sound level is in the range of 157 to 164 dB re 1 µPa. In addition, researchers have found that grey and bowhead whales practiced avoidance at received sound levels between 150-180dB re 1µPa (Richardson et al., 1995; cited in McCauley et al., 2000). It is considered that this avoidance behaviour represents only temporary and minor effect on either the individual or the species unless avoidance results in displacement of whales from breeding, resting or feeding areas. No breeding, resting or feeding areas are known to occur in the area potentially impacted by noise emissions, although a BIA for migrating humpback whales overlaps the operational area so individuals are expected to pass through the area during peak migration periods. Given the potential noise levels potentially emitted during CHA operations, and the temporary and short duration of peak noise emissions (e.g. during discrete workover or pipeline IMR activities, or during maintenance visits), the activity is not expected to lead to long term changes in individual behaviour (e.g. migration) or lead to changes at the population level. There is a lack of information on the effects of underwater noise on pinnipeds, especially in Australian waters (Pidcock et al., 2003). Australian sea lions make underwater sounds including barks, whinnies and buzzing associated with social interactions. It has been measured that the projected sea lion energy for these sounds is between 250 Hz and 2 kHz frequency (Richardson et al., 1995), and their hearing range is approximately between 0 – 4 Hz (Pidcock et al., 2003). It has also been measured that pinnipeds have a high tolerance to strong sound pulses (Harris et al., 2001) and are unlikely to be

	amongst vessels of similar class and the activity being conducted. Under normal operating conditions when the vessel is idling or moving between sites, vessel noise would be detectable only over a short distance. However, when the vessel is holding its position using thrusters, noise may be detectable up to 20 km although this audibility range is reduced under windier (noisier) conditions (BHP Billiton, 2006). Vessel activity is estimated at approximately 20% of the total workover duration. Noise emitted from helicopter operations is typically below 500Hz. Sound pressure in the water directly below a helicopter is greatest at the surface but diminishes with depth. Reports for a Bell 214 (stated to be one of the noisiest) indicated that noise is audible in the air for 4 minutes before the helicopter passed. The Helicopter is audible underwater for only 38s at 3m depth and 11s at 8m depth (BHP Billiton, 2006).	significantly impacted by noise emission associated with these activities. A foraging BIA for sea lions overlaps the operational area, and therefore individuals may be expected in the vicinity of the operational area, however there is not expected to be a significant impact at population level. Turtle hearing is most sensitive in the frequency range of 100 – 700Hz (DoIR, 2007), which overlaps with the sound frequencies produced by vessels and helicopters. It is likely that turtles would be able to hear these activities at distance and would experience some disturbance. Studies indicate that marine turtles may begin to show behavioural responses to received sound levels of approximately 166 dB re 1 µPa and avoidance at around 175 dB re 1 µPa (McCauley et al., 2000). Fish sensitivity and resilience to underwater noise varies greatly depending on the species, hearing capability, habits, proximity to the activity, and if the noise occurs during a critical part of the fish lifecycle (McCauley and Salgado-Kent, 2008). Most marine fish are hearing generalists (Amoser and Ladich, 2005) with relatively poor hearing. Hearing generalists are not as sensitive to noise and vibration as hearing specialists, which have developed hearing specialisations and can be particularly vulnerable to intense sound vibrations because many possess an air-filled swim bladder (Gordon et al., 2004). Elasmobranchs (rays, skates, sharks) do not have swim bladders and are not typical hearing specialists (Baldridge, 1970). Studies indicate that fish (including sharks) may begin to show behavioural responses (e.g., increased swimming) to received sound levels of approximately 156 dB re 1 µPa and active avoidance at around 168 dB re 1 µPa (McCauley et al., 2000). The CHA operational area is not a recognised feeding, breeding or resting area for cetaceans, turtles, migratory birds or shark species however these types of fauna may migrate through the region. Australian sea lions and great white sharks are also expected to forage in the vicinity.
Artificial light	Artificial lighting (navigation and work area lighting) is used during night-time routine operations or pipeline IMR activities on both CHA and any vessels in accordance with marine safety requirements to ensure the vessel / platform can be clearly identified; does not present a collision hazard to other marine users and allows for safe movement of personnel during hours of darkness.	Artificial lighting may attract fauna during peak breeding periods if vessels / CHA are within visual distance of breeding localities. The most sensitive species are likely to be turtle hatchlings as they orientate towards light when first emerging from the nest, which is typically the horizon / wave breaking zone and into open water. Hatchlings attracted to artificial lights when they emerge from a nest can result in disorientation and increased risk of predation. No biologically significant areas (i.e. feeding, breeding or migratory pathways) for turtles are recorded at, or in proximity to, the Cliff Head platform, therefore, these species would, at most, transit through the area. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al., 2001), with traps drawing catches from up to 90 m (Milicich et al., 1992). Lindquist et al. (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by the platforms' light fields. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. Shaw et al. (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas. Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that seabirds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie et al., 2008) and that lighting can attract birds from large catchment areas (Wiese et al.,

		2001). Birds may either be attracted by the light source itself or indirectly as structures in deep water environments tend to attract marine life at all trophic levels, creating food sources and shelter for seabirds (Surman, 2002). The light from offshore rigs and vessels may also provide enhanced capability for seabirds to forage at night. Due to the proximity of CHA to the coast, passerines and other small birds, in particular fork tailed-swift, may be attracted to artificial lighting. Artificial lights can "trap" migratory birds by causing them to lose sight of the horizon and circle within the cone of light endlessly. This can lead to exhaustion or collision with the light source. Artificial light can extend day length for diurnal species, potentially increasing their susceptibility to predators (FFWCC 2013). There is no evidence to suggest that artificial light sources impact on the migratory, feeding or breeding behaviours of cetaceans. Cetaceans predominantly utilise acoustic senses to survey their environment, rather than vision (Simmonds et al., 2004).
Seabed disturbance	*Dropped objects* During manned activities at CHA, lifts will be undertaken from vessels to the CHA Platform utilising the CHA platform crane. While not planned, it is possible that during lifting/workover activities, equipment or solid objects may accidently be dropped overboard leading to loss of or changes to benthic habitats. *IMR Activities* Some disturbance to the seabed during IMR activities could occur as ROVs are utilised (sediment disturbance due to use of thrusters on ROV) or tools are attached to the pipeline (emergency clamping, CP survey equipment, TOFD inspections). Typically a small area of seabed may be disturbed temporarily during the activity due to tool usage as the seabed may need to be disturbed to allow tools to be attached. In addition, seabed disturbance may be expected from the following: *High pressure water jetting* High pressure water jetting to remove marine growth is carried out on the pipeline to reduce the force resulting from drag. This is carried out to maintain the structural integrity of the pipeline. High pressure water jetting is also used to remove insulation for pipeline inspection and to create temporary spans to facilitate inspection (e.g. equipment that envelops the pipeline). Water jetting to remove the pipeline coating results in the coating and foam being reduced to very fine particles and some larger pieces. Larger pieces will be collected	The mostly sandy substrates within the Cliff Head exclusion zone are thought to support low densities of epibenthic communities. No known sensitive seabed features (e.g., reefs, canyons, shipwrecks) are present within the exclusion zone. Thus, minor loss of seabed habitat due to dropped objects is not considered a significant environmental impact given the sparseness of benthic cover. There are large expanses of seagrass beds in the vicinity of the pipeline and these have been surveyed in State waters following the completion of offshore construction activities (as part of the State Waters approval requirements). The monitoring concluded that there had been a net recovery of seagrass although it was considered partially complete due to varying colonisation rates between species. It can be reasonably expected that a similar recovery is expected in the Commonwealth waters area given the similar water depths and seagrass species; and that any seagrass beds impacted would recover over time, particularly given the seasonality of seagrass. ROV usage during IMR activities including attachment of tools to the pipeline will likely result in small areas of seabed disturbance directly beneath the pipeline (e.g. ToFD tool attached which encircles the pipeline). In addition, a small amount of turbidity is likely as the sediment is disturbed. These impacts will be temporary given the nature of the activity and over a small area in the vicinity of the pipeline. High pressure water jetting can result in disturbance to, or loss of, benthic habitat. Such disturbance occurs when biota attached to a section of pipeline, or the seabed in the immediate vicinity of the pipeline, are removed by water jetting. Such removal affects a highly localised area (several metres) and is of short duration (water jetting typically occurs for several hours). Pieces of non-toxic insulation, are removed and small pieces will settle onto the seabed. The removal of marine growth includes sessile fauna such as ascidians, sponges and macroalgae. Installation of stabilisation material is expected to alter the benthic habitat where the material is installed, by providing hard substrate in the marine environment and acting as an artificial reef. Given the relatively shallow depth of the pipeline, stabilisation materials are expected to be colonised rapidly by sessile organisms such as macroalgae and filter feeders. Stabilisation materials provide habitat for species such as the western rock lobster, however, given the small, localised areas requiring installation of stabilisation materials the effects of this are considered to be negligible. The existing habitat in the footprint of areas to be stabilised will be significantly modified, however, the footprint is small and highly localised (8 m^2 of seabed per linear metre of span). The installation of stabilisation

	by ROV where practicable, these pieces are those that won't disperse and float away (as they are large) and those that can be retrieved by the ROV apparatus. By using pre-cleared sections of pipeline, the need to use water jetting to remove the coating and insulation is reduced. High pressure water jetting is carried out by ROV equipped with a water jet on small sections of the pipeline during some IMR activities, namely visual inspection and marine growth removal. *Stabilisation materials* Pipeline IMR activities may require the use of stabilisation materials such as rock dumping, installation of mattresses and grout bags. Installation of stabilisation material may be required for span rectification or pipeline stabilisation. These activities may result in seabed disturbance due to placement of material on the seabed; however, the area of seabed affected will be small and localised and unlikely to extend beyond the area originally impacted during the laying of the pipeline. *Temporary moorings* The installation of temporary moorings may be done to facilitate IMR activities. Mooring installations typically consists of a series of three moorings that allows the vessel to pull up on moorings to maintain position as required.	material will not alter the structure or function of the coastal marine ecosystem, nor interrupt coastal processes such as sediment transport. Temporary moorings will be installed on a pipeline IMR activity-specific basis as required. The installation of temporary moorings may result in disturbance to, or loss of, benthic habitats within the footprint of the mooring (i.e. within the arc through which the mooring chain rotates). The size of the mooring is dependent on the load that it is required to hold, which is a function of vessel size and weather conditions. Given that IMR activities will require calm weather conditions, and the relatively small size of the potential vessels, temporary moorings are expected to be relatively small in size (clump weights up to 1.5 m in diameter, <3 t in weight). Disturbance around the clump weight due to chain disturbance, and the area impacted by the clump weight is conservatively estimated at 9 m^2. Where moorings are installed for long periods of time, the mooring footprint typically becomes bare sediment as the chain results in disturbance to benthic biota such as seagrasses and macroalgae. Where moorings are installed for short periods of time (e.g. 2-3 weeks) and then removed, the potential for disturbance to benthic habitats is considerably reduced. Recovery is also facilitated as habitat forming species (e.g. seagrass species) are still present and may regrow or recolonise the disturbed area. Given the short duration of pipeline IMR activities, the installation of temporary moorings is not expected to result in habitat loss beyond the footprint of the clump weight. Given the relatively small size and temporary nature of the mooring used to facilitate pipeline IMR activities, the impacts and risks to benthic habitats are considered to be relatively small and temporary in nature. During the life of the field, activities will occur that result in an area of seabed disturbance as described above. Given the small areas disturbed (up to 9m^2) in the worst case incidence, the cumulative impacts of multiple disturbances are considered negligible. The frequency of the disturbances will be low (occurring years apart for up to 25 days in total) and therefore no long term impacts are expected. As evidenced through monitoring surveys conducted by TEO, seagrass beds recover over time and can reasonably be expected to recolonise areas disturbed during planned activities.
Interference with other sea users	A safety exclusion zone of 500 m radius around the CHA will be maintained and enforced at all times, as gazetted under Chapter 6 of the OPGGS Act 2006, with the exception of rock lobster fishers with whom the Titleholder has an MoU. Additional vessels will be present intermittently for the duration of pipeline IMR activities within the exclusion zone and within the pipeline corridor. The operational area also encompasses 500 m either side of the pipeline corridor. Vessels are not excluded from the pipeline corridor, however during IMR activities, a 500m exclusion zone is requested through the issue of notice to mariners. The presence of vessels and equipment could present a navigational hazard to shipping and commercial	*Commercial fisheries* Potential impacts to commercial fisheries include loss of fishing area, and a potential inconvenience to fishing practices, or damage to fishing nets. The presence of temporary moorings during pipeline IMR activities may create fishing snags, during the short period the moorings are installed. The Cliff Head operational area is located within an important Rock Lobster Fishing Ground. The Titleholder has consulted extensively with fishing industry representatives prior to and during the design phase and continues to do so during the operations phase. The offshore pipelines and offshore platform have been designed to allow for lobster fishing activities to take place unaffected throughout the area traversed by the pipelines and to permit fishing up to the platform except when workover, construction or maintenance operations are active. Consultation with fisheries is ongoing, in particular with the rock lobster fishery, with which a MoU is in place. *Recreational fishers*

	fishing activities. Temporary moorings will also be installed during IMR activities potentially presenting a snagging hazard to commercial fisheries. In addition, all vessels will be required to stay outside the safety zones, so as to avoid collisions or other accidents. This arrangement may interfere with other users of the area which may include commercial fishers and shipping traffic.	Being relatively close to shore (~11 km) tourism activities are likely in proximity to the Cliff Head platform. Recreational fishing in particular is a popular activity, with the Abrolhos Islands and Port Denison being recreational fishing hubs. The Titleholder has consulted with local councils and recreational fishing charters to minimise impacts. *Shipping* The CHA and the 500 m exclusion zone may be an obstacle for shipping traffic in the region. These impacts include a loss of access to the area, navigational hazards and a collision risk. However, the CHA platform has been in place for over ten years and both the platform and pipeline corridor are marked on current nautical charts and shipping traffic is expected to be low in the area.
Physical presence	The presence of vessels and CHA facilities in the operational area during normal production activities and pipeline IMR activities including but not limited to marine growth removal, emergency clamping and pipeline repair could have the potential to attract or displace marine fauna or have a behavioural impact through localised displacement and temporary interruption to migratory species such as humpback whales due to the presence of vessels.	*Marine growth on subsea infrastructure* Marine growth may occur on subsea infrastructure (e.g. pipeline, stabilisation materials, CHA platform legs) resulting in artificial habitat attracting other species such as fish, mobile invertebrates and higher predators. While marine growth may be removed from the pipeline to ensure integrity, marine growth on other subsea structures is not planned. The additional marine growth provides habitat in an otherwise relative barren environment increasing biodiversity in the area. This has positive impacts on both ecosystem health and productivity, with potential benefits to socioeconomic receptors such as fisheries. It is unlikely that the addition of this habitat will attract fish away from existing habitat (and thus out of accessible fishing grounds) but rather populations around CHA will be recruited from existing habitat and add to the regional metapopulational size and viability. Larger marine fauna may be attracted to these communities, potentially increasing risk of collision and harm to individuals. The effect of physical presence on marine fauna behaviour is discussed below. The effect of noise and light from vessels and the CHA platform, and the potential to attract or displace marine fauna, are discussed above. *Vessel activities* During IMR activities, vessels will be utilised to support the activities 24 hours a day resulting in a temporary physical presence. The use of temporary moorings also presents a temporary hazard to marine fauna. During normal operations, vessels and helicopters are used to transport personnel and equipment to the CHA. *Behavioural effects of vessel presence* The presence of vessels and helicopters has the potential for behavioural impact through localised displacement and temporary interruption to migratory species such as humpback whales. No known resting areas occur in the operational area and therefore no species will be excluded from habitat critical to long term survival or population viability. Cetaceans are naturally inquisitive marine mammals that are often attracted to offshore vessels and facilities, and dolphins commonly 'bow ride' with offshore vessels. The reaction of whales to the approach of a ship is quite variable. Some species remain motionless when in the vicinity of a ship while others are known to be 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). In avoiding vessels, cetaceans may also have longer dive times. All marine fauna species including seabirds, cetaceans and fish species (including whale sharks) are likely to avoid any moving vessels, and return to normal behaviour patterns when the interruption has passed (i.e. vessel or moved on).
Atmospheric emissions	Atmospheric emissions such as NOx, SOx, smoke and particulates will be emitted from all combustion equipment engaged during workovers, normal CHA operations and vessel based activities. This includes the diesel engines on the HWU, CTU, generators/engines on support vessels, crane, and helicopter fuel used in logistical support. These activities will also produce emissions of CO2, a greenhouse gas. Vessels may utilise ozone-depleting substances (ODS) in closed-system rechargeable refrigeration systems. IMR activities are expected to be carried out intermittently and be of short duration (typically less than one week for each IMR activity). IMR activities typically involve the use of one vessel for the duration of each activity. Expected project vessels are relatively small commercial work boats which would typically run on marine diesel supplied locally in accordance with MARPOL Annex VI restrictions on sulphur content. Most fuel use (and hence vessel emissions) will occur during vessel transits; once on station and securely moored, main engine use will be minimal. Onboard combustion engines other than the main engines may include generators and pumps which may run on diesel or petrol; emissions from these engines are expected to be negligible. Note that under normal operational conditions, all power for CHA is supplied from the ASP generators via an electric umbilical (i.e. no combustion emissions during normal operations).	Hydrocarbon combustion may result in a temporary, localised reduction of air quality in the environment immediately surrounding the discharge point during the activity. Non-GHG emissions, such as NOX and SOX, and GHG emissions can lead to a reduction in local air quality which can impact seabirds, marine reptiles and mammals, and humans in the immediate vicinity and add to the national GHG loadings. The visual impacts of smoke may be aesthetic impacts given the close proximity of the CHA to the shoreline. Vessels utilised by the Titleholder typically run on marine diesel supplied locally in accordance with MARPOL Annex VI restrictions on sulphur content. Atmospheric emissions will add to the global inventory of greenhouse gases. The quantities of gaseous emissions are however relatively small and given the short duration of vessel based activities (maximum estimates are ~25 days for pipeline IMR activities) and will under normal circumstances, quickly dissipate into the surrounding atmosphere; they are not expected to have any local environmental consequences. Impacts are therefore expected to be minor and very unlikely.
Planned discharge from vessels	*Deck drainage* Deck drainage from vessels consists of rain water or deck wash-down which may contain a small amount of oil, grease, chemicals or detergent. Deck drains which contain rainwater only are directly overboard. Spills which occur within designated deck containment areas	The potential sources of oily water from vessels include bilge water and deck wash down water. Once discharged into the marine environment, oily water may result in a localised, temporary decrease in water quality and toxicity to marine organisms in the immediate vicinity of the discharge point. Oily water discharged from vessels will be treated to a concentration (<15 ppm) or contained and not discharged to sea, the potential for impact is therefore low and would be further reduced due to the strong tidal movements experienced in the region and the naturally turbid environment. Dispersion and

	where chemicals, oils and wastes are stored, are either pumped out to the waste oil settling tank or mopped up utilising spill clean-up materials. Contaminants on the deck surface will be in trace quantities and will comprise contaminants such as detergents, and oil and grease. *Equipment / machine space drainage* Equipment and machine spaces on vessels are fully contained and have dedicated drains leading to the bilge water system for oily waste products. For vessel larger than 400 gross tonnage, oily water residue is treated in an approved oily water treatment system to an oil-in-water concentration of 15ppm and then discharged to the marine environment. For smaller vessels, or those unable to discharge oily water at a concentration of <15ppm, oily water is retained on board for onshore disposal. An oily water monitor continuously monitors the discharge stream, is routinely calibrated and calibration records retained, as appropriate for the vessel class. Oily residues collected in this system are containerised in transit tanks and returned to shore for disposal. Note that oily water discharge occurs only while the vessel is en route. While the vessel is stationary oil and oily mixtures are retained onboard the vessel. Separated oil collected will be transported to shore for onshore disposal. Oil transfers are documented in the vessel's oil record book, as appropriate for the vessel class. *Sewage, greywater and food scraps* Vessels will generate domestic wastes (greywater, sewage and food scraps) during operational activities. Approximately 100 L of sewage/greywater, and approximately 1 L of food waste, will be produced per person per day. Such wastes are considered to decompose naturally and will be routinely discharged to the marine environment. *Cooling water* Seawater is used as a heat exchange medium for the cooling of machinery engines. Seawater is drawn from	biodegradation of potentially contaminated oily water drainage is expected to be rapid and highly localised resulting in no long-term or adverse effects on water quality or marine ecology. Putrescible waste discharge is routinely carried out as a standard practice during maritime activities and is permitted (and regulated) under the MARPOL Annexes IV (Prevention of pollution – sewage) and V (Prevention of pollution by garbage), as appropriate for vessel class. Putrescible waste discharged to the marine environment may result in a localised, temporary reduction in water quality, namely increased turbidity and nutrient availability. Increased water column turbidity can temporarily inhibit photosynthesis by plankton and benthic primary producers by decreasing light availability in the surface waters. Sewage can result in eutrophication in the surrounding waters resulting in changes to plankton in the immediate area. However, Friligos (1985) reported no appreciable differences in the inorganic nutrient levels between the outfall area and background concentrations suggesting rapid uptake of nutrients and/or rapid dispersion in the surrounding waters. Similar studies (Parnell, 2003) concluded similar results with rapid dispersion and dilution within hours of discharge. Because of the small volumes generated and the well mixed surface waters in the defined area, no significant impacts from routine discharges of putrescible wastes from vessels are expected. Ingestion of sewage discharges by fish, cetaceans, marine turtles or foraging seabirds could result in bioaccumulation of contaminants. In general, dilution after dumping at sea is rapid with results showing 1 in 1000 dilution within 30 minutes (Costello and Read, 1994). Based on this, acute toxicity is unlikely to occur at ecologically significant or detectable levels at dump sites. *Changes in temperature* When discharged to sea, the cooling water will initially be subjected to turbulent mixing and some transfer of heat to the surrounding waters. The plume will disperse and rise to the sea surface where further dilution and loss of heat will occur. The plume of heated water will move in accordance with the prevailing currents. Temperatures will drop swiftly to ambient with distance from the discharge point. Cooling water discharge points vary for each vessel, however, they all adopt the same discharge design that permits cooling water to be discharged above the water line, in order to facilitate cooling and oxygenation of this wastewater stream before mixing with the surrounding marine environment. Woodside undertook waste water discharge modelling (vertical, horizontal and temperature) for their Torosa South-1 appraisal well drilled near Scott Reef (Woodside, 2008). Vertical modelling indicated that most of the discharged volume remains in the upper water column (in the upper 10 metres) due to the neutral buoyancy of the discharge, but a small portion penetrates below the water surface, where it rapidly dissipates through the water column due to strong tides (Woodside, 2008). For the horizontal modelling, results indicate that there are only small differences in movement for each of the four seasons. Results show that a concentration of a component within the discharge stream is reduced to 1% of its original concentration at no less than 50 m from the discharge point under any condition (Woodside, 2008). Temperature dispersion modelling shows that discharge water temperature will decrease quickly as it mixes with the receiving waters, with discharge waters being less than 1°C above background levels within less than 100 m (horizontally) of the discharge point. Vertically, the discharge will be within background levels within 10 m (Woodside, 2008).

	the ocean and flows counter current through closed-circuit heat exchangers, transferring heat from the vessel engines and machinery to the seawater. The seawater is then discharged to the ocean (i.e. it is a once-through system). Cooling water temperatures vary dependent upon the vessels engines work load and activity.	While the environmental conditions may be different in the Perth Basin compared to Scott Reef, such as current speed, wind patterns and water depth, results are indicative of dispersion within open water. Due to the short duration and low frequency of proposed vessel activities associated with CHA operations, relatively low volume of cooling water, temperature differential, the deep, open water surrounding the vessels, and any marine fauna which may occur within 100 m of the vessel will be transitory, impact on water quality is expected to be low and short-term.
Contaminated drainage water and waste oils from CHA platform	CHA has been designed with deck drains (main & mezzanine), which collect and route liquids to deck drainage boxes. Valves allow the liquids to be routed overboard during normal operations (clean rainwater), or to a hose connected to portable storage drums during maintenance and workover activities. At the end of each maintenance period the equipment is cleaned, the decks washed-down and all liquids collected for disposal onshore. The main and cellar decks on the platform are designed with plating and perimeter bunds (inverted half-pipe) to contain spillage and wash water with containment of 19.6m^3. All hydrocarbons and dirty water released during maintenance activities is collected and stored in leak-proof containers for disposal onshore (refer Controlled Use of Drains on CHA Platform Procedure-10/HSEQ/ENV/PC02). High standards in housekeeping practices and mandatory safety standards ensure that decks are kept clean and tidy at all times. The platform has oil spill kits stored at strategic locations to immediately contain any potential spills; therefore, runoff from decks is not highly contaminated. Flushing water is used to flush the production tubing of the well prior to removal of the ESP (during workover activities). This minimises hydrocarbon inventory in the production system prior to workovers for maintenance, and effectively minimises the potential for an oil spill.	Once discharged into the marine environment, rainwater run-off containing trace quantities of oil, grease and detergent from decks may result in a localised, temporary decrease in water quality and toxicity to marine organisms in the immediate vicinity of the discharge point. Dispersion and biodegradation of potentially contaminated drainage is expected to be rapid resulting in no long-term or adverse effects on water quality or marine ecology.
Waste management on CHA platform	The environmental issues in relation to waste and hazardous materials management during operations are: Contamination of marine waters; Health risks to operations personnel and the public; Adverse effects on flora and fauna;	*General Domestic and Industrial Waste* Waste discharges to sea will result in litter and/or pollution that may impact the planktonic or benthic communities due to reduced water quality. General domestic waste such as plastics have the potential to smother benthic environments and harm marine fauna through entanglement or ingestion. Marine turtles and seabirds are particularly at risk from entanglement. Marine turtles may mistake plastics for food; once ingested, plastics can damage internal tissues and inhibit physiological processes, which can both potentially result in fatality.

	Reduction in visual amenity; Inefficient resource use. Key waste streams include: *General Domestic and Industrial Waste* Waste materials include paper, rags, packaging, scrap metal, drums, drainage runoff (from workover activities) and wood. Disposal of these wastes into offshore waters is strictly prohibited. *NORM Waste* Workover activities have the potential to recover completion tubing from a well which may contain Naturally Occurring Radioactive Material (NORM). While this is not considered to be a likely outcome as no NORMs have been recorded offshore to date, it has been included for contingency. Sources of NORM may include process cleaning equipment, which sometimes contains scales and sludges containing radium, and these wastes are described as Naturally Occurring Radioactive Materials (NORM). Any equipment used or recovered during routine operations or well workovers is not to be cleaned or decontaminated on board CHA. NORMs are also present within geological formations and are typically found in sand and produced water brought to the surface during production. *Cuttings from Milling Operations* Cuttings will be generated from milling operations to remove an ESP during work over. The cuttings are generally annular cement and formation cuttings. All cuttings and fluids utilised during milling are contained and transported to shore for appropriate disposal.	*NORM Waste* Harmful low-level radioactive discharges (NORM) to the marine environment have the potential to impact human health in addition to health of marine organisms due to localised changes to water quality and toxic effects on marine species. Occupational health and safety requirements for handling radioactive waste are contained within the Radiation Safety (general) Regulations, 1983. Guidelines to the level of NORMs in waste permitted to be disposed to landfill is provided in the Disposal of radioactive Wastes by the User (1985) while guidelines for the transportation of radioactive waste is provided in the Code of Practice for the Safe Transport of Radioactive substances (Transport Code, 1990). *Cuttings from Milling Operations* Cuttings from milling operations are contained and not discharged to sea. Milling mud and cuttings are all contained with the fluid circulation system, captured by a “junk basket” on surface and the mud is recirculated downhole following treatment via shale shakers (as required). Potential chemicals to be used include organic acid, corrosion inhibitor and biocide.
Workover emissions	Cliff Head oil is a heavy crude with a very low GOR [31scf/Bbl]. Very little gas is evolved during normal production operations. Methane (CH4) is contained in produced gas and has a global warming potential 21 times that of CO_2. Prior to workover activity commencement, wells will be circulated to brine to eliminate hydrocarbons from the well. During workover activity it is possible that an influx	Workover emissions from vented hydrocarbons can contribute to greenhouse gases, and reduce local air quality with possible impacts on marine fauna, in particular seabirds. While it is not expected given the characteristics of CHA crude and well control activities, it is possible that a small volume of gas could be released to air through the degasser/vent on the HWU unit. Further impacts from the release of gaseous emissions are described above in ‘Atmospheric emissions’ environmental event. As the crude is not processed offshore, any flushed fluid will be flowed back onshore to the process plant and it is therefore unlikely that gas will be vented, and if any is vented volumes would be less than 100Sm^3.

	of hydrocarbons may occur into the brine system. All workover fluid is handled via the HWU/CTU circulation system which processes fluid returns. This incorporates an emergency degasser/vent system. When utilising the HWU, a shale-shaker system (for milling operations) is also present. Should hydrocarbons enter the workover fluid, and in the unlikely event of gas generation, the discharge will be released through the degasser/vent. Release of gas through vents/degasser is required for safety purposes.	

Table 4-2: Environmental Risk Treatment Summary for Planned Events

Event	Inherent Risk	Management Controls	Effectiveness of control
Noise Emissions	Low (2)	Machinery maintained in accordance with PMS to ensure noise emissions are ALARP	Reduces risk of physical and behavioural impacts to cetaceans from machinery operations
		Marine fauna sightings are recorded to ensure marine fauna are actively sighted and subsequently avoided	Reduces risk of physical and behavioural impacts to cetaceans, whale sharks, dugongs and turtles from vessels, helicopters and machinery operations
		Contractor procedures reviewed to ensure vessels adhere to EPBC Regulations (Part 8) during activity to reduce potentially harmful noise impacts to cetaceans prior to mobilisation	Reduces risk of physical and behavioural impacts to cetaceans, whale sharks, dugongs and turtles from vessels, helicopters and machinery operations
		Site inductions completed by all personnel to ensure understanding of reporting requirements and EPBC regulations	
		Use existing pipeline inspection locations where possible to minimise requirement to undertake high pressure water jetting to reduce potential for noise impacts	
Light Emissions	Low (4)	Platform to maintain appropriate lighting in accordance with CHA Safety Case to prevent collision	Reduces risk of environmental impact from vessel collisions due to ensuring safety requirements are fulfilled.
		Routine vessel and helicopter activities completed during daylight hours to eliminate potential lighting impacts	Reduces risk of behavioural impacts to marine fauna from lights generated from vessel operations
		If vessels are utilised at night (e.g. during IMR activities) vessels to display appropriate navigation aids to prevent collision	
Seabed disturbance due to dropped objects and high pressure water jetting	Low (2)	All lifting equipment is rated for intended activities and lifting plans implemented	Ensures that lifting equipment is maintained and certified, and that lifting procedures are followed reducing probability of dropped objects occurring.
		Vessels operate within weather limitations	
		Equipment to be securely sea-fastened to prevent objects being lost overboard	Impacts to environment are reduced by preventing dropped object and by retrieving dropped objects where possible
		During water jetting, large pieces of insulation are recovered by ROV wherever feasible	
		Dropped objects retrieved where feasible	
		All personnel receive environmental induction	
		Any dropped object incident is reported	
		No anchoring of vessels during activity	Reduces impacts to seabed caused by vessel anchoring
Seabed disturbance due to stabilisation materials	Low (1)	Pipeline inspections to utilise existing inspection locations where practicable to minimise marine growth removal and subsequent seabed disturbance	Reduces seabed disturbance caused by marine growth removal
		Locations requiring pipeline stabilisation to be confirmed visually prior to stabilisation activities to verify rectification required and extent of marine growth removal required	
		Undertake engineering assessment of pipeline rupture risk prior to freespan rectification activities to verify rectification is required	

Event	Inherent Risk	Management Controls	Effectiveness of control
		Stabilisation material to be lowered to seabed slowly to minimise impact force and sediment resuspension and subsequent seabed disturbance	Reduces seabed disturbance by minimising impact force and sediment resuspension.
Seabed disturbance due to temporary moorings and during planned IMR activities e.g. freespan rectification	Low (1)	Temporary moorings to be clearly marked to ensure vessels can see moorings clearly and avoid the need to anchor, and aid in recovery following completion of activity	Minimise seabed disturbance caused by temporary moorings and IMR activities
		Mooring locations to be installed in accordance with mooring plan within the operational area	
		Temporary moorings to be recovered following completion of inspection and maintenance activities to allow rapid recovery of disturbed seabed	
		Notifications to AUSCOAST issued prior to any activity (that uses a vessel) to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	
		Notifications to AHS issued prior to any IMR using vessels to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	
		ROV footage from the IMR activity will be reviewed after the IMR activities are complete to inform future work	
		Where feasible, floating lines and pennant buoys will be used on temporary clump weight moorings to reduce seabed disturbance from chain drag	
Interaction with other marine users	Low (2)	Consultation with rock lobster fishermen ongoing to ensure they are aware of all upcoming activities and MoU remains valid	Ensure other marine users are aware of all upcoming activities and presence of CHA facilities and its support vessels.
		Vessels to comply with marine orders to ensure navigational equipment present to prevent collision	Reduces risk of environmental impact from vessel collisions due to ensuring safety requirements are fulfilled.
		Vessels to comply with marine orders to ensure radio equipment available to warn other sea users in the vicinity of activities	
		Vessels to comply with marine orders to prevent vessel collisions with other sea users	
		Vessels to display appropriate navigation aids, bridge watch and communication to prevent collision	
		Maintenance of safety exclusion zone around CHA to prevent potential collision with CHA platform, unless users are signatory to MoU	Exclusion zones around the CHA facilities prevents other vessels from getting too close and causing damage to equipment of either party. Gaining access authority through MoU ensures that other titleholders are aware of the presence of CHA facilities preventing interference with the titleholders activities.
		Notifications to AUSCOAST issued prior to any IMR activity to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	Ensure other marine users are aware of any IMR activity and presence of CHA facilities and its support vessels.

Event	Inherent Risk	Management Controls	Effectiveness of control
		Notifications to AHS issued prior to any IMR activity to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	
		Notifications to rock lobster fishery issued prior to any IMR activity to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	
Physical presence	Low (2)	Marine fauna sightings reported to DoEE and any vessel strikes reported	Reduces risk of physical and behavioural impacts to marine fauna
		Contractor procedures reviewed to ensure vessels adhere to EPBC Regulations (Part 8) during activity to reduce potential for impact to cetaceans prior to mobilisation	
		Contractor procedures reviewed to ensure helicopters adhere to EPBC Regulations (Part 8) during activity to reduce potential for impact to cetaceans prior to mobilisation	
		Site inductions completed by all personnel to ensure understanding of reporting requirements and EPBC regulations	
		Vessels to maintain bridge watch as per Marine orders 21 to ensure risk of marine fauna collision is minimised	
		Equipment maintained on a planned schedule to ensure vessels and machinery are working properly and reduce risk of breakdown and subsequent marine fauna impacts (e.g. through loss of propulsion or engine failure resulting in being unable to slow down or avoid marine fauna)	
		Pipeline inspections to utilise existing inspection locations where practicable to minimise marine growth removal and subsequent marine fauna disturbance	
Atmospheric Emissions	Low (2)	Vessels maintain an IAPP certificate or equivalent to certify measures to reduce air emissions are in place	Minimises the volume of air emissions to the environment
		Fuel used is low sulphur to ensure air emissions meet regulatory requirements	Reduces potential impacts of sulphur discharge into the environment
		Equipment that produces air emissions is maintained to ensure efficient operation	Minimises the volume of air emissions to the environment
		Any vessels containing ODS maintain a record book in accordance with MARPOL	Reduces probability of potential impacts to air quality due to ODS emissions
Planned Operational Discharges from vessels – Surface	Low (2)	Bunding in place to prevent oil and chemical spills to sea.	Reduces potential impacts of poorly managed discharges
		Suitable spill kits in accessible locations onboard to be used immediately in the event of a chemical / lubricant spill (including storage of used absorbents) to reduce potential for overboard discharge	Reduces potential impacts of inappropriate discharge of oily/ chemical contaminated water

Event	Inherent Risk	Management Controls	Effectiveness of control
		Spill clean up kits contain absorbents for clean up and are used in preference to deck washing to minimise impacts to water quality	
		Contaminated wastes are contained and shipped to shore for disposal and not discharged to sea to minimise impacts to water quality	Reduces probability of garbage being discharge to sea, reducing potential impacts to marine fauna and water quality.
		MSDS available on board vessels for all chemicals that could potentially be discharged to sea	Reduces potential impacts of inappropriate discharge of chemical contaminated water
		Any chemicals that have the potential to be discharged to sea are assessed to have a low potential for environmental impact	
		Bilge water system and oily waste system drain to contained tanks to prevent untreated oily water being discharged to sea	Reduces potential impacts of planned discharge of oily water to the environment and ensure compliance with legislation
		Oily water discharges do not exceed a concentration of 15ppm	
		Oily residues unable to be treated are disposed of onshore to prevent untreated oily water being discharged to sea	
		Oily water is only discharged en route (if OIW concentration is <15ppm) to ensure rapid dissipation in marine environment	
		Equipment allowing discharges to the marine environment is maintained to ensure discharges meet MARPOL requirements	Reduces risk of impact to marine fauna from unplanned discharges due to poor machinery maintenance
		Cooling water allowed to cool prior to discharge to minimise potential water quality impacts	Minimises potential impacts to marine habitat due to change in water temperature
		Environmental induction includes information on discharge requirements to ensure discharges are as low as reasonably practicable	Minimises impact to the marine environment due to planned discharges
		Sewage discharges to be made in accordance with MARPOL Annex V. If vessels cannot comply with MARPOL Annex V, then no sewage will be discharged to sea	Ensures vessels are compliant with legislation that decreases risks of pollution due to poor sewage or garbage management.
		If vessel can treat sewage in accordance with MARPOL Annex V, the discharges must also be in accordance with marine orders 96. If vessels cannot comply with MARPOL Annex V, then no sewage will be discharged to sea	

Event	Inherent Risk	Management Controls	Effectiveness of control
		Biodegradable detergents used where greywater cannot be treated	
		A record of waste management on board vessels	
		All wastes generated (excluding routine discharges) will be retained onboard, recyclables segregated and disposed of onshore at appropriate facility	
		Implementation of Prescribed Waste Management Procedure (10/HSEQ/ENV/PC04)	Ensures all hazardous wastes are to be handled and disposed of properly
Contaminated water and waste oils from CHA platform	Low (2)	No discharge of hydrocarbons and contaminated water during maintenance activities on CHA	Minimises impact to the marine environment due to discharges of hydrocarbons and contaminated water
		Implementation of Controlled Use of Drains on CHA Platform Procedure (10/HSEQ/ENV/PC02) to ensure no unplanned discharges via drains to sea	Reduces potential impacts of inappropriate discharge of oily/ chemical contaminated water
		Decks are cleaned prior to opening drain lines to allow rainwater discharge to sea	Minimises impact to the marine environment due to planned discharges
		All personnel received environmental induction which includes drainage and discharge requirements	
Waste management on CHA Platform	Low (4)	All solid waste segregated and transported to shore for appropriate disposal	Minimises environmental impact and to reduce the risk of unplanned release of waste to sea
		All waste skips and rubbish bins are covered to prevent loss of wastes overboard	Reduces probability of garbage being discharge to sea, reducing potential impacts to marine fauna.
		All personnel receive environmental induction detailing waste management expectations on CHA	Minimises environmental impact and to reduce the risk of unplanned release of waste to sea
		If NORM waste is a potential (e.g. when downhole equipment is brought to surface), trained radiation specialists are present to identify and containerised	Minimises the potential to impact human health in addition to health of marine organisms due to localised changes to water quality and toxic effects on marine species
		Any NORMs waste generated is containerised and transported to shore for appropriate disposal	Minimises the potential to impact human health in addition to health of marine organisms due to localised changes to water quality and toxic effects on marine species and ensures compliance with available regulations.
		Offshore radiation surveys conducted to identify NORMs as required e.g. when downhole equipment is brought to surface	
		CHA induction includes NORMs management measures	
		Any NORMs packaged or transported is managed in accordance with Radiation Management Plan (10/HSEQ/GEN/PL09)	
		Any NORMs identified has appropriate clearance certificate in accordance with Radiation Management Plan (10/HSEQ/GEN/PL09)	Ensures compliance with available regulations.

Event	Inherent Risk	Management Controls	Effectiveness of control
		Any NORMs identified is disposed of in accordance with Radiation Management Plan (10/HSEQ/GEN/PL09)	Minimises the potential to impact human health in addition to health of marine organisms due to localised changes to water quality and toxic effects on marine species and ensures compliance with available regulations.
		Any cuttings generated are contained and shipped to shore for disposal	Minimises the environmental impacts from discharge of cuttings to the marine environment.
		Shale shakers maintained to ensure efficient operations	Minimises the volume of cuttings generated and ultimately disposed of.
Workover emissions	Low (2)	Reservoir fluids maintained in formation by maintain overbalance to prevent discharge to sea	Ensures that reservoir fluids are retained in formation
		Any gas produced during workover due to hydrocarbons in the workover fluid is vented to atmosphere	Ensures any gas evolved through the treatment of workover fluids is handled in the degasser system (i.e. a safe vent location).

4.6.2 Unplanned Events

Table 4-3 summarise the identified hazards and potential impacts associated with the activity for unplanned events.

Table 4-4, Table 4-5 and Table 4-6 assess environmental impacts of Cliff Head crude and marine diesel on the sensitive receptors and locations. Table 4-7 lists the controls to prevent or mitigate impacts such that impacts and risks are reduced to ALARP and are at acceptable levels.

Table 4-3: Summary of environmental events, hazard description and potential impacts for unplanned events

Event	Hazard description	Potential impacts
Introduction of Invasive Marine Species	Vessels that have mobilised from international waters risk the introduction or establishment of Invasive Marine Species (IMS) to the Operational Area through ballast water exchanges and biofouling. The use (intake/ storage/ discharge) of seawater ballast is a standard operation in the management of vessel stability during operations. It is possible that marine species present within the water column can be taken in with the intake of seawater into ballast tanks and survive within ballast tanks and can be relocated and then	IMS are marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish founder populations. If a species is introduced and survives in the new environment, they may have the potential to colonise a new region and establish a new population, causing a range of potentially serious ecological effects including increased competition with native species and changes in ecosystem function, such as changes in trophic pathways. This may, in turn, impact commercial users of the sea such as fisheries. IMS have been introduced and translocated around Australia by a variety of natural and human means including biofouling. Species of concern are those that are not native to the region; are likely to survive and establish in the region; and are able to spread by human mediated or natural means. Species of concern vary from one region to another depending on various environmental factors such as water

Event	Hazard description	Potential impacts
	discharged with the ballast water into the Operational Area. Biofouling on vessels hulls, on other external/internal niche areas, and on equipment routinely immersed in water all pose a potential risk of translocating marine species. This can lead to the introduction of non-native marine species which can become established IMS, if the environmental conditions at the point of release are suitable.	temperature, salinity, nutrient levels and habitat type. These factors dictate their survival and invasive capabilities. It is recognised that artificial, disturbed and/or polluted habitats in tropical regions are susceptible to introductions which is why ports are often areas of higher IMS risk (Neil et al., 2005). However, in Australia there are limited records of detrimental impact from IMS compared to other tropical regions (such as the Caribbean). Following their establishment, eradication of IMS populations is difficult, limiting management options to ongoing control or impact minimisation. Case studies in Australia indicate that from detection to eradication this can take approximately 4 weeks (Bax 1999). However this is dependent on the environmental conditions and species. For this reason, increased management requirements have been implemented in recent years by Commonwealth and State regulatory agencies. For international vessels, the vessel will carry a current Statement of Compliance for International Anti-fouling Inspection Systems and will be assessed for bio-fouling risk prior to entry into Australian waters in accordance with the National Biofouling Management Guidance to the Petroleum Production and Exploration Industry with any required corrective actions such as inspection, cleaning and coating reapplication undertaken as appropriate.
Vessel collision with Marine Fauna	Vessels operating in the Operational Area during routine production and pipeline IMR activities may present a potential hazard to marine fauna such as cetaceans. Vessel movements can result in collisions between the vessel (hull and propellers) and marine fauna, potentially resulting in injury or mortality. The factors that contribute to the frequency and severity of impacts due to collisions vary greatly due to vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth) and the type, age and behaviour of the animal present.	The presence of vessels and helicopters has the potential for physical and/or behavioural impact on marine fauna including injury/mortality from vessel strike and/or temporary and localised displacement due to physical presence. Marine fauna that are present in shallow or surface waters are most susceptible to vessel strike due to their proximity to the vessel (hull, propeller or equipment) and their limited ability to avoid vessels (i.e. diving) in shallow waters. The species of marine fauna that are likely to be most susceptible to vessel strike are described below. Cetaceans are naturally inquisitive marine mammals that are often attracted to vessels underway; for example, dolphins commonly ‘bow ride’ with vessels. There have been recorded instances of cetacean deaths as a result of vessel collisions in Australian waters (e.g. a Bryde’s whale in Bass Strait in 1992) (WDCS, 2006), though the data collected indicates this is likely to be associated with container ships and fast ferries. Collisions between vessels and cetaceans are most frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (WDCS, 2006). The recently released Conservation Management Plan for the Blue Whale (DoE 2015) identifies vessel strike as one of the threats to Blue Whale species. The reaction of whales to the approach of a ship is quite variable. Some species remain motionless when in the vicinity of a ship while others are known to be 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).

Event	Hazard description	Potential impacts
		Other marine fauna like turtles and whale sharks that are present in shallow waters or surface waters are also susceptible to vessel strike due to their proximity to the vessel (hull, propeller or equipment) and their limited ability to avoid vessels. Whale sharks may be vulnerable to boat strike. They spend a significant amount of time feeding in surface waters (DEH, 2005; Norman, 1999) and scars have been observed on several whale sharks that have likely been caused by boat collision (DEH, 2005). There have also been several reports of whale sharks being struck by bows of larger ships in other regions where whale sharks occur (Norman, 1999).
Loss of well control (including during workover)	A major vessel collision (i.e. a large vessel at speed) could potentially cause CHA to lose stability sufficiently to expose the production well contents to the water column at the seabed. In this event, the hydrostatic pressure of seawater (56 psig) exceeds the highest unassisted production well bore pressure at the seabed (43 psig) and therefore a sub-sea spill is not physically possible. If such a collision resulted in a loss of well integrity at or above sea level, no such hydrostatic pressure would be present. Natural flow tests performed at the CHA platform in November 2010 identified negative Tubing Head Pressure (THP) against a wellhead at atmospheric conditions demonstrating that most of the wells will not flow naturally. Reservoir modelling by the Titleholder's reservoir engineers confirmed the potential for 2 wells to flow naturally at a rate of 3 to 5m^3 oil/day respectively at current reservoir conditions and water cuts of 89% and 96% respectively. A flow test performed demonstrated a maximum rate of 24 m^3 fluids/day at 35% water cut (16 m^3 oil/day) for a short period prior to the rate declining to zero flow 3 days later. This suggests that at current reservoir conditions and water cuts, the duration of the discharge would be less than three days (without water injection and ESPs running[2]). A conservative scenario has been modelled assuming a loss of well integrity resulting in a spill rate of 5 m^3 oil/day for three days.	Cliff Head crude cools and will solidify on discharge onto the water surface. This means it would not spread as a film in the way that low viscosity, low pour-point oils would behave. The spatial concentration of Cliff Head crude would therefore be determined by the volume of semi-solid to solid pieces of oil that are present over a given area. Weathering simulations for Cliff Head crude released at the surface under calm wind conditions (< 8 knots) indicates that approximately 30% of the oil volume would evaporate over the first 2 days and a further 10% would evaporate over the subsequent 2 days. Little further evaporation is then expected since the boiling point of compounds remaining in the weathered residue would be too high. No entrainment is forecasted for this oil type under calm conditions because the viscosity is too high (preventing entrainment) and density is less than sea water (allowing the crude to float to the surface). Further reduction of the mass on the surface would then be determined by the rate of decay of the oil, through photo-oxidation and biological decay. The floating oil is indicated to have a tendency to remain floating, and not to entrain, even in the presence of breaking waves. This is attributed to a combination of the lower density than seawater and the high pour point which should result in the oil presenting as solid or semisolid parcels that will resist dispersion beneath the surface. Simulation of a situation where a proportion of the floating slicks run aground and accumulate on shorelines indicates a higher rate of evaporation should occur from the grounded oil, with the effect that a higher proportion of the total spill is expected to evaporate. Shoreline contact is only expected at the Dongara area of the WA coast. Contact is expected in both summer and winter, with a shorter time to contact and a larger stranded volume estimated during summer. Accumulation of hydrocarbons is expected at all coastlines, albeit in very small volumes. There was no contact predicted with the submerged Abrolhos shoals. Since the behaviour of Cliff Head crude prevents entrainment of hydrocarbons in the water column, and the weathering behaviour leads to reduced amount of dissolved aromatics, the potential impacts of

[2] If not immediately cut off as a result of the incident, water injection and the ESPs would be shut off immediately by the ASP control room.

Event	Hazard description	Potential impacts
	Should power or electrical communications between ASP and CHA fail, CHA is designed to fail shut. The ESPs require power to function, should CHA topple, it is assumed that no power can be supplied to the ESPs and they will cease to function. The ESPs also have inherent auto detection of abnormal power or electrical communication situations and will automatically shut down if an abnormality is detected. As such, any failure in control from the ASP will be detected as abnormal resulting in the ESPs to stop functioning, or CHA to shut down. Therefore, no scenarios are deemed credible for the ESPs to continue functioning in a loss of well control situation. The only credible scenario for a loss of well control would be if CHA toppled as described above.	surface and stranded Cliff Head crude are considered only. The potential impacts of surface and shoreline stranded hydrocarbons on individual sensitive receptors are summarised and assessed in Table **4-4**. These sensitive receptors are present at different locations potentially impacted by a spill. Based on the presence of sensitive receptors, the potential impacts of Cliff Head crude on sensitive locations is summarised in Table 4-5. While assessing the potential impacts on sensitive locations, the worst case scenario was used. Since a greater volume of crude is expected from a pipeline leak over a loss of well control, a release from a pipeline leak was considered the worst case scenario. By assessing the impacts of a larger spill scenario, the environmental risk posed by a loss of well control scenario will be less than that of a pipeline leak and therefore the following assessment is conservative.
Pipeline leak	Accidental release of Cliff Head crude from the pipeline could occur due to: 1) ruptures due to physical damage arising from objects being dropped on the pipeline, vessel interaction (e.g. anchor drag) or equipment (e.g. fishing) being dragged across the pipeline; or 2) leaks due to corrosion, materials fatigue or physical damage (e.g. during IMR activities). Pipeline pressure is monitored from the ASP plant onshore. Should a major rupture occur, shut down of the pipeline can be activated remotely (automatically or manually). The amount of crude that can be released into the marine environment can be estimated as the maximum export oil flow rate (23.2m^3/hour) multiplied by the time taken to identify the loss and shut down the system, 1 minute for automatic (4 m^3), and 2 hours for manual (46.4m^3) and the volume of oil in the pipeline all of which is assumed to be lost to sea (65m^3). This gives a potential release volume of 69 m^3 (automatic shutdown) to 111.4 m^3 (manual shutdown) of Cliff Head crude	Since the potential volume of hydrocarbon released during a pipeline leak is larger than that of loss of well control, a larger area is potentially impacted. Shoreline contact is expected at the Dongara and Leeman area of the WA coast in both summer and winter, the Cervantes area in winter and Geraldton in summer. In general, contact is expected to be quicker and with larger volumes in winter compared to summer. Accumulation of hydrocarbons is expected on all shores, albeit in very small volumes. There was no contact predicted with the Abrolhos shoals. APASA spill modelling results also indicated that after 888 hours (37 days), predictions for the partitioning of oil mass over time through weathering processes for a slow discharge (11.1 m^3/d) of Cliff Head Crude from the seabed at 18 m, more than 50% of spilled crude oil has evaporated, approx.. 30% decayed, 15% ashore and less than 5% floated on surface. Since the behaviour of Cliff Head crude prevents entrainment of hydrocarbons in the water column, and the weathering behaviour leads to reduced amount of dissolved aromatics, the potential impacts of surface and stranded Cliff Head crude are considered only. The potential impacts of surface and shoreline stranded hydrocarbons on individual sensitive receptors are summarised and assessed in Table **4-4**. These sensitive receptors are present at different locations potentially impacted by a spill. Based on the presence of sensitive receptors, the potential impacts of Cliff Head crude on sensitive locations is summarised in Table 4-5.

Event	Hazard description	Potential impacts
	discharged into the marine environment at a conservative (worst case) rate of 23m^3/hr. However, it is possible a smaller leak may occur below the limit of detection by measuring instruments at ASP; it was estimated that a spill of 2% of the daily flow would be below the limit of detection. Since the leak might not be detected by measuring instruments, the only method of detection would be a visible sheen observed during monthly aerial surveys of the area, or by a different sea user such as fishermen or an observed form the shoreline Therefore, the maximum amount of time the spill could go undetected would be 30 days. A hole size that would result in release of 2% of the daily flow was determined as 43 mm. This hole size is considered large for a corrosion hole (when compared to historic records on pipeline corrosion) and therefore is a conservative estimate. The amount of crude that could be released in the worst case scenario (longest time to detection (30 days) combined with the largest hole size without detection (43 mm)) is estimated as 2% of daily export fluids flow rate lost from a pin hole leak (43 mm diameter) (11.13 m^3/day) at export pressure of 150 psi multiplied by the time taken to identify the loss and shut down the system (30 days). This gives a potential release volume of 334 m^3 of Cliff Head crude into the marine environment at a rate of 0.46m^3/hr. Since the undetectable leak from the pipeline resulted in the largest release of Cliff Head crude, the size of the spill and associated impacts will be larger for this scenario, encompassing the impacts of the smaller pipeline rupture scenario. Therefore, the spill trajectory of this scenario was modelled and the potential impacts assessed in the following sections. There is also the same potential risk of a chemical release from the pipeline or umbilical due to loss of integrity. However, due to the nature of the chemicals	

Event	Hazard description	Potential impacts
	used, the potential impacts from a crude release are considered of greater consequence and are therefore assessed in this section.	
Chemical/ hydrocarbon spills/ leaks	There may be accidental releases / discharges to the marine environment of a variety of potentially hazardous materials which are stored and utilised on the CHA deck. The main sources of hazardous liquids are: • Bulk diesel storage tank, 1.8 m^3 • CHA crane diesel fuel tank, 1.1 m^3 • HWU hydraulic power unit diesel engine, 0.4 m^3 • Small amounts of lubrication, hydraulic and waste oils within equipment e.g. hydraulic oil in CTU reel, <50L (0.05 m^3) • Chemicals Fuel transfer from the storage tank to individual equipment will be carried out on CHA. Accidental releases may occur due to hose failure or damage during fuel transfer from CHA to individual equipment, or through damaged or poorly maintained equipment. The chemical injection package is located at ASP, and comprises pumps, tanks and control devices. The chemicals are supplied to CHA via four stainless steel tubes (encapsulated in a flat pack), one dedicated to demulsified, one to a mixture of scale inhibitor and corrosion inhibitor, and the other two allocated as spares. Chemical spills may result from the accidental leakage of process chemicals used for injection into the wells and pipeline on the CHA platform or through loss of integrity of the chemical umbilical or at CHA from a failure at the chemical injection unit. The chemical injection unit has three break tanks each of approximately 190 L, therefore, 190 L is the largest credible spill scenario. Potential impacts as a result of pipeline integrity loss are discussed above in “Pipeline leak’ event.	The impacts associated with the accidental discharge of liquid hazardous materials is related to the nature of the material spilled, the volume and its behaviour in the marine environment (sink/ float/ disperse etc.). In the event of a spill from CHA to the marine environment the liquids would be subjected to rapid dispersion and dilution by the open ocean water conditions and prevailing currents. If hazardous liquids are accidentally lost overboard or due to a loss of pipeline integrity, potential impacts will include a temporary and highly localised decline in water quality with limited potential for toxicity to marine fauna due to the temporary exposure and low toxicity resulting from the rapid dilution and evaporation in the marine environment. Potential impacts are likely to be limited to the immediate vicinity, with no shoreline contact likely, and unlikely to affect overall population viability.

Event	Hazard description	Potential impacts
Workover chemical spills	The fluid to be utilised in workover will be a KCL brine containing additives. This fluid is handled via the HWU/CTU circulation system which processes fluid returns and incorporates a degasser/vent system. The HWU also has a shale-shaker system (for any milling operations). KCL brine is recycled in the workover program wherever possible. The preferred disposal method of the brine (and other workover chemicals including acid wash chemicals) is either injection into an offshore well, reprocessing via the CHA production system or collection in tanks for onshore disposal at ASP. Reprocessed or tank collected workover fluids will be separated onshore at ASP and then pumped from shore via subsea chemical pipeline for reinjection into the reservoir via the water re-injection wells. There is potential that a small amount (<20 L) of workover chemicals could be released to the marine environment via a leak in the CHA production system.	A number of chemicals may be present in workover fluids which could lead to short term, localised reduction in water quality and possible toxicity to marine fauna and flora. However, should an accidental release of workover fluid occur, it is expected that the discharge would quickly disperse within the water column reducing any negative impacts.
Produced formation water (PFW) spills	The PFW recovered from the wells is transported in the production pipeline to the ASP where it is separated from the oil stream. The PFW is disposed of via deep well disposal offshore through the water reinjection pipeline. No PFW will be discharged into the marine environment from the Cliff Head oil field. A pipeline leak or operator error could result in approximately 6.5 m^3 of PFW released into the marine environment, based on the release rate and shutdown time frame.	PFW typically contains low concentrations of: • petroleum hydrocarbons; • phenols; • organic acids; • metals; • radioisotopes; and • residual process chemicals. Petroleum hydrocarbons are the organic components of greatest environmental concern in PFW. PFW may also contain residues from scale and corrosion inhibitors (Cis), biocides and process chemicals added from various stages of the extraction and production process. Release of PFW into the marine environment could cause chronic toxicity to shallow water marine flora and fauna, and local water quality.
Unauthorised access	Unauthorised access to CHA at any time poses a risk to platform infrastructure from damage due to sabotage by activists/terrorists. As the platform is unmanned there are	Worst case scenario would involve the loss of well control or pipeline leak due to intentional damage. The impacts of such a situation would equal those of the largest spill scenario as outlined in unplanned of loss of well control or pipeline leak.

Event	Hazard description	Potential impacts
	only vessels in the vicinity during regular visits to the CHA or during IMR activities.	
Vessel tank ruptures	Vessels are used to support the operations of CHA. Any vessel at sea presents a possible collision hazard to other vessels at sea. A collision capable of causing a hydrocarbon spill requires a scenario whereby a vessel collides with one of the vessels with enough force to cause a hydrocarbon release. No additional surface hazards, such as infrastructure (e.g. platforms, aside from CHA), with which collision with a vessel has potential to cause a rupture of a fuel tank have been identified within the operational area. The greatest risk is a vessel to vessel collision causing sufficient damage such that a fuel tank is ruptured, releasing diesel to the marine environment. Vessel collisions may be caused by poor navigation, vessel equipment failure, adverse weather conditions, or human error. The worst credible scenario for loss of diesel would be an incident whereby all diesel located in the vessel's tanks was released into the marine environment, it is not expected that any vessel with a fuel capacity greater than 500m^3 would be used for CHA operations.	In the marine environment diesel will behave as follows: • Diesel will spread rapidly in the direction of the prevailing wind and waves; • Evaporation is the dominant process contributing to the fate of spilled diesel from the sea surface and will account for >50% reduction of net hydrocarbon balance; • Diesel will also entrain under the water surface particularly when wind speed and resultant wave action increase; • The evaporation rate of diesel will increase in warmer air and sea temperatures; and • Diesel residues usually consist of heavy compounds that may persist longer and will tend to disperse as oil droplets into the upper layers of the water column. • Floating film concentrations exceeding 1 g/m^2, which would appear as a rainbow sheen, are forecasted to potentially occur: ○ up to 60 km from the release site during cooler winter conditions; and ○ up to 20-30 km from the release site under summer conditions. Diesel spills can cause chemical (e.g. toxic) and physical (e.g. coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species and a decline in water quality. Also a hydrocarbon spill could cause a disruption to other marine users, in particular commercial fisheries. The severity of the impact of a hydrocarbon spill depends on the magnitude of the hydrocarbon spill (i.e. extent, duration) and sensitivity of the receptor. Due to the nature of marine diesel, evaporation occurs at a much greater rate than Cliff Head crude leading to a shorter duration in the potential impacts described in Table 4-6, compared to those discussed in Table **4-4**. Potential sensitive receptors include: • Plankton; • Intertidal and shoreline habitats; • Fish (including those targeted by commercial and recreational fishers); • Marine mammals; • Marine reptiles; • Seabirds; • Commercial and recreational fisheries; • Tourism;

Event	Hazard description	Potential impacts
		• Key ecological features (KEFs); and • Commonwealth and State marine reserves.
Diesel spill during refuelling	Refuelling of vessels at sea is considered an unlikely occurrence given the distance to the nearest port for refuelling, however it is retained as a contingency option. A minor spill (~37.5 m^3) of marine diesel could occur during refuelling resulting in a loss of hydrocarbons to the marine environment at sea surface. Spills during refuelling can occur through several pathways, including fuel hose breaks, coupling failure or tank overfilling. Spills resulting from overfilling will be contained within the vessel drains and slops tank system. In the event that the refuelling hose is ruptured, the fuel bunkering activity will cease by turning off the pump; the fuel remaining in the transfer line will escape to the environment as well as fuel released prior to the transfer operation being stopped. The AMSA (2013) Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities provides guidance for calculating a maximum credible spill volume for a refuelling spill. The guidance provided by AMSA (2013) for a refuelling spill under continuous supervision is considered appropriate given refuelling would be constantly supervised. The maximum credible spill volume during refuelling is calculated as: transfer rate x 15 minutes of flow. The detection time of 15 minutes is seen as conservative but applicable following failure of multiple barriers followed by manual detection and isolation of the fuel supply. Based on a worst case transfer rate of 150 m^3/ hr, a marine diesel spill of 37.5 m^3 was calculated as the maximum credible volume of marine diesel that could be released into the marine environment during refuelling.	Spills of marine diesel during refuelling events have the potential to cause impacts to the marine environment through a reduction in water quality and marine fauna exposure. Marine diesel at the sea surface will spread rapidly in the direction of the prevailing wind and surface currents. Diesel spills can cause chemical (e.g. toxic) and physical (e.g. coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species and a decline in water quality. Potential impacts of marine diesel have already been described for a much larger spill of 500m^3 due to a vessel collision, therefore impacts from a refuelling spill would be much less. Refer to Table 4-6 for further impact description.
Leakage or spillage on-board vessel	There may be accidental releases / discharges to the marine environment of a variety of potentially hazardous materials and chemicals (liquid) which are stored and	The impacts associated with the accidental discharge of liquid hazardous materials is related to the nature of the material spilled, the volume and its behaviour in the marine environment (sink/ float/ disperse etc.).

Event	Hazard description	Potential impacts
	utilised on the vessel decks. Such releases will generally be small (<80 L) and may include diesel lubrication oils, hydraulic oil and waste oil.	In the event of a spill from the vessel to the marine environment, the hydrocarbons and chemicals would be subjected to rapid dispersion and dilution by the open ocean water conditions and prevailing currents. If hydrocarbons are accidentally lost overboard, potential impacts will include a temporary and highly localised decline in water quality with limited potential for toxicity to marine fauna due to the temporary exposure and low toxicity resulting from the rapid dilution in the marine environment. Potential impacts are likely to be limited to the immediate vicinity and unlikely to affect overall population viability.
Oil spill response	While spill response activities are intended to reduce the potential environmental consequences of a hydrocarbon spill, response activities can exacerbate or cause further environmental harm. Poorly planned and coordinated response activities can result in a lack of, or inadequate, information and poor decisions made during incident response. After source control, there are six operational oil spill response options: • Monitoring and evaluation (including natural recovery); • Chemical dispersants; • Offshore containment and recovery; • Shoreline protection and deflection; • Shoreline clean-up; and • Oiled Wildlife Response: this will not remove oil from the environment but will mitigate the impact of the spill by rehabilitating oiled wildlife These response options are described in detail in the accompanying Cliff Head OPEP (10/HSEQ/ENV/PL02).	Response activities can result in: • Disturbance to marine fauna and flora from increased vessel and / or helicopter movements; • Spreading of hydrocarbons further beyond the zone of contamination (e.g. secondary contamination due to hull contamination of response vessels); • Inadequate surveillance leading to poor information and unforeseen impacts; • Unnecessary application of chemical dispersants causing reduced water quality and impact to sensitive receptors; or • Inappropriate response implemented and additional sensitive receptors impacted (e.g. use of dispersants when containment and recovery would have been of greater benefit). The potential impacts of a release of Cliff Head crude and marine diesel on sensitive receptors is assessed in Table **4-4** and Table 4-6. In line with response strategy priorities sensitive receptors were prioritised in the following order: • Environmentally sensitive locations (habitat, cultural, flora/fauna); • Commercial/ industrial resources/ properties/ and assets; and • Recreational and human amenity resources. • The most sensitive receptors are deemed to be: • Sandy beaches; • Intertidal reefs; • Foraging/nesting seabirds/shorebirds; • Breeding marine mammals; • Mangroves; and • Tourism. Based on the volumes of Cliff Head crude predicted to accumulate / become stranded at sensitive locations and the presence of sensitive receptors at these locations, the impact of a hydrocarbon spill on sensitive locations was assessed in Table 4-5. Response strategy assessment

Event	Hazard description	Potential impacts
		A summary of the available spill response strategies, potential environmental impacts and operational considerations of response strategies for CHA credible spill scenarios are discussed in Table 5-3.

Table 4-4: Potential impacts of Cliff Head crude on sensitive receptors

Sensitivity receptor	Impact description		Impact assessment	
	Surface	Stranded / accumulated shoreline	Surface	Stranded / accumulated shoreline
General offshore				
Plankton	There is the potential for localised mortality of plankton due to reduced water quality and toxicity, particularly near the surface of the water where the hydrocarbons are most likely to occur. Due to the viscosity of the crude, it is possible that light reduction, with potential impacts on photosynthesis, may occur close to the source of the spill.	N/A	Due to the small amounts of crude that could be released, the effects are likely to be minimal. The area potentially impacted by a spill is characterised by a low standing crop of plankton which is not an important source of primary productivity in the area. Further, the affected area is a relatively small portion of the marine offshore environment, therefore the level of impact consequence has been determined to be low	N/A
Invertebrates	Adult marine invertebrates and larvae usually reside within benthic substrates and pelagic waters, rarely reaching the water's surface in their life cycle (to breed, breathe and feed). Therefore, surface hydrocarbons are not considered to pose a high risk to marine invertebrates within the spill trajectory area.	N/A	Since marine invertebrates, specifically rock lobsters, do not generally reside at the sea surface, the impacts of surface hydrocarbons are unlikely to occur.	N/A

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Fish	The variety of benthic habitats in the Perth Basin (reefs, seagrasses and offshore waters) supports a diverse assemblage of fish. Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth. Due to the tendency of Cliff Head crude to form waxy, solid droplets, ingestion of these by larger predatory fish is possible.	N/A	Due to the viscosity of the crude, in the event of a spill very little will be become entrained in the water column, where fish are more susceptible to toxic impacts. Due to the low level of entrainment, surface crude is unlikely to impact fish eggs and larvae. As such impacts are likely to be low and short-term in duration.	N/A
Marine reptiles	Four species of turtle are known to exist with the waters in proximity to the Cliff Head platform. Since marine turtles are not known to breed close to the CHA, hatchling turtles are not expected in great numbers. For adult, juvenile and hatchling turtles, the main pathways for exposure include ingestion and inhalation of vapours. Adult and juvenile turtles are particularly prone to ingestion of surface oil, especially where it forms solid masses such as tar balls. Oil ingested by a turtle does not pass rapidly through its digestive tract. It may be retained for several days, increasing internal contact and the likelihood that toxic compounds will be absorbed. The risk of gut impaction also increases for turtles that have ingested oil.	N/A – no nesting beaches occur in areas where stranded hydrocarbons could occur	Although the impacts of Cliff Head crude on adult turtles can be severe, the low density of turtles expected in the region (due to lack of breeding aggregations) implies that few individuals would be affected. As such the impact has been determined to be moderated.	N/A

Marine mammals	Seven species of marine mammal may be present in the waters in proximity of the Cliff Head facilities. Of these, four species are listed as threatened; the humpback, blue whale, southern right whale and the Australian sea lion. The operational area does not include any known blue whale feeding, breeding or resting areas. Humpback whales are frequently sighted in the region as they migrate annually from the cold feeding waters of the Antarctic to the warm water breeding areas in the Kimberley. Peak migratory periods in Cliff Head area for the northbound leg are around mid-June. The location of the Cliff Head platform is at towards the northern limit of the Southern right whale distribution and only occasional sightings have been made as far north as Geraldton indicating few individuals may be present. Australian sea lions forage around the larger reefs in the area. The nearest breeding grounds are on the Beagle Islands (35 km south) and the Abrolhos Islands (112 km northwest). There is no seasonal peak in breeding, with breeding cycles being asynchronous between colonies. Surfacing within a hydrocarbon slick may lead to a toxic level of exposure. However, cetaceans have a thickened epidermis that greatly reduces the likelihood of hydrocarbon toxicity from skin contact with oiled waters (Geraci 1990, O'Shea and Aguilar 2001). Should pinnipeds come into contact with Cliff Head crude, the crude may stick to the fur and be ingested during grooming incurring the associated toxicological effects. The fur may also become smothered leading to reduced waterproofing and hypothermia.	N/A	The impacts of Cliff Head crude on marine mammals can result in lethal or sub-lethal impacts on individuals. Although cetaceans are not expected to be present in large numbers, should a spill occur during a migration period large numbers of individuals could potentially be impacted. While sea lions breed asynchronously (i.e. with no peak in breeding activity) they are present year round and could be impacted by a spill. As such the impacts are considered moderate.	N/A

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Seabirds	Seabirds either pass across the region or use the waters within and near to the permit area as their main habitat, with nine species of threatened seabird possibly occurring in the area. The Abrolhos CMR and Jurien CMR in particular are important foraging areas for the threatened Australian noddy and soft-plumaged petrel, and other migratory species. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour. Direct contact with surface hydrocarbons can lead to irritation of skin and eyes. Smothering can lead to reduced water proofing of feathers leading to hyperthermia. Smothering of feathers can also lead to excessive preening, diverting time away from other behaviours, leading to starvation and dehydration. Preening of oiled feathers will also result in to ingestion of hydrocarbons and the associated impacts of toxicity and potential illness. Due to the behaviour of Cliff Head crude in water, the potential for smothering is likely to be less than for lighter crudes. However, there is a possibility that ingestion of solid waxy droplets may occur if they are mistaken for prey.	N/A	The impacts of Cliff Head crude on seabirds can result in lethal or sub-lethal impacts on individuals. Since a spill could potentially occur at any time of year there is potential to overlap with peak nesting periods where a large number of seabirds, including those listed as protected could potentially be impacted by a spill. As such the impacts are considered moderate.	N/A
Subtidal zone				

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Submerged reefs and shoals	Submerged coral reefs and shoals can be located in areas around the Abrolhos Islands and the nearshore areas of the WA coast. Significant shoals are found to the east of the Abrolhos Islands. Due to the high viscosity of the Cliff Head crude oil, very little will become entrained in the water column with the vast majority floating on the sea surface. Therefore, surface crude is unlikely to have any negative impacts on fully submerged features or their associated fauna.	N/A	The impacts of surface oil in submerged reefs is negligible	N/A
Intertidal zone				
Seagrass	Seagrass habitat is found in areas around the Abrolhos Islands and the nearshore areas of the WA coast. The impact of surface oil on seagrasses will largely be dependent on the distribution of the habitat; deeper communities will be protected from oiling particularly when considering the high viscosity of the Cliff Head crude. Shallow seagrasses may be effected by stranded or accumulated oil should they be emergent, as described in the next column. Macrophytes such as seagrasses require light to photosynthesise. The presence of surface oil at sea, and directly coating of seagrasses, can affect the ability of macrophytes to photosynthesise, potentially reducing primary productivity. Surface oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in sections above.	Direct contact with hydrocarbon can smother seagrass leading to toxicity and preventing respiration with lethal and sub-lethal effects (Taylor and Rasheed 2011). Smothering can also lead to a reduction in photosynthesis as described in the previous column. Stranded oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in sections above.	Due to the properties of Cliff Head crude, surface oil is unlikely to impact seagrasses directly, unless they are emergent as discussed in the next column. At most surface oil could lead to a reduction in primary productivity. Therefore the impacts are considered low.	Stranded or accumulated oil can have lethal or sub-lethal effects potentially leading to a reduction in productivity. These impacts combined could result in detrimental effects on the overall ecological community. However, it is unlikely large areas of emergent seagrass habitat will be present and therefore the impacts are considered low.

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Rocky shore, intertidal reefs	Rocky shore and intertidal habitats are found intermittently along the WA coast and around the Abrolhos Islands. Due to the high viscosity of the Cliff Head crude oil, very little will become entrained in the water column with the vast majority floating on the sea surface. Therefore, surface crude is unlikely to have any negative impacts on fully submerged features. If the feature is emergent, surface crude will result in stranded oil discussed in the next column. Surface oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in sections above.	Due to the composition of Cliff Head crude, it is likely to remain stranded with relatively slow natural recovery (as a result of wave action) compared to light crudes or condensate. Therefore, the stranded crude has potential to persist in the environment for longer periods of time increasing the potential toxic and physical (smothering) effects. Impacts of contact with surface oil can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates (Villanueva *et al*., 2008). Stranded oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in sections above.	Surface oil may become stranded on emergent features. Impacts of stranded crude are assessed in the next column.	Since stranded oil can have lethal and sub-lethal effects on coral reefs and the associated impacts on fauna and flora. As such the impacts are considered moderate.

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Mangroves	Surface oil is not predicted to make contact with the Abrolhos Islands on which a small amount of mangrove habitat is present.	The impacts of surface hydrocarbons on mangroves include damage as a result of smothering of lenticels (mangrove breathing pores) on pneumatophores or prop roots, or by the loss of leaves (defoliation) due to chemical burning (Duke *et al*. 1999). Thorhaug (1987) concluded that while defoliation of mangroves was a common occurrence when exposed to hydrocarbon slicks, massive mortality was not always the ultimate outcome. Mangrove death is predicted whenever more than 50% of the leaves are lost (Evans 1985). It is also known that mangroves take up hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death (Wardrop *et al*. 1987).	N/A	Since stranded oil can have lethal and sub-lethal effects on mangroves and the associated impacts on fauna and flora, the impacts are considered moderate

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Sandy shores/beaches	A number of sandy beaches are found along the WA coast and around the Abrolhos Islands. Where surface oil slick makes contact with sandy shores or beaches it is likely to become stranded, impacts of which are described in the next column.	As discussed for surface hydrocarbons, there is the potential for some hydrocarbons to be temporarily stranded on the sandy shores and beaches as the tide ebbs. Due to the composition of Cliff Head crude, it is likely to remain stranded with relatively slow natural recovery compared to light crudes or condensate. Therefore, the stranded crude has potential to persist in the environment for longer periods of time increasing the potential toxic and physical (smothering) effects. Such effects may impact fauna such as polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans and insects, and the vertebrates that prey upon them (e.g. shorebirds).	Surface oil may become stranded on sandy beaches. Impacts of stranded crude are assessed in the next column.	Since stranded oil may persist on sandy beaches with slow natural degradation, this may result in lethal and sub-lethal effects on associated fauna and flora. As such the impacts are considered moderate
Saltmarshes	Surface crude is not expected to make contact with this receptor	N/A	N/A	N/A
Sublittoral zone				

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Seabird breeding, feeding and resting areas	N/A	The Abrolhos Islands are an important breeding, foraging and resting area for various species of seabird and shorebird. Seabirds and shorebirds are also likely to occur along the coastlines of WA albeit in lower numbers. The physical and toxic effects of crude on seabirds are discussed above.	N/A	The impacts of Cliff Head crude on seabirds and shorebirds can result in lethal or sub-lethal impacts on individuals. Since a spill could potential occur at any time of year there is potential to overlap with peak nesting periods where a large number of seabirds could potentially be impacted by a spill. As such the impacts are considered moderate.
Sea lion breeding and resting areas	N/A	Sea lions come ashore to pup, raise their offspring and rest. The nearest breeding and haul out areas are on the Beagle Islands 35 km to the south and the Abrolhos Islands 112 km to the northwest. Sea lions may encounter stranded crude as they haul out. Pups in particular are quite immobile, being restricted to breeding grounds until weaning and may therefore be affected by stranded crude more in comparison to adults. The physical and toxic impacts of crude are described above.	N/A	The impacts of Cliff Head crude on sea lions can result in lethal or sub-lethal impacts on individuals. While sea lions breed asynchronously they may be present at breeding sites year round. As such the impacts are considered moderate.
Socioeconomic				

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Fisheries	Surface oil has the potential to negatively affect fisheries as fishing activity may be excluded from the area of the slick and its proximity. However, due to low levels of entrained oil, as a result of the Cliff Head crude properties, fish are unlikely to be affected, therefore any effect on catch rates are likely to be temporary as a result of loss of access. Further, the most economically important fishery in the area is the West Coast Lobster fishery. Since January 2013, this fishery has been able to operate year round (i.e. there is no closed season) working in a quota system, reducing the impacts of delayed catches.	Stranded shoreline crude is unlikely to greatly impact fishing activities unless the crude became stranded around fishing ports (e.g. Geraldton Harbour, Port Denison) which could restrict movement of fishing vessels.	Surface oil may lead to loss of access for commercial fisheries. However, the impact is expected to be temporary with little impact on annual catch rates. As such, impacts are assessed as low.	Stranded oil could lead to temporary loss of access for commercial fisheries. It is not expected that this would significantly impact annual catch rates and therefore the impact has been assessed as low.
Tourism and recreation	Surface oil has the potential to impact on tourism activities in the area as recreational fishing and wildlife watching are popular in and around the Abrolhos Islands. In the event of a crude spill, recreational activities would not be possible in the affected area and its proximity with potential negative effects on local tourism. A longer term reduction in tourism may result due to bad publicity of the local area.	The WA coastline is popular with tourists, with a number of sandy beaches and the fishing town of Port Denison attracting visitors. If crude oil becomes stranded at these locations access will be reduced with negative effects on local tourism. A longer term reduction in tourism may result due to bad publicity of the local area.	Since potential impacts of surface oil include temporary loss of access for tourism in addition to a longer term effect on reputation, the impacts have been assessed as moderate.	Since potential impacts of stranded oil include temporary loss of access but also a longer term effect on reputation, the impacts have been assessed as moderate.
Defence activities	There is not expected to be high levels of defence activities in the area surrounding the CHA. Surface oil may lead to restricted access for defence activities.	Due to the nature of defence activity in the area (limited to restricted airspace), stranded oil is unlikely to have any significant impact on defence activities	Although surface oil could result in a temporary loss of access, defence activities are not expected to be great in the area and therefore the impacts have been assessed as low.	The impacts of stranded oil on defence activities is negligible

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Shipping	Shipping vessels may need to change course to avoid surface slicks leading to delays.	Stranded shoreline crude is unlikely to greatly impact shipping activities unless the crude became stranded around Geraldton Port which could restrict movement of shipping vessels	Surface oil may lead to loss of access for shipping. However, the impact is expected to be temporary. As such, impacts are assessed as low.	Stranded oil could lead to temporary loss of access for shipping. The impact is expected to be temporary and therefore the impact has been assessed as low.
Key Ecological Features:				
Commonwealth marine environment surrounding the Houtman Abrolhos	Surface crude could potentially overlap with this KEF. While surface crude is unlikely to impact benthic and pelagic habitats, foraging seabirds are sensitive to the effects of surface crude as discussed above	Since this KEF is in open water, stranded or accumulated hydrocarbons are unlikely to impact sensitivities.	Due to the potential impacts of surface crude on foraging seabirds (described above) the impacts are assessed as moderate	The impacts of stranded / accumulated crude on this KEF is negligible
Western Rock Lobster	Surface crude could potentially overlap with this KEF. However, since the western rock lobster is a benthic species, they are unlikely to be affected by surface crude due to the low level of entrainment expected of Cliff Head crude.	Since this KEF is located in the benthic environment, stranded or accumulated hydrocarbons will not impact sensitivities.	The impacts of surface crude on this KEF is negligible	The impacts of stranded / accumulated crude on this KEF is negligible
Ancient Coastline	Given that this KEF is located on the seafloor, impacts due to surface crude are not expected	Since this KEF is located in the benthic environment, stranded or accumulated hydrocarbons will not impact sensitivities.	The impacts of surface crude on this KEF is negligible	The impacts of stranded / accumulated crude on this KEF is negligible

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Commonwealth marine environment within and adjacent to the west coast inshore lagoons	While benthic habitats and associated fauna are not susceptible to the effects of surface crude (see above), some emergent habitats may occur such as reefs and seagrasses. These are discussed above.	The potential impacts of stranded hydrocarbons on emergent habitats such as seagrasses and reefs are discussed above. Stranded oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in sections above.	Due to the properties of Cliff Head crude, surface oil is unlikely to impact seagrasses directly, unless they are emergent as discussed in the next column. At most surface oil could lead to a reduction in primary productivity. Therefore, the impacts are considered low.	Stranded or accumulated oil can have lethal or sub-lethal effects potentially leading to a reduction in productivity. These impacts combined could result in detrimental effects on the overall ecological community. However, it is unlikely large areas of emergent seagrass habitat will be present and therefore the impacts are considered low.
Western demersal slope and associated fish communities	Impacts to fish are discussed in 'Fish' above	N/A	Due to the low level of entrainment, surface crude is unlikely to impact fish, fish eggs and larvae. As such impacts are likely to be low and short-term in duration, as assessed above.	N/A
Protected areas:				
Abrolhos Islands' Fish Habitat Protection Area	Surface crude is not predicted to make contact with this protected area.	Small amounts of accumulated oil may gather at this protected area. The protected area is important for the conservation of fish, fish breeding areas and associated aquatic ecosystem, and are popular for aquatic tourism and recreational activities. The impacts of accumulated oil on fish, fisheries and tourism are discussed above.	The impacts of surface crude on this protected area is negligible	Due to the potential impacts of accumulated / stranded oil on fish, fisheries and tourism discussed above, the overall impact on this protected area is low.
Abrolhos Commonwealth Marine Reserve	Surface crude is not expected to make contact with this protected area.	Since this protected area is located offshore stranded or accumulated hydrocarbons are unlikely to impact sensitivities.	The impacts of surface crude on this protected area is negligible	The impacts of accumulated/stranded crude on this protected area is negligible

Sensitivity receptor	Impact description		Impact assessment	
	Surface	**Stranded / accumulated shoreline**	**Surface**	**Stranded / accumulated shoreline**
Jurien Marine Park	There is a 1% chance surface crude is not predicted to make contact with this protected area. Potential sensitivities that may be impacted by surface oil include seabirds and sea mammals. Impacts on these receptors are discussed above.	Small amounts of accumulated oil may gather at this protected area. The protected area is important for breeding sea lions and seabirds. The impacts of accumulated oil on seabirds and sea lions are discussed above.	Due to the potential impacts of surface crude on seabirds and sea mammals (described above) the impacts are assessed as moderate	Due to the potential impacts of accumulated / stranded oil on seabirds and sea lions discussed above, the overall impact on this protected area is moderate.
Jurien Commonwealth Marine Reserve	There is a 1% chance surface crude is not predicted to make contact with this protected area. Potential sensitivities that may be impacted by surface oil include seabirds and sea mammals. Impacts on these receptors are discussed above.	Since this protected area is located offshore stranded or accumulated hydrocarbons are unlikely to impact sensitivities.	Due to the potential impacts of surface crude on seabirds and sea mammals (described above) the impacts are assessed as moderate	The impacts of accumulated/stranded crude on this protected area is negligible

Table 4-5: Potential impacts of Cliff Head crude on sensitive locations

Sensitive locations	Sensitive receptors	Impact description		Impact assessment	
		Surface/ stranded	Entrained	Surface/ stranded	Entrained
Shoal point to Oakabella Creek	Sandy beaches Rocky shore Submerged reefs Foraging/nesting shorebirds Tourism Commercial fisheries	There is a low probability of surface diesel making contact at this location with negligible volumes expected to make contact. Therefore, it is unlikely that impacts to receptors at this location would occur.	There is a low probability of entrained diesel making contact at this location. Therefore, it is unlikely that impacts to receptors at this location would occur.	Although some sensitive receptors may be affected by surface diesel at this location, given the low probability of contact with a surface slick, the potential impacts are considered low	Although some sensitive receptors may be affected by entrained diesel at this location, given the low probability of contact with entrained diesel, the potential impacts are considered low
Around Geraldton	Sandy beaches Submerged reefs Foraging/nesting shorebirds Tourism Shipping Commercial fisheries	There is a low probability of surface diesel making contact at this location with small volumes expected to make contact. Therefore, it is unlikely that impacts to receptors at this location would occur	There is a moderate probability of entrained diesel making contact at this location. Therefore, it is possible that impacts to receptors in particular, submerged reefs at this location would occur. Individual receptors are discussed in Table 7.8.	Although some sensitive receptors may be affected by surface diesel at this location, given the low probability of contact with a surface slick, the potential impacts are considered low	Sensitive receptors may be affected by entrained diesel at this location with a moderate probability of contact with entrained diesel. Given the moderate concentrations receptors may be exposed to, the potential impacts are considered moderate
Around Dongara	Sandy beaches Submerged reefs Intertidal reefs Foraging/nesting shorebirds Tourism Commercial fisheries	There is a high probability that surface diesel will make contact at this location with moderate volumes of diesel potentially becoming stranded with potential to impact individual sensitive receptors, in particular tourisms, sandy beaches, seabirds and commercial fisheries.	There is a high probability of entrained diesel making contact at this location. Therefore, it is possible that impacts to receptors in particular, submerged and intertidal reefs at this location would occur.	Sensitive receptors may be present within the area potentially coming into contact with a surface slick. However, given the small volumes potentially encountered at this location, the impacts are considered moderate.	Sensitive receptors may be affected by entrained diesel at this location with a moderate probability of contact with entrained diesel. Given the moderate concentrations receptors may be exposed to, the potential impacts are considered moderate.
Around Leeman	Sandy beaches Submerged reefs Foraging/nesting shorebirds Tourism	There is a moderate probability of surface diesel making contact with this location with moderate volumes of diesel predicted in the worst case scenario. This volume of diesel has potential to impact individual sensitive receptors, in particular tourisms, sandy beaches and seabirds.	There is a moderate probability of entrained diesel making contact at this location. Therefore, it is possible that impacts to receptors in particular, submerged reefs at this location would occur.	Although some sensitive receptors may be affected by surface diesel at this location, given the low probability of contact and maximum volume spilled, the potential impacts are considered low	Sensitive receptors may be affected by entrained diesel at this location, given the moderate probability of contact with entrained diesel and potential concentrations, the potential impacts are considered moderate.

Sensitive locations	Sensitive receptors	Impact description		Impact assessment	
		Surface/ stranded	Entrained	Surface/ stranded	Entrained
Around Cervantes	Jurien Bay CMR and Marine Park Sandy beaches Submerged reefs and shoals Intertidal reefs Marine mammal breeding (sea lion) Foraging/nesting shorebirds and seabirds	There is a low probability of surface diesel making contact at this location with small volumes expected to make contact. This volume of diesel has potential to lead to a low level of impact to a large number of individual sensitive receptors, including sandy beaches, intertidal reefs, marine mammals and seabirds.	There is a moderate probability of entrained diesel making contact at this location. Therefore, it is possible that impacts to receptors in particular, submerged reefs at this location would occur.	Although some sensitive receptors may be affected by surface diesel at this location, given the low probability of contact and maximum volume spilled, the potential impacts are considered low	Sensitive receptors may be affected by entrained diesel at this location, given the moderate probability of contact with entrained diesel and potential concentrations, the potential impacts are considered moderate.
Lancelin to Ledge Point	Sandy beaches Submerged reefs Foraging/nesting shorebirds Tourism	There is a low probability of surface diesel making contact at this location with small volumes expected to make contact. Therefore, it is unlikely that impacts to receptors at this location would occur.	There is a low probability of entrained diesel making contact at this location. Therefore, it is unlikely that impacts to receptors at this location would occur.	Although some sensitive receptors may be affected by surface diesel at this location, given the low probability of contact with a surface slick, the potential impacts are considered low	Although some sensitive receptors may be affected by entrained diesel at this location, given the low probability of contact with entrained diesel, the potential impacts are considered low
Abrolhos Islands and CMR	Sandy beaches Rocky shore Intertidal reefs Mangroves Foraging/nesting shorebirds and seabirds Fish Marine mammal breeding (sea lion) Submerged reefs and shoals Seagrass Tourism	There is a low probability of surface diesel making contact at this location with very small volumes expected to make contact. While a number of sensitive receptors are present, it is unlikely that impacts to these receptors at this location would occur.	There is a low probability of entrained diesel making contact at this location. Therefore, it is unlikely that impacts to receptors at this location would occur.	Although some sensitive receptors may be affected by surface diesel at this location, given the low probability of contact with a surface slick, the potential impacts are considered low	Although some sensitive receptors may be affected by entrained diesel at this location, given the low probability of contact with entrained diesel, the potential impacts are considered low
Abrolhos shoals	Submerged reefs and shoals Marine mammals Marine reptiles Seabirds Fish Commercial fisheries Tourism	There is a low probability of surface diesel making contact at this location with negligible volumes expected to make contact. Therefore, it is unlikely that impacts to receptors at this location would occur.	There is a low probability of entrained diesel making contact at this location. Therefore, it is unlikely that impacts to receptors at this location would occur.	Although some sensitive receptors may be affected by surface diesel at this location, given the low probability of contact with a surface slick, the potential impacts are considered low	Although some sensitive receptors may be affected by entrained diesel at this location, given the low probability of contact with entrained diesel, the potential impacts are considered low

Table 4-6: Potential impacts of marine diesel on sensitive receptors

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
General offshore				
Plankton	*There is the potential for localised mortality of plankton due to reduced water quality and toxicity, as described for entrained diesel in the next column. Plankton will not be impacted by stranded diesel*	*Hydrocarbons can potentially interfere with swimming or feeding structures of plankton and pelagic invertebrates and direct coating or ingestion could occur. It should be noted, however, that the primary pathway for impacts to plankton and pelagic invertebrates is likely to be through exposure to aromatic hydrocarbons dissolved within the water column.*	*The area potentially impacted by a diesel spill is characterised by a low standing crop of plankton which is not an important source of primary productivity in the area. Further, the affected area is a relatively small portion of the marine offshore environment, therefore the level of impact consequence has been determined to be low*	
Invertebrates	Adult marine invertebrates and larvae usually reside within benthic substrates and pelagic waters, rarely reaching the water's surface in their life cycle (to breed, breathe and feed). Therefore surface hydrocarbons are not considered to pose a high risk to marine invertebrates within the spill trajectory area.	Acute or chronic exposure, through surface contact, and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton, for example with rock lobsters will reduce the impact of hydrocarbon absorption through the surface membrane. Other invertebrates with no exoskeleton and larval forms may be more prone to impacts from pelagic hydrocarbons. Furthermore, the concentration of entrained and dissolved hydrocarbons at or above thresholds of concern will be less in any one location in comparison to surface oil because of the effects of dilution with seawater.	Since marine invertebrates, specifically rock lobsters, do not generally reside at the sea surface, the impacts of surface hydrocarbons are unlikely to occur.	Although entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms, impacts to adult species is considered reduced as a result of the exoskeleton. Considering the large extent of suitable marine habitat (and potential spawning areas), the impact on marine invertebrates, specifically rock lobsters, the impact is considered minor.
Fish	Surface diesel will have minimal impacts on fish with the exception of species found in the upper section of the water column	The variety of benthic habitats in the Perth Basin (reefs, seagrasses and offshore waters) supports a diverse assemblage of fish. Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets	Impacts of surface diesel on fish are considered low.	While negative impacts to fish and fish eggs/larvae, due to the rapid dispersion of diesel in the water column any impacts are likely to be localised and short-term in duration. As such the overall impact is considered low.

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	Entrained/ dissolved aromatics	Surface/ stranded	Entrained/ dissolved aromatics
		or contaminated food leading to reduced growth. There is potential for localised mortality of fish eggs and larva due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.		
Marine reptiles	Four species of turtle are known to exist with the waters in proximity to the Cliff Head platform. Since marine turtles are not known to breed close to the CHA, hatchling turtles are not expected in great numbers. For adult and hatchling turtles, the main pathways for exposure include ingestion and inhalation of vapours. Since marine diesel does not tend to form solid massess such as tar balls, ingestion of diesel is not considered as great an impact compared to more viscous hydrrocarbons. Sea turtles' diving behavior also puts them at risk. They rapidly inhale a large volume of air before diving and continually resurface over time. Adults doing this in an oil spill would experience both extended physical exposure to the oil and prolonged exposure to hydrocarbon vapors.	Marine turtles may come into contact with entrained diesel while diving. Impacts are similar to those described for surface diesel.	Although the impacts of diesel on turtles can be severe, the low density of turtles expected in the region (due to lack of breeding aggregations) implies that few individuals would be affected. As such the impact has been determined to be moderated.	Although impacts of entrained diesel on turtles can be severe, due to the rapid dispersion of diesel within the water column, combined with the low density of turtles expected in the area, potential impacts are considered low.
Marine mammals	Seven species of marine mammal may be present in the waters in proximity of the Cliff Head facilities. Of these, four species are listed as threatened; the humpback, blue whale, southern right whale and the Australian sea lion. The operational area does not include any known blue whale feeding, breeding or resting areas. Humpback whales are frequently sighted in the region as they migrate annually from the cold feeding waters of the Antarctic to	Marine mammals may come into contact with entrained diesel while diving and foraging. Impacts are similar to those described for surface diesel	The impacts of diesel on marine mammals can result in lethal or sub-lethal impacts on individuals. Although cetaceans are not expected to be present in large numbers, should a spill occur during a migration period large	The impacts of entrained diesel on marine mammals can be severe. However, due to the rapid dispersion of diesel within the water column, potential impacts are considered low.

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
	the warm water breeding areas in the Kimberley. Peak migratory periods in Cliff Head area for the northbound leg are around mid-June. The location of the Cliff Head platform is at towards the northern limit of the Southern right whale distribution and only occasional sightings have been made as far north as Geraldton indicating few individuals may be present. Australian sea lions forage around the larger reefs in the area. The nearest breeding grounds are on the Beagle Islands (35 km south) and the Abrolhos Islands (112 km northwest). There is no seasonal peak in breeding, with breeding cycles being asynchronous between colonies. Surfacing within a hydrocarbon slick may lead to a toxic level of exposure. However, cetaceans have a thickened epidermis that greatly reduces the likelihood of hydrocarbon toxicity from skin contact with oiled waters (Geraci 1990, O'Shea and Aguilar 2001). Should pinnipeds come into contact with diesel, the diesel may stick to the fur and be ingested during grooming incurring the associated toxicological effects. The fur may also become smothered leading to reduced waterproofing and hypothermia. For surface oil, inhalation of vapors at the water's surface and ingestion of hydrocarbons during feeding are often more likely pathways of exposure.		numbers of individuals could potentially be impacted. While sea lions breed asynchronously (i.e. with no peak in breeding activity) they are present year round and could be impacted by a spill. As such the impacts are considered moderate.	
Seabirds	Seabirds either pass across the region or use the waters within and near to the permit area as their main habitat, with nine species of threatened seabird possibly occurring in the area. The Abrolhos CMR and Jurien CMR in particular are important foraging areas for the threatened	Seabirds may come into contact with entrained diesel while diving and foraging. This may result in irritation of skin and eyes, and ingestion and associated impacts of toxicity and potential illness.	The impacts of diesel on seabirds can result in lethal or sub-lethal impacts on individuals. Since a spill could potentially occur at any time of	The impacts of entrained diesel on seabirds can be severe. However, due to the rapid dispersion of diesel within the water column, potential impacts are considered low.

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
	Australian noddy and soft-plumaged petrel, and other migratory species. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour. Direct contact with surface hydrocarbons can lead to irritation of skin and eyes. Smothering can lead to reduced water proofing of feathers leading to hyperthermia. Smothering of feathers can also lead to excessive preening, diverting time away from other behaviours, leading to starvation and dehaydration. Preening of oiled feathers will also result in to ingestion of hydrocarbons and the associated impacts of toxicity and potential illness.		year there is potential to overlap with peak nesting periods where a large number of seabirds, including those listed as protected could potentially be impacted by a spill. As such the impacts are considered moderate.	
Subtidal zone				
Submerged reefs and shoals	Submerged coral reefs and shoals can be located in areas around the Abrolhos Islands and the nearshore areas of the WA coast. Significant shoals are found to the east of the Abrolhos Islands. Due to the distance between the sea surface and fully submerged features impacts on such features or their associated flora and fauna are unlikely.	Direct contact of entrained diesel with hard corals can lead to reduced capacity for photosynthesis or chemical toxicity across cellular structures leading to coral bleaching or colony death. Sub-lethal impacts could include reduced growth of coral colonies and reduced reproductive output/success. Physical effects from entrained oil have the potential to coat contacted coral reefs. The phenomena of smothering of exposed coral surfaces or polyps by oil spills has only been reported where very large oil spill quantities, or very sticky oil slicks, have been encountered. Response to hydrocarbon exposure can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates (Villanueva *et al*., 2008).	The impacts of surface diesel in submerged reefs is negligible	The impacts of entrained diesel on submerged reefs and shoals can lead to lethal and sub-lethal effects reducing quality and extent of important habitats. As such the impacts are considered moderate.

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	Entrained/ dissolved aromatics	Surface/ stranded	Entrained/ dissolved aromatics
Intertidal zone				
Seagrass	Seagrass habitat is found in areas around the Abrolhos Islands and the nearshore areas of the WA coast. Macrophytes such as seagrasses require light to photosynthesise. The presence of surface oil at sea, and directly coating of seagrasses, can affect the ability of macrophytes to photosynthesise, potentially reducing primary productivity. Direct contact with hydrocarbon can smother seagrass leading to toxicity and preventing respiration with lethal and sub-lethal effects (Taylor and Rasheed 2011). Smothering can also lead to a reduction in photosynthesis as described in the previous column. Surface and stranded oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in sections above.	Direct contact with hydrocarbon can smother seagrass leading to toxicity and preventing respiration with lethal and sub-lethal effects (Taylor and Rasheed 2011). Smothering can also lead to a reduction in photosynthesis as described in the previous column.	Surface or stranded diesel can have lethal or sub-lethal effects potentially leading to a reduction in productivity. These impacts combined could result in detrimental effects on the overall ecological community. However, it is unlikely large areas of emergent seagrass habitat will be present and therefore the impacts are considered low.	The impacts of entrained diesel on seagrasses can lead to lethal and sub-lethal effects reducing quality and extent of important habitats. As such the impacts are considered moderate.
Rocky shore, intertidal reefs	Rocky shore and intertidal habitats are found intermittently along the WA coast and around the Abrolhos Islands. Surface diesel is unlikely to have any negative impacts on fully submerged features. If the feature is emergent, impacts can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates (Villanueva *et al*., 2008). Surface and stranded oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in sections above.	Physical effects from entrained oil have the potential to coat contacted coral reefs and rocky shore fauna such as filter feeders. Response to hydrocarbon exposure can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates (Villanueva *et al*., 2008).	Since surface and stranded diesel can have lethal and sub-lethal effects on coral reefs and the associated impacts on fauna and flora. As such the impacts are considered moderate.	Since entrained diesel can have lethal and sub-lethal effects on coral reefs and the associated impacts on fauna and flora. As such the impacts are considered moderate.
Mangroves	The impacts of surface hydrocarbons on mangroves include damage as a result of smothering of lenticels (mangrove	Entrained hydrocarbons may potentially impact mangrove communities through the sediment/mangrove root interface.	Since surface and stranded diesel can have lethal and sub-	Since entrained diesel can have lethal and sub-lethal effects on mangroves and the associated impacts on fauna and

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
	breathing pores) on pneumatophores or prop roots, or by the loss of leaves (defoliation) due to chemical burning (Duke *et al*. 1999). Thorhaug (1987) concluded that while defoliation of mangroves was a common occurrence when exposed to hydrocarbon slicks, massive mortality was not always the ultimate outcome. Mangrove death is predicted whenever more than 50% of the leaves are lost (Evans 1985). It is also known that mangroves take up hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death (Wardrop *et al*. 1987).	Entrained hydrocarbons contain contaminants that may become persistent in the sediments (e.g. trace metals, PAHs), leading to direct effects on mangroves due to direct uptake, or indirect effects due to impacts on benthic infauna leading to reduced rates of bioturbation and subsequent oxygen stress on the plants' root systems.	lethal effects on mangroves and the associated impacts on fauna and flora, the impacts are considered moderate	flora, the impacts are considered moderate
Sandy shores/beaches	A number of sandy beaches are found along the WA coast and around the Abrolhos Islands. There is the potential for some diesel to be temporarily stranded on the sandy shores and beaches as the tide ebbs. Stranded crude has potential to persist in the environment for longer periods of time increasing the potential toxic and physical (smothering) effects. Such effects may impact fauna such as polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans and insects, and the vertebrates that prey upon them (e.g. shorebirds).	Entrained diesel will have negligible impacts on sandy beaches.	Impacts of stranded diesel include lethal and sub-lethal effects on associated fauna and flora. As such the impacts are considered moderate	Not applicable
Sublittoral zone				

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
Seabird breeding, feeding and resting areas	The Abrolhos Islands are an important breeding, foraging and resting area for various species of seabird and shorebird. Seabirds and shorebirds are also likely to occur along the coastlines of WA albeit in lower numbers. The physical and toxic effects of diesel on seabirds are discussed above.	Entrained diesel will have negligible impacts on seabird breeding, feeding and resting areas.	The impacts of diesel on seabirds and shorebirds can result in lethal or sub-lethal impacts on individuals. Since a spill could potential occur at any time of year there is potential to overlap with peak nesting periods where a large number of seabirds could potentially be impacted by a spill. As such the impacts are considered moderate.	Not applicable
Sea lion breeding and resting areas	Sea lions come ashore to pup, raise their offspring and rest. The nearest breeding and haul out areas are on the Beagle Islands 35 km to the south and the Abrolhos Islands 112 km to the northwest. Sea lions may encounter stranded diesel as they haul out. Pups in particular are quite immobile, being restricted to breeding grounds until weaning and may therefore be affected by stranded diesel more in comparison to adults. The physical and toxic impacts of crude are described above.	Entrained diesel will have negligible impacts on sea lion breeding and resting areas	The impacts of diesel on sea lions can result in lethal or sub-lethal impacts on individuals. While sea lions breed asynchronously they may be present at breeding sites year round. As such the impacts are considered moderate.	Not applicable
Saltmarshes	Surface hydrocarbons may coat saltmarsh flora reducing photosynthesis and can lead to toxic effects, both negatively impacting vegetation growth. Associated fauna (including birds) also has potential to be impacted and has been assessed above.	Entrained hydrocarbons may be absorbed through the roots of saltmarsh flora which may cause defoliation through leaf damage. Associated fauna (including birds) also has potential to be impacted and has been assessed above.	Stranded oil may have toxic effects on flora species that comprise saltmarsh habitats and also on the species which inhabit and forage upon them. However, given the location of	Although entrained diesel can have toxic impacts to salt, marsh flora, given the location of the saltmarshes and the sand banks providing protection, the impacts are considered low.

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
			the saltmarshes and the sand banks providing protection, the impacts are considered low.	
Socioeconomic				
Fisheries	Surface diesel has the potential to negatively affect fisheries as fishing activity may be excluded from the area of the slick and its proximity. However, the most economically important fishery in the area is the West Coast Lobster fishery. Since January 2013, this fishery has been able to operate year round (i.e. there is no closed season) working in a quota system, reducing the impacts of delayed catches. Stranded shoreline diesel is unlikely to greatly impact fishing activities unless it became stranded around fishing ports (e.g. Geraldton Harbour, Port Denison) which could restrict movement of fishing vessels.	Entrained diesel may impact fish and invertebrate species as described above leading to a reduction in annual catch rate.	Surface and stranded diesel may lead to loss of access for commercial fisheries. However, the impact is expected to be temporary with little impact on annual catch rates. As such, impacts are assessed as low.	The impact of entrained diesel on fish is considered low and therefore the indirect impact on fisheries is also considered low.
Tourism and recreation	Surface and stranded diesel has the potential to impact on tourism activities in the area as recreational fishing and wildlife watching are popular in and around the Abrolhos Islands. In the event of a diesel spill, recreational activities would not be possible in the affected area and its proximity with potential negative effects on local tourism. A longer term reduction in tourism may result due to bad publicity of the local area.	Entrained diesel may impact fauna associated with tourism, such as cetaceans and fish species targeted by recreational fishers. However, entrained diesel will unlikely lead to the same level of disruption as stranded or surface diesel.	Since potential impacts of surface and stranded include temporary loss of access for tourism in addition to a longer term effect on reputation, the impacts have been assessed as moderate.	Although entrained diesel may impact some tourism activities, it will unlikely lead to the level of disturbance stranded or surface diesel could result in. As such impacts are considered low.
Defence activities	There is not expected to be high levels of defence activities in the area surrounding the CHA. Surface or stranded diesel may lead to restricted access for defence activities.	Entrained diesel will have negligible impacts on defence activities	Although surface or stranded diesel could result in a temporary loss of access, defence activities are not expected to be great in the area and	Not applicable.

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
			therefore the impacts have been assessed as low.	
Shipping	Shipping vessels may need to change course to avoid surface slicks leading to delays. Stranded diesel is unlikely to greatly impact shipping activities unless the crude became stranded around Geraldton Port which could restrict movement of shipping vessels	Entrained diesel will have negligible impacts on shipping	Surface oil may lead to loss of access for shipping. However, the impact is expected to be temporary. As such, impacts are assessed as low. Stranded oil could lead to temporary loss of access for shipping. The impact is expected to be temporary and therefore the impact has been assessed as low.	Not applicable
Key Ecological Features:				
Commonwealth marine environment surrounding the Houtman Abrolhos	Surface diesel could potentially overlap with this KEF. While surface diesel is unlikely to impact benthic and pelagic habitats, foraging seabirds are sensitive to the effects of surface diesel as discussed above	Entrained diesel has potential to impact habitats and associated fauna in this KEF as described above	Due to the potential impacts of surface diesel on foraging seabirds (described above) the impacts are assessed as moderate	Due to the potential impacts of entrained diesel on marine habitats (described above) the impacts are assessed as moderate
Western Rock Lobster	Surface diesel could potentially overlap with this KEF. However, since the western rock lobster is a benthic species, they are unlikely to be affected by surface diesel.	Since the western rock lobster is a benthic species, they are unlikely to be affected by entrained diesel which is unlikely to be in high concentrations at the seafloor.	The impacts of surface diesel on this KEF is negligible	The impacts of entrained diesel on this KEF is negligible
Ancient Coastline	Given that this KEF is located on the seafloor, impacts due to surface crude are not expected	N/A	N/A	N/A

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
Commonwealth marine environment within and adjacent to the west coast inshore lagoons	While benthic habitats and associated fauna are not susceptible to the effects of surface crude (see above), some emergent habitats may occur such as reefs and seagrasses. Associated fauna include fish, marine reptiles, mammals, birds and invertebrates. These are discussed in more detail above.	Entrained diesel has the potential to impact benthic habitats and associated fauna such as fish, marine reptiles, mammals, birds and invertebrates, impacts to which are discussed in more detail above.	The impacts of surface oil benthic habitats is negligible	Due to the variety of receptors potentially impacted, the impacts are considered moderate.
Western demersal slope and associated fish communities	Impacts to fish are discussed in 'Fish' above	Impacts to fish are discussed in 'Fish' above	Impacts of surface diesel on fish are considered low.	While negative impacts to fish and fish eggs/larvae, due to the rapid dispersion of diesel in the water column any impacts are likely to be localised and short-term in duration. As such the overall impact is considered low.
Protected areas				
Abrolhos Islands' Fish Habitat Protection Area	There is a low probability of surface diesel entering this protected area. Small amounts of accumulated diesel may gather at this protected area. The protected area is important for the conservation of fish, fish breeding areas and associated aquatic ecosystem, and are popular for aquatic tourism and recreational activities. The impacts of surface and stranded diesel on fish, fisheries and tourism are discussed above.	There is a low probability of entrained diesel entering this protected area. Small amounts of accumulated diesel may gather at this protected area. The protected area is important for the conservation of fish, fish breeding areas and associated aquatic ecosystem, and are popular for aquatic tourism and recreational activities. The impacts of entrained on fish, fisheries and tourism are discussed above.	Due to the low probability of contact, impacts to this protected area are considered low	Due to the low probability of contact, impacts to this protected area are considered low
Abrolhos Commonwealth Marine Reserve	There is a low probability of surface diesel entering this protected area. The area is important for marine fauna such as seabirds and cetaceans, impacts to which are discussed above. Since this protected area is located offshore stranded or accumulated diesel are unlikely to impact sensitivities.	There is a low probability of entrained diesel entering this protected area. The area is important for marine fauna such as fish, marine mammals and sensitive habitats, impacts to which are discussed above.	Due to the low probability of contact, impacts to this protected area are considered low.	Due to the low probability of contact, impacts to this protected area are considered low

Sensitive receptor	Impact description		Impact assessment	
	Surface/ stranded	**Entrained/ dissolved aromatics**	**Surface/ stranded**	**Entrained/ dissolved aromatics**
Jurien Marine Park	There is a low chance surface diesel will enter this protected area with small volumes of accumulated diesel predicted. Potential sensitivities that may be impacted by surface oil include seabirds and sea mammals. Impacts on these receptors are discussed above.	There is a moderate chance entrained diesel will enter this protected area with small volumes of accumulated diesel predicted. Potential sensitivities that may be impacted by entrained oil include fish, marine mammals and sensitive habitats (e.g. coral, seagrass). Impacts on these receptors are discussed above.	Due to the potential impacts of surface and stranded diesel on fish, marine mammals and sensitive habitats (described above) the impacts are assessed as moderate	Due to the potential impacts of entrained diesel on fish, marine mammals and sensitive habitats (described above) the impacts are assessed as moderate
Jurien Commonwealth Marine Reserve	There is low chance surface diesel will enter this protected area. Potential sensitivities that may be impacted by surface diesel include seabirds and sea mammals. Impacts on these receptors are discussed above. Since this protected area is located offshore stranded or accumulated diesel is unlikely to impact sensitivities.	There is a moderate chance entrained diesel will enter this protected area with small volumes of accumulated diesel predicted. Potential sensitivities that may be impacted by entrained oil include fish, marine mammals and sensitive habitats (e.g. coral, seagrass). Impacts on these receptors are discussed above.	Due to the potential impacts of surface diesel on seabirds and sea mammals (described above) the impacts are assessed as moderate	Due to the potential impacts of entrained diesel on fish, marine mammals and sensitive habitats (described above) the impacts are assessed as moderate

Table 4-7: Environmental Impact Treatment Summary for Unplanned Events

Event	Risk Ranking	Management Controls	Effectiveness of control
Introduction of Invasive Marine Species (IMS)	Medium (6)	All project vessels to have a suitable antifouling coating in sound condition on the hull to minimise risk of IMS attachment	The risks of introducing IMS are reduced due to anti-foulant systems
		All project vessels and submersible equipment to be subject to IMS risk assessment prior to contracting	The risks of introducing IMS are reduced due to assessment procedure
		Vessels adhere to Australian Quarantine & Inspection Service (AQIS) quarantine requirements and other requirements applied by the WA government	Reduces the risk of introducing IMS through procedures managing ballast water exchange and identifying high risk ballast water
		Ballast water on all vessels managed to reduce risk of IMS	
		No high risk (i.e. beyond Australia) ballast water on board vessels	
		No ballast water discharge or hull cleaning in CHA exclusion zone to reduce chance of IMS establishment on existing infrastructure.	
Marine Fauna collision	Low (2)	Marine fauna sightings are recorded to ensure marine fauna are actively sighted and subsequently avoided	Reduces risk of physical and behavioural impacts to cetaceans
		Site inductions completed by all personnel to ensure understanding of reporting requirements and EPBC regulations	
		Any ship strike incident to be recorded on national ship strike database	Reduces risk of physical and behavioural impacts to cetaceans
		Contractor procedures reviewed to ensure vessels adhere to EPBC Regulations (Part 8) during activity to reduce potential for impact to cetaceans prior to mobilisation	
		Vessels to maintain bridge watch as per Marine orders 21 to ensure risk of marine fauna collision is minimised	
Hydrocarbon release (loss of well control)	Medium (4)	Cellar deck is bunded to contain any hydrocarbon losses to deck	Reduces risk and size of hydrocarbon releases to sea
		Monitoring of flowlines to detect any abnormalities that may be an indicator for loss of well control scenario	
		Automatic shutdown if low pressure detected	
		Remote shutdown capability in place to limit risk and volume of potential spills	
		Remote shutdown capability in place to limit risk of spills	
		ESPs have automatic shutdown capability if abnormal conditions detected	
		CCTV in place on platform is monitored to detect issues in event that other monitoring equipment fails	
		Titleholder maintains capability to respond to loss of well control through AMOSC membership and adequate oil spill equipment	

Event	Risk Ranking	Management Controls	Effectiveness of control
		Personnel on vessels and CHA are appropriately trained in spill response procedures to limit potential impacts from a loss of well control	
		All personnel receive environmental induction	
		Fluid monitoring is conducted in accordance with recognised Australian/International standards to reduce risk of loss of well control	
		NOPSEMA accepted OPEP provides options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigates potential impacts. In all cases, the NEBA of the spill response is considered when implementing the OPEP	Ensures TEO have capability to respond to hydrocarbon spills
		Notifications to AUSCOAST issued prior to any IMR activity to ensure other sea users aware of activity and reduce potential for 3rd party collision	Information provided on the production and/ or IMR activity so that the maritime industry is aware of petroleum activities to reduce risk of vessel collision with the platform, project/ support vessels or equipment
		Notifications to AHS issued prior to any IMR using vessels to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	
		NOPSEMA accepted WOMP details the loss of well control prevention controls	Minimises the risk of loss of well control
		Ongoing consultation with other sea users undertaken prior to any activity (that uses a vessel) to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	Information provided on the production and/ or IMR activity so that the maritime industry is aware of petroleum activities to reduce risk of vessel collision with the platform, project/ support vessels or equipment
		Vessels to comply with marine orders to ensure navigational equipment present to prevent collision	Reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment
		Vessels to comply with marine orders to ensure radio equipment available to warn other sea users in the vicinity of activities	Reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment
		Vessels to comply with marine orders to prevent vessel collisions with other sea users	Reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment
		Vessels to display appropriate navigation aids, bridge watch and communication to prevent collision	Monitor the 500m exclusion zone and reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment

Event	Risk Ranking	Management Controls	Effectiveness of control
		Safety exclusion zone gazetted around CHA to minimise interference with third parties. MoU maintained with rock lobster fishermen to ensure risks of collision with CHA are managed to ALARP	Monitor the 500m exclusion zone and reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment
Hydrocarbon release due to pipeline leak	Medium (4)	Pipelines designed and installed in accordance with industry standards to ensure integrity is appropriate	Reduces the risk of pipeline leak due to pipeline rupture or pipeline corrosion
		Corrosion control system in place to prevent corrosion of pipeline and subsequent leaks	Reduces the risk of pipeline leak due to pipeline rupture or pipeline corrosion
		Pipeline is present on marine charts to reduce potential for third party interference	Reduces the risk of pipeline rupture due to physical damage or being dragged by fishing equipment
		Remote shutdown capability in place to limit risk and volume of potential spills	Minimises the impacts of hydrocarbon release due to pipeline leak
		All lifting equipment is rated for intended activities and maintained	Minimises the risk of pipeline leak due to dropped object
		Lifting plans implemented to reduce potential for dropped objects to prevent impact to pipeline	Minimises the risk of pipeline leak due to dropped object
		Pipeline wall integrity assessments completed to ensure adequate load strength and reduce potential for pipeline rupture	Reduces the risk of pipeline leak due to pipeline rupture or pipeline corrosion
		Pipelines flushed to ensure they are hydrocarbon free prior to undertaking pipeline repair to reduce potential hydrocarbon releases to sea	Reduces potential hydrocarbon releases to sea during pipeline intervention
		Prior to undertaking high pressure water jetting, the water pressure is assessed to ensure pipeline rupture cannot occur.	Reduces potential hydrocarbon releases to sea during pipeline intervention
		Appropriate stabilisation materials selected to ensure no damage to pipeline during IMR activities	Reduces potential hydrocarbon releases to sea during pipeline intervention
		Moorings installed away from the pipeline to reduce potential for dropped objects on the pipeline	Minimises the risk of pipeline leak due to dropped object
		NOPSEMA accepted OPEP provides options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigates potential impacts. In all cases, the NEBA of the spill response is considered when implementing the OPEP	Includes controls and steps to ensure potential impacts from unplanned hydrocarbon/chemical spills are mitigated
		Vessels operation within weather limitations	Reduces the risk of pipeline leak due to pipeline rupture or pipeline corrosion
		Production shut in during heavy lifts to reduce potential losses to the marine environment if a dropped object was to rupture the pipeline	Minimises the risk of pipeline leak due to dropped object
		Dropped object analysis undertaken prior to heavy lifts	Minimises the risk of pipeline leak due to dropped object

Event	Risk Ranking	Management Controls	Effectiveness of control
		Monthly aerial surveys undertaken to observe for sheen in vicinity of operational area	Identifies any accidental hydrocarbon release
Chemicals/ Hydrocarbon/ Leaks	Low (2)	Any equipment or machinery with the potential to leak oil will be enclosed in continuous bunding.	Prevents probability of unplanned hydrocarbon spills or leaks leading to negative impacts to the marine environment.
		Deck of CHA is bunded to contain spills	Prevents probability of unplanned hydrocarbon spills or leaks leading to negative impacts to the marine environment.
		Suitable spill kits in accessible locations to be used immediately in the event of a spill to reduce potential for overboard discharge	Effective management of an accidental spill (discharge to sea) to reduce impact to the environment.
		Suitable spill kits in accessible locations to be used immediately in the event of a spill. Contaminated wastes are contained and shipped to shore for disposal and not discharged to sea to minimise impacts to water quality	Effective management of an accidental spill (discharge to sea) to reduce impact to the environment.
		All chemicals (environmentally hazardous) and hydrocarbons will be stored in appropriately bunded areas in accordance with MARPOL 73/78	
		Chemical storage and handling areas are routinely inspected	Reduces probability of unplanned chemical spills or leaks leading to negative impacts to the marine environment.
		CCTV on platform to ensure any visible leaks are observed whilst platform is unmanned	
		Implementation of Controlled Use of Drains on CHA Platform Procedure (10/HSEQ/ENV/PC02) to ensure no unplanned discharges via drains to sea	
		Implementation of Controlled Use of Drains on CHA Platform Procedure (10/HSEQ/ENV/PC02) to allow rainwater to be discharged overboard	Reduces the risk of spills and leaks (discharges) to the sea by controlling the storage, handling and clean up.
		Drainage system is cleaned following a spill or leak with liquids retained for onshore disposal	Improve water quality discharge (reduce toxicity) to the marine environment
		All personnel received environmental induction which includes hydrocarbon and chemical management requirements	Aids in the process of chemical/ hydrocarbon management that reduces the risk of accidental discharge to sea.
		All lifting equipment is rated for intended activities and maintained	Ensures that lifting equipment is maintained and certified, and that lifting procedures are followed reducing probability of dropped objects occurring with the potential to result in hydrocarbon spills.
		Lifting plans implemented to reduce potential for dropped objects	
		Contaminated wastes are contained and shipped to shore for disposal and not discharged to sea to minimise impacts to water quality	Reduces the risk of spills and leaks (discharges) to the sea by controlling the storage, handling and clean up.
		MSDS available on board CHA for all chemicals	Improve water quality discharge (reduce toxicity) to the marine environment.

Event	Risk Ranking	Management Controls	Effectiveness of control
		Any accidental discharges of hazardous waste are recorded and reported	Ensures compliance with regulations
		Machinery and equipment containing hydrocarbons maintained to reduce potential for leaks	Reduces probability of unplanned chemical spills or leaks leading to negative impacts to the marine environment.
		Chemicals used are assessed for environmental impact prior to purchase; 00/HSEQ/OHS/PC01 Control of Chemicals, Dangerous Goods and Hazardous Substances and 10/OP/GO/PC06 Chemical Management are used to inform selection.	Reduces toxicity to marine environment. Only environmentally acceptable chemicals would be released in the event of an accidental discharge to sea.
		Automatic shutdown if low pressure detected	Prevents probability of unplanned chemical spills or leaks leading to negative impacts to the marine environment.
Workover chemical spills	Low (2)	Brine utilised in workovers is reprocessed or returned to shore for downhole injection – no discharge to sea	Reduces toxicity to marine environment.
		Equipment utilised for workovers is maintained to ensure maximum efficiencies	
		Chemicals used are assessed for environmental impact prior to purchase; 00/HSEQ/OHS/PC01 Control of Chemicals, Dangerous Goods and Hazardous Substances and 10/OP/GO/PC06 Chemical Management are used to inform selection.	Reduces toxicity to marine environment. Only environmentally acceptable chemicals would be released in the event of an accidental discharge to sea.
		Chemical volumes are calculated to avoid excessive usage	Reduces toxicity to marine environment.
		Workover fluid use and disposal route is recorded	Identifies discrepancies in chemical usage
Produced Formation water (PFW) spills	Low (4)	Pipelines designed and installed in accordance with industry standards to ensure integrity is appropriate	Reduces the risk of pipeline leak due to pipeline rupture or pipeline corrosion
		Corrosion control system in place to prevent corrosion of pipeline and subsequent leaks	Reduces the risk of pipeline leak due to pipeline rupture or pipeline corrosion
		Pipeline is present on marine charts to reduce potential for third party interference	Reduces the risk of pipeline rupture due to physical damage or being dragged by fishing equipment
		Remote shutdown capability in place to limit risk and volume of potential spills	Minimises the impacts of hydrocarbon release due to pipeline leak
		Automatic shutdown if low pressure detected	
		Production shut in during heavy lifts to reduce potential losses to the marine environment if a dropped object was to rupture the pipeline	Minimises the risk of pipeline leak due to dropped object
		All lifting equipment is rated for intended activities and maintained	
		Lifting plans implemented to reduce potential for dropped objects to prevent impacts to pipeline	
		Dropped object analysis undertaken prior to heavy lifts	

Event	Risk Ranking	Management Controls	Effectiveness of control
Unauthorised access	Medium (5)	Gates are provided that will prevent unauthorised access	Minimises the risk of unauthorised access
		Closed circuit TV security cameras are provided to enable the onshore control room operators to monitor petroleum activities	To detect any unauthorised access
		Warning signs in place on CHA advising that unauthorised access is prohibited	Minimises the risk of unauthorised access
		In event of unauthorised access, remote shutdown is possible to prevent potential impacts due to interference or sabotage	Prevents probability of hydrocarbon release from loss of well control due to intentional damage
Vessel tank rupture	Medium (5)	Marine operations undertaken within weather limits	Reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment
		Vessels compliant with OSV to ensure correct implementation of SOLAS	
		Vessels to comply with marine orders to ensure navigational equipment present to prevent collision	
		Vessels to comply with marine orders to ensure radio equipment available to warn other sea users in the vicinity of activities and prevent collision	
		Vessels to comply with marine orders to prevent vessel collisions with other sea users	
		Vessels compliant with COLREGS	
		Oil record book or equivalent is maintained to record all oil waste management	Ensures compliances with regulations and identifies discrepancies in waste oil volume
		Vessels have spill response plan in place specific to vessel	Includes controls and steps to ensure potential impacts from unplanned hydrocarbon/chemical spills are mitigated
		Spill response exercises on vessels undertaken at regular intervals	Ensures personnel are prepared in responding to hydrocarbon spill to minimise potential impacts.
		All personnel received environmental induction which includes hydrocarbon management requirements	Minimises potential impacts from unplanned hydrocarbon spills
		Vessels to display appropriate navigation aids, bridge watch and communication to prevent collision	Reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment
		NO HFO or IFO used during activity to minimise potential impacts to sea	Reduces toxicity to the environment in case of spill
		NOPSEMA accepted OPEP provides options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigates potential impacts. In all cases, the NEBA of the spill response is considered when implementing the OPEP	Includes controls and steps to ensure potential impacts from unplanned hydrocarbon/chemical spills are mitigated
		Notifications to AUSCOAST issued prior to any IMR activity to ensure other sea users aware of activity and reduce potential for 3rd party collision	Information provided on IMR activity so that the maritime industry is aware of petroleum activities to reduce risk of vessel collision with the project vessel or equipment

Event	Risk Ranking	Management Controls	Effectiveness of control
		Notifications to AHS issued prior to any IMR using vessels to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	
		Ongoing consultation with other sea users undertaken prior to any activity (that uses a vessel) to ensure other sea users aware of activity and reduce potential for 3rd party vessel interference	Information provided on the production and/ or IMR activity so that the maritime industry is aware of petroleum activities to reduce risk of vessel collision with the platform, project/ support vessels or equipment
Diesel spill during refuelling	Low (2)	Refuelling operations undertaken within weather limits	Reduces risk of diesel spill during refuelling causing potential harm to the marine environment
		Vessels compliant with OSV to ensure correct implementation of SOLAS	Reduces risk of diesel spill during refuelling causing potential harm to the marine environment
		Vessels have spill response plan in place specific to vessel	Includes controls and steps to ensure potential impacts from unplanned hydrocarbon/chemical spills are mitigated
		Spill response exercises on vessels undertaken at regular intervals	Ensures personnel are prepared in responding to hydrocarbon spill to minimise potential impacts.
		NO HFO or IFO used during activity to minimise potential impacts to sea	Reduces toxicity to the environment in case of spill
		Bulk liquid transfer procedures reduce potential for accidental overboard release	Reduces risk of accidental discharge to sea.
		NOPSEMA accepted OPEP provides options for controlling the source of any unplanned hydrocarbon spills and mitigates potential impacts. In all cases, the NEBA of the spill response is considered when implementing the OPEP	Includes controls and steps to ensure potential impacts from unplanned hydrocarbon/chemical spills are mitigated
		All personnel received environmental induction which includes hydrocarbon management requirements	Minimises potential impacts from unplanned hydrocarbon spills during refuelling
Leakage or spillage onboard vessel	Low (2)	Vessels have spill response plan in place specific to vessel	Includes controls and steps to ensure potential impacts from unplanned hydrocarbon/chemical spills are mitigated
		Spill response exercises on vessels undertaken at regular intervals	Ensures personnel are prepared in responding to hydrocarbon spill to minimise potential impacts.
		Bunkering procedure implemented for all transfers	Reduces risk of accidental discharge to sea.
		Temporary containers are stored in secondary containment to ensure proper bunding	Prevents probability of unplanned hydrocarbon spills or leaks leading to negative impacts to the marine environment.
		Suitable spill kits in accessible locations to be used immediately in the event of a spill to reduce potential for overboard discharge	Effective management of an accidental spill (discharge to sea) to reduce impact to the environment.
		Suitable spill kits in accessible locations to be used immediately in the event of a spill. Contaminated wastes are contained and shipped to shore for disposal and not discharged to sea to minimise impacts to water quality	Effective management of an accidental spill (discharge to sea) to reduce impact to the environment.

Event	Risk Ranking	Management Controls	Effectiveness of control
		All personnel received environmental induction which includes hydrocarbon management requirements	Minimises potential impacts from unplanned hydrocarbon/chemical spills
Oil spill response including the following strategies: • Source control; • Monitor and evaluate; • Offshore containment and recovery; • Protection and deflection; • Shoreline cleanup; • Oiled wildlife response; and • Scientific monitoring.	Low (4)	The overarching control to ensure the selection of spill response activities is having an overall net benefit to the environment is the application of a Net Environmental Benefit Analysis (NEBA). Due to the use of vessels for oil spill response, the following aspects are considered to occur and have already been discussed in other sections of this EP and are therefore not repeated here • Noise • Artificial Light • Planned discharges • Atmospheric emissions	Shoreline clean-up has potential for additional impacts including to damage sensitive flora and fauna and disturb or displace marine fauna. Oiled wildlife response may also lead to displacement or behavioural disturbance of marine fauna. However, the consequence of not conducting these response strategies may result in greater consequences to these receptors. The NEBA procedure will ensure that the benefits of this response strategy outweigh the potential consequences.

5 Implementation Strategy

The activity will be managed in compliance with all measures and controls detailed within the approved EP accepted by NOPSEMA under the OPGGS (E) Regulations, other environmental legislation and TEO's Environmental Management Framework.

The objective of the EP is to ensure that potential adverse environmental impacts associated with unplanned events and planned events associated with the Activity, are identified and assessed, and to stipulate mitigation measures to avoid and/or reduce any adverse impacts to the environment to ALARP.

The approved EP details specific performance objectives, standards and procedures, and identifies the range of controls to be implemented (consistent with the standards) to achieve the performance objectives. The approved EP also identifies the specific measurement criteria and records to be kept to demonstrate the achievement of each performance objective.

During the period that activities described in the EP are undertaken, the Titleholder will ensure environmental performance is managed through an inspection and monitoring regime undertaken by TEO representatives or delegates based on the vessels.

Environmental compliance of an activity with the approved EP and the environmental performance objective is measured using planned and systematic audits or inspections to identify weaknesses and non-conformances in the system and processes so that they can be identified. Improvement opportunities identified through HSE reviews, audits and incident investigations are implemented in a controlled manner and communicated to all relevant workforce, contractors and relevant third parties. Audits and inspections are in place to identify possible incidents and actions taken to prevent them from happening.

Non-conformances found are addressed and resolved by a systematic corrective action process and are reported to NOPSEMA where relevant. The EP identifies specific responsibilities for each role during the activity. Incident notification and reporting to NOPSEMA and other regulators will be conducted as per the OPGGS(E)R, as detailed within the EP. Reported HSE incidents and hazards will be communicated to personnel during daily pre-start meetings.

Upstream PS as the contract operator of the Cliff Head Oil Field has implemented an Integrated Management System (IMS). The IMS aspects relevant to ensuring that the implementation strategy is appropriately implemented, such as the roles and responsibilities of personnel, record keeping, continual improvement, emergency response and auditing are addressed in the Upstream PS Management System Standards (MSS).

5.1 Management of change (MOC)

Changes to the EP and OPEP will be made in accordance with the Environmental Management of Change Procedure (MoC) (10/HSEQ/GEN/PC18). The Cliff Head Environmental Change Request Form (10/HSEQ/ENV/PC07/FM01) is used to assess the environmental impacts of the proposed change and inform the MoC process. The MoC procedure will determine whether a revision of the environment plan is required and whether that revision is to be submitted to NOPSEMA pursuant to Regulation 17 of the OPGGS(E) Regulations.

The MoC process manages the change(s) or proposed change(s) to an activity and/or changes to impact and risk profiles associated with an activity. The MoC process facilitates the identification of these changes and ensures that the regulatory approval commitments and requirements including stakeholder consultation are managed accordingly. Implementation of the MoC process ensures all the activities that are undertaken by TEO are in full compliance with regulatory approvals and conditions and are risk assessed in accordance with the process

described in this EP (Section 4). This process is coordinated by the Upstream PS HSEQ Manager ensuring compliance of the activities with the in force EP.

Any changes made under the MoC procedure will maintain the environmental impacts and risks of the activity at an acceptable level and ALARP. Implementation of additional control measures may be required to ensure impacts and risks are reduced to ALARP and acceptable levels. If the impacts or risks differ significantly from those in the EP (as per Regulation 17), then a revision of the EP is required to be submitted to NOPSEMA.

Following approval of the MoC internally, this will be communicated to all relevant personnel via daily toolbox talks, HSE meetings and/or bulletins to site and office personnel.

5.2 Emergency response procedures

An Emergency Management Plan (EMP) (10/HSEQ/GEN/PL01) together with the Cliff Head OPEP (10/HSEQ/ENV/PL02) have been developed for the protection of personnel, contractors, community, environment, TEO assets and the public perception of the company.

TEO will implement the OPEP in the event of a significant hydrocarbon spill (Tier 2). To maintain a state of oil spill preparedness, personnel with OPEP responsibilities will be made aware of their obligations, oil spill response equipment will be maintained, contracts with critical equipment and personnel suppliers will be managed, and agreements will be in place with national regulatory agencies for support in oil spill response. TEO will also implement its oil spill response exercise and training schedule.

While spill response activities are intended to reduce the potential environmental consequences of a hydrocarbon spill, response activities can exacerbate or cause further environmental harm. Poorly planned and coordinated response activities can result in a lack of, or inadequate, information and poor decisions made during incident response.

After source control, there are six operational oil spill response options:

- Monitoring and evaluation (including natural recovery);
- Chemical dispersants;
- Offshore containment and recovery;
- Shoreline protection and deflection;
- Shoreline clean-up; and
- Oiled Wildlife Response: this will not remove oil from the environment but will mitigate the impact of the spill by rehabilitating oiled wildlife

5.2.1 Spill response capability

5.2.1.1 OPEP Resources strategy

Tier 2 and Tier 3 spills may require deployment of significant field service resources for an extended period of time. These resources will be obtained from Government support agencies and third party contractors. These resources will be obtained through the contact lists as specified in the OPEP.

5.2.1.2 Equipment readiness

Equipment can be sourced from AMOSC, AMSA and TEO. AMOSC equipment is located at a number of sites. The primary stockpile is maintained at the Centre in Geelong VIC, and Fremantle WA with a range of equipment pre-deployed to Exmouth and Broome, WA. Up to date details of equipment held by AMOSC can be accessed via the member's login on the AMOSC website. Equipment available to TEO includes containment booms, skimmers and pumps, oil recovery

vessels, shoreline barriers, decontamination stations, and supporting equipment for these systems.

TEO Spill Response Equipment is specified in Table 5-1.

Table 5-1: TEO Spill Response Equipment

Equipment (& contents)	Site Location
CHA	
PPE including: - 2 pairs chemical resistant boots - 2 pairs chemical resistant gloves - 2 pairs chemical resistant goggles - Dust Masks Heavy Duty plastic garbage bags	CHA Mezzanine Deck
Mobile Hydrocarbon Spill kit including: 170L Booms, absorbent pads and material	CHA Mezzanine Deck
Two (2) eye wash stations (chemical store/drum shed	CHA Main deck CHA Mezzanine Deck
(2) Safety Shower & Eye-wash Stations	As required
Helicopter	Dongara
TEO Warehouse Facilities	
Oil only absorbent boom (water -repellent) (2 containers) (Each container has 8x3m sections 48m)	TEO Warehouse Facilities
High Density Landing Nets [Econets](6)	
IBCs 1,000ltr (4)	
IBC Funnel (4)	

5.2.1.3 Industry Arrangements

AMOSC

Industry assistance is available through the Australian Marine Oil Spill Centre (AMOSC), an industry funded response facility based at North Corio Quay, Geelong, Victoria. AMOSC resources include:

- AMOSC spill response equipment.
- Oil company equipment based at various locations.
- Trained industry response (“Core Group”) personnel.

Australian Petroleum Production and Exploration Association (APPEA) and Industry Groups

TEO is signatory to the Mutual Aid Memorandum of Understanding that sets up a framework for ‘best endeavours’ mutual assistance arrangements in drilling relief wells and responding hydrocarbon spills. The Parties to the Memorandum acknowledge that from time to time, emergency conditions arise that require drilling one or more relief wells. This would necessitate an urgent response and assistance by industry to minimise adverse impacts. To facilitate timely response, the Parties agree that the general principles of the MoU will form the basis for subsequent arrangements with the Drilling Operator, drilling unit(s) and contractor personnel, equipment, materials, consumables and other well-site services.

5.2.1.4 Operational Preparations

Source Control

Spills from the export line will be halted by shutting down the pipeline either using the automatic systems or manually. Source control of vessel based spills will be achieved by implementation of the relevant SOPEP and EMP.

Tier 1 Response Equipment

Triangle Energy (Operations) Pty Ltd tier 1 response equipment is available on site and listed in Table 5-1.

Communication Services

The TRT Site Emergency Controller (SEC) will maintain contact with the IMTL to ensure effective communication. This will be undertaken via land-line or satellite phone. Personnel in the field will communicate with VHF/UHF radios on land and marine frequencies. Additional radios required for an oil spill response incident will be sourced from suppliers.

Medical Services

All Upstream PS personnel are trained in Senior First Aid. Medical and Ambulance facilities are located at Dongara. The nearest hospital is located in Geraldton. Medical services will be contacted as per the Cliff Head Development Emergency Response Plan.

Weather Forecasting Services

Weather conditions and predictions are available from the Duty Officer of the Bureau of Meteorology (BoM).

AMOSC Services

As a participating member of AMOSC, TEO has access to AMOSC's oil spill recovery and response equipment, and technical (human) capabilities along with those resources held by member companies as outlined in the AMOSPlan on a 24 hour, 7 day a week basis. This includes access to AMOSC equipment stockpiles in Geelong, Exmouth and Broome as well as other operating members' local resources. In addition to support from 12 AMOSC staff, TEO has access to the industry Core Group (100 trained response personnel employed by AMOSC member companies).

The Core Group re-validates every 2 years through additional training and exercising at AMOSC and relies on competence based training for its skill base. Procedures for accessing oil industry assistance for a spill response, through AMOSC, are documented in "AMOSPlan". As a member of AMOSC, resources are available to TEO at the request of one of the TEO"Authorising Officers".

AMOSC will also provide a liaison officer within the IMT, whose role will be to coordinate AMOSPlan resources and manage deployment in cooperation with AMSA liaison officer (for Tier 2 and 3 spills). The AMOSC liaison officer will also provide oil spill response technical expertise to the TEO spill response and coordinate availability of AMOSC resources.

AMOSC support is facilitated through the AMOSPlan using the various legal instruments signed by all members (e.g., Master Service Contract, Principal and Agency Agreement). TEO's primary interface with the AMOSPlan during an oil spill response is via AMOSC's 24/7 Duty Officer, who provides the initial point of contact for oil spill responses that require AMOSC assistance. The Duty Officer will evaluate TEO's request, provide technical advice, and if needed provide resources that best meet TEO's needs, using AMOSC's own, or members' resources. Upon TEO's request, and as soon as practicable, AMOSC will deploy Technical / Liaison Officers to the TEO IMT and provide a direct interface with AMOSC.

If AMSA has not assigned a Liaison Officer, the AMOSC Liaison Officer, delegated by the TEO IMTL, will work with AMSA on TEO's behalf (i.e. with an AMOSC representative acting as Technical Liaison Officer within the TEO IMT) during an oil spill to enable deployment of national resources without compromising regional capability.

The AMOSPlan is available on the AMOSC website at: http://www.amosc.com.au/amosc.php

AMSA Resources

In the event of a spill, TEO will send a Pollution Report (Form) (POLREP) to AMSA and if required the TEO Emergency Controller will negotiate the use of NatPlan resources with the AMSA liaison officer. AMSA will provide support in a cooperative manner under the National Plan arrangements. AMSA may provide a liaison officer to the TEO Incident Response Team to enable this cooperative support role. These resources that can be deployed under the National Plan include oil spill trajectory modelling, fixed wing aerial support and the movement and hire of AMSA owned oil spill response equipment. This may also include NatPlan human resources (National Response Team (NRT)) members and National Response Support Team (NRST) members.

The NatPlan is available on the AMSA website at:
http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/Contingency_Plans_and_Management/Oil_Spill_Contingency_Plan.asp

AMSA will provide a support role and will not act as a control agency and will not assume the role of Incident Commander/Incident Management Team Leader.

AMSA National Response Support Team (NRST)

The National Response Support Team (NRST) is available via the National Plan to support an incident response: Environmental Advisers, Finance & Administration Officers, Wildlife Officer, Equipment Operators, Marco Operators, Offshore Containment/Recovery, Inshore Containment/Recovery, Marine Qualifications, Shoreline Assessment and Shoreline Clean-up

AMSA can provide personnel to fulfil all roles within the IMT if required e.g. for extended Tier 3 incidents. The personnel include: Planning Officer, Operations Officer, Liaison officer, plus if requested a Liaison officer to the TRT.

DoT (Support Agency)

Where a spill enters or threatens to enter State waters,DoT will provide the same support as defined by AMSA. Where State waters are impacted by a Level 2/3 MOP emergency resulting from an offshore petroleum activity in Australian Government waters, DoT will only assume the role of Controlling Agency for that portion of the response activity that occurs within State waters.

DoT will provide Liaison officers to the IMT if requested by the IMTL.

This will provide access to DoT personnel and resources.

Equipment resources is limited e.g. equipment held in Ports for their own first strike response capability so access may be restricted to what they consider reasonable at the time arrangements with operators are agreed by consultation with WA DoT

DoT has State Response Team and State Response Support Team

- State Response Team = 30 personnel (approx.)
- State Response Support Team = approx. 20 personnel

Note that some of the State Response Support Team may also be in the National Plan Support Team.

Personnel (subject to availability) can fulfil all roles in the emergency response arrangements - except Incident Commander/Incident Management Team Leader e.g. operations, logistics and planning officers. Advisors can also be provided to the IMTL as well as to all other functions within the Incident Response Team.

DoT can also provide a Wildlife Liaison officer to inform response procedures and techniques - this person may be made available to the IMT either in person or by phone via DoT.

The WestPlan is available on the WA DoT website at:

http://www.transport.wa.gov.au/imarine/19128.asp#Westplan

Logistics

The Logistics function is responsible for the provision of equipment, personnel, services and support materials for the TRT.

Tier 1

For small-scale responses, the Logistics function is the responsibility of the field superintendent. The field superintendent is responsible for locating and obtaining local equipment and services. The field superintendent is responsible for locating and obtaining non-local equipment and services.

Tier 2

In larger scale responses resources will be allocated by the IMTL.

Table 5-2 provides approximate timeframes for transport of equipment to Dongara.

Table 5-2: Equipment Response Logistical Timeframes

Location	Road Transport	Sea Transport
Broome	24 hr	4 days 8 hrs
Exmouth	11 hr	2 days 4hrs
Fremantle	6 hrs	21 hrs
Geelong	1 day 18hrs	7 days 15 hrs
Geraldton	1 hr	4 hrs

5.2.2 Net Environmental Benefit Analysis

In order to assess the potential impacts of each response strategy on the environment with regards to the effect of the hydrocarbon spill on the environment, a Net Environmental Benefit Analysis (NEBA) procedure was developed. The NEBA procedure comprises the following steps

(1) Identify sensitive receptors and locations:
   (a) Assess consequence of hydrocarbon spill on sensitive receptors; and
   (b) Determine which receptors are at which location potentially impacted.
(2) Prioritise sensitive locations based on receptors present and time to hydrocarbon contact.
(3) Assess the response strategies for:
   (a) Positive and negative environmental impacts for each response strategy and identify receptors potentially impacted; and
   (b) Assess the key operability and safety constraints for each response strategy for each spill scenario.
(4) Summarise the NEBA analysis of operationally viable strategies for each sensitive receptor.
(5) Produce a preliminary NEBA of operationally viable strategies for each spill scenario for sensitive locations, identified through stochastic trajectory modelling, based on presence of sensitive receptors.

The NEBA procedure will be adopted in the highly unlikely event of a spill, a preliminary NEBA, based on the spill trajectory modelling for the credible spill scenarios, has been completed as part of the OPEP development to ensure operational readiness.

The EMP/OPEP defines how the Perth based Incident Management Team (IMT) will support the site based Tactical Response Team (TRT) in responding to an emergency situation either at the ASP facility or on the CHA platform to minimise impact on the environment and to ensure the safety of company personnel and the integrity of the facilities. The EMP/OPEP will be regularly tested through the use of annual desktop and simulated exercises.

Emergency Shutdown Systems (ESS) (10/OP/PS/PC17) have been developed, the purpose of which are to:

- Monitor and automatically detect abnormal operational and equipment conditions;
- Alert the Control Room operator to excursions from pre-determined operational parameters;

- Provide executive actions that control and reduce the consequence of a process incident or equipment hazard;
- Reduce the probability of ignition or explosion by isolating ignition sources in the event of a hydrocarbon release, and
- Automatically manage the process control to a safe state.

The ESS also includes details of the fire and gas detection systems for both CHA and ASP.

6 Stakeholder Consultation

Since the development of Cliff Head in 1999, TEO has undertaken comprehensive stakeholder consultation. Details of earlier consultation can be found in the Cliff Head PER (April 2004).

Since then a consultation plan has been formulated, identifying key steps for both preparatory and ongoing consultation phases within which separate tasks are required (Cliff Head Stakeholder Consultation Plan, 10/HSEQ/ENV/PL12, Rev 0 and Cliff Head Communication and consultation framework (4716-HS-H0113, Rev 0). These steps are outlined in Table 6-1 along with details of when the tasks are to be carried out, a description and details of the implementation.

Table 6-1: Key steps identified for the consultation process

Step	Task	Timing	Details	Implementation strategy
Preparatory consultation				
1	Initial consultation	During preparation of EP	Provide overview of operational, workover and pipeline IMR activities.	Letters sent to all stakeholders identified as relevant outlining proposed activity.
2	Incorporate feedback into activity plans	During preparation of EP	Assessment of feedback regarding proposed activity.	Where feedback is received, the merits of feedback are assessed and evaluated. Where appropriate and practicable, commitments have been identified accordingly as outlined in the EP (e.g. notifications to AHS and AMSA)
Ongoing consultation				
3	Review for addition stakeholders	Once a year following EP acceptance date	Review stakeholder engagement register to identify any new relevant stakeholders	Date and outcome of review (list of stakeholders) provided in the Annual Performance Report.
4	Engage with new stakeholders	Following stakeholder review (Step 3)	Provide stakeholders with information provided during initial consultation	Notification letters distributed to stakeholders, details provided in Annual Performance Report. Should any change in activity be required as a result of the stakeholder feedback, the changes will be reviewed in line with the MoC procedure outlined in Section 5.1, and the EP revised and resubmitted if necessary.
5	Notification of workover or pipeline IMR activities	4 weeks prior to pipeline IMR activities or workover	Specific stakeholders to be notified prior to pipeline IMR or workover activities	Notification letters distributed to stakeholders.
6	Notification of change in proposed activities	As soon as reasonably practicable after identification of change in activity	Relevant stakeholders to be notified of any change in how activities are conducted where the change leads to a new or increased impact or risk	Change in activity will first be assessed in the MoC procedure outlined in Section 5.1, and the EP revised and resubmitted if necessary. Impacts to individual stakeholders are included in the MoC assessment and should any additional impacts be identified, stakeholders who may be effected will be notified of the changes. The change in activity will not occur until stakeholder feedback has been received and assessed, unless not carrying out the change in activity poses unacceptable health, safety or environmental risks.
7	Fisheries Liaison Officer	Ongoing	Provides a focal point for continual communication with members of the rock lobster fishing industry throughout the activity.	Based in Dongara and available for face to face meetings with stakeholder where appropriate to discuss issues and identify options to resolve issues. The feedback received and potential options will be assessed supported by TEO Perth based personnel.

Step	Task	Timing	Details	Implementation strategy
				Any changes to activity plans will be communicated back to stakeholders via the Fisheries Liaison Officer or directly to the fisheries associations to ensure agreement is met. This will ensure that risks and impacts to socioeconomic values are continually reduced to ALARP.
8	Maintenance of stakeholder engagement records	Ongoing	Stakeholder engagement register on IMS is maintained to record all correspondence between TEO and stakeholders.	The Stakeholder Engagement Register is updated as feedback is received and include details such as information received, response from TEO and outcome. Should any change in activity be required as a result of the stakeholder feedback, the changes will be reviewed in line with the MoC procedure outlined in Section 5.1, and the EP revised and resubmitted if necessary. The Stakeholder Engagement Register is reviewed monthly to ensure all feedback received is addressed and closed-out. A summary of additional feedback received is provided in the Annual Performance Report.

6.1 Preparatory Consultation

Specifically, for the revision of this EP for NOPSEMA, stakeholder consultation letters (including fishery associations and representative bodies) were reissued on the 20th June 2016, with a follow up email or telephone call on the 7th July 2016 for those stakeholders where a response or acknowledgement had not been received. In addition to consulting fishers through the appropriate fishing association or representative body, letters to all individual licence holders of the state-managed fisheries were issued on the 1st July 2016. A list of organisations contacted is provided in Table 6-2.

Table 6-2: List of stakeholders consulted

Government Agencies	
Department of Environment and Energy	Australia Maritime Safety Authority
WA Department of Fisheries	Australian Hydrographic Service (RAN)
WA Department of Mines and Petroleum	Border Protection Command
WA Department of Transport	Department of Defence
WA DER	Geoscience Australia
WA Environment Protection Agency	Geraldton Port Authority
WA DPAW	
Community	
City of Geraldton	Shire of Coorow
Mid-West Development Commission	Shire of Dandaragan
Shire of Carnamah	Shire of Irwin
Shire of Chapham Valley	Shire of Northampton
Fisheries	
Dongara Professional Fisherman's Association	Western Rock Lobster Council
Geraldton Professional Fisherman's Association	Westmore Seafood's
Recfishwest	Abalone Fishery - all licence holders
WA Fishing Industry Council	Abrolhos Islands and Mid-West Trawl Managed Fishery - all licence holders
A Raptis & Sons	Cockles and Pipis Fishery - all licence holders
Australian Fisheries Management Authority (AFMA)	Mackerel Managed Fishery - all licence holders
Australian Southern Bluefin Tuna Industry Association	Marine Aquarium Managed Fishery - all licence holders
Commonwealth Fisheries Association	Octopus Fishery - all licence holders
Geraldton Fisherman's Co-operative	Specimen Shell Managed Fishery - all licence holders
MG Kallis	West Coast Deep Sea Crustacean Management Fishery - all licence holders
Northern Fishing Companies Association	West Coast Demersal Gillnet and Demersal Longline (Interim) Management Fishery - all licence holders
Seasport Tackle Fishing Charters	West Coast Managed Rock Lobster Fishery - all licence holders
	West Coast Nearshore Net Fishery - all licence holders
NGOs	
Australian Institute of Marine Science	WA Conservation Council
Australian Marine Mammal Centre	

6.1.1 Stakeholder submissions

Up to the date of submission of this EP, 12 responses have been received from stakeholders. All correspondence is entered into the Stakeholder Engagement Register which includes:

- Contact details of the stakeholder;

- A log of feedback received from stakeholders;
- A log of TEO's response to the feedback;
- Actions to be completed in seeking mutual acceptance;
- A summary of the outcomes of the correspondence (e.g. additional controls implemented as a result);
- A completed check box to be ticked once correspondence is closed-out.

Table 6-3: Stakeholder submissions

Stakeholder	Date and means of correspondence	Response	Actions/Outcome
DoEE	20/06/2016 Email	Thanked for keeping the Department informed of ongoing developments within the project. Informed that the project has been handed back to the Post Approvals Section (in Compliance and Enforcement Branch) for any ongoing matters. Requested to direct all future email correspondence relating to the Cliff Head EPBC approval to post.approvals@environment.gov.au. Original email was forwarded to the Post Approvals Section.	Contact details updated No further action required
RAAF	20/06/2016 Email	Confirmation that email was received at AIS-AF and forwarded to Air services for action. Informed that Air services are now the authoritative mangers of vertical obstruction information for Australia, subsequently; all future vertical obstruction notifications should be reported directly to Air services at vod@airservicesaustralia.com	Contact details updated No further action required
Recfishwest	20/06/2016 Email	Thanked for the update.	No further action required
Australian Hydrographic Service (RAN)	21/06/2016 Email	Acknowledgement that email was received by the AHS.	No further action required
City of Geraldton	22/06/2016 Email	Requested confirmation of the location of Cliff Head as it looks as though it is in the Shire of Irwin.	Confirmed the Cliff Head platform is located in waters adjacent to the Shire or Irwin. Explained that City of Geraldton were consulted out of courtesy, given the proximity of the council to the facility.
	22/06/2016 Email	Thanked for clarification, no further comments	No further action required
Australia Maritime Safety Authority	21/6/16 Email	Provided an AIS traffic plot for the region which shows minimal commercial traffic transiting near the platform and pipeline. For maintenance activities conducted on the pipeline or other offshore infrastructure and that fall outside of the NOPSEMA gazetted Petroleum Safety	AIS traffic plot Notification requirements included in EP.

Stakeholder	Date and means of correspondence	Response	Actions/Outcome
		Zone, a radio-navigation warning and / or a notice to mariners (NTM) should be issued. Activities which would warrant a radio-navigation warning would be an ROV visual inspection, ToFD ultrasonic inspection, CP inspection and rectification and emergency clamping. Due to the longer periods required for the freespan rectification, marine growth removal and umbilical or subsea cable repair, these activities would warrant a radio-navigational warning and a NTM. Radio-navigation warnings are issued as an AUSCOAST warning. To have this warning promulgated please ensure that the maintenance vessel (or staff if shore based) notifies AMSA's Joint Rescue Coordination Centre (JRCC) through rccaus@amsa.gov.au (Phone: 1800 641 792 or +61 2 6230 6811) for the AUSCOAST warning broadcasts, 24-48 hours before maintenance operations commence. AMSA's JRCC will require the vessels details (including call sign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone) and area of operation and need to be advised when the maintenance work starts and ends. For the promulgation of NTM, the Australian Hydrographic Service (AHS) must be contacted through datacentre@hydro.gov.au no less than four working weeks before maintenance activities commence. The AHS will require the vessel's name, area of operations and start and finish dates.	
WA Department of Fisheries	28/06/2016 Email	Department of Fisheries acknowledge the withdrawal of the pipeline maintenance EP and the ongoing operational activities for the Cliff Head field.	No further action required
WA Department of Transport	30/06/2016 Email	Confirmed receipt of email	No further action required
WA Department of Mines and Petroleum	7/07/2016 Email	Confirmed receipt of email and advised that it was passed on to the appropriate member of the team and we will be in contact shortly. Requested that future submission are sent to the Petroleum Environment email	Contact details updated Respond to further feedback should it arise
Australian Institute of Marine Science	7/07/2016 Email	Advised that original email and reminder email were forwarded on to our staff in Perth and the Commercial services group.	Respond to further feedback should it arise
Shire of Dandaragan	7/07/2016 Email	Advised that the Shire does not have any comments on the proposal.	No further action required

Stakeholder	Date and means of correspondence	Response	Actions/Outcome
WA Department of Environment Regulation	11/07/2016 Email	Confirmed receipt of email and advised it had been forwarded to be actioned by the relevant officer. Requested that future enquiries be sent to info@der.wa.gov.au	Contact details updated Respond to further feedback should it arise
WA Department of Parks and Wildlife	11/07/2016 Email	Advised that based on Parks and Wildlife's understanding that no works are proposed on land based facilities within Beekeeper's Nature Reserve, the department does not have any comments.	No further action required
Environment Protection Agency	13/07/2016 Email	Advised that they had no comments on the proposal.	No further action required
WA Department of Mines and Petroleum (now DMIRS)	25/07/2016 Email	DMP does not have any concerns with the approach.	No further action required
Department of Transport	13/02/2017 Teleconference	Roc Oil conducted a teleconference with DOT to discuss recent updates to the Cliff Head Offshore Operations EP and OPEP and consult with the DoT in line with the DOT offshore petroleum industry guidance note (Marine Oil Pollution: Response and Consultation arrangements); DOT have confirmed that they will provide support to TEO during OPEP submission.	Roc to provide DOT with: * detail on zone of potential impact for worse case pipeline leak; * copy of MOU in place with AMSA; * Confirm statement "TEO understand that DOT will be in control of Oil spill response control however will need to provide resources as per Annex 2 of the DOT guidance note"; TEO to provide DoT with OPEP once approved by NOPSEMA for use.
Department of Transport	21/03/2017 Email	Roc oil requested permission from the DoT for access to the Port Denison parking lot in the event of an emergency oil spill response. Dot responded stating that, yes, in the event of a spill the DoT would definitely permit use of the Port Denison car park as a staging area.	TEO to discuss with DOT 27th of March about detail into what material would be located at the proposed staging area at the Port Denison.

No other responses to this consultation have been received, and no other issues or concerns regarding the proposed activities have been raised by any other stakeholders contacted during this preparatory consultation. TEO / Upstream PS believes that it has given each organisation/person sufficient information, time and opportunity to allow them to make an informed assessment of the possible consequences of the ongoing operations on their functions, interests or activities. Therefore, in the context of the nature and scale of the proposed activity, the environmental sensitivities and values of the operational area, and the outcomes of the risk assessment conducted in this EP, TEO / Upstream PS are satisfied that further attempts to contact the stakeholders who haven't responded so far will not alter significantly the manner in which the activity will be conducted. A lack of any response from the consultation has been taken as confirmation that the organisation/person contacted has no particular issues or concerns regarding the CHA operations.

Given the nature of IMR activities however, TEO will follow up with key stakeholders following confirmation of IMR activity dates to ensure relevant stakeholders are aware of the activity. This will include phone calls or emails to provide detailed information. In particular, the rock lobster fisheries will be informed of the dates, vessels and location to minimise potential conflicts.

6.1.2 Stakeholder submissions

Up to the date of submission of this EP, 12 responses have been received from stakeholders. Feedback and outcomes of correspondence with stakeholders is logged and registered in our Stakeholder engagement register. All correspondence is entered into the Stakeholder Engagement Register which includes:

- Contact details of the stakeholder;
- A log of feedback received from stakeholders;
- A log of TEO's response to the feedback;
- Actions to be completed in seeking mutual acceptance;
- A summary of the outcomes of the correspondence (e.g. additional controls implemented as a result);
- A completed check box to be ticked once correspondence is closed-out.

No other responses to this consultation have been received, and no other issues or concerns regarding the proposed activities have been raised by any other stakeholders contacted during this preparatory consultation. TEO/Upstream PS believes that it has given each organisation/person sufficient information, time and opportunity to allow them to make an informed assessment of the possible consequences of the ongoing operations on their functions, interests or activities. Therefore, in the context of the nature and scale of the proposed activity, the environmental sensitivities and values of the operational area, and the outcomes of the risk assessment conducted in this EP, TEO/Upstream PS are satisfied that further attempts to contact the stakeholders who haven't responded so far will not alter significantly the manner in which the activity will be conducted. A lack of any response from the consultation has been taken as confirmation that the organisation/person contacted has no particular issues or concerns regarding the CHA operations.

Given the nature of IMR activities however, TEO will follow up with key stakeholders following confirmation of IMR activity dates to ensure relevant stakeholders are aware of the activity. This will include phone calls or emails to provide detailed information. In particular, the rock lobster fisheries will be informed of the dates, vessels and location to minimise potential conflicts.

6.2 Ongoing consultation

The ongoing consultation plan is outlined in Table 6-1 above and consists of the following steps:

- Annual review for additional stakeholders
- Engagement with new stakeholders identified, providing overview of the facility and activities conducted (Appendix D of EP)
- Notification of specific stakeholders for workover or pipeline IMR activities (Section 6.1.4 of EP)
- Notification of relevant stakeholders in event of change in activities
- Fisheries Liaison Officer available to correspond with rock lobster fisheries, if TEO does not receive direct responses e.g. to IMR specific notifications;
- Maintenance of records in the Stakeholder Engagement Register to ensure ongoing feedback from stakeholders is assessed as appropriate.

Furthermore, stakeholders are able to provide feedback to TEO at any time after the acceptance of this EP via the contact details provided in the consultation letter distributed (Appendix D in EP). A record of correspondence maintained in the Stakeholder Engagement Register. Furthermore, a system is in place to ensure that there is a response to the stakeholder's expectations and concerns through the *Complaint Management and Community Liaison procedure* (00/HSEQ/GEN/PC24). This procedure includes:

- Details on how to respond to an inquiry for information or a complaint
- Which roles have the responsibility of responding to the inquiry or complaint
- Process for investigating any complaint due to the site being operated outside the operating licence for the facility
- Process for reporting any complaints
- Process for logging the inquiry or complaint

Following the change of ownership in 2017 from ROC to TEO, selected stakeholders were informed of the change where it affected contracts. Given there is no change to the activity and how it is managed, additional notifications to all stakeholders were not considered necessary.

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