# Driftwood-1 Exploration Drilling Environment Plan Summary
# Environment Plan Summary

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## ACRONYMS

| Abbreviation | Description |
|---|---|
| AFMA | Australian Fisheries Management Authority |
| AIS | Automatic Identification System |
| ALARP | As Low As Reasonably Practicable |
| AMOSC | Australian Marine Oil Spill Centre |
| AMOSplan | Australian Marine Oil Spill Plan |
| AMSA | Australian Marine Safety Authority |
| API | American Petroleum Institute |
| ASBTIA | Australian Southern Bluefin Tuna Association |
| BOP | Blowout Preventer |
| CAMBA | China Australia Migratory Bird Agreement |
| CALM | Department of Conservation and Land Management (former department) |
| CFA | Commonwealth Fisheries Association |
| CMR | Commonwealth Marine Reserves |
| DEC | WA Department of Environment and Conservation (former department) |
| DEWHA | Department of the Environment, Water, Heritage and the Arts (former department) |
| DMP | Department of Mines and Petroleum |
| DoD | Department of Defence |
| DoE | Commonwealth Department of the Environment (formerly Department of the Environment and Heritage, and Department of the Environment, Water, Heritage and the Arts). |
| DoF | WA Department of Fisheries |
| DoT | WA Department of Transport |
| DPaW | WA Department of Parks and Wildlife |
| EMBA | Environment that May Be Affected |
| EP | Environment Plan |
| EPA | WA Environmental Protection Authority |
| EPBC | Environment Protection and Biodiversity Conservation |
| EPO | Environmental Protection Outcome |

| Abbreviation | Description |
|---|---|
| EPS | Environmental Performance Standards |
| ESD | Emergency Shutdown |
| GHG | Greenhouse Gas |
| HEV | High Environmental Value (areas) |
| HSE | Health Safety Environment |
| IAP | Incident Action Plan |
| IAPPC | International Air Pollution Prevention Certificate |
| IMDG | International Maritime Dangerous Goods |
| IMS | Introduced Marine Species |
| IOPP | International Oil Pollution Prevention |
| ISPP | International Sewage Pollution Prevention |
| KEF | Key Ecological Feature |
| LCM | Lost Circulation Material |
| MARPOL | Marine Pollution International Convention for the Prevention of Pollution from Ships |
| MC | Measurement Criteria |
| MDRT | Measured Depth from Rotary Table |
| MNES | Matters of National Environmental Significance |
| MMA | Marine Management Area |
| MoC | Management of Change |
| MODU | Mobile Offshore Drilling Unit |
| MP | Marine Parks |
| MOU | Memorandum of Understanding |
| NEBA | Net Environmental Benefit Analysis |
| NOPSEMA | National Offshore Petroleum Safety and Environmental Management Authority |
| NWS | North West Shelf |
| OCNS | Offshore Chemical Notification Scheme |
| ODS | Ozone Depleting Substances |

| Abbreviation | Description |
|---|---|
| OHS | Occupational Health and Safety |
| OIM | Offshore Installation Manager |
| OPGGS Act | Offshore Petroleum and Greenhouse Gas Storage Act 2006 |
| OPEP | Oil Pollution Emergency Plan |
| OPGGS(E)R | Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 |
| OSRT | Oil Spill Response Team |
| OWA | Oiled Wildlife Advisors |
| OWR | Oiled Wildlife Response |
| P&A | Plug and Abandon |
| PHG | Pre-Hydrated Gel |
| PLONOR | Pose Little or No Risk (to the environment) |
| PPA | Pearl Producers Association |
| ROV | Remotely Operated Vehicle |
| RT | Rotary Table |
| SDS | Safety Data Sheet (formerly known as Material Safety Data Sheet) |
| SFRT | Subsea First Response Toolkit |
| SMP | Scientific Monitoring Plan |
| SMPEP | Shipboard Marine Pollution Emergency Plan |
| SOPEP | Shipboard Oil Pollution Emergency Plan |
| SRT | State Response Team |
| TD | Total Depth |
| VRASS | (Biofouling) Vessel Risk Assessment |
| VSP | Vertical Seismic Profiling |
| WA | Western Australia |
| WAF | Water Accommodated/Available Fraction |
| WAFIC | Western Australian Fishing Industry Council |
| WAOWRP | Western Australian Oiled Wildlife Response Plan |

| Abbreviation | Description |
|---|---|
| WOMP | Well Operations Management Plan |
| WBM | Water-based Mud |
| WHA | World Heritage Area |

# 1. INTRODUCTION

Quadrant Energy Australia (Quadrant Energy) is the registered operator for Petroleum Production Licence WA-320-P. Quadrant Energy proposes to drill the Driftwood-1 exploration well located in Commonwealth waters off the coast of Western Australia. The primary reservoir target is oil.

## 1.1 Titleholders

**Table 1-1** lists the titleholder companies for the petroleum activities covered under this Environment Plan (EP).

**Table 1-1: Titleholder details for the petroleum activity**

| Aspect | Details |
|---|---|
| Permit | WA-320-P |
| Titleholder | Quadrant Permits Pty Ltd |
| Other titleholders | OMV Australia Pty Ltd<br>JX Nippon Oil and Gas Exploration (Australia) Pty Ltd<br>Tap (NCB) Pty Ltd |
| Titleholder business address | Level 9, 100 St Georges Tce, Perth WA 6000 |
| Titleholder telephone number | (08) 6218-7100 |
| Titleholder fax number | (08) 6218-7200 |
| Titleholder ACN | 131 225 619 |

## 1.2 Compliance

The overall purpose of the *Driftwood-1 Exploration Drilling Environment Plan (EA-00-RI-10156)* (the EP) is to comply with statutory requirements of the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS (E) Regulations) and to ensure that the activity is planned and conducted in line with Quadrant Energy's policies and standards. The EP was assessed and accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) on the 6th July 2016. This EP summary has been prepared in accordance with the requirements of regulation 11 (4) of the OPGGS (E) Regulations.

## 1.3 Activity duration and timing

The drilling activity is expected to commence in August 2016. The time to drill the exploration well and permanently plug and abandon the well is expected to be approximately 35 days. This accounts for over-runs that may be caused by unfavourable weather, additional drilling (e.g. a re-spud) or operational changes. During the activity, operations will be 24 hours per day. The petroleum activity will be deemed complete once the well has been plugged and abandoned and the permit area vacated. To account for potential delays or schedule changes, the environmental assessment accounts for petroleum activities at any time of year between July 2016 and the end of 2017.

## 2. ACTIVITY LOCATION

All petroleum activities will be conducted in permit area WA-320-P (**Figure 2-1**). Within the permit area, the Operations Area is set as a 2-km radius around the well location to account for support vessels on standby.

The well location is approximately 55 km from Onslow, the closest mainland township. The nearest land is Rosily, Thevenard and Airlie islands approximately 18 km, 32 km and 34 km respectively from the well location. The well will be located within a 1-km radius of the coordinates in **Table 2-1**. The water depth at the well location is approximately 99 m.

**Table 2-1: Driftwood-1 well location**

| Well | Latitude | Longitude |
|---|---|---|
| Driftwood-1 | 21° 11’ 24.35” S | 114° 52’ 04.34” E |

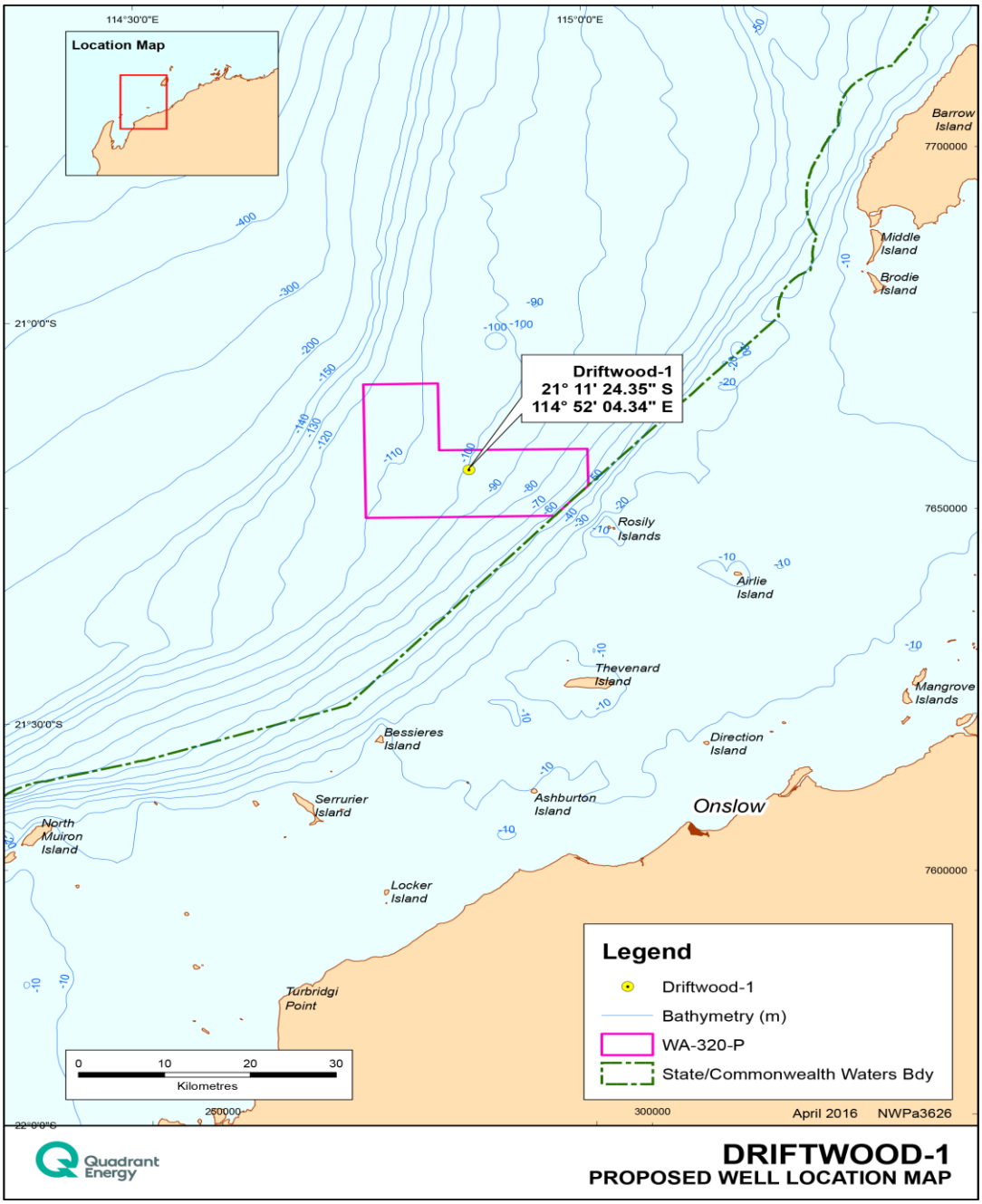


**Figure 2-1: Driftwood-1 well location in permit area WA-320-P**

# 3. DESCRIPTION OF THE ACTIVITY

## 3.1 Activities

This EP provides for exploration drilling and associated activities, including:

- Move the rig to location, position rig, pre-load and jack-up to operational elevation.
- Spud the well and drill conductor hole.
- Run and cement ported conductor.
- Drill surface hole section riserless.
- Run and cement surface casing.
- Installation of surface wellhead and blowout preventers (BOPs).
- Drill remaining section to well total depth (TD).
- Well plug and abandon (P&A) activities, including setting permanent cement barriers.
- Drill using water-based muds (WBM).
- Contingency use of aqueous lost circulation materials (LCM).
- Use of chemicals for drilling and P&A activities.
- Downhole formation evaluation including wireline logging, vertical seismic profiling (VSP) and coring.
- Side-tracking and re-spud drilling (contingent and unplanned activities).
- Commissioning activities (e.g. equipment testing, tank cleaning).
- Temporary placement of equipment on the seabed.
- Use of support vessels, helicopters and remotely operated vehicles (ROV).

### 3.1.1 MODU

This is a one-well petroleum activity requiring the use of a jack-up mobile offshore drilling unit (MODU) to drill the well. The jack-up MODU which will remain at location (i.e. drilling site) for the duration of the drilling activity and will be towed on and off location with a support vessel(s).

### 3.1.2 Exploration well

The well design for Driftwood-1 includes setting a structural conductor string approximately 50 m below mud line (seabed) before drilling a surface hole (riserless) to set the surface casing. The surface wellhead and BOPs will be installed and tested before the well is drilled to TD. The planned TD is approximately 2,060 m MDRT (measured depth from rotary table); however, the TD may be less or more depending on the geology and operational issues.

Only water-based drilling fluid systems will be used for the well.

The conductor and surface hole sections (or intervals) will be drilled using seawater and PHG (pre-hydrated gel) sweeps to clean the hole. This fluid will exit the well at seabed while drilling the hole to install the conductor (i.e. the conductor hole section). Once the conductor is installed and while drilling the surface hole section, the fluid will exit the well close to sea level via ports in the side of the conductor (i.e. riserless drilling practices).

Once the surface casing is installed, thereby establishing a closed circulating system, the remainder of the well will be drilled with a weighted brine/shale-inhibited (e.g. KCl/Klastop) water-based mud (WBM). The WBM will be discharged from the MODU at sea surface either on cuttings or from surface storage tanks/mud pits when no longer required.

Aqueous lost circulation material (LCM) will be available to pump should downhole losses occur.

Similar to drilling fluids, cuttings for the conductor hole section will exit the wellbore at the seabed. Cuttings for the surface hole section will be discharged from a ported conductor joint close to sea level. Cuttings for the remaining hole section to TD will be discharged at sea level after being removed from the WBM system through the solids control system. The solids control system comprises of shale shakers and if required to remove ultra-fine solids in the recovered drilling fluid, centrifuges.

Two primary casing cement jobs are planned for cementing the conductor and surface casing in place. These cement jobs will provide a structural base for the well and are critical to well integrity. Any cement returns during the conductor job would be to seabed.

During cementing operations, surface cementing equipment and lines will need to be flushed, washed and cleaned with water to prevent hard setting. The residual cement and wash water will be discharged to sea after each cement job. Cement spacer in well returns and residual surface tank volumes will also be discharged to sea during cementing operations.

### 3.1.3 Well abandonment

The well will be abandoned downhole and the casings cut below the seabed. Three abandonment cement plugs are planned to safely plug and abandon the well; the final abandonment program will ensure moveable fluids (identified while drilling) are isolated per the NOPSEMA-accepted Well Operations Management Plan (WOMP).

### 3.1.4 Drilling discharges

Drilling discharges account for:

- Drill solids or cuttings;
- Drilling fluids;
- Brines; and
- Cement (set or unset).

### 3.1.5 Well evaluation and testing

No downhole well testing is planned for the well. Downhole formation evaluation will be performed which may include wireline logging, VSP and coring.

### 3.1.6 Support vessels

The MODU will be assisted by support vessels that will transfer food, bulk drilling fluid materials, diesel and equipment used in the drilling process. Typically only two support vessels will be required during the activity, however up to four vessels may be required at times.

At least one support vessel will remain on location for the duration of the activity.

No vessel anchoring or mooring is planned.

### 3.1.7 Helicopters

Crew changes for personnel aboard the MODU will involve transfer via helicopter. These flights will occur several times a week dependent on the progress of the drilling program and logistical constraints.

### 3.1.8 ROV operations

An observation-class remotely operated vehicle (ROV) will be available on site. It is likely that the ROV will be operated from the MODU; however, the vehicle could also be operated from a support vessel.

### 3.1.9 Waste

In addition to the drilling discharges to sea (above), other operational waste streams from the MODU and support vessels are likely to include:

- Deck drainage;
- Food scraps and sewage;
- Oily water;
- Cooling water;
- Desalination plant effluent (brine) and backwash water discharge; and
- Ballast water.

# 4. DESCRIPTION OF ENVIRONMENT

## 4.1 Environment that may be affected (EMBA)

Although most events may only affect the environment within a few hundred metres around the MODU, an unplanned hydrocarbon spill may extend substantially beyond a few hundred metres. To determine this extent, stochastic hydrocarbon dispersion and fate modelling (GHD, 2016) was completed for the hydrocarbon spill scenarios summarised in **Table 4-1**. Modelling considered three key physical and/or chemical phases of hydrocarbons that pose differing environmental affects: surface oil (10 g/m$^2$), total water accommodated fraction (WAF) (500 ppb) and dissolved WAF (100 ppb).

The largest predicted area impacted by surface oil, total WAF and dissolved WAF is linked to the loss of well control scenario (**Table 4-1**) and it was used to define the Environment that May Be Affected (EMBA) (**Figure 4-1**). The EMBA includes accumulated shoreline loading of oil ≥1 tonne, depicted as the 'shoreline EMBA'.

**Table 4-1: Summary of credible hydrocarbon spill events**

| Scenario | Hydrocarbon Type | Volume | Comment |
|---|---|---|---|
| Minor hydrocarbon spills | Hydraulic fluid | 1 m$^3$ | Loss of hydraulic fluid during transfer. |
| Hydrocarbon spill (diesel) during refuelling | Diesel | 20 m$^3$ | Volume based on 15 minutes of flow (from refuelling hose) at a pumping rate of 1.25 m$^3$/min. |
| Hydrocarbon spill (diesel) from vessel collision – vessel tank | | 250 m$^3$ | Volume based on the holding capacity of largest flank fuel tank on support vessel. |
| Hydrocarbon spill from a loss of control scenario – **surface** release | Light crude | 7,932 m$^3$ (102 m$^3$/d initial) | Flow potential derived by combining the most optimistic flow parameters. |
| Hydrocarbon spill from a loss of control scenario – **seabed** release | | 6,988 m$^3$ (91 m$^3$/d initial) | |

It is important to note that the EMBA illustrates the sum of many different spill scenarios modelled for different seasonal conditions over a year. The actual area affected from a single spill event could extend to the boundary of the EMBA, but would be considerably smaller than the total area covered in **Figure 4-1**.

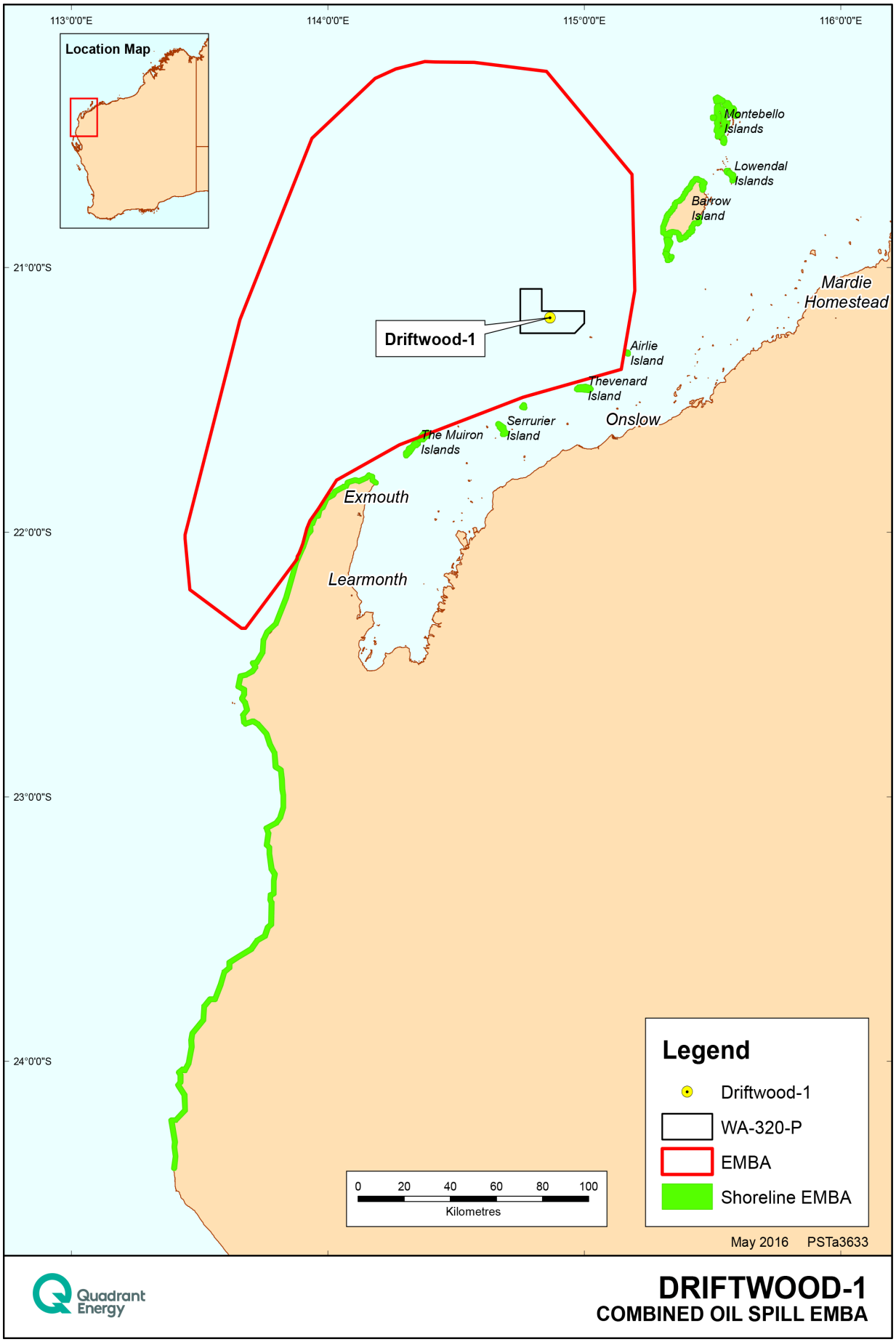


**Figure 4-1: Driftwood-1 EMBA (all hydrocarbon phases) for modelled hydrocarbon spills**

### 4.1.1 Physical environment and habitats

*Physical environment*

North West Shelf (NWS) waters are usually thermally stratified with a marked change in water density at approximately 20 m (SSE, 1993). Surface temperatures vary annually, being warmest in March (32˚C) and coolest in August (19˚C). During summer (October–March), the prevailing non-storm winds are from the southwest, west and northwest at an average speed of less than 10 knots, peak average speeds of 15–25 knots, and maximum speeds of 30 knots. Non-storm winds prevail from the north-east through to south-east at average speeds of 5–6 knots, peak average speeds of 10–15 knots, and maximum speeds of 20 knots. The wave climate is generally composed of locally generated wind waves (seas) and swells that are propagated from distant area (WNI, 1995; 1996). In the open ocean, sustained winds result in wind-forced currents of approximately 3% of the wind speed (Holloway and Nye, 1985).

Tidal and wind-forcing are the dominant contributions to local sea surface currents. The tides of the NWS have a strong semi-diurnal signal with four tide changes per day (Holloway and Nye, 1985) and a spring tidal range of 1.9 m and a highest astronomical tide of 2.9 m (Chevron Australia, 2010). The dominant sea surface offshore current (typically seaward of the 200 m isobath) is the Leeuwin Current, which carries warm tropical water south along the edge of WA's continental shelf, reaching its peak strength in winter and becoming weaker and more variable in summer. The current is described as a sea surface current, extending in depth to 150 m (BHPB, 2005; Woodside, 2005). Closer to the coast, the Ningaloo Current flows in a northerly direction, in the opposite direction to the Leeuwin Current, along the outside of the Ningaloo Reef and across the inner shelf from September to mid-April (BHPB, 2005; Woodside, 2005). The Indonesian Throughflow is the other important current influencing the upper 200 m of the outer NWS (Woodside, 2005). This current brings warm and relatively fresh water to the region from the western Pacific via the Indonesian Archipelago.

Offshore drift currents are represented as a series of interconnected eddies and connecting flows that can generate relatively fast (1–2 knots) and complex water movement. These offshore drift currents also tend to persist longer (days to weeks) than tidal current flows (hours between reversals) and have greater influence upon the trajectory of slicks over time scales exceeding a few hours (GHD, 2016).

### 4.1.2 Habitats

The Operations Area does not contain any shoreline habitat; the nearest land is Rosily, Thevenard and Airlie islands located approximately 18 km, 32 km and 34 km respectively from the well location. Quadrant Energy has seabed survey data from a geophysical and geotechnical site survey (side scan sonar, multi-beam, drop cores and drop camera) undertaken within a portion of the permit area in July 2015. The location of the seabed survey is approximately 10-15 km from the Operations Area and in comparable water depths (approximately 100–115 m depth). The 2015 survey revealed the seabed to be composed of silt sediment underlain by clayey carbonate mud, with occasional benthic fauna and single or clusters of pockmarks and depressions of up to 130 m in diameter in an otherwise featureless seabed (Advanced Geomechanics, 2015; Fugro, 2015).

A deepwater habitat survey was commissioned by Chevron in 2009 as part of the Wheatstone Project. Transects of the proposed trunkline route were surveyed using an ROV installed with a video camera (URS, 2010). Two of the ROV transect locations lie within permit area WA-320-P and the habitat is described as gently sloping or flat sand/silt with moderate bioturbation including trace occurrences of sponges, soft corals, ascidians and sea pens, varying degrees of relief in some areas and large infauna mounds (URS, 2010).

Although no specific seabed surveys have been undertaken in the Operations Area, given the similar water depth, it is reasonable to extrapolate the data to suggest that the seabed at the Driftwood-1 well location and the Operations Area may exhibit similar habitat to that within the geotechnical/geophysical survey area (Advanced Geomechanics, 2015; Fugro, 2015) and deepwater habitat survey (URS, 2010). Given the depth of water at the well location (~99 m) and Operations Area, and therefore limited light availability at

the seabed, it would be reasonable to suggest that the Operations Area would not contain hard corals, seagrass meadows or macroalgal communities.

*Habitat within the EMBA*

Given the spatial extent of the EMBA and the inclusion of shallow water and shoreline areas, there is a wide variety of marine and coastal habitats present. **Table 4-2** provides an indication of the distribution of these habitats within the receptor regions within the EMBA.

**Table 4-2: Habitats associated with receptor regions identified within the EMBA**

| Receptor Regions | Subtidal/Intertidal Habitats | | | | | Shoreline Habitats | | | EMBA Presence | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Soft Sediments | Coral Reefs | Macroalgal Beds | Seagrass Beds | Hard Substrates (Flora/ Fauna) | Rocky Shorelines | Sandy Beaches | Mangroves | Operations Area | EMBA | Shoreline Contact |
| Muiron Islands | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | ✓ | ✓ |
| Thevenard Island | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | x | ✓ |
| Barrow Island | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | ✓ |
| Lowendal Islands | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | x | ✓ |
| Montebello Islands | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | ✓ |
| Barrow-Montebello Surrounds | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | x | x | ✓ | x |
| Southern Islands Coast | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | x | ✓ |
| Ningaloo Coast North | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | ✓ | ✓ |
| Ningaloo Coast South | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | ✓ |
| Outer Ningaloo Coast North | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | x | x | ✓ | x |
| Outer NW Ningaloo | ✓ | x | x | x | ✓ | x | x | x | x | ✓ | x |
| Offshore Ningaloo | ✓ | ✓ | ✓ | x | ✓ | x | x | x | x | ✓ | x |

### 4.1.3 Protected and significant areas

Commonwealth marine reserves, state marine parks and marine management areas, world heritage areas, wetlands of international importance, Commonwealth or national heritage places and key ecological features present within the EMBA are listed in **Table 4-3** and shown in **Figure 4-2**. None of these areas were identified within, or nearby, the Operations Area for the activity. A description of those protected or significant areas within the EMBA are provided below.

**Table 4-3: Environmentally protected or significant areas within the Operations Area and EMBA**

| Value/Sensitivity | Distance from Operations Area (km) | Operations Area Presence | EMBA Presence | |
|---|---|---|---|---|
| | | | EMBA | Shoreline Contact |
| **Commonwealth Marine Reserves** | | | | |
| Gascoyne CMR | 104 | x | ✓ | N/A |
| Ningaloo CMR | 83 | x | ✓ | N/A |
| Montebello CMR | 54 | x | ✓ | N/A |
| **State Marine Parks (MP) and Marine Management Areas (MMA)** | | | | |
| Ningaloo MP | 84 | x | ✓ | ✓ |
| Muiron Islands MMA | 63 | x | ✓ | ✓ |
| Barrow Island MP | 61 | x | x | ✓ |
| Barrow Island MMA | 48 | x | x | ✓ |
| Montebello Islands MP | 90 | x | x | ✓ |
| **World Heritage Area (WHA)** | | | | |
| Ningaloo Coast World Heritage Area (incl. the Muiron Islands) | 63 | x | ✓ | ✓ |
| **National Heritage Places** | | | | |
| Ningaloo Coast Listed Place | 63 | x | ✓ | ✓ |
| **Commonwealth Heritage Place** | | | | |
| Ningaloo Marine Area – Commonwealth waters | 83 | x | ✓ | N/A |
| **Threatened Ecological Communities** | | | | |
| There are no listed Threatened Ecological Communities in the Operations Area or EMBA. | | | | |
| **Key Ecological Features** | | | | |
| Ancient coastline at 125 m depth contour | 12 | x | ✓ | N/A |
| Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula | 37 | x | ✓ | N/A |
| Commonwealth waters surrounding Ningaloo Reef | 84 | x | ✓ | N/A |
| Continental Slope Demersal Fish Communities | 24 | x | ✓ | N/A |

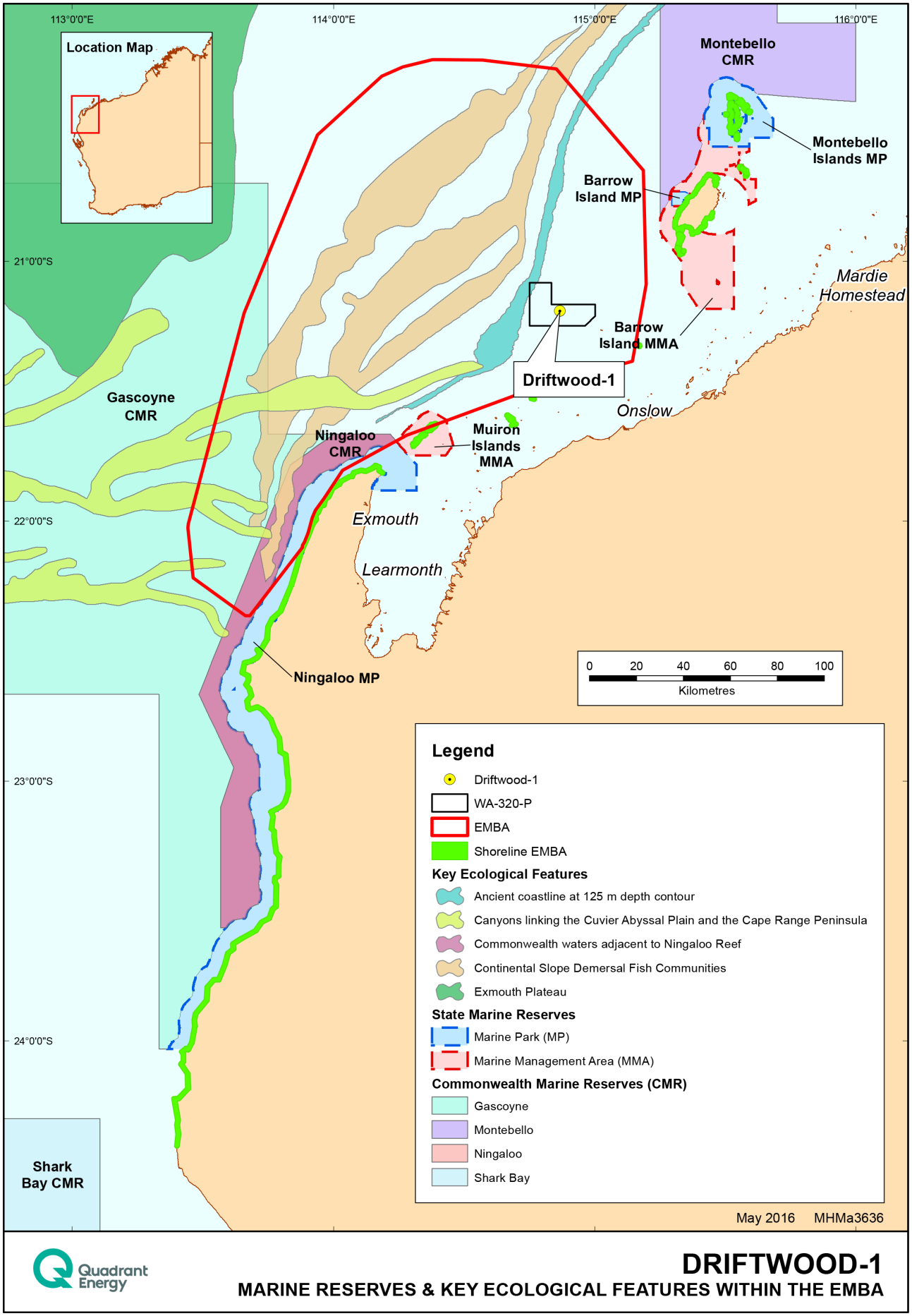


**Figure 4-2: Environmentally protected or significant areas within the Operations Area and EMBA**

**Commonwealth Marine reserves**

*Gascoyne CMR*

The Gascoyne Commonwealth Marine Reserve (Multiple Use Zone – IUCN Category VI; Habitat Protection Zone – IUCN Category IV; Marine National Park Zone – IUCN Category II) protects the following conservation values (DoE, 2014):

- Important foraging areas for: migratory seabirds threatened and migratory hawksbills and flatback turtles; and vulnerable and migratory whale shark;
- A continuous connectivity corridor from shallow depths around 15 m out to deep offshore waters on the abyssal plain at over 5,000 m in depth;
- Seafloor features including canyon, terrace, ridge, knolls, deep hole/valley and continental rise. It also provides protection for sponge gardens in the south of the reserve adjacent to Western Australian coastal waters;
- Ecosystems examples from the Central Western Shelf Transition, the Central Western Transition and the Northwest province provincial bioregions as well as the Ningaloo meso-scale bioregion;
- Three key ecological features;
- The canyons in this reserve are believed to be associated with the movement of nutrients from deep water over the Cuvier Abyssal Plain onto the slope where mixing with overlying water layers occurs at the canyon heads. These canyon heads, including that of Cloates Canyon, are sites of species aggregation and are thought to play a significant role in maintaining the ecosystems and biodiversity associated with the adjacent Ningaloo Reef; and
- The reserve therefore provides connectivity between the inshore waters of the existing Ningaloo Commonwealth marine park and the deeper waters of the area.

*Ningaloo CMR*

Ningaloo Commonwealth Marine Reserve is approximately 300 km along the west coast of the Cape Range Peninsula near Exmouth, Western Australia (DSEWPaC, 2012). Ningaloo Reef is the longest fringing barrier reef in Australia and is the only example in the world of extensive fringing coral reef on the west coast of a continent. It is included in the adjacent Western Australian Ningaloo Marine Park (State Waters), which lies between the Ningaloo Commonwealth Marine Reserve and the Western Australian coast (DSEWPaC, 2012).

The Ningaloo Commonwealth Marine Reserve (Recreational Use Zone – IUCN Category II) protects the following conservation values (DoE, 2014):

- Important habitat (foraging areas) for vulnerable and migratory whale sharks;
- Areas used for foraging by marine turtles adjacent to important nesting sites;
- Part of the migratory pathway of the protected humpback whale;
- Shallow shelf environments which provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features; and
- Seafloor habitats and communities of the Central Western Shelf Transition.

*Montebello CMR*

The Montebello Commonwealth Marine Reserve (Multiple Use Zone – IUCN Category VI) covers an area of approximately 3,413 km$^2$ and protects the following conservation values (DoE, 2014):

- Foraging areas for migratory seabirds that are adjacent to important breeding areas;
- Areas used by vulnerable and migratory whale sharks for foraging;
- Foraging areas for marine turtles which are adjacent to important nesting sites;

- Section of the north and south bound migratory pathway of the humpback whale;
- Shallow shelf environments with depths ranging from 15–150 m which provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features;
- Seafloor habitats and communities of the Northwest Shelf Province provincial bioregions as well as the Pilbara (offshore) meso-scale bioregion; and
- One key ecological feature.

**State Marine Parks and Marine Management Areas**

*Ningaloo MP*

The park covers an area of 263,343 km$^2$, including both State and Commonwealth waters, extending 25 km offshore.

The park protects a large portion of Ningaloo Reef, which stretches over 300 km from North West Cape south to Red Bluff. It is the largest fringing coral reef in Australia, forming a discontinuous barrier that encloses a lagoon that varies in width from 200 m to 7 km. The Ningaloo Marine Park forms the backbone of the nature-based tourism industry, and recreational activities in the Exmouth region. Seasonal aggregations of whale sharks, manta rays, sea turtles and whales, as well as the annual mass spawning of coral attract large numbers of visitors to Ningaloo each year (CALM, 2005).

The reef is composed of partially dissected basement platform of Pleistocene marine or Aeolian sediments or tertiary limestone, covered by a thin layer of living or dead coral or macroalgae.

*Muiron Islands MMA*

The Ningaloo Marine Park Management Plan (CALM, 2005) created a MMA for the Muiron Islands, immediately adjacent to the northern end of the Park.

The Muiron Islands, located 15 km northeast of the North West Cape comprise the North and South Muiron Islands and cover an area of 1,400 ha (AHC, 2006). They are low limestone islands with some areas of sandy beaches, macroalgae and seagrass beds in the shallow waters (particularly on the eastern sides) and coral reef up to depths of 5 m, which surrounds both sides of South Muiron Island and the eastern side of North Muiron Island.

*Barrow Island MP*

The Barrow Island Marine Park covers 4,169 ha, all of which is zoned as sanctuary zone (the Western Barrow Island Sanctuary Zone) (DEC, 2007). It includes Biggada Reef, an ecologically significant fringing reef, and Turtle Bay, an important turtle aggregation and breeding area (DEC, 2007). Representative areas of seagrass, macroalgal and deep water habitat are also represented within the marine park (DEC, 2007). Passive recreational activities (such as snorkelling, diving and boating) are permitted but extractive activities such as fishing and hunting are not.

*Barrow Island MMA*

The Barrow Island Marine Management Area (MMA) is the largest reserve within the Montebello/Barrow Islands marine conservation reserves (DEC, 2007) and includes most of the waters around Barrow Island, the Lowendal Islands and the Barrow Island Marine Park, with the exclusion of the port areas of Barrow Island and Varanus Island.

The MMA is not zoned apart from one specific management zone: the Bandicoot Bay Conservation Area. This conservation area is on the southern coast of Barrow Island and has been created to protect benthic fauna and seabirds. It includes the largest intertidal sand/mudflat community in the reserves, is known to be high in invertebrate diversity and is an important feeding area for migratory birds.

As for the other reserves in the Montebello/Barrow Islands marine conservation reserves, the Barrow Island MMA includes significant breeding and nesting areas for marine turtles and the waters support a diversity of tropical marine fauna, important coral reefs and unique mangrove communities (DEC, 2007).

Green, hawksbill and flatback turtles regularly use the island's beaches for breeding, and loggerhead turtles are also occasionally sighted.

*Montebello Islands MP*

The Montebello Islands Marine Park (MP) is an 'A' Class reserve (DEC, 2007) and its northern and western boundaries follow the seaward extent of Western Australian state waters (DEC, 2007). Zoning within the Montebello Islands MP is a combination of sanctuary, recreation, special purpose (benthic protection), special purpose (pearling), and general use (DEC, 2007).

The Montebello Islands comprise over 100 islands, the majority of which are rocky outcrops; rocky shore accounts for 81% of shoreline habitat (DEC, 2007). Other marine habitats within the marine park include coral reefs, mangroves, intertidal flats, extensive sheltered lagoonal waters, and shallow algal and seagrass reef platform extending to the south of the Montebello Islands to the Rowley Shelf.

Ecologically, the marine park's values include important turtle nesting sites, feeding and resting areas for migrating shorebirds, seabird nesting areas, dugong foraging areas, globally-unique mangrove communities, and highly diverse fish and invertebrate assemblages (DEC, 2007). Also, the sediment and water quality of the marine park are considered pristine (DEC, 2007) and are essential to the maintenance of the marine ecosystems and associated biota.

Economic values within the Montebello Islands MP include commercial pearl culture, commercial line and trap fishing, and an increasing recreational usage (DEC, 2007). Special purpose zones for pearling are established for the existing leaseholder to allow pearling to be the priority use of these areas (DEC, 2007). Commercial fishing includes a trap fishery for reef fishes, mainly in water depths of 30–100 m, and wet lining for reef fish and mackerel. Fish trawling also occurs in the waters near to the Montebello Islands. A tourist houseboat operates out of Claret Bay, at the southern end of Hermite Island, during the winter months. The Montebello Islands are becoming more frequently used by recreational boaters for camping, fishing and diving activities.

**World and National Heritage Places**

Key heritage places in Australia are protected under the EPBC Act and are listed as World Heritage Properties, National Heritage Properties and Commonwealth Heritage Places. These lists contain places which have important natural, historic or indigenous significance. No heritage places occur within the Operations Area. Heritage places occur within the EMBA (**Table 4-3**) are the Ningaloo Coast (Listed Place and World Heritage declared property) and the Ningaloo Marine Area – Commonwealth Waters (Commonwealth Heritage Place).

*Ningaloo Coast World Heritage Area (WHA) and National Heritage Property*

The Ningaloo Coast is a listed place included on the World Heritage List in 2011 and was inscribed for outstanding natural universal values:

- An example of superlative natural phenomena; and
- Containing important and significant habitats for in situ conservation of biological diversity.

The Ningaloo Coast WHA includes (DEWHA, 2010):

- Ningaloo Commonwealth Marine Reserve (previously named Ningaloo Marine Park – Commonwealth waters);
- Ningaloo Marine Park (Western Australia state waters);
- Muiron Islands Marine Management Area (including the Muiron Islands);
- Jurabi Coastal Park;
- Bundegi Coastal Park;
- Cape Range National Park; and

- Learmonth Air Weapons Range.

**Key Ecological Features**

No Key Ecological Features (KEFs) occur within the Operations Area. Descriptions of the KEFs that occur within the EMBA are provided below.

*Ancient coastline at 125 m depth contour*

The shelf of the North-west Marine Region contains several terraces and steps which reflect changes in sea level that occurred over the last 100,000 years. The most prominent of these features occurs at a depth of 125 m as an escarpment along the North West Shelf and Sahul Shelf (DSEWPaC, 2012). Where the ancient submerged coastline provides areas of hard substrate it may contribute to higher biological diversity. Little detailed knowledge is available, but the hard substrate of the escarpment is likely to support sponges, corals, crinoids, molluscs and echinoderms (DSEWPaC, 2012).

Parts of the ancient coastline are thought to provide biologically important habitats in areas otherwise dominated by soft sediments. The topographic complexity of these escarpments may also facilitate vertical mixing of the water column providing a relatively nutrient-rich environment for species present on the escarpment (DSEWPaC, 2012).

*Canyons linking the Cuvier Abyssal Plain with the Cape Range Peninsula*

Cape Range Peninsula and the Cuvier Abyssal Plain are linked by canyons, the largest of which are the Cape Range Canyon and Cloates Canyon. These two canyons are located along the southerly edge of Exmouth Plateau adjacent to Ningaloo Reef and are unique due to their close proximity to the North West Cape (DSEWPaC, 2012).

The Leeuwin Current interacts with the heads of the canyons to produce eddies resulting in delivery of higher nutrient, cool waters from the Antarctic intermediate water mass to the shelf (Brewer *et al*. 2007). Strong internal tides also create upwelling at the canyon heads (Brewer *et al*. 2007). Thus the canyons, the Exmouth Plateau and the Commonwealth waters adjacent to Ningaloo Reef interact to create the conditions for enhanced productivity seen in this region (Sleeman *et al*., 2007 in DSEWPaC, 2012). The canyons are also repositories for particulate matter deposited from the shelf and sides of the canyons and serve as conduits for organic matter between the surface, shelf and abyssal plains (DSEWPaC, 2012).

The canyons that link the Cuvier Abyssal Plain with the continental slope off Cape Range Peninsula are believed to support the productivity and species richness of Ningaloo Reef (DSEWPaC, 2012).

*Commonwealth waters surrounding Ningaloo Reef*

The Ningaloo Reef extends almost 300 km along the Cape Range Peninsula to the Red Bluff. Commonwealth waters adjacent to the reef are thought to support the rich aggregations of marine species at Ningaloo Reef through upwellings associated with canyons on the adjacent continental slope and interactions between the Ningaloo and Leeuwin currents (Brewer *et al*., 2007; DEWHA, 2008; DSEWPaC, 2012). The narrow continental shelf (10 km at its narrowest) means that the nutrients channelled to the surface via canyons are immediately available to reef species. Terrestrial nutrient input is low, hence this deepwater source is a major source of nutrients for Ningaloo Reef and therefore very important in maintaining this system (DEWHA, 2008).

The Ningaloo Commonwealth Marine Reserve includes this Key Ecological Feature.

*Continental slope demersal fish communities*

The Australian continental slope provides important habitat for demersal fish communities, characterised by high endemism and species diversity. Specifically, the continental slope between North West Cape and the Montebello Trough is the most diverse slope bioregion in Australia with more than 500 fish species, 76 of which are endemic (Last *et al*., 2005 in DSEWPaC, 2012). The Timor Province and Northwest Transition bioregions are the second-richest areas for demersal fish across the entire continental slope (DSEWPaC, 2012).

**Threatened Ecological Communities**

There are no listed threatened ecological communities within the Operations Area or wider EMBA.

### 4.1.4 Hotspots

The EMBA for the activity covers a moderate spatial extent and contains several protected and significant areas. There are considerable advantages in focussing assessment on those parts of the EMBA that overlap protected and significant areas. One of the key advantages is that it allows an evaluation of impacts and risks, and spill response planning, to be based on modelled 'worst-case' single spill runs reaching those areas of highest environmental value.

Quadrant Energy's process for defining areas of Highest Environmental Value (HEV) was applied in the EP for the environmental assessment and spill response purposes. Quadrant Energy uses a scoring system to rank HEV areas and refers to those locations with the highest ranking as 'Hotspots'. Hotspots ranked 1 are deemed to have the highest protection priority, followed by 2 and then 3. Hotspots within the EMBA are presented in **Figure 4-3**.

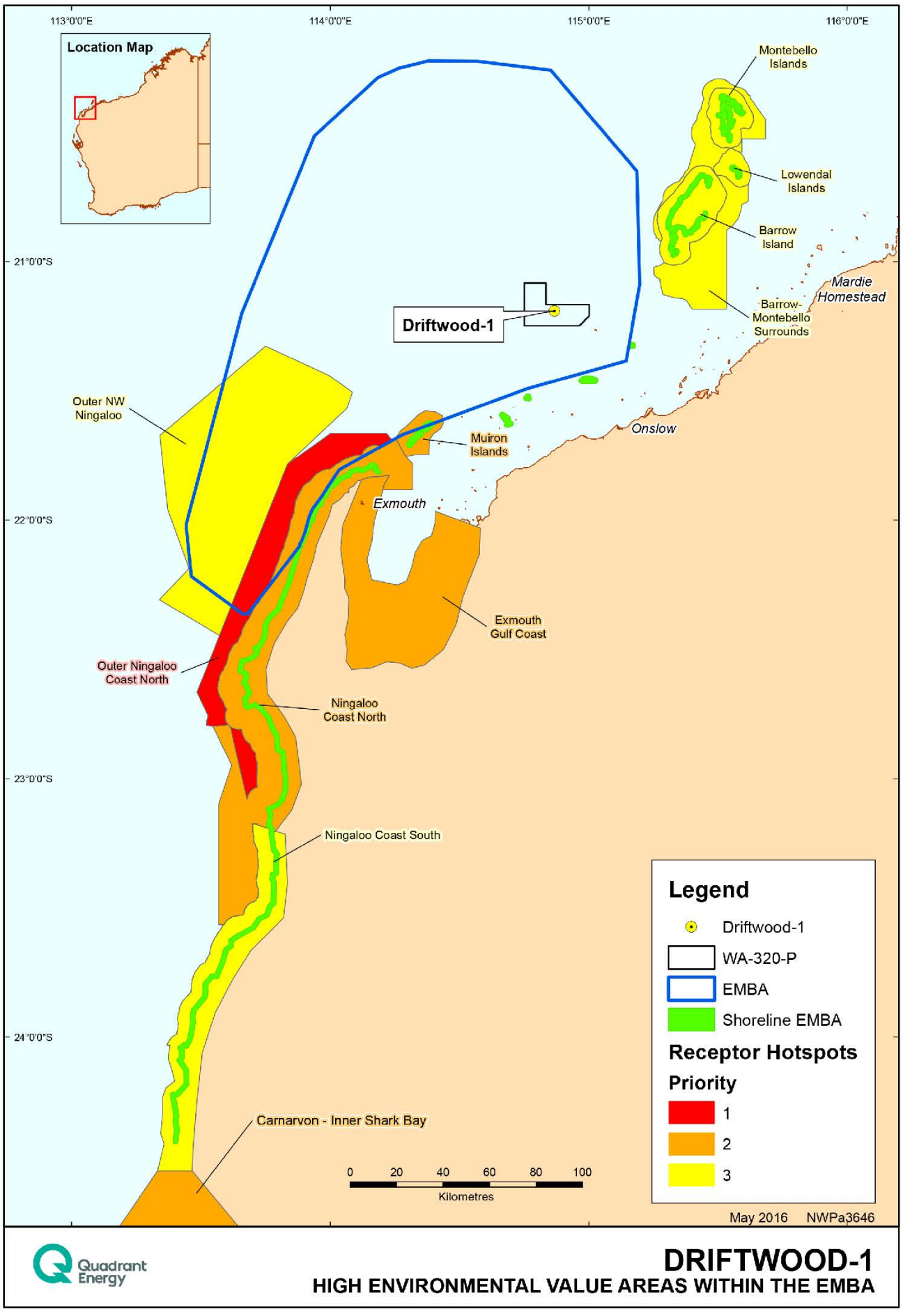


**Figure 4-3: Highest environmental value areas (HEVs) within the EMBA**

### 4.1.5 Marine fauna

Desktop searches of the Operations Area and EMBA were undertaken using DoE's Protected Matters Search Tool for the purposes of identifying species listed under the EPBC Act. The search identified 18 Listed Threatened Species and 34 Listed Migratory Species as having the potential to occur within the EMBA.

An assessment of all the marine and coastal species was undertaken to identify if these species have the potential to occur in either the Operations Area or EMBA. Those listed threatened or vulnerable species that have been identified as likely to be present in the Operations Area or EMBA are summarised in **Table 4-4**. Migratory species are listed for the Operations Area only.

**Table 4-4: Environmental values and sensitivities – marine fauna**

| Value/Sensitivity | | EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory | Operations Area presence | Particular values or sensitivities within Operations Area | EMBA presence | Particular values or sensitivities within EMBA |
|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | | | | | |
| **Protected Species and Communities: Fish and Sharks** | | | | | | |
| Whale shark | *Rhincodon typus* | V, M | ✓ | Transient individuals may occur | ✓ | Foraging, feeding or related behaviour known to occur |
| Grey nurse shark (west coast population) | *Carcharias taurus* | V | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| Great white shark | *Carcharodon carcharias* | V, M | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| Dwarf sawfish | *Pristis clavata* | V | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| Green sawfish | *Pristis zijsron* | V, M | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| Giant manta ray | *Manta birostris* | M | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| Reef manta ray | *Manta alfredi* | M | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| **Protected Species and Communities: Marine Mammals** | | | | | | |
| Blue whale | *Balaenoptera musculus* | E, M | ✓ | Transient individuals may occur | ✓ | Migration route known to occur |
| Southern right whale | *Eubalaena australis* | E, M | ✓ | Transient individuals may occur | ✓ | Species or species habitat likely to occur |
| Humpback whale | *Megaptera novaeangliae* | V, M | ✓ | Migration route known to overlap Operations Area | ✓ | Species or species habitat known to occur. Congregation or aggregation known to occur |

| Value/Sensitivity | | EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory | Operations Area presence | Particular values or sensitivities within Operations Area | EMBA presence | Particular values or sensitivities within EMBA |
|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | | | | | |
| Bryde's whale | *Balaenoptera edeni* | M | ✓ | Transient individuals may occur | ✓ | Species or species habitat may occur |
| Killer whale | *Orcinus orca* | M | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| Spotted bottlenose dolphin (Arafura/Timor Sea populations) | *Tursiops aduncus* | M | ✓ | Transient individuals may occur | ✓ | Species or species habitat may occur |
| **Protected Species and Communities: Marine Reptiles** | | | | | | |
| Loggerhead turtle | *Caretta caretta* | E, M | ✓ | Transient individuals may occur | ✓ | Foraging, feeding or related behaviour known to occur |
| Green turtle | *Chelonia mydas* | V, M | ✓ | Transient individuals may occur | ✓ | Foraging, feeding or related behaviour known to occur |
| Leatherback turtle | *Dermochelys coriacea* | E, M | ✓ | Transient individuals may occur | ✓ | Species or species habitat known to occur |
| Hawksbill turtle | *Eretmochelys imbricata* | V, M | ✓ | Transient individuals may occur | ✓ | Foraging, feeding or related behaviour known to occur |
| Flatback turtle | *Natator depressus* | V, M | ✓ | Transient individuals may occur | ✓ | Foraging, feeding or related behaviour known to occur |
| Short-nosed sea snake | *Aipysurus apraefrontalis* | CE | **x** | Not identified in search area in MNES data search | ✓ | Species or species habitat likely to occur |
| **Protected Species and Communities: Marine Birds** | | | | | | |
| Southern giant-petrel | *Macronectes giganteus* | E, M | ✓ | Transient individuals may occur | ✓ | Species or species habitat may occur |
| Soft-plumaged petrel | *Pterodroma mollis* | V | **x** | Not identified in search area in MNES data search | ✓ | Species or species habitat may occur |

| Value/Sensitivity | | EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory | Operations Area presence | Particular values or sensitivities within Operations Area | EMBA presence | Particular values or sensitivities within EMBA |
|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | | | | | |
| Australian fairy tern | *Sternula nereis nereis* | V | ✓ | Transient individuals may occur | ✓ | Breeding known to occur |
| Campbell albatross | *Thalassarche melanophris impavida* | V, M | **x** | Not identified in search area in MNES data search | ✓ | Species or species habitat may occur |
| Osprey | *Pandion haliaetus* | M | ✓ | Transient individuals may occur | ✓ | Breeding known to occur |

### 4.1.6 Socio-economic environment

Socio-economic activities that may occur within the EMBA include commercial fishing, shipping and oil and gas exploration and production (**Table 4-5**).

**Table 4-5: Socio-economic activities and values in the EMBA**

| Category | Activities or values within EMBA | Present in Operations Area | Present within EMBA |
|---|---|---|---|
| **Commonwealth Commercial Fisheries** | North West Slope Trawl Fishery | x | ✓ |
| | Southern Bluefin Tuna Fishery<br>NB: This fishery is not currently active within the NW Marine Region | ✓ | ✓ |
| | Western Skipjack Tuna Fishery<br>NB: This fishery is not currently active with management arrangements under review. | ✓ | ✓ |
| | Western Deepwater Trawl Fishery | x | ✓ |
| | Western Tuna and Billfish Fishery | ✓ | ✓ |
| **State Commercial Fisheries** | Marine Aquarium Fish Fishery<br>NB: This fishery collect specimens by diving or wading at depths shallower than Operations Area | ✓ | ✓ |
| | Specimen Shell Managed Fishery<br>NB: This fishery collect specimens by diving or wading at depths shallower than Operations Area | ✓ | ✓ |
| | Beche-de-mer Fishery<br>NB: This fishery collect specimens by diving or wading at depths shallower than Operations Area | ✓ | ✓ |
| | Mackerel Managed Fishery (Area 2 and 3) | ✓ | ✓ |
| | Land Hermit Crab Fishery | ✓ | ✓ |
| | Pilbara Trap (open to traps) and Trawl Managed Fishery | ✓ | ✓ |
| | Pilbara Line Fishery | ✓ | ✓ |
| | Pearl Oyster Managed Fishery (Zone 1, Zone 2, Zone 3)<br>NB: This is a dive based fishery at depths shallower than Operations Area | ✓<br>**(Zone 1)** | ✓<br>**(Zone 1)** |
| | Onslow Prawn Managed Fishery<br>NB: This is a coastal fishery that would not be active in Operations Area | ✓ | ✓ |
| | West Coast Rock Lobster Fishery | x | ✓ |
| | Roe's Abalone Fishery<br>NB: Fishery currently closed north of Moore River and operates at depths shallower than the Operations Area | ✓ | ✓ |
| | West Coast Deep Sea Crab (Interim) Managed Fishery.<br>NB: Operates at depths deeper than the Operations Area. | ✓ | ✓ |
| **Recreational Fishing** | Within the North Coast Bioregion, recreational fishing is experiencing significant growth, with a distinct seasonal peak in winter when the local population increases significantly. Increased recreational fishing has also been attributed to those involved in the construction or operation of developments within the region. | x | ✓ |

| Category | Activities or values within EMBA | Present in Operations Area | Present within EMBA |
|---|---|---|---|
| | Consultation has indicated recreational fishing hotspots within the EMBA include the Muiron Islands and the Ningaloo Coast are of high value to recreational fishers. Charter Boat and tourism operators also frequent those areas not easy accessible by recreational fishers. | | |
| **Commercial Shipping** | There is no charted shipping fairway within or near the Operations Area. However, general marine vessel traffic may be encountered travelling to/from Barrow and Exmouth.<br><br>Commercial shipping moves through the offshore waters en route to or from the marine terminals at Thevenard Island and Barrow and Varanus Islands. Shipping using North West Shelf waters includes iron ore carriers, oil tankers and other vessels proceeding to or from the ports of Dampier, Port Walcott and Port Hedland; however, these are predominantly heading north from these ports. Large cargo vessels carrying freight bound or departing from Fremantle, transit along the WA coastline heading north and south in deeper waters. | x | ✓ |
| **Oil and Gas Industry** | The area of the NW Shelf is a major oil and gas hub in Australia, with several companies operating on the Shelf. The EMBA supports a large petroleum industry, with production/drilling infrastructure common throughout the area. The closest onshore facilities to the Operations Area are at Barrow and Thevenard islands. Production on Thevenard Island ceased in 2014 and will be decommissioned. The Tee Tree-1 and Rosily 1A wells within the Permit Area WA-320-P were drilled in 1999 and 1982 respectively; both wells have been plugged and abandoned. The Wheatstone pipeline crosses the Permit Area; the pipeline is not inside the Operations Area and will not be impacted by the drilling activities. The Griffin Field lies to the west of the Permit Area consisting of a series of wells (Griffin, Scindian and Chinook) which will be decommissioned. | x | ✓ |
| **Tourism** | In the waters immediately surrounding the Operations Area, tourism activities are limited due to its distance from the mainland and island shorelines, and water depth.<br><br>However, there are many sources of marine-based tourism within the wider EMBA. Aquatic recreational activities such as boating, diving and fishing occur near the coast and islands off of the Pilbara and Ningaloo coasts. There are locations with high value for eco-tourism based on specific local values (e.g. whale sharks, game fish, nearshore reef snorkelling and diving). Social amenities of the area including beachside recreation (camping, non-fishing water activities), 'iconic' locations, landscape and scenery are also capitalised on by the tourism industry. | x | ✓ |
| **Cultural Heritage** | No known sites of cultural heritage significance within the Operations Area or wider environment. | x | ✓ |

## 5. STAKEHOLDER CONSULTATION

Quadrant recognises that its petroleum activities have the potential to impact the community and the environment, particularly in locations which feature or are near sensitive receptors, or that overlap with other economic, cultural or community uses.

To facilitate informed assessment by stakeholders of the likely potential impact of Quadrant Energy activities, Quadrant Energy seeks to establish long-term and meaningful dialogue with those stakeholders who have an interest in its present and planned future activities in Australia.

Quadrant Energy clearly articulates engagement and consultation standards, goals, and mechanisms, seeks to effectively manage change during the life of its projects and activities, and strives to continuously improve all aspects of its stakeholder engagement processes. The key stakeholders identified for the activity are based on the operations area and EMBA and are provided in **Table 5-1**.

**Table 5-1: List of stakeholders consulted for the activity**

| Group | Stakeholder |
|---|---|
| **Marine Conservation** | • WA Department of Fisheries (DoF)<br>• WA Department of Parks and Wildlife (DPaW) |
| **Shipping safety and security** | • Australian Maritime Safety Authority (AMSA)<br>• Commonwealth Department of Defence (DoD)<br>• WA Department of Transport (DoT)<br>• Pilbara Port Authority |
| **Adjacent regulator** | • WA Department of Mines and Petroleum |
| **Fishing bodies** | • A Raptis and Sons<br>• Austral Fisheries<br>• Australian Fisheries Management Authority (AFMA)<br>• Australian Southern Bluefin Tuna Industry Association (ASBTIA)<br>• Commonwealth Fisheries Association (CFA)<br>• Fat Marine<br>• Marine Tourism WA<br>• MG Kailis<br>• Pearl Producers Association<br>• Quest Maritime Services<br>• Recfishwest<br>• RNR Fisheries<br>• Shark Bay Seafoods<br>• Western Australian Fishing Industry Council (WAFIC)<br>• Western Wild Fisheries<br>• WestMore Seafoods |
| **Nearby Petroleum Operators** | • BHP Billiton Petroleum<br>• Chevron Australia<br>• ENI Australia<br>• Woodside |

Quadrant Energy maintains a comprehensive stakeholder database, which is overseen by a dedicated Consultation Coordinator. The purpose of the database is to enable the identification, initial and ongoing contact with an appropriate group of stakeholders for any given project, and to facilitate the building of long-term and meaningful dialogue with those stakeholders with whom Quadrant Energy has regular contact.

Planned drilling within WA-320-P was included in Quadrant Energy's March 2016 Quarterly Consultation Update, distributed to a wide stakeholder group on 10 March 2016. An activity-specific consultation package for the drilling program in WA-320-P including project summary, coordinates, permit area location

map, water depth, distances to key regional features, activity petroleum exclusion zone details and estimated timing were distributed to stakeholders on 18 March 2016. Indicative coordinates of the Driftwood-1 well were provided to stakeholders, however, the name of the well was not provided as it was not available at the time.

### 5.1 Addressing consultation feedback

Quadrant Energy's Consultation Coordinator is available before, during and after completion of the activity to ensure opportunities for stakeholders to provide feedback are available. Consultation feedback is provided to relevant activity personnel to ensure the Quadrant Energy business has a thorough understanding of how the activity is being received by relevant persons.

Prior to activity commencement, a Quadrant Energy Notification Package will be distributed to all stakeholders listed in **Table 5-1**. The notification will be distributed approximately four weeks prior to the activity, and will include specific timing, location and activity details, e.g. MODU name.

If an additional control measure, or change to an existing control measure, is deemed necessary as an outcome of the stakeholder consultation process, then Quadrant Energy would manage the change in accordance with its *Environmental Management of Change Procedure* (MOC) (EA-91-IQ-10001) (refer **Section 7**).

### 5.2 Summary

Quadrant Energy considers that consultation with regulators and key stakeholders for this activity has been adequate; all stakeholders and relevant parties have been actively engaged by Quadrant Energy regarding its activities on the NW Shelf (including this activity) and also, where applicable the proposed oil spill response strategies for these activities.

No objections to the Driftwood-1 activity were raised during this consultation period and a summary of stakeholder responses is provided in **Table 5-2**.

**Table 5-2: Consultation summary for activity**

| Stakeholder | Assessment of Consultation Undertaken |
|---|---|
| **Fishing bodies** | |
| A Raptis and Sons | A Raptis and Sons was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No comment on this activity has been received to date, and the stakeholder has previously confirmed that no response means 'no concern' with the given activity. No action arising from this consultation for this EP. |
| Austral Fisheries | Austral Fisheries was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No comment on this activity has been received to date, and the stakeholder has previously confirmed that no response means 'no concern' with the given activity. No action arising from this consultation for this EP. |
| Australian Fisheries Management Authority | AFMA was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. Previous interaction with this stakeholder has reassured Quadrant Energy that a response would only be received in the event of concern regarding the planned activity. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| Australian Southern Bluefin Tuna Industry Association (ASBTIA) | ASBTIA was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. Kristin Rough of ASBTIA responded to the Quarterly Consultation Update on March 11, 2016, noting no concern with listed activities. No action arising from this consultation for this EP. |

| Stakeholder | Assessment of Consultation Undertaken |
|---|---|
| Commonwealth Fishing Association | The CFA was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents.<br>No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| Fat Marine | Fat Marine was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| Marine Tourism WA | MTWA was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No comment has been received to date relating to the WA-320-P activity. Previous interaction with this stakeholder has reassured Quadrant Energy that a response would only be received in the event of concern regarding the planned activity. No action arising from this consultation for this EP. |
| MG Kailis | MG Kailis was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No comment has been provided on this project at time of submission.<br>Kailis responded to the March Quarterly Consultation Update on March 12, 2016, noting no concern with listed activities. No action arising from this consultation for this EP. |
| Pearl Producers Association | The PPA was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| Quest Maritime Services | Quest Maritime Services was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| Recfishwest | Recfishwest was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| RNR Fisheries | RNR Fisheries was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| Western Australian Fishing Industry Council | WAFIC was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. In phone consultation on April 18, 2016, a WAFIC representative advised fishers had little concern with short drilling campaigns such as this and confirmed information would be passed on to members. No further action arising from this consultation for this EP. |
| Western Wild Fisheries | Western Wild Fisheries was provided the WA-320-P Drilling consultation package on March 18, 2016, and receive all Quadrant Energy's Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| WestMore Seafoods & Shark Bay Seafoods | These fishers were provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents.<br>WestMore Seafoods also represents Shark Bay Seafood, and operates within the Western Deep Water Trawl Fishery, North West Slope Trawl Fishery, Shark Bay |

| Stakeholder | Assessment of Consultation Undertaken |
|---|---|
| | Prawn Fishery, Pilbara Fish Trawl, Nickol Bay Prawn Fishery and the Kimberley Prawn Fishery zones.<br>No comment on this activity has been received to date, and the stakeholder has previously confirmed that no response means 'no concern' with the given activity. No action arising from this consultation for this EP. |
| **Marine Conservation** | |
| WA Department of Fisheries | Information regarding drilling in the WA-320-P permit was lodged using DoF's online Environmental Impact Assessment form on October 20, 2015.<br>DoF provided advice for the permit WA-320-P, dated 9 December 2015, regarding fishing activities and fish spawning grounds in the area, OPEP advice and biosecurity. Quadrant Energy incorporates this advice from DoF in all Quadrant Energy EPs.<br>Quadrant Energy advised on a name change for the activity from Palmerston-1 to Driftwood-1 and advised drilling was expected to commence in July 2016, in an email on April 1, 2016. DoF confirmed by email on April 5, 2016, the name change was understood and advice previously received on December 9, 2015, remains valid for this activity.<br>DoF was contacted on 14 June 2016 to confirm that Quadrant Energy has assessed the merits of the DoF's recommendation on biofouling controls. Quadrant Energy received a response from the DoF on 17/6/16 advising DoF's advice remains valid and raising no concern with Quadrant Energy's response.<br>Quadrant Energy commits to ongoing consultation with DoF to ensure this advice remains valid through the duration of this EP using DoF's online Environmental Impact Assessment form.<br>DoF receive Quadrant Energy's Quadrant Energy Quarterly Consultation Updates. |
| Department of Parks and Wildlife | DPaW was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents.<br>Based on historic consultation with this stakeholder, Quadrant Energy would not expect DPaW to comment on this activity given its distance from any marine conservation reserves.<br>No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| **Shipping safety and security** | |
| Australian Maritime Safety Authority | AMSA was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents.<br>AMSA responded to this consultation on March 23, 2016, noting vessel traffic in the area. Vessel traffic plot provided indicated major shipping fairways are not in the vicinity of the planned well.<br>Quadrant Energy ensures control measures are in place during drilling activities to manage risk in relation to the presence of other sea users, marine navigation and vessel safety.<br>No action arising from this consultation for this EP. |
| Department of Defence | The Department was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| WA Department of Transport | DoT was provided the WA-320-P consultation package on March 18, 2016. DoT responded on March 22, 2016, noting this information had been received and passed on to the relevant officer. No action arising from this consultation for |

| Stakeholder | Assessment of Consultation Undertaken |
|---|---|
| | this EP.<br>DoT receive all Quadrant Energy Quarterly Consultation Update documents.<br>Advice received through previous consultation and interaction with DoT has been adopted by Quadrant Energy in the preparation of the OPEPs. |
| **Adjacent Regulators** | |
| WA Department of Mines and Petroleum | DMP was provided the WA-320-P consultation package on March 18, 2016, and receive all Quadrant Energy Quarterly Consultation Update documents.<br>At the time of submission no response on the planned activity had been received. DMP is a valued stakeholder and Quadrant Energy commits to open on ongoing consultation before, during and after this activity Including the provision of pre-start and cessation notifications as per DMP's consultation guidelines. |
| **Adjacent Operators** | |
| BHP Billiton Petroleum | This operator was provided the WA-320-P consultation package on March 18, 2016. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| Chevron Australia | This operator was provided the WA-320-P consultation package on March 18, 2016. No response regarding the WA-320-P activity has been received to date. No action arising from this consultation for this EP. |
| ENI Australia | This operator was provided the WA-320-P consultation package on March 18, 2016. A representative responded March 23, 2016, with no objection and noting ENI equipment exists in permit WA-25-L as charted. No action arising from this consultation for this EP. |
| Woodside | This operator was provided the WA-320-P consultation package on March 18, 2016. A representative responded on March 29, 2016, noting this information had been received and raised no concern. No action arising from this consultation for this EP. |

## 6. ENVIRONMENTAL ASSESSMENT

The impact and risk assessment approach applied to the EP is consistent with the requirements of AS/NZS ISO 31000:2009 Risk Management – Principles and guidelines and ISO/IEC 31010 Risk management – Risk management techniques. The approach can be mapped to the requirements of the OPGGS (E) Regulations for an EP, as described by NOPSEMA (N04750-GN1344 Rev 2 2015). The key steps are illustrated in **Figure 6-1.**

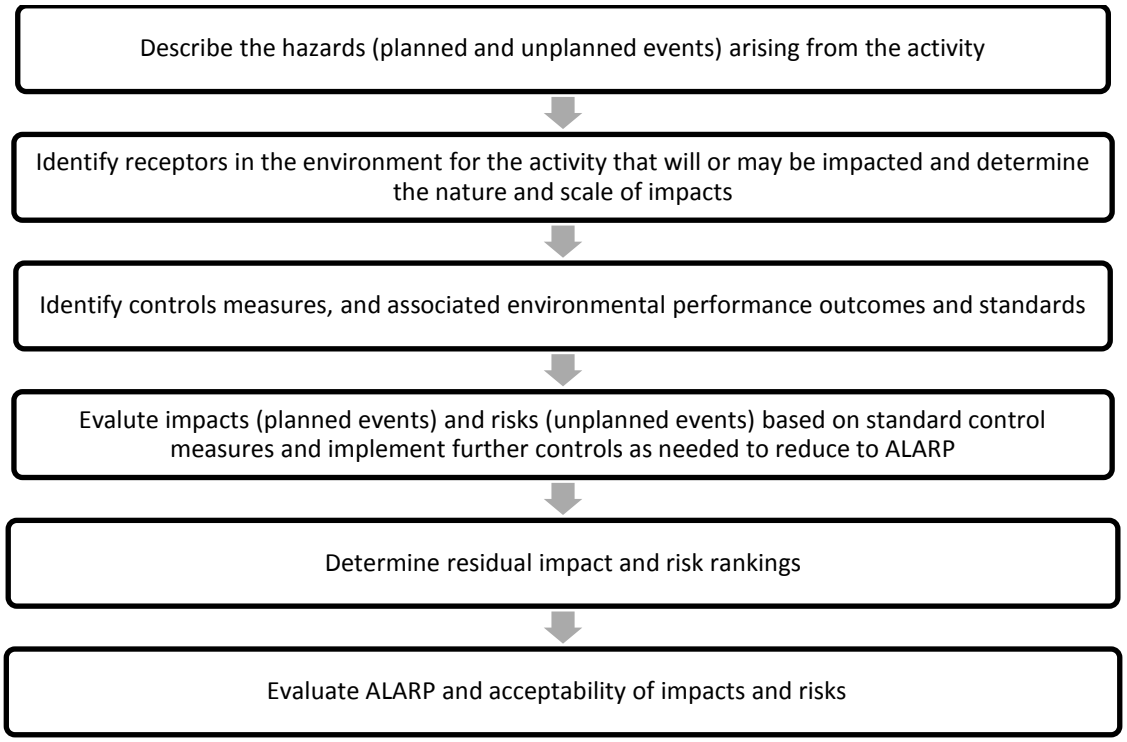


**Figure 6-1: Environmental impact and risk assessment process**

### 6.1 Summary of the environmental impact and risk assessment approach

Quadrant Energy's *Environmental Hazard Identification and Assessment Procedure* (EA-91-IG-004) includes consideration of the following factors in an impact and risk assessment:

- Description of the activity.
- Description of the EMBA.
- High environmental value (HEV) areas.
- Stakeholder consultation.
- Environmental legislation.
- Quadrant Energy policy.

These factors were considered in an environmental impact and risk assessment workshop held on 17 March 2016. The risk workshop involved participants from Quadrant Energy's Drilling and Competitions, HSE and Reservoir Engineering departments; and MODU contractor and specialised environmental consultants.

The environmental impact and risk assessment was based on the Driftwood-1 petroleum activity described in **Section 3**. The assessment identified eight potential unplanned events and seven planned events. Environmental aspects/hazards identified for the activity are summarised in **Table 6-1** and **Table 6-2**. The actual or potential impacts from each planned or unplanned event were assessed by considering the magnitude of an impact and sensitivity of the environmental receptors affected. Magnitude is a function of factors such as impact severity, extent and duration. Sensitivity is a function of factors such as vulnerability, uniqueness and protection status.

For the EP, the magnitude of an impact and sensitivity of environmental receptors affected were determined using modelling (e.g. hydrocarbon spill modelling), scientific reports, literature reviews and Quadrant Energy HSE professionals and specialist consultants.

### 6.2 Identifying control measures and performance requirements

For each planned and unplanned event, various control measures, environmental performance outcomes and performance standards, and measurement criteria were identified. The majority of these were based on Quadrant Energy's *Environmental Management Standards for Drilling and Completion Activities* (AE-00-ZD10001).

### 6.3 Determining impact and risk levels

For each planned and unplanned event, an environmental consequence (impact) level was assigned for each of the following receptors:

- Threatened/migratory fauna.
- Physical environment/habitat.
- Threatened ecological communities.
- Protected areas.
- Socio-economic receptors.

Each receptor has pre-defined impact criteria, which consider impact severity, extent and duration. Consequence levels considered during the environmental assessment were: Critical, Major, Moderate, Minor or Negligible. The consequence definitions are outlined below.

| Consequence Level | Description |
|---|---|
| Negligible | No impact or negligible impact. |
| Minor | Detectable but insignificant change to local population, industry or ecosystem factors. Localised effect with rapid recovery. |
| Moderate | Significant impact to local population, industry or ecosystem factors. Medium term recovery. |
| Major | Major long-term effect on local population, industry or ecosystem factors. Slow recovery over decades. |
| Critical | Complete loss of local population, industry or ecosystem factors AND/ OR major wide-spread regional impacts with slow recovery. |

For unplanned events, a risk ranking was also determined using an assessment of the likelihood (likelihood ranking) of the event as well as the consequence level of the potential impact should that event occur. The likelihood rankings used during the environmental assessment were: Very Rare, Rare, Very Unlikely, Unlikely, Likely, Possible and Expected.

### 6.4 Evaluating impact and risk acceptability

Quadrant Energy considers an impact or risk to be acceptable if the following criteria are met:

1. The consequence level of a planned event is ranked as Negligible or Minor; or the risk ranking of an unplanned event is ranked as Tolerable Risk or ALARP.
2. An assessment has been completed to determine if further information/studies are required to support or validate the consequence assessment. Additional information is utilised where required.
3. Performance standards are consistent with legal and regulatory requirements.

4. Activity is consistent with Quadrant Energy's Environmental Management Policy.
5. Stakeholder feedback relevant to the impact or risk has been evaluated and any concerns managed.
6. Control measures have been demonstrated to reduce the impact or risk to ALARP.

### 6.5 Evaluating if impacts and risks are ALARP

For planned and unplanned events, an assessment was undertaken to demonstrate that the standard control measures adopted reduce the impact (consequence level) or risk to as low as reasonably practicable (ALARP). This process relies on demonstrating that further potential control measures would require a disproportionate level of cost/effort in order to reduce the consequence level or risk. If this cannot be demonstrated, then the further controls are adopted. The level of detail included within the ALARP assessment is based upon the nature and scale of the potential impact or risk. For example, more detail is required for a risk ranked as ALARP compared to a risk ranked as Tolerable Risk.

### 6.6 Environmental assessment outcomes

**Table 6-1** and **Table 6-2** provide an environmental assessment summary for planned and unplanned events associated with the activity, including the control measures that will be implemented to ensure impacts and risks remain acceptable and ALARP for the duration of the activity.

**Table 6-1: Environmental assessment summary for planned events**

| Hazard / Event | Potential Impacts | Consequence | Control Measures | Required Performance |
|---|---|---|---|---|
| Light emissions | Continuous lighting in the same location from the MODU and support vessels for an extended period of time may result in alterations to normal marine fauna behaviour. | Negligible | None | No standard controls are in place other than those required for navigational and safety requirements. |
| Noise emissions | Noise generated by the MODU, support vessels, helicopters and VSP during the activity may result in potential impacts from noise disturbance to threatened/migratory and local cetaceans, turtles, whale sharks and fish which are either known to be present in or traverse the Operations Area. Underwater noise generated may impact on marine fauna by causing:<br>• Physical injury to hearing organs;<br>• Behavioural changes including displacement from biological important habitats (such as breeding feeding, calving and nursery sites); and<br>• Masking or inference with other biologically important sounds such as communication or echolocation systems.<br>The extent of the impacts from underwater noise on marine fauna will depend upon the noise frequency range, the intensity of the noise produced, the duration of the noise source and the sensitivity of the animal affected. | Negligible | Procedures for interacting with cetaceans. | Support vessels comply with Part 8 of the EPBC Regulations for interacting with cetaceans and maintain distance from cetaceans to reduce noise impacts from propellers.<br>Helicopter complies with Part 8 of EPBC Regulations for interacting with cetaceans to reduce noise impacts. |
| | | | MODU seismic survey procedures | Vertical seismic profile (VSP) or check-shot survey implemented in accordance with Quadrant Energy's Environmental Checklist for MODU Seismic Operations which includes controls that reduce the risk of harm to cetaceans, whale sharks and marine turtles (defined as marine fauna). The checklist includes the following standards:<br>• A crew member observing for marine fauna during daylight.<br>• Soft start procedures enacted over 30 minutes.<br>• Continuous operations providing no marine fauna within 1 km of the MODU during soft start.<br>• Shut down procedures enacted if marine fauna within 500 m of the MODU during continuous operations.<br>• Daylight operations continue into night providing there have not been 3 marine fauna shut downs in last 24 hours.<br>• Night start-up using soft start procedures providing not 3 marine fauna shut downs in the last 24 hours, or providing at least 2 hours of daylight observations within the last 24 hours and no marine fauna within 1 km of the MODU. |
| Atmospheric emissions | Air emissions caused by fuel combustion to power engines, generators and mobile and | Negligible | Fuel oil quality | Sulphur content of fuel oil will not exceed 3.5% m/m resulting in reduced sulphur emissions during the activity. |

| Hazard / Event | Potential Impacts | Consequence | Control Measures | Required Performance |
|---|---|---|---|---|
| | fixed plant, and equipment may result in a temporary, localised reduced of air quality immediately surrounding the discharge point. During the activity, discharges will include greenhouse gases (GHG), non-GHG, volatile organic compounds, ozone depleting substances (ODS), particulate matter (e.g. soot). | | Air pollution prevention certification | MODU and support vessels will maintain a current International Air Pollution Prevention (IAPP) Certificate which certifies that measures to prevent ozone-depleting substance (ODS) emissions, and reduce NOx, SOx emissions during the activity are in place. |
| | | | Ozone-depleting substance handling procedures | Ozone-depleting substances (ODS) managed in accordance with MARPOL Annex VI to reduce the risk of an accidental release of ODS to air. |
| | | | Waste incineration procedure | Waste incineration managed in accordance with MARPOL Annex VI to manage air pollution.<br>Incineration is prohibited on the MODU. |
| Planned operational discharges | Operational discharges will be small and depend on rainfall, machinery activity and the number of persons onboard. Discharges include sewage, brine (from desalination), cooling water, deck drainage, oily water and small volumes of chemicals. The small volumes of non-hazardous discharges may cause a decrease in water quality from localised nutrient enrichment, organic and particulate loading, thermal impacts and increased salinity primarily in surface (<5 m) waters.<br>Sensitive receptors that may be impacted include fish at surface, marine turtles and mammals, and seabirds. Given the offshore location and short duration, rapid dilution would occur such that lethal effects are not expected. | Negligible | Waste (garbage) management procedure | Procedure implemented to reduce the risk of unplanned release of waste (garbage) to sea. The procedure includes standards for bin types, lids and covers, waste segregation and bin storage.<br>No waste (garbage) discharged to sea, unless the waste is food waste disposed in accordance with MARPOL Annex V.<br>Pursuant to MARPOL Annex V, placards displayed to notify personnel of waste disposal restrictions. |
| | | | Deck cleaning product selection procedure | Deck cleaning products released to sea are not hazardous, are readily biodegradable and non-bio-accumulative. |
| | | | Sewage treatment system | Pursuant to MARPOL Annex IV, MODU and support vessels have a current International Sewage Pollution Prevention (ISPP) Certificate which certifies that required measures to reduce impacts from sewage disposal are in place.<br>Sewage discharged in accordance with MARPOL Annex IV.<br>Preventive maintenance on sewage treatment equipment is completed as scheduled. |
| | | | Oily water treatment system | Oily mixtures discharged to sea in accordance with MARPOL Annex I to reduce impacts from planned oil discharges.<br>Preventative maintenance on oil filtering equipment completed as scheduled.<br>Pursuant to MARPOL Annex I, a MODU and support vessel will have an International Oil Pollution Prevention (IOPP) Certificate which certifies that required measures to reduce impacts of planned oil |

| Hazard / Event | Potential Impacts | Consequence | Control Measures | Required Performance |
|---|---|---|---|---|
| | | | | discharges are in place. |
| Physical presence | The presence of the MODU and support vessels and associated safety exclusion zones while on location could potentially inhibit commercial shipping, fishing and other oil and gas activities, and the presence of vessels could pose a collision risk and inconvenience to fishing practices during these operations.<br>Seabed disturbance, leading to impact of benthic and associated marine fauna/flora as a result of planned and contingent activities (e.g. spudding of jack-up MODU legs, , tow line in contact with the seabed, spudding the well and installing conductor).<br>The seabed at the Driftwood-1 well location and the Operations Area is predicted to be composed of silt sediment underlain by clayey carbonate mud with occasional benthic fauna on an otherwise featureless seabed. Impacts from seabed disturbance are therefore likely to be short-term as mobile fauna rapidly recolonise the site, although infilling of the depressions on the seabed from positioning of the MODU are likely to take several years. | Minor | MODU move procedure | MODU move procedure contains a passage plan to reduce risk of collision. |
| | | | Site assessment process | To inform spud can placement to avoid impacting sensitive benthic habitats. Information is used to identify presence of significant raised seabed features and if present allow repositioning of spud can location if required to maximise the distance from the raised seabed features within the technically and financially feasible margins. |
| | | | MODU identification system | MODU has a RACON (radar transponder) or Automatic Identification System (AIS) to aid in its detection at sea. |
| | | | Standby vessel | Support vessel equipped with AIS to aid in its detection at sea, and radar to aid in the detection of approaching third party vessels.<br>Competent crew on the support vessel shall maintain a constant bridge watch.<br>At least one support vessel on standby at all times to monitor the MODU 500 m exclusion zone to identify approaching third-party vessels and communicate with the vessels. |
| | | | Maritime notices | Information provided to Australian Maritime Safety Authority (AMSA), Department of Defence Australian Hydrographic Service (AHS) and nearest port authority on MODU arrival and departure so that the maritime industry is aware of petroleum activities (including how the site is left) to reduce risk of vessel collision. |
| | | | Stakeholder consultation strategy | Relevant persons notified in advance of activities to reduce the impact to them.<br>Stakeholder database records all correspondence.<br>Quadrant Energy's Consultation Coordinator remains available before, during and after completion of the planned activity to ensure stakeholder feedback is evaluated and considered during the operational activity phases. |
| Drilling discharges | During drilling operations, drilling discharges including drilled solids or cuttings, drilling fluids and solid additives | Minor | Chemical selection procedure for drilling and cementing | Drilling and cementing chemicals used downhole are Gold/Silver/D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a complete risk assessment as per Quadrant Energy's *Drilling* |

| Hazard / Event | Potential Impacts | Consequence | Control Measures | Required Performance |
|---|---|---|---|---|
| | (e.g. barite), brine and cement chemicals are expected. Depending on the stage of activity, discharges may occur at the sea surface and/or seabed.<br>Sensitive receptors that may be effected due to drilling discharges at sea surface include fish at surface, marine turtles, mammals, cetaceans, sharks, whale sharks and seabirds. Mobile marine species are expected either to avoid turbid stretches of water or pass through with no significant impacts. Environmental receptors have the potential to be impacted through smothering (sediment deposition and toxicological effects) and through reduction to water quality (turbidity and toxicological effects).<br>The larger drill cuttings are expected to settle directly around the MODU, whereas finer particles associated with the drilling muds and cement discharges would be carried away with the prevailing currents and eventually settle. Local minor changes to soft sediment habitat will result from cuttings and associated drilling mud deposition near the MODU. | | chemicals. | *Fluid and Chemical Risk Assessment Procedure* (EA-91-II-008) so that only environmentally acceptable products are used. |
| | | | Cuttings management system | Reduces the concentration of drilling mud on cuttings prior to discharge while drilling with a closed circulating system, thereby reducing the total volume of mud lost to sea. Measures include:<br>• All well returns to the MODU are diverted to shale shakers, which separate the drilled cuttings/solids from the drilling fluid. The recovered drilling fluid is recycled to the mud pits and separated drilled cuttings/solids diverted overboard.<br>• The shale shakers are fitted with screens that meet API standards for solids removal particle size cut points.<br>• Shale shakers operated at a high drilled cutting/solids removal efficiency through API screen size selection optimisation.<br>• Centrifuges are used to remove additional finer drilled cuttings/solids that are too small for the shale shakers to remove.<br>• Shaker shakers are continuously inspected by the dedicated shale shaker hand whilst drilling to ensure: shakers are running and screens vibrating; whole drilling is not unintentionally flowing over the shakers screen to the cutting discharge chute; and shaker screens are not damaged or blinding. |
| | | | Inventory control procedure | Restricts the type and volume of drilling discharges, and includes a decision-making framework for managing left over bulk products.<br>Only residual water-based drilling fluids, brine, drill water, cement and cement spacer within MODU mud pits and surface tanks that is no longer required will be diverted overboard.<br>Unusable bulk cement, drilling fluid solid additives, brine, and drill water on-board the MODU managed according with the decision-making process detailed in the EP. |
| Hydrocarbon spill response activities (refer to | Impacts to the environment from implementing hydrocarbon spill response activities, including:<br>• Source control; | Minor | Standard Management Controls as per above, and in addition:<br>Spill response has an | Refer to **Section 8** for further information.<br><u>Overall spill response</u>:<br>• Spill response activities selected on basis of a NEBA.<br><u>Light Emissions</u>: |

| Hazard / Event | Potential Impacts | Consequence | Control Measures | Required Performance |
|---|---|---|---|---|
| **Section 8** for further information) | • Surface and subsea chemical dispersion;<br>• Monitoring and evaluation;<br>• Protection and deflection;<br>• Containment and recovery;<br>• Shoreline clean-up;<br>• Oiled wildlife response;<br>• Waste management; and<br>• Scientific monitoring.<br>Impacts would include those operational impacts previously specified from the operation of vessels and aircraft (including air, noise and artificial light emissions, vessel operational discharges, vessel presence and interference with other sea users, collisions with marine fauna, and invasive marine species).<br>There is the potential for these activities to create additional impacts or to exacerbate existing oil spill impacts.<br>Implementing oiled wildlife response may cause additional distress, physical and behavioral impacts, separation and increased predation to wildlife if not undertaken correctly.<br>The use of chemical dispersants has the potential to increase the concentration of entrained oil and dissolved aromatic hydrocarbons within the water column above sensitive habitats such as corals, seagrasses, macroalgae and other filter feeding organisms. This increase in concentration could also impact fish and invertebrates (e.g. prawns, pearl oysters) which support fisheries and aquaculture in | | overall net environmental benefit.<br>Light spill onto shorelines and coastal waters is reduced to ALARP during spill response.<br>Noise emissions reduced to ALARP during spill response.<br>Spill response vessel emissions meet MARPOL requirements.<br>Impacts from spill response operational discharges are reduced to ALARP.<br>Prevention of secondary contamination of oily waste and litter during spill response.<br>Disturbance to habitats, fauna and culturally sensitive areas during spill response is reduced to ALARP.<br>Additional impacts from dispersant application are reduced to ALARP.<br>Disruption to other users of marine and coastal areas and townships during spill response is | • No night time nearshore booming and skimming operations (vessels stand-off at night with navigation lighting only).<br>• Use of directional lighting for shoreline operations.<br>• Review shoreline lighting to a type (colour) that will reduce impacts to fauna.<br>• Selection of temporary camp sites in consultation with DoT and DPaW.<br><u>Noise Emissions</u>:<br>• Support vessel and aircraft compliance with EPBC Act Regulation 8 (cetacean interactions).<br>• Selection of temporary camp sites in consultation with DoT and DPaW.<br><u>Atmospheric Emissions</u>:<br>• Selection of non-harmful deck wash chemicals.<br>• Vessels meet applicable MARPOL and Marine Park sewage disposal requirements.<br>• Vessel meet applicable MARPOL requirements for oily water (bilge) discharges.<br>• Offshore equipment washdown confined to hotzone.<br>• Decant oily water from offshore containment and recovery behind boom.<br>• Approval from DoT/ AMSA prior to decanting oily water.<br>• Use of environmentally friendly degreaser for offshore washdown.<br>• Onshore equipment washdown in decontamination unit.<br>• Use of competent personnel.<br>• Low pressure flushing of shoreline habitats.<br>• Selection of appropriate water (salinity/temperature) for flushing.<br>• Use of booms to contain shoreline flushing liquids. Will be accepted on a case by case basis – may be preferred if remobilisation of oil could further impact sensitive habitats. May |

| Hazard / Event | Potential Impacts | Consequence | Control Measures | Required Performance |
|---|---|---|---|---|
| | the region. Dispersants will only be applied if the response is seen as having a net environmental benefit as per the overarching NEBA analysis of spill response strategies. | | reduced to ALARP. | not be applied if impacts from deploying booms exceed potential benefit.<br>• Compliance with controlled waste, unauthorised discharge and landfill regulations.<br>• Use of no-leachate containers for oily waste.<br>• Implementation of waste management plan. Will be implemented when large camp set-ups required.<br>• Municipal waste containers present onsite.<br>• Compliance with local government municipal waste requirements.<br>• Minimise waste going to landfill.<br><u>Physical Presence and Disturbance</u>:<br>• Use of shallow draft vessels for shoreline and nearshore operations.<br>• Vessel Risk Assessment Scoresheet (VRASS) completed for interstate and international vessels (only).<br>• Ballast water management plan for international vessels.<br>• Use of competent vessel crew/personnel.<br>• Conduct shoreline/nearshore habitat/bathymetry assessment. Accept based on potential for spill to enter sensitive shoreline locations and can be adopted during planning with minimal cost.<br>• Establish demarcation zones for vessel, boom and skimmer usage. Accept based on potential for spill to enter sensitive shoreline locations and can be adopted during planning with minimal cost.<br>• Maintenance and inspection personnel assigned to boom sets.<br>• OSRT Team Leader assessment/selection of vehicles appropriate to shoreline conditions.<br>• Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat.<br>• Operational restriction of vehicle and personnel movement to |

| Hazard / Event | Potential Impacts | Consequence | Control Measures | Required Performance |
|---|---|---|---|---|
| | | | | limit erosion and compaction.<br>• Prioritise use of existing roads and tracks.<br>• Use of competent personnel.<br>• Use of Heritage Advisor if spill response activities overlap with potential areas of cultural significance.<br>• Selection of temporary camp sites in consultation with DoT and DPaW.<br>• Pre-cleaning and inspection of equipment (quarantine).<br>• Soil profile assessment prior to earthworks.<br><u>Chemical Dispersant Application</u>:<br>• Chemical dispersant selected from AMSA approved list or risk assessed through Quadrant Energy's *Chemical Selection, Evaluation and Approval Procedure* (EA-91-II-10001).<br>• Dispersant application location and volume assessment undertaken.<br>• Selection of correct equipment for application.<br>• Use of competent personnel.<br><u>Disruption to Other Users of Marine and Coastal Area and Townships</u>:<br>• Stakeholder communication.<br>• Utility resource assessment and support to be conducted if activity is of significant size in comparison to the size of the coastal community.<br>• Accommodation assessment to reduce strain on accommodation.<br>• Security Management Plan (for large scale deployment in areas with potential security risk) to reduce potential for security threat causing disruptions in response activities.<br>• Transport Management Plan (for large scale deployment in highly populated areas) to reduce potential for traffic disruptions. |

**Table 6-2: Environmental assessment summary for unplanned events**

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| Dropped solid objects on the seabed | During the activity, objects could be dropped from the MODU or support vessels within the Operations Area from lifting operations, manual handling, MODU/vessel motion, unsecure fixtures and fittings, equipment collisions and malfunctions.<br>Seabed disturbance from unplanned dropped solid objects will be limited to the Operations Area and confined to the footprint of the dropped object.<br>The benthic habitat of the Operations Area is likely to be composed of clayey and silt sediment with traces of shell fragments and occasional benthic fauna. Impacts will be short-term as new benthic infauna and epifauna recolonise the area and sediment settles over disturbed area. | **Negligible** | **Tolerable Risk** | Dropped object prevention procedures | MODU Safety Case includes control measures for dropped objects that reduce the risk of objects entering the marine environment.<br>Lifting operations managed in accordance with MODU work instructions or procedures.<br>MODU objects dropped overboard are recovered to mitigate the environmental consequences from objects remaining in the marine environment unless the environmental consequences are negligible or safety risks are disproportionate to the environmental consequences. |
| Marine operations (physical interaction with marine fauna) | During the activity, support vessels have the potential to result in direct impacts to fauna through collisions with large marine fauna (cetaceans, whale sharks, marine turtles and sharks) that may transit the Operations Area and therefore be susceptible to vessel strike.<br>The Operations Area overlaps known migration fauna routes and the activity may be scheduled to be undertaken during their migration season. The Operations Area is not significant for marine fauna aggregations. | **Minor** | **Tolerable Risk** | Procedures for interacting with cetaceans | Support vessel complies with Part 8 of EPBC Regulations for interacting with cetaceans to avoid collision with cetaceans.<br>Reduces risk of vessel collision with cetaceans (and causing harm) by limiting speeds and approach distances in the presence cetaceans. |
| | | | | Standby vessel (bridge watch) | Competent crew on the support vessel shall maintain a constant bridge watch for monitoring of surrounding marine environment to identify potential collision risks (and reducing harm) including with marine fauna/ cetaceans. |
| | | | | Reporting arrangements | Any vessel strikes with cetaceans will be reported in the National Ship Strike Database at <https://data.marinemammals.gov.au/report/shipstrike> |
| Introduction of invasive marine | Invasive marine species (IMS) can be introduced by vessels carrying IMS on external biological fouling, internal systems | **Negligible** | **Tolerable Risk** | Biofouling vessel risk assessment | An international and domestic (interstate) plying MODU or support vessel has a completed biofouling vessel risk assessment (VRASS) to reduce the risk of introduced marine |

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| species | (sea chests, seawater systems etc.), on marine equipment (ROVs, etc.).<br>Ballast exchange may also result in the unplanned introduction of marine species (IMS). Cross contamination between vessels can also occur.<br>IMS, if they successfully establish, can out compete native species for food or space, preying on native species or changing the nature of the environment. Some IMS pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports and tourism.<br>The water depth in the Operations Area creates an unfavourable habitat for colonisation (i.e. light limiting and expected low habitat biodiversity – essentially bare sediment) and as such IMS introduction and establishment in the Operations Area is not expected. | | | | species.<br>The risk of introducing invasive marine pest species is assessed as 'low' as determined by the VRASS or acceptable as determined by a qualified IMS inspector in writing. |
| | | | | Ballast water management plan | The plan addresses requirements for compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediment 2004. |
| Non-hydrocarbon surface release – Solids | Non-hydrocarbon solids such as plastics have the potential to smother benthic environments and harm marine fauna through entanglement or ingestion.<br>Release of hazardous solids (e.g. wastes) may result in the pollution of the immediate receiving environment leading to detrimental health impacts to marine flora and fauna.<br>Physiological damage can result through ingestion, or absorption and may occur to individual fish, cetaceans, sharks, marine reptiles or seabirds. | **Minor or Negligible** | **Tolerable Risk** | Dropped object prevention procedures | Minimises drop risk during MODU lifting operations that may cause secondary spill (discharges) resulting in reduction in water quality.<br>As detailed previously (above). |
| | | | | Waste (garbage) management procedure | Waste management procedure implemented to reduce the risk of unplanned release of waste to sea.<br>As detailed previously (above). |
| | | | | Hazardous chemical management procedures | Reduces the risk of spills and leaks (discharges) to the sea by controlling the storage, handling and clean-up.<br>For hazardous chemicals, the following standards apply to reduce the risk of an accidental release to sea:<br>• Storage containers closed when the product is not being |

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| | | | | | used.<br>• Storage containers managed in a manner that provides for secondary containment in the event of a spill or leak.<br>• Storage containers labelled with the technical product name as per the safety data sheet (SDS).<br>• Spills and leaks to deck, excluding storage bunds and drip trays, immediately cleaned up.<br>• Storage bunds and drip trays do not contain free flowing volumes of liquid.<br>• Spill response equipment readily available. |
| | | | | General chemical management procedures | Aids in the process of chemical management that reduces the risk of accidental discharge to sea by controlling the storage, handling and clean-up.<br>SDS available for all chemicals to aid in the process of hazard identification and chemical management.<br>Chemicals managed in accordance with SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations. |
| | | | | Maritime Dangerous Goods Code | Dangerous goods managed in accordance with International Maritime Dangerous Goods Code (IMDG Code) to reduce the risk of an environmental incident, such as an accidental release to sea or unintended chemical reaction. |
| | | | | Bulk solid transfer procedures | Bulk solids transferred in accordance with bulk transfer procedures to reduce the risk of an unintentional release to sea. The procedures will require:<br>• Hose integrity: certified hoses replaced after 24 months of use.<br>• Hose flotation: bulk hoses in the water fitted with floatation collars.<br>• Valve alignment: a MODU supervisor checks that all valves are lined up correctly.<br>• Supervision: dedicated hose watch person while |

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| | | | | | pumping bulk product.<br>• Communications: constant radio communications between MODU control room, watch person and vessel.<br>• Inventory control: MODU control room monitors tank fill levels or air vents watched to detect tank overfill.<br>• Emergency shutdown: vessel emergency pumping stop tested before each transfer operation. |
| Non-hydrocarbon surface release – Liquids | An accidental release of chemicals and other non-hydrocarbon liquids (e.g. brine, muds, base fluids, cement, cleaning products, cooling agents, stored or spent chemicals, leftover paint materials etc.) into the marine environment may result in a reduction of water quality, which may which in turn may impact on the health and reproductive development of marine fauna (e.g. pelagic fish, cetaceans, marine reptiles and seabirds) and have a flow-on effect through the whole ecosystem including socio-economic receptors. Contaminated fish stocks can also pass on harmful chemicals to humans, if consumed.<br>The small volumes and rapid dispersion and dilution expected in the local receiving environment suggest that a liquid release would disperse in a short period of time. As a result, the area defined by concentrations that may result in toxic effects is relatively small.<br>No impacts are predicted to occur that would affect protected area values. No impact to regional ecotourism operators of local fisheries is expected. | **Negligible** | **Tolerable Risk** | Dropped object prevention procedures | Minimises drop risk during MODU lifting operations that may cause secondary spill (discharges) resulting in reduction in water quality.<br>As detailed previously (above). |
| | | | | Hazardous chemical management procedures | As detailed previously (above). |
| | | | | General chemical management procedures | As detailed previously (above). |
| | | | | Maritime Dangerous Goods Code | As detailed previously (above). |
| | | | | Bulk liquid transfer procedure | Bulk liquid transferred in accordance with bulk transfer procedures to reduce the risk of an unintentional release to sea. The procedures will require:<br>• Hose integrity: certified hoses replaced after 12 months of use, except for drill water and brine hoses which shall be replaced after 24 months of use.<br>• Hose flotation: bulk hoses in the water fitted with floatation collars.<br>• Hose connections: hoses used for hydrocarbons fitted |

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| | | | | | with hammer union connections at the MODU's manifold, self-sealing (dry-break) connections at the vessel end and self-sealing break-away connections when two or more hoses are joined together.<br>• Valve alignment: a MODU supervisor checks that all valves are lined up correctly.<br>• Tank venting: air vents for hydrocarbon storage tanks bunded if there is a risk of spill to deck.<br>• Supervision: dedicated hose watch person while pumping bulk product.<br>• Communications: constant radio communications between MODU control room, hose watch person and vessel.<br>• Inventory control: MODU control room monitors tank fill levels.<br>• Emergency shutdown: vessel emergency pumping stop tested before each transfer operation. |
| | | | | MODU and support vessel spill response plans | Effective management of an accidental spill on-board to reduce risk to the environment.<br>MODU and support vessel have and implement a Shipboard Oil Pollution Emergency Plan (SOPEP), or Shipboard Marine Pollution Emergency Plan (SMPEP), pursuant to MARPOL Annex I.<br>SOPEP or SMPEP spill response exercises conducted not less often than every three months to ensure personnel are prepared. |
| Hydrocarbon spill – Minor losses from operational activities | Accidental loss of fuel and other hydrocarbons used or stored onboard the MODU and support vessels (e.g. hydraulic fluids, lubricant oils and stored waste oils), during the activity to the marine environment.<br>The most credible worst-case spill scenario | **Minor** | **Tolerable Risk** | Dropped object prevention procedures | As detailed previously (above). |
| | | | | Hazardous chemical management | As detailed previously (above). |

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| | on board the MODU is considered to be loss of less than 1 $m^3$ of hydraulic fluid during transfer from a support vessel.<br>There is predicted to be only a minor effect on the local water quality owing to a detectable but localised impact. Due to relatively small spill volumes into open ocean environment, rapid dilution and dispersion is expected.<br>No impacts are predicted to occur that would affect protected area values. No impact to local fisheries is expected. | | | procedures | |
| | | | | General chemical management procedure | As detailed previously (above). |
| | | | | Maritime Dangerous Goods Code | As detailed previously (above). |
| | | | | MODU and support vessel spill response plans | As detailed previously (above). |
| | | | | Remotely operated vehicle (ROV) inspection and maintenance procedures | Maintenance and pre-deployment inspection on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to sea. |
| Hydrocarbon spill – Diesel | Diesel spill as a result of:<br>• Vessel collision;<br>• Refuelling incident (fuel hose failure/rupture, coupling failure or tank overfilling); and<br>• Other minor diesel spills.<br>The worst-case release of marine diesel (250 $m^3$) to the environment is that resulting from the rupturing of a side mounted fuel tank of a support vessel during a vessel | **Moderate** | **ALARP** | MODU move procedure | MODU move procedure contains a passage plan to reduce risk of collision. |
| | | | | Bulk liquid transfer procedures | As detailed previously (above). |
| | | | | MODU and support vessel spill response plans | As detailed previously (above). |

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| | collision.<br>Hydrocarbons are predicted to reach offshore islands and mainland shorelines with low contact (hydrocarbons ashore) probabilities of <16% (Montebello Islands, the Lowendal Islands, Barrow Island, Thevenard Island, the Southern Islands Coast, Ningaloo Coast South, the Muiron Islands, and the Outer Shark Bay Coast). The only threshold exceedances (total and dissolved WAF) were predicted at offshore receptors (Offshore Ningaloo, Outer Ningaloo Coast North).<br>No protected areas are predicted to be contacted by diesel above the oil spill modelled threshold values.<br>Threatened/ Migratory fauna will be at risk of contact from oil. Potential impacts to marine fauna from ingestion, oiling/smothering; and toxicological effects. Deterioration of water quality and impacts to shallow water environments and sensitive coastal receptors from hydrocarbons that reach shorelines. | | | Maritime notices | Information provided to Australian Maritime Safety Authority (AMSA), Department of Defence Australian Hydrographic Service (AHS) and nearest port authority on MODU arrival and departure so that the maritime industry is aware of petroleum activities to reduce risk of vessel collision. |
| | | | | Standby vessel | To reduce risk of vessel collision and subsequent unplanned release of hydrocarbons (diesel) causing potential harm to the marine environment.<br>Support vessel equipped with AIS to aid in its detection at sea, and radar to aid in the detection of approaching third party vessels.<br>Competent crew on the support vessel shall maintain a constant bridge watch.<br>At least one support vessel on standby at all times to monitor the MODU 500 m exclusion zone to identify approaching third-party vessels and communicate with the vessels. |
| | | | | The *Driftwood-1 Exploration Drilling Oil Pollution Emergency Plan* (EA-00-RI-10157). | In the event of an oil spill to sea, the Quadrant Energy OPEP requirements will be implemented to mitigate environmental impacts and to ensure effective management of an accidental hydrocarbon spill (discharge to sea) to reduce impact to the environment.<br>Refer to **Section 8** for Hydrocarbon Spill Response Arrangements. |
| | | | | MODU identification system | MODU has a RACON (radar transponder) or Automatic Identification System (AIS) to aid in its detection at sea. This will minimise risk of vessel collision. |
| Hydrocarbon spill – Loss of well control | Loss of well control is a risk for all petroleum drilling activities.<br>Light crude oil may be released either at the | **Major** | **ALARP** | Well operations management plan (WOMP) | Includes control measures for well integrity that reduce the risk of an unplanned release of hydrocarbons. |

| Hazard / Event | Potential Impacts | Consequence | Residual Risk | Control Measures | Required Performance |
|---|---|---|---|---|---|
| | MODU floor or seabed. Worst-case release of 7,932 $m^3$ of light crude oil until well control can be established.<br>Environmental impacts are predicted to be greater for an oil spill released at the MODU floor. Oil dissolution and entrainment of the released oil droplets are predicted to be low and therefore the highest risk of environmental impact is posed by floating oil and oil reaching shorelines.<br>Six 'hotspots' considered as the most sensitive environmental areas within the EMBA and those at highest risk (vulnerability) to oiling impacts (based on predicted shoreline oil loading and probability of shoreline oil loading: Barrow Island, Montebello and Muiron Islands, Ningaloo Coast North, Outer Ningaloo Coast North and Outer NW Ningaloo.<br>Potential impacts to marine fauna from ingestion, oiling/smothering; and toxicological effects. Deterioration of water quality and impacts to shallow water environments and sensitive coastal receptors from hydrocarbons that reach shorelines. | | | Safety Case | MODU Safety Case includes control measures for well control that reduce the risk of an unplanned release of hydrocarbons. |
| | | | | Well lifecycle management system | Includes control measures for well integrity and well control that reduce the risk of an unplanned release of hydrocarbons. |
| | | | | The *Driftwood-1 Exploration Drilling Oil Pollution Emergency Plan* (EA-00-RI-10157). | As detailed previously (above). |

## 7. MANAGEMENT APPROACH

The implementation strategy described in the EP is comprised of, but not limited to, the following key elements:

1. Environmental management system and policy.
2. Environmental control measures, performance standards and performance outcomes.
3. Leadership, roles and responsibilities.
4. Workforce training and competencies.
5. Inspections and monitoring.
6. Management of change.
7. Reporting requirements.
8. Performance review and continuous improvement.

Senior Quadrant Energy and contractor personnel will be accountable for ensuring conformance with the EP. All personnel will be made aware of the EP and empowered to 'stop-the-job' to ensure the activity is managed in an environmentally responsible manner.

During the activity, Quadrant Energy will ensure environmental performance is managed through an inspection and monitoring regime on the MODU and support vessels.

Non-conformances will be investigated and resolved using a systematic corrective action process. Non-conformances will be documented in Quadrant Energy's incident management system.

Improvement opportunities identified through inspections, monitoring and incident investigations will be assessed and if accepted, communicated and implemented in a controlled manner.

Incident notification and reporting to NOPSEMA, and other regulators, will be conducted as per the OPGGS (E) Regulations and as detailed within the EP. An end-of-activity environmental performance report will be submitted to NOPSEMA.

Quadrant Energy's *Environmental Management of Change Procedure* (MOC) (EA-91-IQ-10001) process provides a systematic approach to initiate, assess, document, approve, communicate and implement change. The MOC process will be applied should there be a change to the activity, change to environmental impacts or risks, or change in the manner in which the environmental impacts and risk will be managed (i.e. controls or implementation strategy).

## 8. HYDROCARBON SPILL RESPONSE ARRANGEMENTS

Credible hydrocarbon spill scenarios are identified in **Table 4-1**. In the event of a spill, initial actions will be managed offshore in line with the MODU or support vessel Shipboard Oil Pollution Emergency Plan (SOPEP). Should the spill require further action, such responsibilities will be taken over by the Combat Agency, in this instance Quadrant Energy in accordance with the *Driftwood-1 Drilling Oil Pollution Emergency Plan (OPEP)* (EA-00-RI-10157).

The following response strategies may be applied to credible spill scenarios:

- Source control: relief well, well intervention and deployment of subsea first response toolkit (SFRT);
- Subsea chemical dispersion;
- Monitor and evaluate: surveillance and spill fate modelling;
- Surface chemical dispersion (of floating oil);
- Protection and deflection;
- Containment and recovery of oil;
- Physical dispersion of floating oil: mechanical dispersion through use of vessels;
- Shoreline clean-up;
- Oiled wildlife response operations: including hazing and capture/treatment; and
- Operational and scientific monitoring: to determine extent of spill and impact and recovery assessment of sensitive marine receptors exposed to oil – tier 2 and 3 spills.

A justification and description of the strategies is provided in **Table 8-1**.

### 8.1 Preparedness and implementation of response arrangements

Quadrant Energy will implement its OPEP in the event of a significant hydrocarbon spill (tier 2 or 3). In order 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. Quadrant Energy will also implement its oil spill response exercise and training schedule.

Following acceptance of an OPEP, the arrangements of the plan are tested by the Emergency & Oil Spill Coordinator through a communications test to all external agencies and companies with roles defined within the plan. The external agencies and companies/suppliers are notified of the start-up schedule of the activity and are evaluated for the preparedness to deliver on their committed function.

**Table 8-1: Applicable oil spill response strategies for the activity**

| Strategy | Applicability | | Justification and Description |
|---|---|---|---|
| | Light Crude | Diesel | |
| Source control | Yes | Yes | Source control is one of the first response strategies implemented when mounting a spill response. Source control minimises the volume of hydrocarbons lost to the environment by securing the source of the spill. For diesel refuelling spills and diesel tank rupture (collision scenarios source control options include ESD of pumps, closing drainage system, implementing shipboard spill clean-up equipment, redistributing stored hydrocarbons into slack tanks or into other vessels, vessel trimming and plugging and repairing of leaks.<br>For a loss of well control scenario, source control options include drilling for a relief well (primary control), direct intervention using well control experts (if safe and technically feasible to do so), and deployment of subsea first response tool kit (SFRT). A subsea Capping Stack is not a viable option for controlling wells drilled using a Jack-up drilling rig and therefore cannot be installed to cap a subsea leak in this instance. |
| Source control (subsurface chemical dispersion) | Yes (only as part of source control) | No | Subsea dispersants aim to increase dispersion (entrainment of fine oil droplets) of oil released subsea and reduce the amount of oil expressing at surface. Subsea chemical dispersant injection can result in less chemical dispersant being used (in comparison to surface application) as the application is more targeted and concentrated. By reducing the volume of oil expressing at surface near the release site, subsea dispersants may reduce the volume of oil loading onto shorelines.<br>However, by reducing surface expression of oil, the opportunity for the oil to evaporate at surface is reduced. For the type of oil expected to be encountered for this activity (light crude) it is considered better to allow the oil to volatilise at surface rather than reduce surface expression near the release site. Nevertheless, subsea dispersant use may be beneficial to aid source control decision-making or may be of environmental benefit if the oil does not volatilise to the degree expected. For these reasons it is kept as an option for spill response.<br>The decision for application of this response, as with all response options, will be subject to a Net Environmental Benefit Analysis (NEBA). |
| Monitor and evaluate | Yes | Yes | Monitor and Evaluate activities include vessel and aerial surveillance, spill fate modelling, remote sensing/satellite imagery and use of tracking buoys.<br>Surveillance activities are used to monitor and evaluate the dispersion of the released hydrocarbon, and to identify and report on any potential impacts to flora and fauna that may occur while the spill disperses.<br>Surveillance results are used to assist in escalating or de-escalating response strategies as required.<br>This strategy is vital to ensure that there is sufficient information to gain situational awareness and make informed decisions on response planning and execution. Data from monitor and surveillance activities will be used to inform the NEBA. |
| Physical dispersion | Yes | No | Physical dispersion is unlikely to be applied near the release site due the nature of the oil type - preferentially relying on evaporation or recovery strategies rather than dispersing components of the |

| Strategy | Applicability | | Justification and Description |
|---|---|---|---|
| | Light Crude | Diesel | |
| | | | hydrocarbon into the water column. Mechanical dispersion may be used opportunistically in the vicinity of shorelines once oil has already undergone weathering over the initial days following a spill. This is most likely to be performed opportunistically by vessels engaged in offshore booming especially if containing and collecting the oil using booms is proving ineffective. |
| Surface chemical dispersion | Yes | No | Surface chemical dispersant may be viable, either by vessel or plane.<br>Based on the expected properties of the oil encountered a high degree of evaporation (expected 50-60% of volume) will occur within the first 12 hours of the spill. Dispersant effectiveness is also predicted to be highest within 12 hours of the spill based on crude testing on an oil expected to have similar properties to those likely to be encountered but of lower efficiency than evaporation in removing oil from the surface. Based on these results, the natural process of volatilisation is expected to be the favoured process of removing oil volume from the environment and reducing shoreline loading.<br>Natural volatilisation is considered a more environmentally acceptable process over chemical dispersant application given chemical dispersants increase the volume of oil within the water column which could lead to impacts to submerged receptors.<br>Nevertheless, surface dispersants have been kept as an option should the dispersant amenability window be longer than expected or if oil behaves differently to expected, in terms of weathering properties. This information would only be known at the time of the spill and will be collected through monitor and evaluate strategies, providing data for the NEBA decision-making process. |
| Containment and recovery | Yes | No | For a spill resulting from this activity, volatilisation/evaporation is initially the preferred way to remove hydrocarbons from the water. Containment and recovery could be employed near sensitive shorelines to reduce the volume of oil loading. However, given that oil is predicted to spread thinly near shorelines, due to the light properties and low worst-case release rate, containment and recovery may not be efficient in collecting worthwhile volumes of oil from the surface (1 $m^3$/day is set as minimum target). Notwithstanding this, offshore booming may provide some benefit in mechanically breaking up and dispersing oil near shorelines (mechanical dispersion). |
| Protection and deflection | Yes | Yes | Activities are focused on areas of high protection value in low energy environments based upon real-time operational surveillance provided the environmental and metocean conditions are favourable for an effective implementation. Consequently, this strategy may not be applicable across all receptors identified as priority for protection. |
| Shoreline clean-up | Yes | Yes | Contacted shorelines will be assessed for their shoreline clean-up potential. This response has the potential to cause secondary disturbance associated with the clean-up, so applicability of the strategy is based on aerial surveillance reconnaissance, Oiled Shoreline Response Team (OSRT) observations and NEBA in the shoreline clean-up assessment. Given the light nature of the oil and the low concentration of oil expected to accumulate on shorelines, clean-up techniques may not be efficient and may not be employed based on outcome of a NEBA. Natural or assisted bioremediation may be more applicable than direct intervention and removal of oil, oiled sediments and oiled flora. |

| Strategy | Applicability | | Justification and Description |
|---|---|---|---|
| | Light Crude | Diesel | |
| Operational and Scientific Monitoring | Yes | Yes | Operational monitoring activities include initial surveillance monitoring, hydrocarbon characterisation and weathering, shoreline and coastal habitat assessment and megafauna assessment.<br>Scientific monitoring activities may include water and sediment quality monitoring, shoreline and coastal habitat monitoring (including sandy/rocky shores, intertidal zones and mangroves), benthic habitat monitoring and monitoring of seabird/shorebirds, marine mammals and turtles. In addition fish, fisheries and aquaculture and seafood monitoring may be initiated.<br>Extent/impact of spill to determine the extent of operational and scientific monitoring. Resources are available to implement operational and scientific monitoring as required. |
| Oiled wildlife response | Yes | Yes | Mobilisation of experts, trained work forces, facilities and equipment will likely be needed if oil reaches shorelines and nearshore waters. Wildlife response activities may take place at sea, on shorelines and in specialised facilities further inland.<br>Options for wildlife management have to be considered and a strategy determined guided by the Western Australian Oiled Wildlife Response Plan (WAOWRP). |
| In situ burning | No | No | In-situ burning is not an applicable response strategy given several limiting factors that are likely to prevent implementation. For in-situ burning to be undertaken oil has to be thicker than 1-2 mm but as light crude (and diesel) tend to have high evaporation rates and spread into very thin films rapidly, this strategy is not applicable for this activity.<br>In-situ burning cannot be undertaken in rough conditions as containment is likely to be interrupted by winds greater than approximately 20 knots and waves are higher than 3 feet. |

## 8.2 Net environmental benefit analysis

During any response incident, there is a documented decision-making process to ensure that response strategies are identified and evaluated prior to implementation via the Incident Action Plan (IAP). The Incident Control Team use a Net Environmental Benefit Analysis (NEBA) process to inform the development and refinement of the IAPs, to ensure the most effective response strategies with the least detrimental environmental impacts are identified, documented and executed. The Environmental Team Lead is responsible for reviewing the priority receptors identified within the EP and the OPEP, and with real-time knowledge of the fate and transport of the spill, apply the NEBA.

The application of the NEBA is to:

- Identify sensitivities within the area potentially affected by a spill at that time of the year;
- Assist in prioritising and allocating resources to sensitivities with a higher ranking; and
- Assist in determining appropriate response strategies.

## 8.3 Oil spill response resources

Oil spill response equipment and resources are a combination of Quadrant Energy, AMOSC (Australian Marine Oil Spill Centre Pty Ltd), AMSA, DoT, National Plan (NatPlan), OSRL (Oil Spill Response Limited), and other operator resources available through the AMOSPlan mutual aid arrangements. Under the

Memorandum of Understanding (MOU) between AMSA and Quadrant Energy, AMSA will provide all resources available through NatPlan to support a Quadrant Energy spill response. The DoT coordinates the State Response Team (SRT) oil spill response personnel and equipment resources. The DoT will work with Quadrant Energy in an oil spill response and will define termination criteria for the shoreline operations designed to reduce the environmental impacts and risk to as low as reasonably practicable (ALARP) in State waters. Where oil contacts shorelines in Commonwealth waters, Quadrant Energy will work with the Department of the Environment to establish shoreline clean-up priorities, activities and termination criteria.

In the event of an oiled wildlife response, Quadrant Energy will activate the West Australian Oiled Wildlife Response Plan (WAOWRP) and work with DPaW in determining resources and capability requirements. DPaW and Industry (AMOSC) Oiled Wildlife Advisors (OWAs) ensure minimum standards for oiled wildlife response, as outlined within the WAOWRP, are met and ensure timely mobilisation of appropriate resources (equipment and personnel) through communication with the wildlife logistics team. Quadrant Energy is able to access:

- AMOSC core group responders;
- DPaW staff and approved volunteers/subject matter experts;
- Additional local resources under current contracts and suppliers; and
- Access international support through Wildlife Response Services.

During and post-spill scientific response monitoring activities require resources external to Quadrant Energy and include specialist technical capabilities. Astron Environmental Services Pty Ltd (Astron) is contracted as Quadrant Energy's primary control support agency for scientific response monitoring activities. If additional support is required, Quadrant Energy has Master Service Agreements with other service providers to support scientific response monitoring activities.

## 9. CONTACT DETAILS

Further information about the Driftwood-1 drilling activity can be obtained from:

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