Outer Barrow Exploration & Appraisal Drilling Environment Plan Summary

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1. INTRODUCTION

Quadrant Energy Australia Pty Ltd (Quadrant) is the registered operator for petroleum production Licence's WA-214-P, WA-33-R, WA-55-R, WA-192-P, WA-29-L, WA13-L. Quadrant plan to further develop the gas condensate reserves of the Outer Barrow region in Commonwealth waters within these permit areas through the drilling of exploration and appraisal wells. Assuming a maximum success rate and favourable market conditions for exploration, Quadrant Energy estimates up to a maximum of 10 wells maybe drilled within these permits over the period of validity (5 years) of this Environment Plan (EP).

1.1 Titleholders

Table 1-1 lists the titleholder companies for the petroleum activities covered under this EP.

1.2 Compliance

The overall purpose of the *Outer Barrow (EA-00-RI-10066)* Environment Plan (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 environmental policies and standards, including the corporate Environmental Policy. The EP was assessed and accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) on the 29th October 2015. 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 duration for drilling each well will vary from approximately 20 to 80 days depending on the well design/reservoir target (with an average of 30 -40 days). In the event that unplanned events occur it is also possible that the estimated number of days may be exceeded on any one well.

During the activity, operations will be 24 hours per day. The first activity is scheduled to commence in quarter one 2016.

Table 1-1 Title Holder Details for Outer Barrow Exploration and Development Wells

Aspect	Davis-1	Spartan-1	Kultarr-2	Scott-1	John Brookes-7	East Spar Infill-1 East Spar Infill-2
Permit	WA-214-P	WA-33-R	WA-55-R	WA-192-P	WA-29-L	WA-13-L
Title holder	Quadrant Northwest Pty Ltd	Quadrant Oil Australia Pty Limited	Quadrant Northwest Pty Ltd	Quadrant Northwest Pty Ltd	Quadrant Northwest Pty Ltd	Quadrant Oil Australia Pty Ltd
Other Title holder	Santos (BOL) Pty Ltd	Santos (BOL) Pty Ltd Tap (Shelfal) Pty Ltd Hydra Energy (WA) Pty. Ltd.	Harriet (Onyx) Pty Ltd	Kufpec Australia Pty Ltd	Santos (BOL) Pty Ltd	Quadrant Kersail Australia Pty Ltd Quadrant East Spar Pty Ltd Santos (BOL) Pty Ltd
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2. ACTIVITY LOCATION

The Activity location (Project Area) is defined by petroleum permit permits WA-214-P, WA-33-R, WA-55-R, WA-29-L, WA-13-L and WA-192-P located within Commonwealth waters of the Carnarvon Basin in the NW Shelf region of Western Australia (**Figure 2-1**).

Within the Project Area, activities will be undertaken over smaller areas referred to as the Operational Areas. The Operational Area is defined as the permit area within which the MODU is connected or intended to be connected to the seabed. Only one MODU will be operating in the Operational Area at any point in time, however multiple support vessels and helicopters may be operating in the Operational Area at any one time.

The Project Area is approximately 90 km from the closest mainland coast, 150 km from Dampier and 100 km from Onslow (closest population centres). Permits WA-55-R and WA-192-P are the closest to a land mass (the Montebello Group, approx. 7 km away) and are located within the Montebello Commonwealth Marine Reserve (CMR) sharing boundaries with the Montebello Islands State Marine Park (MP). The remaining four permit areas are to the west of WA-55-R and WA-192-P and out of these, only WA-214-P is also partially located within the Montebello CMR.

Error! Reference source not found.**Table 2-1** summarises the proposed permits, approximate water depths and target reservoir.

Table 2-1: Summary of the Activity

Permit	WA-214-P	WA-192-P	WA-33-R	WA-55-R	WA-29-L	WA-13-L
Water Depth (range)	108 – 134 m (SW Permit) 20 – 72 m (NE Permit)	30-40 m	50 – 84 m	27-47 m	56-98 m	84 – 112 m
Target Reservoir	Maitland Sandstone		Barrow Group	Flag Sandstone	Upper Barrow Group	

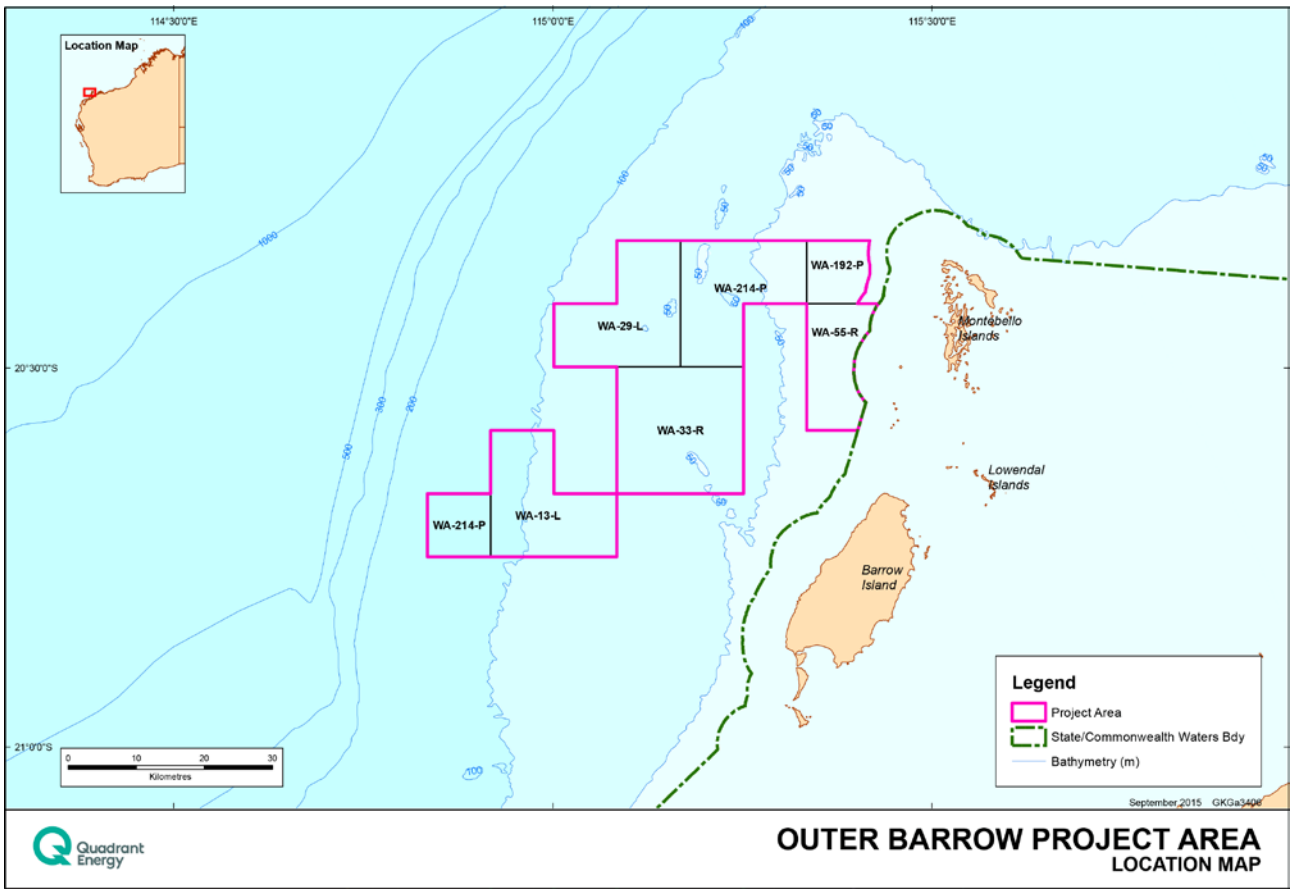

Figure 2-1: Permit areas (Project Area) covered by this EP.

3. DESCRIPTION OF THE ACTIVITY

3.1.1 Activities

This EP covers drilling, evaluating, completing, and abandoning activities related to exploration/appraisal and development gas wells, and can include any /all of the following:

- Riserless drilling;
- Installation of a blow-out preventer (BOP);
- Drilling using Water Based Muds (WBM);
- Contingency drilling using Non-Aqueous Fluid (NAF) muds;
- Contingency use of Loss Circulation Materials (LCM);
- Installation of lower and upper completions;
- Perforating operations and flowback/clean up,;
- Use of chemicals for well completion and appraisal activities;
- Cementing of casing strings;
- Wireline logging;
- Contingent Vertical Seismic Profiling (VSP);
- Plug and abandonment of exploration wells;
- Installing completions and suspending[1];
- Handing well over to production teams;
- Well testing (sampling, clean up and flaring);
- Stimulation treatment of production zones;
- Side tracking and/or redrilling sections of wells due to operational difficulties or scope change to acquire additional well evaluation data;
- MODU commissioning activities (e.g. equipment testing, tank cleaning); and
- Temporary placement of equipment on the seabed.

Activities that are not covered in this EP include, but are not limited to, installation, production and decommissioning activities as well as vessel based seismic surveys.

3.1.2 MODUs

Drilling will be undertaken using either a jack-up or a semisubmersible MODU which will remain at location (i.e. drilling site). The actual rigs used may change during the five-year program. Although extremely unlikely, concurrent drilling activities over two wells are possible over the Project Area, but will not be within the same permit (operational) area.

3.1.3 Exploration and appraisal wells.

These well will be drilled in three sections: surface, intermediate, and production. The surface section will be drilled using seawater and bentonite sweeps and discharges will be returned to the seabed in this uncased section. The intermediate and production sections will be drilled with inhibited polymer water

[1] In the event Quadrant Energy would like to convert a well to a producer, wells may be temporarily abandoned (suspended) and additional activities would be covered under a separate Environment Plan (ie Operation/ Development Well EP).

based mud (WBM). The extracted cutting and recoverable fluids (WBM) generated while drilling the lower two well intervals will be brought to the MODU through the riser, before being treated by solids control equipment to separate the drilling fluid from the cuttings before discharge of cuttings to the marine environment at sea surface.

The riserless sections of the well will be drilled with seawater and gel sweeps, the drill cuttings can only be discharged to the seabed. Once the conductor/surface string is installed however, cuttings are returned to the surface with the drilling fluid and are screened by the MODU shakers to remove the entrained cuttings. The recovered mud is then pumped to the mud tanks for reuse during the drilling program.

3.1.4 Well abandonment

After final well operations, the Outer Barrow wells will be permanently abandoned by installing and testing down hole barriers (such as cement) prior to severing all casing strings below seabed.

3.1.5 Drilling Discharges

Drilling discharges account for:

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

A heat exchanger/heater may also be used in well testing and heated water (i.e. fresh or seawater) will be discharged to sea.

3.1.6 Well evaluation and testing

Well testing and evaluation involves the collection of data on the well and surrounding formation. Wireline logging will be conducted during drilling activities and it is also possible that VSP will be used.

In some cases, the hydrocarbons in the reservoir may need to be tested to appraise their type, quantity and flow rate. To do this, the hydrocarbon from the reservoir is flowed at varying rates for periods ranging from a few hours to a few days. As there are no production handling facilities on the drilling rig, it is customary to dispose of the produced gas and/or oil by burning.

During well testing, formation water may be produced from the reservoir. Any formation water produced would be discharged to the marine environment following oil filtration.

3.1.7 Support Vessels

The MODU will be assisted by up to four support vessels that will transfer food, bulk drilling fluid materials, diesel and equipment used in the drilling process.

A support vessel standby mooring may be installed for the activity period.

3.1.8 Helicopters

Helicopters will be used for crew changes and medivac, and occasionally equipment and material deliveries. Helicopter flights will occur several times a week dependent on the progress of the drilling program and logistical constraints.

3.1.9 ROV Operations

Remotely operated vehicle (ROV) operations and surveys will occur periodically throughout the Activity to determine the condition of subsea infrastructure (including submerged parts of the MODU), monitor drilling operations, manipulate subsea equipment, and confirm site adequacy (site survey if required).

3.1.10 Waste

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

- Deck drainage;
- Putrescible waste and sewage;
- Oily water;
- Cooling water from operation of engines;
- Desalination plant effluent (brine) and backwash water discharge;
- Ballast water; and
- Solid and liquid waste.

3.1.11 Fuel and Chemical Handling

The main engines and equipment (e.g. pumps, cranes, winches, power packs, generators) used on MODUs, and support vessels require diesel for fuel, hydraulic fluid and lubricating oils for operation and maintenance of moving parts.

4. DESCRIPTION OF ENVIRONMENT

4.1 Environment that May Be Affected (EMBA)

Although most events and hazards may only affect the environment within a few hundred metres around the MODU, the worst case potential environmental impact is linked to unplanned hydrocarbon releases and may extend substantially beyond a few hundred metres. The largest predicted impact area is linked to the loss of containment scenario (GHD, 2014) (**Table 4-1**) and it was used to define the Environment that May Be Affected (EMBA) (**Figure 2-1)**. The combined EMBA was used to complete a search of the Matters of National Environmental Significance (MNES) data base, which in turn identified the environmental values and sensitivities within the existing environment.

Table 4-1 Summary of largest credible hydrocarbon spill events considered

Scenario	Hydrocarbon Type	Maximum Credible Volume	Comment
Minor hydrocarbon spills		0.16 m^3	Maximum credible ROV hydraulic fluid loss
Hydrocarbon spill (diesel) during refuelling	Diesel	20 m^3	Maximum credible volume based on 15 minutes of flow at a pumping rate of 1.25 m^3/min.
Hydrocarbon spill (diesel) from vessel collision – vessel tank		250 m^3	Maximum credible volume based on the holding capacity of largest flank fuel tank on support vessel.
Hydrocarbon spill from a loss of containment scenario – **surface** release	Condensate	1,180,000 m^3 (<15,500 m^3/d)	Highest flow potential derived by combining the most optimistic flow parameters
Hydrocarbon spill from a loss of containment scenario – **seabed** release		1,190,000 m^3 (<15,700 m^3/d)	

Stochastic hydrocarbon dispersion and fate modelling, applied to the largest credible hydrocarbon spill scenarios summarised in **Table 4-1**, was undertaken to determine the extent of three key physical and/or chemical phases of the hydrocarbon that pose differing environmental risks: surface oil (10 g/m^2), total water accommodated fraction (WAF)(500 ppb) and dissolved aromatic hydrocarbons (DAH)(100 ppb). It is important to note that the areas presented in **Figure 2-1** represent 440 possible spill scenarios over different seasonal environmental conditions (made up of two possible release scenarios (surface and subsea) at two representative 'worst case' locations over the various seasons). The actual area of impact from a single spill event would be considerably smaller than represented in **Figure 2-1**.

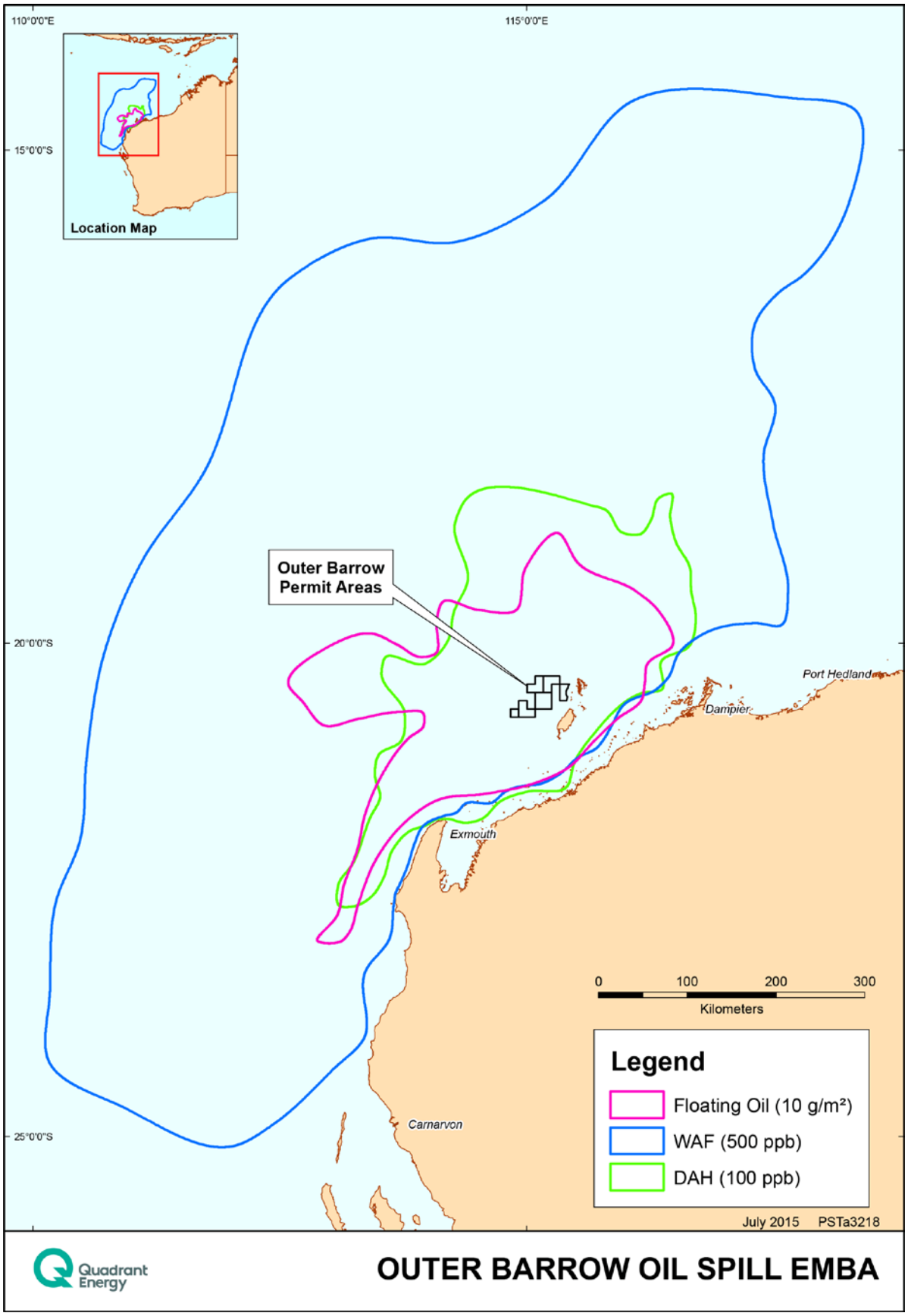

Figure 4-1. Environment that May be Affected (EMBA) from Floating oil, Entrained oil and Dissolved Aromatic Hydrocarbons (DAHs).

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, 2015).

4.1.2 Habitats

The Project Area occurs completely within the Northwest Shelf Province.

This bioregion is located primarily on the continental shelf in water depths from 0 to 200 m (DEWHA 2008). The sandy substrates on the shelf within this bioregion are thought to support low density benthic communities of bryozoans, molluscs and echinoids (DEWHA 2008). Sponge communities are also sparsely distributed on the shelf, but are found only in areas of hard substrate. The region between Dampier and Port Hedland has been described as a hotspot for sponge biodiversity (Hooper & Ekins 2004).

The Project Area does not contain shoreline habitat, and the nearest land are the Montebello Islands approximately 7km away. The benthic habitat across the Project Area comprises mostly sand and subtidal soft bottom communities. Given the depth of water and therefore limited light availability at the seabed, the Project Area does not contain hard corals, seagrass meadows or macroalgal communities.

The benthic habitats within the Project Area are widely represented at a regional scale on the NWS.

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 geographical features identified in **Figure 4-1.**

Table 4-2 also provides a summary of the identified receptors that could potentially be impacted in the event of a diesel spill or loss of well control including the hydrocarbon phase that would contact. The information in **Table 4-2** reflects the contours illustrated in **Figure 4-1.**

Table 4-2 Habitats associated within the geographical features identified within the EMBA

Geographical Feature	Subtidal/Intertidal Habitats					Shoreline Habitats				Loss of well control			
	Soft Sediments	Coral Reefs	Macroalgal Beds	Seagrass Beds	Hard Substrates (Flora/Fauna)	Rocky Shorelines	Sandy Beaches	Mangroves	Diesel Spills	Shoreline Contact	Surface Oil >10 g/m^2 contact	Total Water Column Oil >500 ppb contact	Dissolved Aromatic Hydrocarbon >100 ppb Contact
Northwest Shelf Province													
Muiron Islands	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
Thevenard Island	✓	✓	✓	✓			✓			✓	✓	✓	✓
Barrow Island	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lowendal Islands	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
Montebello Islands	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dampier Archipelago	✓	✓	✓	✓	✓	✓	✓	✓		✓			
Onslow Region	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dampier Region	✓	✓	✓	✓	✓	✓	✓	✓		✓			
Central Western Transition													
Ningaloo Region	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓
Central Western Shelf Province													
Carnarvon Region	✓	✓	✓	✓	✓	✓	✓	✓		✓			

4.1.1 Commonwealth Marine Reserves, State Marine Parks and Marine Management Areas

Protected and significant areas with the potential to be impacted by this program have been identified in **Table 4-3.** This includes Commonwealth and State protected areas present within the EMBA. The Montebello CMR occurs within the Project or Operational Area, all other identified values occur within the EMBA indicating that they could be contacted in the event of a hydrocarbon spill.

Table 4-3 Marine protected areas within the EMBA

Value/Sensitivity	EMBA					
	Project Area (Planned activities)	Diesel Spills	Loss of Well Control			
			Shoreline contact	Surface oil (10 g/m^2)	Total Oil (500 ppb)	Dissolved (100 ppb)
Commonwealth Marine Reserves						
Abrolhos CMR			N/A	✓	✓	
Carnarvon Canyon CMR			N/A	✓	✓	
Shark Bay CMR			N/A	✓	✓	
Gascoyne CMR			N/A	✓	✓	✓
Ningaloo CMR			N/A	✓	✓	✓
Montebello CMR	✓	✓	N/A	✓	✓	✓
Argo Rowley CMR			N/A	✓	✓	
State Marine Parks (MP) and Marine Management Areas (MMA)						
Ningaloo Marine Park			✓	✓	✓	✓
Muiron Islands MMA			✓	✓	✓	✓
Barrow Island MP		✓	✓	✓	✓	✓
Barrow Island MMA		✓	✓	✓	✓	✓
Montebello Islands MP		✓	✓	✓	✓	✓

Commonwealth Marine reserves

Abrolhos CMR

The Abrolhos CMR includes Marine National Park Zones (Marine National Park Zone – IUCN Category II-; Habitat Protection Zone – IUCN Category VI; Multiple Use Zone – IUCN Category VI; Special Purpose Zone – IUCN Category VI) and provides important foraging areas for the

- Threatened Australian lesser noddy;
- Northernmost breeding colony of the threatened Australian sea lion; and
- Migratory common noddy, wedge-tailed shearwater, bridled tern, Caspian tern and roseate tern.

In addition, there are a number of examples of both deep and shallow ecosystems, seafloor features and canyons (DoE, 2014). Six KEFs are also present (see Table 4-4).

Carnarvon Canyon CMR

The Carnarvon Canyon Commonwealth Marine Reserve (Habitat Protection Zone – IUCN Category IV) protects the following conservation values (DoE 2014):

- The Carnarvon Canyon a single channel canyon with seabed features that include slope, continental rise and deep holes and valleys; the canyon ranges in depth from 1500 m to over 5,000 m, thereby providing habitat diversity for benthic and demersal species; and
- Central Western Transition provincial bioregion ecosystem examples are found here, which are characteristic of the biogeographic faunal transition between tropical and temperate species.

Shark Bay CMR

The Shark Bay Commonwealth Marine Reserve (Multiple Use Zone – IUCN Category VI) protects the following conservation values (DoE 2014):

- Foraging areas adjacent to important breeding areas for several species of migratory seabirds;
- Part of the migratory pathway of protected humpback whales;
- Waters that are adjacent to the largest nesting area for loggerhead turtles in Australia;
- Shelf and slope habitats as well as a terrace feature;
- Examples of the shallower ecosystems of the Central Western Shelf Province and Central Western Transition provincial bioregions including the Zutydorp meso-scale bioregion; and
- Connectivity between the inshore waters of the Shark Bay World Heritage Area and the deeper waters of the area.

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

Drilling activities are proposed within the Montebello CMR (Multiple Use Zone – IUCN Category VI), the CMR 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.

Argo-Rowley CMR

The Argo-Rowley Commonwealth Marine Reserve (Multiple Use Zone – IUCN Category VI; Marine National Park Zone – IUCN Category II) protects the following conservation values (DoE 2014):

- Foraging areas that are important for migratory seabirds as well as the endangered loggerhead turtle;
- Important habitat and foraging for sharks;
- Protection for communities and habitats of the deeper offshore waters (220 metres to over 5,000 m) of the region;
- Seafloor features including aprons and fans, canyons, continental rise, knolls/abyssal hills and the terrace and continental slope;
- Communities and seafloor habitats of the Northwest Transition and Timor Province provincial bioregions;
- Connectivity between the existing Mermaid Reef Marine National Nature Reserve and reefs of the Western Australian Rowley Shoals Marine Park and the deeper waters of the region;
- Two key ecological features in the reserve.

State Marine Parks and Marine Management Areas

Ningaloo Marine Park

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. This is managed as an integrated area together with the Ningaloo Marine Park, but its status as a MMA means that some activities, including oil and gas exploration, are still permitted under a strict environmental assessment process involving both the DMP and NOPSEMA.

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.

Table 4-4 Key Ecological Features within the EMBA

Value/Sensitivity	EMBA				
	Project Area	Diesel Spills	Loss of Well Control		
			Surface Oil (10 g/m^2)	Total Oil (500 ppb)	DAH (100 ppb)
KEF's					
Ancient coastline at 125 m depth contour	✓	✓	✓	✓	✓
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula		✓	✓	✓	✓
Commonwealth waters surrounding Ningaloo Reef			✓	✓	✓
Continental Slope Demersal Fish Communities		✓	✓	✓	✓
Exmouth Plateau			✓	✓	✓
Glomar Shoals			✓		✓

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, 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 and is discussed in Section 4.1.2.

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).

Exmouth Plateau

The Exmouth Plateau covers an area of 49,310 km^2 and is located approximately 150 km northwest of Exmouth. The plateau ranges in water depths from 800 to 4,000 m (Heap & Harris 2008 in DSEWPaC 2012). The plateau's surface is rough and undulating at 800–1,000 m depth. The northern margin is steep and intersected by large canyons (e.g. Montebello and Swan canyons) with relief greater than 50 m. The western margin is moderately steep and smooth and the southern margin is gently sloping and virtually free of canyons (Falkner *et al*. 2009 in DSEWPaC 2012).

The Exmouth Plateau is a regionally and nationally unique tropical deep sea plateau. It may serve an important ecological role by acting as a topographic obstacle that modifies the flow of deep waters that generate internal tides, causing upwelling of deeper water nutrients closer to the surface (Brewer *et al*. 2007).

Glomar Shoals

The Glomar Shoals are a submerged feature situated at a depth of 33–77 m, approximately 150 km north of Dampier on the Rowley Shelf (Falkner *et al*. 2009 in DSEWPaC 2012). They consist of a high percentage of marine-derived sediments with high carbonate content and gravels of weathered coralline algae and shells

(McLoughlin & Young 1985 in DSEWPaC 2012). The area's higher concentrations of coarse material compared to surrounding areas are indicative of a high energy environment subject to strong seafloor currents (Falkner *et al*. 2009 in DSEWPaC 2012).

Biological communities found at the Glomar Shoals have not been comprehensively studied, however the shoals are known to be an important area for a number of commercial and recreational fish species such as rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish. Catch rates at the Glomar Shoals are high, indicating that the area is a region of high productivity (Falkner et al. 2009, Fletcher & Santoro 2009 in DSEWPaC 2012).

The Glomar Shoals are regionally important for their potentially high biological diversity and localised productivity. Biological data specific to the Glomar Shoals is limited, however the fish of the shoals are probably a subset of reef-dependent species and anecdotal evidence suggests they are particularly abundant (DSEWPaC 2012).

4.1.2 National Heritage Places

National and Commonwealth Places with the potential to be impacted by this program have been identified in **Table 4-5.** No Heritage places occur within the Project or Operational Area, all identified values occur within the EMBA indicating that they could be contacted in the event of a hydrocarbon spill.

Table 4-5 National and Commonwealth Heritage Places within the EMBA

Value/Sensitivity	EMBA					
	Project Area	Diesel Spills	Loss of Well Control			
			Shoreline Contact	Surface Oil (10 g/m^2)	Total Oil (500 ppb)	DAH (100 ppb)
National Heritage Places						
Ningaloo Coast *Listed Place*			✓	✓	✓	✓
Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves (*Nominated Place*)		✓	✓	✓	✓	✓
Dampier Archipelago (including Burrup Peninsula) *Listed Place*			✓			
Commonwealth Heritage Place						
Ningaloo Marine Area – Commonwealth waters			✓	✓	✓	✓

Ningaloo Coast

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 Island Marine Management Area (including the Muiron Islands);
- Jurabi Coastal Park;
- Bundegi Coastal Park;
- Cape Range National Park; and
- Learmonth Air Weapons Range.

Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves

These are a Nominated Place, discussed in further detail in **Section 4.1.1**.

Dampier Archipelago (including Burrup Peninsula)

Dampier Archipelago was included on the National Heritage List in July 2007. Approximately 36,860 ha at Dampier were listed, comprising parts of the Burrup Peninsula and surrounding islands. Reefs, shoals and islands of the Dampier Archipelago provide important habitat for many native plant and animals. The Burrup Peninsula includes Aboriginal rock art where engravings provide an outstanding visual record of Australia's history. The area contains one of the densest concentrations of rock engravings in Australia with some sites containing thousands or tens of thousands of images. There is a high density of stone arrangements on the Burrup Peninsula including standing stones, stone pits and more complex circular stone arrangements (Commonwealth of Australia 2007).

4.1.3 Commonwealth Heritage Places

The Ningaloo marine area is discussed further in **Section 4.1.2** and **4.1.3**.

4.1.4 Hot Spots

The locations that have been ranked priority 1, 2 or 3 (identified in Quadrant Energy's *Environmental Sensitivities and Priorities for Protection* guidelines EA-91-ZI-10008) that occur within the EMBA are illustrated in **Figure 4-2.** These areas are considered to have High Environmental Value (HEV) regionally.

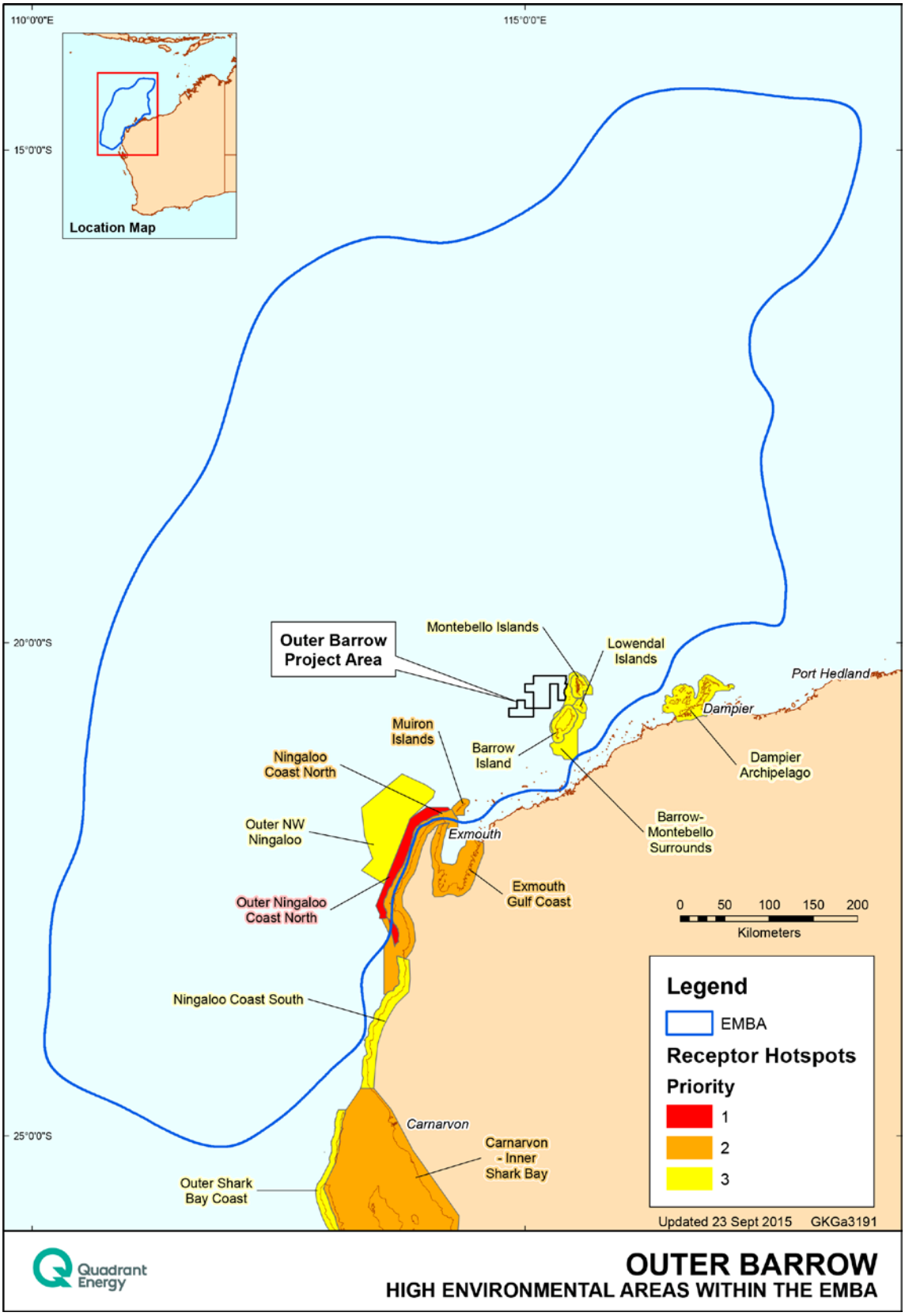

Figure 4-2 High Environmental Value areas (hotspots) within the EMBA

4.1.5 Marine Fauna

Desktop searches of the Operational Area and larger EMBA were undertaken using DoE's Protected Matters Search Tool for the purposes of identifying species listed under the EPBC Act.

An assessment of all the marine and coastal species was undertaken to identify if these species have the potential to occur in either the Operational Area or larger EMBA. Those listed threatened or vulnerable species that have been identified as likely to be present in the Operational Area or EMBA are summarised in **Table 4-5**. Migratory species are only listed if also threatened or vulnerable.

Table 4-6: Environmental values and sensitivities – marine fauna

Value/Sensitivity		EPBC Act Status				EMBA				
Common Name	Scientific Name	Critically Endangered	Endangered	Vulnerable	Migratory	Project Areas	Diesel Spills	Loss of Well Control		
								Surface Oil (10 g/m^2)	Total Oil (500 ppb)	DAH (100 ppb)
Protected Species and Communities: Marine Birds										
Whale shark	*Rhincodon typus*			✓	✓	✓	✓	✓	✓	✓
Grey nurse shark (west coast population)	*Carcharias taurus*			✓			✓	✓	✓	✓
Great white shark	*Carcharodon carcharias*			✓	✓	✓	✓	✓	✓	✓
Dwarf sawfish	*Pristis clavata*			✓			✓	✓	✓	✓
Green Sawfish	*Pristis zijsron*			✓				✓	✓	
Blind gudgeon	*Milyeringa veritas*			✓			✓	✓	✓	✓
Protected Species and Communities: Marine Mammals										
Sei whale	*Balaenoptera borealis*			✓	✓			✓	✓	
Blue whale	*Balaenoptera musculus*		✓		✓	✓	✓	✓	✓	✓
Fin whale	*Balaenoptera physalus*			✓	✓			✓	✓	
Southern right whale	*Eubalaena australis*		✓		✓		✓	✓	✓	✓
Humpback whale	*Megaptera novaeangliae*			✓	✓	✓	✓	✓	✓	✓
Protected Species and Communities: Marine Reptiles										
Loggerhead turtle	*Caretta caretta*		✓		✓	✓	✓	✓	✓	✓
Green turtle	*Chelonia mydas*			✓	✓	✓	✓	✓	✓	✓
Leatherback turtle	*Dermochelys coriacea*		✓		✓	✓	✓	✓	✓	✓
Hawksbill turtle	*Eretmochelys imbricata*			✓	✓	✓	✓	✓	✓	✓

Value/Sensitivity		EPBC Act Status				EMBA				
Common Name	Scientific Name	Critically Endangered	Endangered	Vulnerable	Migratory	Project Areas	Diesel Spills	Loss of Well Control		
								Surface Oil (10 g/m^2)	Total Oil (500 ppb)	DAH (100 ppb)
Flatback turtle	*Natator depressus*			✓	✓	✓	✓	✓	✓	✓
Short-nosed sea snake	*Aipysurus apraefrontalis*	✓				✓	✓	✓	✓	✓
Protected Species and Communities: Birds										
Southern giant-petrel	*Macronectes giganteus*		✓		✓	✓	✓	✓	✓	✓
Northern giant-petrel	*Macronectes halli*			✓	✓			✓	✓	
Soft-plumaged petrel	*Pterodroma mollis*			✓			✓	✓	✓	✓
Australian fairy tern	*Sternula nereis nereis*			✓				✓	✓	✓
Indian yellow-nosed albatross	*Thalassarche carteri*			✓	✓			✓	✓	
Shy albatross	*Thalassarche cauta cauta*			✓	✓			✓	✓	
White-capped albatross	*Thalassarche cauta steadi*			✓	✓			✓	✓	
Black-browed albatross	*Thalassarche melanophris*			✓	✓			✓	✓	
Campbell albatross	*Thalassarche melanophris impavida*			✓	✓			✓	✓	✓

4.2 Socio-economic Environment

Socio-economic activities that may occur within the Project Area EMBA include commercial fishing (Fletcher and Santoro 2013), shipping and oil and gas exploration and production (**Table 4-6**).

Table 4-7: Environmental (Socioeconomic) Values and Sensitivities in the EMBA

Value/Sensitivity	EMBA				
	Project Area	Diesel Spills	Loss of Well Control		
			Surface oil (10 g/m^2)	Total Oil (500 ppb)	Dissolved (100 ppb)
Commonwealth Managed Fisheries					
North West Slope Trawl			✓	✓	✓
Western Skipjack Tuna Fishery NB: This fishery is not currently active with management arrangements under review.	✓	✓	✓	✓	✓
Western Deepwater Trawl Fishery			✓	✓	✓
Western Tuna and Billfish Fishery	✓	✓	✓	✓	✓
State Managed Fisheries (Whole of State)					
Marine Aquarium Fish Fishery NB: This fishery collect specimens by diving or wading at depths shallower than Project Area	✓	✓	✓	✓	✓
Specimen Shell Managed Fishery NB: This fishery collect specimens by diving or wading at depths shallower than Project Area	✓	✓	✓	✓	✓
Beche-de-mer Fishery NB: This fishery collect specimens by diving or wading at depths shallower than Project Area	✓	✓	✓	✓	✓
Mackerel Managed Fishery (Area 2 and 3)	✓	✓	✓	✓	✓
State Managed Fisheries (North Coast Bioregion)					
Pilbara Trap (open to traps) and Trawl Managed Fishery	✓	✓	✓	✓	✓
Pilbara Line Fishery	✓	✓	✓	✓	✓
Pilbara Developing Crab Fishery NB: This is a coastal fishery that would not be active in Project Area	✓	✓	✓	✓	✓
Pearl Oyster Managed Fishery (Zone 1, Zone 2, Zone 3) NB: This is a dive based fishery at depths shallower than Project Area	✓ **(Zone 1)**	✓ **(Zone 1)**	✓ **(All Zones)**	✓ **(All Zones)**	✓ **(Zone 1&2)**
Onslow Prawn Managed Fishery NB: This is a coastal fishery that would not be active in Project Area	✓	✓	✓	✓	✓
Aquaculture Pearling Sites		✓	✓	✓	✓

Value/Sensitivity	EMBA				
	Project Area	Diesel Spills	Loss of Well Control		
			Surface oil (10 g/m^2)	Total Oil (500 ppb)	Dissolved (100 ppb)
State Managed Fisheries (Gascoyne Bioregion)					
Gascoyne Demersal Scalefish Fishery			✓	✓	✓
Exmouth Gulf Prawn Fishery			✓	✓	✓
State Managed Fisheries (West Coast Bioregion)					
West Coast Rock Lobster Fishery			✓	✓	✓
Roe's Abalone Fishery NB: Fishery currently closed north of Moore River and operates at depths shallower than the Project Area	✓	✓	✓	✓	✓
West Coast Deep Sea Crab (Interim) Managed Fishery NB: Operates at depths deeper than the Project Area	✓	✓	✓	✓	✓

Shipping	Advice provided by AMSA in consultation during September 2015, noted the nearest charted shipping fairway lies well to the East of Barrow Island and will not affect this activity. However, tanker and cargo vessel traffic will be encountered travelling along the charted Montebello-Tryal Rocks recommended track to and from NW Cape / Exmouth. This is near the Davis-1 and Scott-1 well locations. Any risk to these activities is mitigated through notifications sent to the AMSA's Joint Rescue Coordination Centre (JRCC) for Auscoast warnings and the Australian Hydrographic Service must (AHS) for Notices to Mariners. Commercial shipping moves through the offshore waters en route to or from the marine terminals at Thevenard Island, Barrow and Varanus Islands. Shipping using North West Shelf (NWS) 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.
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. Consultation has indicated recreational fishing hotspots including Eighty Mile Beach, the Montebello Islands, Barrow Island, the Lowendal Islands, the Muiron Islands, Dampier Archipelago, the Broome North Coast and the Ningaloo and Exmouth Coast are of high value to recreational fishers. Charter Boat and tourism operators also frequent those areas not easy accessible by recreational fishers including Mermaid Reef, Imperieuse Reef, Clerke Reef, Camden Sound, the Lacepede Islands and the Kimberley Coast.
Oil and Gas	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 Project Area are at Barrow and Varanus Islands.
Tourism	There are many sources of marine-based tourism within the EMBA. Aquatic recreational activities such as boating, diving and fishing occur near the coast and islands off the Pilbara, and Ningaloo

	coasts. These activities are concentrated near population centres such as Exmouth, Dampier and Onslow. The socio-economic and heritage features in the region are of high value for the tourism industry. Within the EMBA there are locations with high value for eco-tourism based on specific local values (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. Fishing charters off the Montebello Islands are also popular.
Cultural Heritage	No known sites of Cultural Heritage significance within the operational area.

5. STAKEHOLDER CONSULTATION

Quadrant recognises that its development 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 potential impact of Quadrant activities, Quadrant 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 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 operational area and EMBA and are provided in **Table 5-1**.

Table 5-1: Summary of stakeholders consulted

Group	Stakeholder
Marine Conservation	• Department of Fisheries (DoF) • Department of Parks and Wildlife (DPaW) • Marine Parks and Reserves Authority
Shipping safety and security	• Australian Maritime Safety Authority (AMSA) • Department of Defence (DoD) • Department of Transport (DoT)
Adjacent regulator	• Department of Mines and Petroleum (State)
Fishing groups	• A Raptis and Sons. • Austral Fisheries • Australian Fisheries Management Authority (AFMA) • Australian Southern Bluefin Tuna Industry Association (ASBTIA) • Commonwealth Fisheries Association (CFA) • Marine Tourism WA • MG Kailis • Pearl Producers Association • Recfishwest • Shark Bay Seafoods • Western Australian Fishing Industry Council (WAFIC) • WestMore Seafoods • Individual Fishing Licence Holders

Exmouth Stakeholder Reference Group	• Cape Conservation Group • Department of Parks and Wildlife (Exmouth) • Department of Transport (Exmouth) • Exmouth Chamber of Commerce • Exmouth District High School • Exmouth Game Fishing Club • Federal Member of Parliament • Gascoyne Development Commission • Member of the Legislative Assembly • North West Cape Exmouth Aboriginal Corporation • Ningaloo Station • Ningaloo Coast World Heritage Area Program Manager • Shire of Exmouth Administration • Shire of Exmouth Council • Toll Exmouth
Dampier Stakeholder Reference Group	• Dampier Port Authority • Port Hedland Port Authority (PHPA) • Shire of Roebourne • Town of Port Hedland

Quadrant 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 has regular contact.

A stakeholder consultation package outlining activities under the Outer Barrow EP was distributed to stakeholders on March 12, 2015. This included explanation of the five-year nature of this EP and locations for indicative wells.

A revision to this consultation package was issued to stakeholders on September 10, 2015. This clearly outlined the EP would allow for the drilling of up to ten wells over the listed permits, including the Scott-1 well in permit WA-192-P (additional to previous consultation), as well as to outline the possibility of well suspension and testing activities for these wells.

No concern or objections to these activities were been raised throughout the consultation period commencing March 2015. It is considered stakeholders have had adequate time to respond as valuable comment and advice has been received following the circulation of the consultation package and revision, all which has been addressed and considered within this EP.

5.1 Addressing consultation feedback

All correspondence with external stakeholders is recorded in the stakeholder database. Quadrant Energy's Consultation Coordinator is available before, during and after completion of the proposed activity to ensure opportunities for stakeholders to provide feedback are available. Stakeholder 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 key stakeholders.

Prior to commencement of an activity covered by this EP, a risk assessment will be undertaken to identify potentially affected stakeholders. The key stakeholder set will be notified prior to commencement of each well specific activity covered under this EP, ensuring that any commitments arising from the consultation process are recognised as performance standards required for that activity.

5.2 Ongoing Consultation

Four to six weeks prior to undertaking a well specific activity under this EP, Quadrant will provide a notification to each relevant stakeholder identified in the MoC assessment; in the form of an Quadrant Energy Notification Package or Consultation Update. All feedback will be assessed, evaluated and closed out prior to commencing the activity.

Stakeholders are also regularly updated on Quadrant Energy activities through Quadrant Energy *Quarterly Project Updates*. These regular, non-project oriented updates detail Quadrant Energy's ongoing and proposed activities on the NWS, looking out three to nine months. Information provided in this way is intended to afford stakeholders an opportunity to request additional information on specific activities or elements that may be of interest to them, and voice any concerns. Should stakeholders request additional information or raise concerns this can then be incorporated into relevant documentation, and dialogue with Quadrant Energy can continue should the concerns or issues require further consultation.

5.3 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 concerns with the proposed activities within the Outer Barrow Project Area were raised during this consultation period.

All correspondence with external stakeholders is recorded in the stakeholder database and Quadrant will remain available before, during and after completion of the development activity. Concerns will be listed against contact details for the relevant project personnel. Consultation material will be provided to relevant personnel and is summarised in **Table 5-2**. Quadrant has detailed communications procedures for the life of the project and will maintain two-way communications with stakeholders regarding the activity and all current or proposed activities undertaken on the NW Shelf. Many stakeholders have stated that they will contact Quadrant by exception, that is, if upon receiving the Stakeholder Consultation Package they feel the activity poses a risk to them, they will contact Quadrant Energy.

Table 5-2: Consultation summary for activity

Stakeholder	Assessment of Consultation Undertaken
Commercial Fishers	
Australian Fisheries Management Authority	AFMA were provided the Outer Barrow Consultation Packages and did not provide comment on the activity. Previous interaction with stakeholder has reassured Quadrant Energy that a response would only be received in the event of concern. No action arising from this consultation for this environment plan.
Department of Fisheries	DoF provided detailed advice on activities in permits WA-214-P, WA-33-R, WA-55-R, WA-29-L, and WA-13-L, which is valid for six months from the date marked in correspondence. Quadrant Energy commits to ongoing consultation with DoF to ensure this advice remains valid through the lifecycle of the five-year EP. Quadrant Energy provided response on September 30, 2015 to each of the key issues raised in DoF's consultation. Quadrant Energy believes each of the key issues is addressed within the EP and all requirements have been met. DoF have provided advice on permit WA-192-P on August 19, 2014. In a phone conversation with DoF September 30, 2015, they confirmed that the advice was still current. Quadrant Energy commits to updating information per permit through DoF's online Environmental Impact Assessment form three months prior to an activity commencing, as requested.

Stakeholder	Assessment of Consultation Undertaken
Western Australian Fishing Industry Council	WAFIC were provided the Outer Barrow Consultation Packages and did not provide comment on the activity. WAFIC has previously suggested Quadrant Energy consult directly with fishing licence holders and Quadrant Energy has commenced with this providing all holders with the Quarterly Project Update.
Commonwealth Fishing Association	The CFA received the Outer Barrow Consultation Packages and did not provide comment on the activity. Quadrant Energy continues ongoing and open consultation with the CFA.
A Raptis and Sons	A Raptis and Sons received the Outer Barrow Consultation Package and did not provide comment on the activity. Stakeholder has previously confirmed that no response means 'no concern' with the given activity.
Austral Fisheries	Austral Fisheries received the Outer Barrow Consultation Package and did not provide comment on the activity. Stakeholder has previously confirmed that no response means 'no concern' with the given activity.
WestMore Seafoods & Shark Bay Seafoods	These fishers received the Outer Barrow Consultation Package and did not provide comment on the activity. Gary Kessell at Westmore Seafoods also represents Shark Bay Seafood, and operates within the Western Deep Water Trawl Fishery, North West Slope Trawl Fishery, Shark Bay Prawn Fishery, Pilbara Fish Trawl, Nickol Bay Prawn Fishery and the Kimberley Prawn Fishery zones. No response received on this consultation. Stakeholder has previously confirmed that no response means 'no concern' with the given activity.
MG Kailis	MG Kailis responded to consultation on the Outer Barrow EP noting fish trawling activities in the area (Pilbara Fish Trawl Zone 1) no longer occur.
Pearl Producers Association	The PPA have received all Outer Barrow consultation packages since as early as March 2015 and provided no comment on this activity.
Individual fishing licence holders	Licence holders receive Quadrant Energy Quarterly Project Updates by post; no response has been received regarding the activity. Quadrant Energy does not anticipate a response from licence holders given the location and nature of the activity. License holders are represented by WAFIC, Recfishwest, The Charter Boat Association and DoF, who have all been consulted.
Recreational Fishers	
Recfishwest	Recfishwest received the Outer Barrow Consultation Package and did not provide comment on the activity.
Marine Tourism WA	MTWA received the Outer Barrow Consultation Package and did not provide comment on the activity. Previous interaction with stakeholder has reassured Quadrant Energy that a response would only be received in the event of concern.
Marine Conservation	
Department of Parks and Wildlife	DPaW provided combined advice regarding a number of Quadrant's five year drilling EPs including Outer Barrow on July 17, 2015. DPaW noted the proximity of the Montebello Marine Park to the Outer Barrow Project Area. DPaW's advice has been incorporated into the preparation of Quadrant Energy EPs, particularly with inclusion of the 2.5km buffer adjacent to the marine park **Figure 6-2.**
Marine Parks and Reserves Authority	Given some of the wells proximity to the Marine Park, the MPRA received a consultation package outlining the proposed Outer Barrow EP. The MPRA responded with thanks, and noted DPaW were their nominated body to continue receiving notifications about individual activities.
Shipping safety and security	
Australian Maritime Safety	AMSA responded to consultation providing vessel traffic plots for all Outer

Stakeholder	Assessment of Consultation Undertaken
Authority	Barrow wells, advising vessel traffic may be encountered especially around the Scott-1 and Davis-1 locations. Quadrant Energy commits to AMSA RCC and the AHS notifications as requested, to mitigate this risk. Quadrant Energy's relationship with AMSA is clearly defined and Quadrant Energy is satisfied with the arrangements in place. AMSA continue to be communicated with as required during ongoing Operations. Quadrant Energy has an MOU in place which is the result of consultation between Quadrant Energy and AMSA, and sets out their understanding of their respective roles and responsibilities when responding to ship-sourced marine pollution incidents and non-ship sourced marine pollution incidents.
Department of Defence	Defence provided response to consultation on September 29, 2015, citing no objection to the activity. Defence's advice noted unexploded ordnance may be encountered in the activity area, and noted the requirement for JACC notifications of aviation activities and AHS pre-activity notifications.
Hydrocarbon spill response	
Australian Marine Oil Spill Centre	AMOSC received the Outer Barrow Consultation Packages and did not provide comment on the activity. Previous interaction with stakeholder has reassured Quadrant Energy that a response would only be received in the event of concern. No response received on this consultation. Roles and responsibilities of AMOSC have been clearly defined in prior consultation relating to Quadrant Energy Oil Pollution Emergency Plan (OPEPs). Quadrant Energy is currently working with AMOSC to have an MOU in place for support in relation to all of oil spill response plans for the NWS. Currently AMOSC are engaged specifically for their support to each OPEP.
Department of Transport	The DoT responded to consultation on the Outer Barrow EP with thanks and will review the OPEP.
Adjacent Regulators	
State Department of Mines and Petroleum	DMP received a detailed Outer Barrow Consultation Package aligning with their stakeholder consultation guidelines on September 23, 2015. DMP responded to this consultation package on September 25, 2015, noting the information has been reviewed and no further information is required. Quadrant Energy commits to providing DMP with pre-start and cessation notifications for all activities occurring under this EP. Quadrant Energy notes DMPs particular interest in the Scott-1 and Kultarr-2 wells given their close proximity to environmental sensitivities, and commits to open and ongoing consultation regarding these activities.

6. ENVIRONMENTAL HAZARDS AND CONTROLS

The impact and risk assessment approach 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 (N4700-GN1074 Rev 1 2013). The key steps are illustrated in **Figure 6-1.**

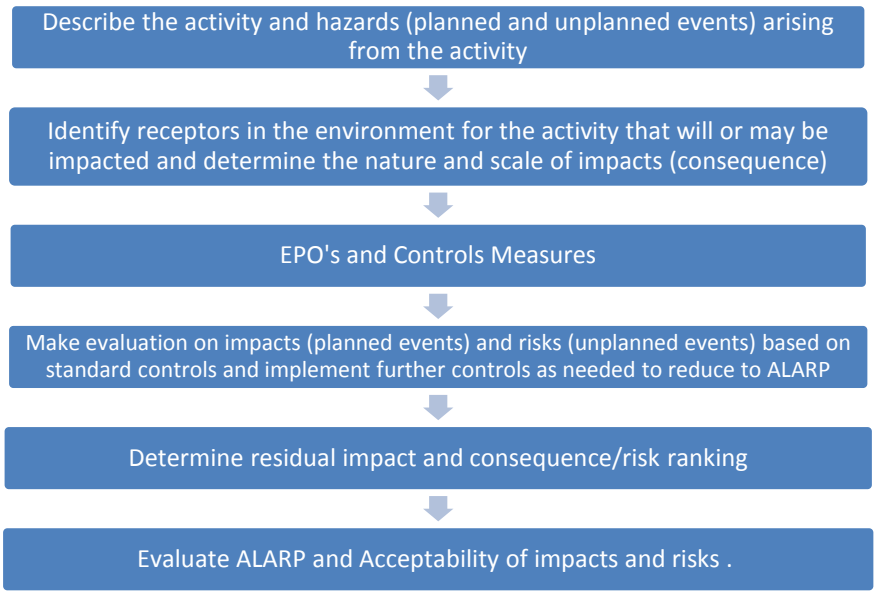

Figure 6-1: Risk and Impact Process

An assessment against the activity was undertaken and the environmental hazards or aspects were then identified. The risk assessment identified 6 potential unplanned events and 8 planned events. Environmental aspects/hazards identified for the activity are summarised in **Table 6-1** and **Table 6-2**.

The extent of actual or potential impacts from each planned or unplanned event is assessed using, where required, modelling (e.g. for hydrocarbon spill modelling), and data from scientific reports/literature. Impact mechanisms and any thresholds for impact are determined and described. This step looks at the causal effect between the aspect/hazard and the identified receptor. Impact thresholds for different critical life stages are also identified where relevant.

The consequence level of the impact is then determined for each planned and unplanned event based on the severity of the impact to relevant receptors. This process determines a consequence level based on criteria set for Quadrant for each receptor category and takes into consideration the duration and extent of the impact, receptor recovery time and the effect of the impact at a population, ecosystem or industry level. The consequence definitions are outlined below.

Consequence Level		Consequence Level description
A	Negligible	No impact or negligible impact.
B	Minor	Detectable but insignificant change to local population, industry or ecosystem factors. Localised effect with rapid recovery
C	Moderate	Significant impact to local population, industry or ecosystem factors. Medium term recovery
D	Major	Major long-term effect on local population, industry or ecosystem factors. Slow recovery over decades
E	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 is 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.

For each planned and unplanned event a set of Environmental Performance Outcome(s), Environmental Performance Standards and Measurement Criteria are identified. The definitions of the performance outcomes, standards and measurement criteria are consistent with the OPGGS (E) Regulations. For planned and unplanned events, an ALARP and Acceptability assessment is also undertaken.

6.1 ALARP Evaluation

The ALARP principle is that the residual impacts and risk shall be 'As Low As Reasonably Practicable'. It has particular connotations as a route to reduce risks when considering law, regulation and standards.

For an impact or risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the impact or risk further would be grossly disproportionate to the benefit gained. The ALARP principle arises from the fact that infinite time, effort and money could be spent on the attempt of reducing a risk to zero. It should not be understood as simply a quantitative measure of benefit against detriment. It is more a best common practice of judgement of the balance of impact or risk and societal benefit.

For planned and unplanned events, an ALARP assessment is undertaken to demonstrate that control measures adopted reduce the impact 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 for the level of impact or risk reduction they would provide. If this cannot be demonstrated then the further controls are implemented. The level of detail included within the ALARP assessment is based upon the nature and scale of the potential impact and risks. .

6.2 Acceptability Evaluation

Quadrant considers the impacts or risks associated with the program to be acceptable if they meet the following set of criteria:

1. A consequence from a planned event is ranked as A or B; or a risk of impact from an unplanned event is ranked low to medium;
2. An assessment has been completed to determine if further information/studies are required to support or validate the consequence assessment;
3. Performance standards are consistent with legal and regulatory requirements;
4. Performance standards are consistent with Quadrant Environmental Management Policy;
5. Performance standards are consistent with stakeholder expectations; and
6. Performance standards have been demonstrated to reduce the impact or risk to ALARP.

Table 6-1 and **Table 6-2** summarise the identified hazards and potential impacts associated with the activity. **Table 6-3** summarises the controls to prevent or mitigate impacts such that impacts and risks are reduced to ALARP and are at acceptable levels.

Table 6-1: Environmental Impact Summary of Planned Events

Hazard / Event	Potential Impacts	Consequence
Light Emissions	Continuous lighting from MODU or support vessels in the same location for an extended period of time may result in alterations to normal marine fauna behavior. In the event of a well test, light may be generated from flaring activities.	Negligible
Noise Emissions	Noise generated by the MODU, project vessels and VSP during the activity may result in physiological or behavioural impacts to marine fauna	Negligible
Atmospheric Emissions	Air emissions through the release of ozone depleting substances (ODS), and use of fuel may result in a temporary, localised reduction of air quality in the environment immediately surrounding the discharge point.	Negligible
Heat Radiation	Well test flaring is an intermittent source of thermal radiation during the drilling campaign. Heat may locally increase sea surface water temperature. A heat exchanger/heater may also be used in well testing and heated water (i.e. fresh or seawater) will be discharged to sea.	Negligible
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 (e.g. corrosion inhibitor and hydraulic fluid). The small volumes of non-hazardous discharges may cause localised nutrient enrichment, organic and particulate loading, thermal impacts and increased salinity primarily in surface (<5 m) waters.	Negligible
Physical Presence	The presence of the project vessels and the operational area 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. Planned activities may result in disturbance of the seabed, leading to impact of benthic habitat and associated marine flora and fauna. IMS can be introduced by vessels carrying IMS on external biological fouling, internal systems (sea chests, seawater systems etc.), on marine equipment (ROVs etc.), or through ballast water exchange. Cross contamination between vessels can also occur. Some IMS pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports and tourism	Minor
Drilling Discharges	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).	Minor
Spill response Activities	Impacts to the environment from implementing source control, monitoring and evaluation, oiled wildlife response and scientific monitoring include those operational impacts previously specified from the operation of vessels and aircraft. Implementing oiled wildlife response may cause additional distress, physical and behavioral impacts, separation and increased predation to wildlife if not undertaken correctly	Minor/Medium

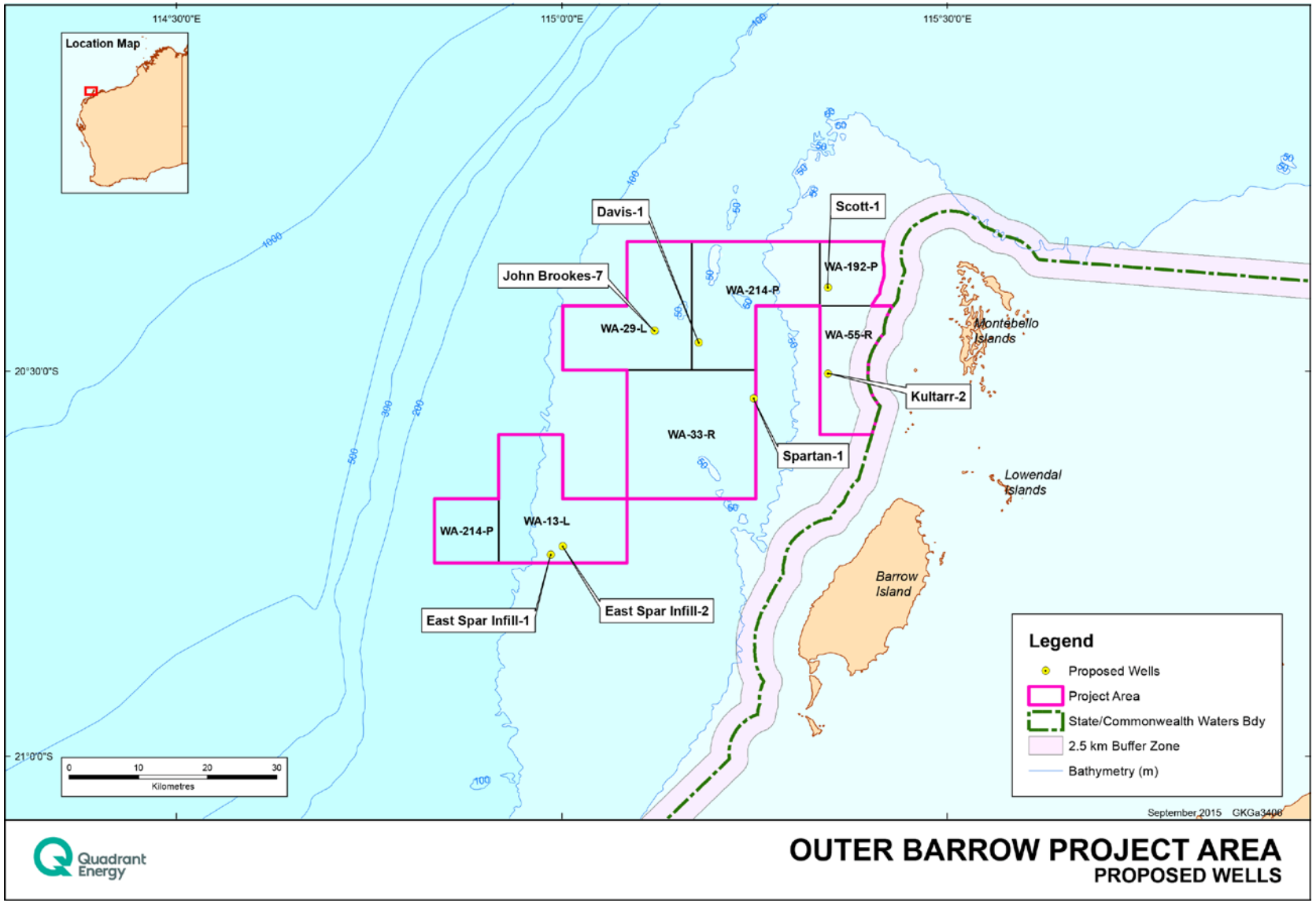

Figure 6-2 2.5km buffer from Montebello State Marine Park

Table 6-2: Environmental Impact Summary for Unplanned Events

Hazard / Event	Potential Impacts	Risk Ranking (Likelihood x consequence[2])
Marine Operations (Collision with marine fauna)	During the Activity, use of a MODU and support vessels have the potential to result in direct impacts to fauna through collisions with marine mega fauna (cetaceans, whale sharks, turtles).	**Low** (Rare x Very Low)
Non-hydrocarbon release (surface) – solid	Non-hydrocarbon solids such as plastics have the potential to smother benthic environments and harm marine fauna through entanglement or ingestion. Release of hazardous solids (e.g. wastes) may result in the pollution of the immediate receiving environment.	**Low** (Rare x Very Low)
Non-hydrocarbon release (surface) – liquid	An accidental release of chemicals and other non-hydrocarbon liquids into the marine environment may result in a reduction of water quality and potential toxicity impacts to local marine fauna Ballast exchange may also result in the unplanned introduction of marine species (IMS).	**Low** (Rare x Very Low)
Hydrocarbon spill - minor	Accidental loss of fuel and other hydrocarbons used or stored onboard the MODU and support vessels, during the Activity to the marine environment resulting in a reduction of water quality and potential impacts to local marine fauna.	**Low** (Rare x Very Low)
Hydrocarbon release – diesel	Diesel spill as a result of: • Vessel collision • Refuelling incident (fuel hose failure/rupture, coupling failure or tank overfilling) Other minor diesel spills (Structural failure of infrastructure containing diesel on vessel or MODU and Lifting – dropped objects damaging diesel infrastructure	**Low** (Rare x Very Low)
Hydrocarbon release (loss of containment)	Loss of containment (surface and subsurface) due to: • Shallow gas • Well kick • Failure to keep the hole full • Working over live well • Tripping/swabbing • Loss of primary and secondary well containment Failure to keep the correct mud density	**Medium** (Rare x Major)

[2] NB. Worst case consequence is provided

Table 6-3 Summary of control measures and environmental performance of planned and unplanned events

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Planned	Light Emissions	No standard controls	A baseline level of artificial lighting is required on a 24 hour basis to alert other marine users of the Activity. There are also minimum light requirements that will be followed to provide safe working conditions. Flaring procedure ensure that gases are disposed of in a controlled manner. No standard controls are in place to measure performance against.
Planned	Heat radiation	No standard controls	No other standard mitigation controls are in place. There is no safe and feasible alternative to flaring to complete the Activities. Flaring results in some localised heat radiation. Since heat radiation will occur within a relatively small impact area intermittently for short periods only during flaring, and avoidance mechanisms are expected in marine fauna and seabirds, its impact is considered ALARP
Planned	Noise Emissions	Procedures for interacting with cetaceans	Support vessel complies with Part 8 of EPBC Regulations for interacting with cetaceans to avoid collision with cetaceans.
Unplanned	Marine Operations – interaction with marine fauna		Helicopter complies with Part 8 of EPBC Regulations for interacting with cetaceans, unless taking off or landing because they are taking reasonable actions necessary to reduce safety risk to humans to reduce impacts to marine fauna.
Unplanned	Non-hydrocarbon surface release – solids	Dropped object prevention procedures	MODU Safety Case includes control measures for dropped objects that reduce the risk of objects entering the marine environment
Unplanned	Non-hydrocarbon surface release – liquids		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.
Unplanned	Hydrocarbon spill – minor losses from operational activities		When it is necessary for the MODU mooring line to traverse over subsea infrastructure the anchor must be decked on the support vessel and double secured to prevent dropped objects entering the marine environment.
Planned	Physical presence – maintenance of	MODU move procedure	MODU move procedure contains a passage plan to prevent accidental contact with the

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
	station		seabed and subsea infrastructure during the MODU move.
Unplanned	Hydrocarbon spill – diesel		
Planned	Operational Discharges	Waste (garbage) management procedure	Waste management procedure implemented to reduce the risk of unplanned release of waste to sea. The procedure includes standards for: • Bin types. • Lids and covers. • Waste segregation. • Bin storage.
Unplanned	Non-hydrocarbon surface release – solids		No waste (garbage[3]) discharged to sea, unless the waste is food waste disposed in accordance with MARPOL Annex V to reduce impacts to marine environment.
			Pursuant to MARPOL Annex V, placards displayed to notify personnel of waste disposal restrictions to ensure proper waste handling.
Unplanned	Non-hydrocarbon surface release – liquids	Hazardous chemical[4] management procedures	For hazardous chemicals including hydrocarbons, the following standards apply to reduce the risk of an accidental release to sea: • Storage containers closed when the product is not being used. • Storage containers managed in a manner that provides for secondary containment in the event of a spill or leak. • Storage containers labelled with the technical product name as per the safety data sheet (SDS). • Spills and leaks to deck, excluding storage bunds and drip trays, immediately cleaned up. • Storage bunds and dip trays do not contain free flowing volumes of liquid. • Spill response equipment readily available.
Unplanned	Hydrocarbon spill – minor losses from operational activities		

[3] Garbage as defined by MARPOL Annex V and excludes waste generated as part of the 'drilling' process as described in these standards.
[4] Chemical in both liquid and solid form.

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Planned	Operational Discharges	Deck cleaning product selection procedure	Deck cleaning products released to sea are not hazardous, readily biodegradable and non-bio-accumulative to minimise potential impacts to the marine environment.
Unplanned	Non-hydrocarbon surface release – liquids		
Unplanned	Hydrocarbon spill – minor losses from operational activities		
Unplanned	Non-hydrocarbon surface release – liquids	General chemical management procedures	Safety data sheet available for all chemicals to aid in the process of hazard identification and chemical management.
			Chemicals managed in accordance with SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations.
Unplanned	Non-hydrocarbon surface release – liquids	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.
Unplanned	Non-hydrocarbon surface release – liquids	Bulk liquid transfer procedures	Bulk liquids transferred in accordance with the bulk transfer procedures to reduce the risk of a release to sea. The procedures will require:

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Unplanned	Hydrocarbon spill – diesel		• 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. • Hose flotation: bulk hoses in the water fitted with floatation collars. • Hose connections: hoses used for hydrocarbons fitted 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. • Valve alignment: a MODU supervisor checks that all valves are lined up correctly. • Tank venting: air vents for hydrocarbon storage tanks bunded if there is a risk of spill to deck. • Supervision: dedicated hose watch person while pumping bulk product. • Communications: constant radio communications between MODU control room, hose watch person and vessel. • Inventory control: MODU control room monitors tank fill levels. • Emergency shutdown: vessel emergency pumping stop tested before each transfer operation.
Unplanned	Non-hydrocarbon surface release – solids	Bulk solid transfer procedure	Bulk solids transferred in accordance with bulk transfer procedures to reduce the risk of an unintentional[5] release to sea. The procedures includes standards for: • Hose integrity: certified hoses replaced after 24 months of use. • Hose flotation: bulk hoses in the water fitted with floatation collars. • Valve alignment: a MODU supervisor checks that all valves are lined up correctly. • Supervision: dedicated hose watch person while pumping bulk product. • Communications: constant radio communications between MODU control room, watch person and vessel. • Inventory control: MODU control room monitors tank fill levels or air vents watched to detect tank overfill. • Emergency shutdown: vessel emergency pumping stop tested before each transfer operation.

[5] Tank venting and associated product loss is an intentional release to sea for safety reasons.

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Unplanned	Non-hydrocarbon surface release – liquids	MODU and support vessel spill response plans	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 to ensure Quadrant Energy is prepared.
Unplanned	Hydrocarbon spill – minor losses from operational activities		SOPEP or SMPEP spill response exercises conducted not less often than every three months to ensure personnel are prepared.
Unplanned	Hydrocarbon spill – diesel		
Unplanned	Hydrocarbon spill – minor losses from operational activities	Remotely operated vehicle (ROV) inspection and maintenance procedures	Preventative maintenance on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to sea.
			ROV pre-deployment inspection completed to reduce the risk of hydraulic fluid releases to sea.
Planned	Physical presence – interaction with other marine users	Maritime notices	Information provided to Australian Maritime Safety Authority (AMSA), Department of Defence Australian Hydrographic Service (AHO) and nearest port authority on MODU arrival and departure so that the maritime industry is aware of petroleum activities.
Unplanned	Hydrocarbon spill – diesel		
Planned	Physical presence – interaction with other marine users	Standby vessel	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.
Unplanned	Marine Operations – interaction with marine fauna		Support vessel will be equipped with an automatic identification system (AIS) and radar to aid in its detection at sea.
Unplanned	Hydrocarbon spill – diesel		Competent crew on the support vessel shall maintain a constant bridge-watch to identify approaching third-party vessels.
Unplanned	Hydrocarbon spill –	Oil pollution emergency plan	In the event of an oil spill to sea, the Quadrant Energy OPEP requirements implemented to

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
	diesel	(OPEP)	mitigate environmental impacts.
Unplanned	Hydrocarbon spill – minor losses from operational activities	Well operations management system	Quadrant Energy Well Operations Management Plan (WOMP) includes control measures for well integrity that reduce the risk of an unplanned release of hydrocarbons.
Unplanned	Hydrocarbon spill – loss of well control		MODU Safety Case includes control measures for well control that reduce the risk of an unplanned release of hydrocarbons.
			Quadrant Energy Well Acceptance Criteria (WAC) for critical well operations and integrity aspects are achieved. WAC will be selected based on the well objectives and Quadrant Energy's Well Lifecycle Management System (WLMS) technical standards, being: • Location, rig moves and support. • Well control equipment. • Well barriers. • Drilling and completions fluids. • Surveying and trajectory control. • Casing, liner and tubing. • Cement. • Wellhead and production trees. • Completion components.

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Planned	Noise Emissions	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 and whale sharks (defined as marine fauna). The checklist includes the following standards: • A crew member observing for marine fauna during daylight. • Soft start procedures enacted over 30 minutes. • Continuous operations providing no marine fauna within 1 km of the MODU during soft start. • Shut down procedures enacted if marine fauna within 500 m of the MODU during continuous operations. • Daylight operations continue into night providing there have not been 3 marine fauna shut downs in last 24 hours. • 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.
Planned	Atmospheric Emissions	Waste incineration	Waste incineration managed in accordance with MARPOL Annex VI, except incineration within the 500-m exclusion zone shall not occur.
Planned	Atmospheric Emissions	Fuel oil quality	Sulphur content of fuel oil will not exceed 3.5% m/m resulting in reduced sulphur emissions during the activity.
Planned	Atmospheric Emissions	Air pollution prevention certification	Pursuant to MARPOL Annex VI, 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 and incineration emissions during the activity are in place.
Planned	Atmospheric Emissions	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.
Planned	Physical presence – interaction with other marine users	Regulatory notifications	NOPSEMA and DMP notified that the activity is to commence at least 10 days before the activity commences.
			NOPSEMA and DMP notified that the activity is completed within 10 days after the

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
			completion.
Unplanned	Non-hydrocarbon surface release – liquids	Biofouling vessel risk assessment (VRASS)	An international and domestic (interstate) plying MODU or support vessel has a completed biofouling vessel risk assessment (VRASS) before entering a Quadrant Energy petroleum permit to reduce risk of IMS. VRASS includes weighted assessment criteria for: • Vessel type. • Vessel location history. • Period out-of-water. • Vessel inspections. • Age of foulant control coating • Ballast water treatment and discharge. • Planned activities.
			The risk of introducing invasive marine pest species is assessed as 'low' as determined by the VRASS or by a qualified IMS inspector in writing.
Planned	Physical presence – interaction with other marine users	MODU identification system	MODU has a RACON (radar transponder) or Automatic Identification System (AIS) to aid in its detection at sea.
Planned	Physical presence – maintenance of station	MODU station keeping system	MODU station keeping system maintains the MODU at the desired location to reduce risks to seabed habitat and petroleum infrastructure.
			For an anchored MODU, anchors positioned and maintained at locations defined in the rig mooring analysis to reduce risks to seabed habitat and petroleum infrastructure.
			All parts of the MODU mooring system deployed to sea are recovered within 3 months of MODU departure to mitigate consequences from objects remaining in the marine environment.
Planned	Physical presence – maintenance of station	Standby vessel mooring procedure	Mooring or moored standby vessel will not: • Be within 500-m of subsea infrastructure. • Damage benthic habitat containing coral. • Be within a marine conservation reserve.

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
			• Be within 500-m of a listed shipwreck. • Be within 500 m of a MODU.
Unplanned	Hydrocarbon spill – diesel		Standby vessel mooring will be recovered within 3 months of MODU departure to mitigate consequences from objects remaining in the marine environment.
Planned	Operational Discharges	Ballast water management plan	Pursuant to the International Convention for the Control and Management of Ships' Ballast Water and Sediment 2004, MODU and support vessels carrying ballast water and engaged in international voyages shall manage ballast water in accordance with a Ballast Water Management Plan so that marine pest species are not introduced. Pursuant to the Convention, the plan shall provide details to be taken to comply with the following Convention requirements: • Ballast water exchange. • Ballast water management systems • Sediment management. • Duties of officers and crew. • Coordination with local authorities. • Record keeping.
Unplanned	Non-hydrocarbon surface release – liquids		
Planned	Operational Discharges	Sewage treatment system	Pursuant to MARPOL Annex VI, 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.
			Sewage discharged in accordance with MARPOL Annex IV.
			Preventive maintenance on sewage treatment equipment is completed as scheduled.
Planned	Operational Discharges	Oily water treatment system	Oily mixtures only discharged to sea in accordance with MARPOL Annex I.
			Preventative maintenance on oil filtering equipment completed as scheduled.
			Pursuant to MAPROL 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 discharges are in place.

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Planned	Drilling discharges	Chemical selection procedure for drilling and completions chemicals[6]	Drilling, completions, production appraisal and cement 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 Apache's *Drilling Fluid and Chemical Risk Assessment Procedure* (EA-91-II-008) so that only environmentally acceptable products are used.
Unplanned	Non-hydrocarbon surface release – liquids		
Planned	Drilling discharges	Cuttings management system	Cuttings returned to the MODU are treated through the on-board cuttings management system to reduce the concentration of drilling mud on cuttings prior to discharge.
			Shaker screens inspected daily during drilling operations to ensure shaker screens are operating as intended.
			If drilling with non-aqueous fluid (NAF), the average oil-on-cuttings discharged to sea shall not exceed 10% for any well section[7].
			In the event that the average oil-on-cuttings of <10% for a well section cannot be achieved, cuttings will be retained in enclosed containers and shipped ashore in accordance with jurisdictional requirements.
			'Soft' cement returned to the MODU will be diverted directly overboard if shale shakers are at risk of becoming blocked. If using non-aqueous fluid (NAF), oil content measurements will be included in the well section totals.
Unplanned	Hydrocarbon spill – minor losses from operational activities	Inventory control procedure	Only water-based mud, brine and drilling water within MODU mud pits that is no longer required will diverted overboard.
			Non-aqueous fluid (NAF) and base oil operational readiness checklist completed prior to

[6] Quadrant Energy's Drilling Fluid and Chemical Risk Assessment Procedure (EA-91-II-008) applies to drilling, completion and cement chemicals used downhole during drilling and completion operations. The procedure define's the requirement for chemicals to meet the following criterion at the time of use to reduce environmental risk and impact:

- Certified Gold/Silver/E or D through the Offshore Chemical Notification Scheme (OCNS);
- Pose Little or No Risk to the Environment (PLONOR) as listed by the Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR); or
- Risk assessed by Quadrant and deemed environmentally acceptable.

Environmental acceptability is based on volume/concentration, ultimate fate and ecotoxicity data (aquatic toxicity, biodegradability and/or bioaccumulation data where applicable i.e. biodegradation and bioaccumulation potential are not applicable to inorganic substances).

[7] 'Interval' is a synonym for 'section' in this standard.

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
			taking product onto the MODU, or prior to mixing or circulating if the product is already on the MODU. The following will be checked: • Systems of work. • Equipment. • Maintenance. • Deck drainage. • Spill containment. • Valves and lines. • Hoses.
			Non-aqueous fluid (NAF) within MODU mud pits that is no longer required will not be released to sea
			If non-aqueous fluid (NAF) has been displaced out of the well bore, only interface fluids with residual oil content of <1% will be discharged overboard if no longer required.
			Only unusable inventories of brine, drilling fluids and solids, and cement will be diverted overboard.
		Oil content measurement procedure	All drilling-related oil content measurements and calculations will be made in accordance with the methods detailed in Quadrant Energy's *Operational Guidelines and Environmental Performance Measures for Handling and Usage of Drilling Fluids and Bulks (DR-91-ID-016).*
Planned	Drilling discharges	Lost-circulation material procedures	Surface returns of hydrocarbon-based lost-circulation material (LCM) will be contained for onshore disposal if the circulating material can be isolated; otherwise the material will be discharged directly to sea following an MOC to ensure impacts and risks have been adequately assessed and reduced to ALARP and are Acceptable.
Planned	Drilling discharges	Well test procedures	MODU Safety Case Revision for well testing includes control measures that reduce the risk of hydrocarbons from entering the marine environment.
Unplanned	Hydrocarbon spill – minor losses from operational activities		Quadrant Energy Well Test Program checklists completed to ensure safety and environmental control measures are implemented

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Unplanned	Hydrocarbon spill – loss of well control		Burner to remain ignited during a well test to reduce the risk of hydrocarbons being released to sea and air.
			Burner monitored by a dedicated flare watcher during a well test to identity and communicate an unplanned flare drop-out.
			In the event of a flare drop-out or hydrocarbon being observed on the sea surface then the well test shall cease and the event investigated and corrected before proceeding with the well test to reduce the risk of hydrocarbons being released to sea and air.
			During a well test formation water and completion fluids containing hydrocarbons must be: • Flared with hydrocarbons; • Stored in tanks on-board and shipped ashore for disposal; and/or • Treated through an oil-water filtration system before being disposed to sea.
			Oil-water filtration equipment will be: • Designed to reduce oil-in-water to <30 ppm. • Calibrated prior to use • Connected to an oil-in-water monitoring system to assess the performance of the filtration equipment.
Planned	Noise Emissions	Marine Park buffer	No well surface location 2.5 km or less from the boundary of a State marine reserve to minimise potential for impacts on marine reserves.
Planned	Drilling discharges		
Unplanned	Hydrocarbon spill – diesel	SIMOPS	Any simultaneous operations (SIMOPS) will be conducted in accordance with facility safety cases, and associated plans and procedures.
Planned	Physical presence – maintenance of station	Equipment Placement	Equipment placed on the seabed in the Operational Area will be recovered at the end of the activity.

Planned/Unplanned Event	Hazard / Event	Control measure	Environmental Performance
Planned	Physical presence – maintenance of station	Equipment Restrictions	Spare anchor chain will not be stored on the seabed within a marine reserve.
Planned	Physical presence – maintenance of station	'Site Assessment Process'[8]	Prior to MODU arrival, a seabed survey will be undertaken for well locations that do not have existing seabed survey results to identify any significant seabed features prior to undertaking an activity .
Planned	Drilling Discharges		The Quadrant Energy Management of Change (MOC) process will be undertaken for new wells, based on seabed survey results, to evaluate potential impacts and additional control measures such that seabed impacts are reduced to ALARP and acceptable levels.
Planned	Drilling discharges	Environmentally acceptable bulk powders, brines, and water based drilling fluids disposal method	In the event that leftover bulk powders, brines and water based drilling fluids remain on the MODU at the end of the well, they will be disposed of in one of the following ways once an assessment has been completed to ensure disposal route is ALARP: • Retain stock; • Sell stock; • Minimise stock; • Transfer stock to alternate rig; • Transfer stock to a land-based facility; or • Overboard disposal of stock (minimal volumes only)

[8] A pre-spud site assessment. This is a process that Quadrant Energy use to identify any significant seabed features prior to undertaking an activity. The following steps are taken:

1. Assess existing benthic habitat information from available sources (MNES, State and Commonwealth data layers, previous surveys etc)
2. If there is the potential for a KEF to be present, or other sensitive benthic habitat (for example within a Commonwealth Marine reserve), and no prior information available, a survey will be completed to enable an informed risk assessment.
3. Information from either the survey and/or any other available information will be assessed (presence, area covered, and type) through the Quadrant Energy MOC. This will ensure that potential risks and impacts from all activities have been assessed adequately.
4. Where any new impacts or risks are identified* (e.g the presence of a KEF or sensitive benthic habitat) additional management controls will be considered including the potential relocation of the well/anchor away from sensitive habitats.
5. Assessment of impacts will be completed and reduced to ALARP.
6. The Acceptability of the impact will also be assessed considering nature and scale, and must be minor or negligible to be Acceptable.

**Potential impacts from placement of a well/anchor on benthic habitats will consider physical presence and also drilling discharges.*

Table 6-4 Spill Response Control measures

Spill Response Aspect	Management Control	Environmental Performance
Spill Response Operations – Source Control	Subsea First Response Toolkit (SFRT)	SFRT is mobilised in accordance to the Source Control Emergency Response Plan during a loss of well control (Doc No DR-00ZF-10001) in the event of a subsea release
	Capping Stack	Capping stack installation implemented in accordance to the Source Control Emergency Response Plan during a loss of well control (Doc No DR-00ZF-10001)
	Direct Surface Intervention via Well Control Experts	Suitable well control experts brought in for direct intervention support during a surface loss of well control if the condition permits
	Relief Well	Suitable third party operator rig accessed through APPEA MOU to drill a relief well
		Relief well drilling implemented in accordance to the Source Control Emergency Response Plan during a loss of well control (Doc No DR-00ZF-10001)
	Chemical Dispersant Deployment	Deployment schedule available which nominates rates of chemical dispersant application for the spill duration
	Chemical Dispersant Stockpile	Access to dispersants stockpile as per deployment schedule
	Dispersant Subsea Application Equipment and Services	*Refer to Performance Standard related to SFRT (Source Control)*a s this equipment is part of the tool kit.
Monitor and Evaluate	Vessel surveillance	Surveillance using vessels of opportunity* capable of being initiated within 24 hours of the Tier 2/3 release **Contracted vessels doing other response work utilised opportunistically for the purpose of surveillance*
	Manned Aerial Surveillance	Suitable aircraft complete with support crews and aerial observers capable of conducting 2 fly-overs per day will be at site by Day 2 for a Level 2 or 3 spill release
	Tracking Buoys	Access to 4 tracking buoys every 24 hours, and tracking buoys reused/redeployed to track the plume
	Entrained oil monitoring equipment and services	Capability to deploying 2 fluorometers via wave gliders using 2 vessels will be onsite by Day 5 for deployment to specific locations within Level 3 spill areas
	Oil Spill Modelling	Oil Spill modelling commissioned within 24 hours for a Level 2 or 3 spill notification

Surface Chemical Dispersion	Chemical Dispersant Deployment	Deployment schedule available which nominates rates of chemical dispersant application for the spill duration
	Chemical Dispersant Stockpile	*Same performance standard as the subsea chemical dispersant stockpile*
	Dispersant spraying aircraft	• Capability to deploy fixed dispersant application aircrafts with 30m3 /day dispersant supply and Air Attack Observation Aircraft by Day 2
	Dispersant application vessel	• Capability to deploy at least 2 vessels complete with dispersant spraying systems and $20m^3$ /day dispersant supply made available by Day 2
Shoreline Protection	Shoreline protection equipment and vessels	Vessels, protection equipment and personnel capable of being mobilised to priority protection hotspots within the stipulated timeframes as defined in OPEP
Offshore Containment and Recovery (C&R)	Offshore C&R equipment and vessels	Vessels, C& R equipment and personnel capable of being mobilised for containment and recovery operations offshore of the priority protection hotspots within the stipulated timeframes as defined in OPEP.
Shoreline Clean-up	Shoreline Clean-up equipment and vehicles/vessels	Vessels, clean-up equipment and personnel capable of being mobilised to clean-up priority protection hotspots within the stipulated timeframes as defined in OPEP
Oiled Wildlife Response (OWR)	OWR equipment and personnel	Level 3 OWR resources capable of being mobilised within the stipulated timeframes defined in OPEP
Waste Management	Waste Management Plan	The demand for waste management resources capable of being met based on the worst case volume anticipated to be generated at each hotspot as per waste management plan in OPEP

7. MANAGEMENT APPROACH

The Outer Barrow drilling activities will be managed in compliance with all measures and controls detailed within the EP accepted by NOPSEMA under the OPGGS (E) Regulations, other environmental legislation and Quadrant's Management System (e.g. Environmental Management Policy).

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

The EP details specific performance outcomes, standards and procedures, and identifies the range of controls to be implemented (consistent with the standards) to achieve the performance outcomes. The controls for the activities are summarised in **Section 6**. The EP also identifies the specific measurement criteria and records to be kept to demonstrate the achievement of each performance outcomes.

As described in the EP, the implementation strategy includes the relevant details of the following:

1. Environmental management policy
2. Environmental performance standards and outcomes
3. Environmental Management System including ownership and objectives, audits, monitoring and review
4. Leadership and responsibilities
5. Workforce training and competency
6. Performance review and continuous improvement
7. Records
8. Management and review of the EP
9. Routine and incident reporting

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

Acknowledging that this is a 5 year EP, Quadrant Energy will assume as default that all wells that are to be drilled in WA-214-P, WA-33-R, WA-55-R, WA-29-L, and WA-13-L permits under this EP, will be assessed using Quadrant's Management of Change Procedure (MoC) (EA-91-IQ-10001). Quadrant's MOC process provides a systematic approach to initiate, assess, document, approve, communicate and implement change(s) or proposed change(s), to EPs and OPEPs (currently in force) whilst meeting the requirements of the OPGGS (E) Regs. The MoC process, is applied where there is a change to an activity (including new activity or new stage of activity), change to environmental impacts or risks, or change in the manner in which the environmental impacts and risk are managed (i.e. controls or implementation strategy) under the EP or OPEP currently in force to ensure compliance with all relevant legislation.

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

Non-conformances found are addressed and resolved by a systematic corrective action process and are reported to NOPSEMA where relevant.

Senior Quadrant and vessel contractor personnel will be accountable for ensuring conformance with environmental performance outcomes and standards and all personnel will be empowered to 'stop-the-job'

to ensure the activity is being implemented in an environmentally responsible manner. The EP identifies specific responsibilities for each role during the activity.

Incident notification and reporting to NOPSEMA and other regulators will be conducted as per the OPGGS (E) Regulations, as detailed within the EP. Reported HSE incidents and hazards will be communicated to personnel during daily operational meetings.

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 undertaken by the Rig OIM/Vessel Master in line with the MODU/ 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 Outer Barrow Drilling Oil Pollution Emergency Plan (OPEP) (EA-00-RI-10065).

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

- Monitor and evaluate: surveillance and spill fate modelling;
- Source control: relief well and well intervention including the use of a capping stack. Subsurface dispersant operations will be required in association with the source control strategy of capping stack;
- Containment and recovery of oil;
- Mechanical dispersion of floating oil: mechanical dispersion through use of vessels;
- Chemical dispersion of floating oil;
- Wildlife operations: including hazing and capture/treatment;
- Shoreline operations for protection/deflection and clean-up; and
- Operational and scientific monitoring: to determine extent of spill and impact and recovery assessment of sensitive marine receptors exposed to oil – tier 3 spills.

A justification and description of the strategies is provided in **Table 8-1.** Control measures and environmental performance measures are outlined in **Table 6-4**.

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

STRATEGY	Applicability		Justification and Description
	Condensate	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. For a loss of well control scenario, source control options include MODU ESD systems and BOP, implementing subsea response tool kit and capping stack and drilling for a relief well.
Source control (subsurface chemical dispersion)	No* (only as part of source control)	No	Subsea dispersants application is not considered to be a suitable option due to the nature of condensate (high volatility, the ability to significantly disperse in the water column naturally and, evaporate/weather/biodegrade rapidly naturally). The preferred strategy is to allow natural evaporation and biodegradation to occur at the surface. *However subsea chemical dispersant injection may be required for safe implementation of a capping stack installation. In that case the decision to adopt this control option is done for safe operations purposes and not driven by the need to reduce shoreline contact.
Monitor and evaluate	Yes	Yes	Monitor and Evaluate activities include vessel and aerial surveillance, spill fate modelling and use of tracking buoys. 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. Surveillance results are used to assist in escalating or de-escalating response strategies as required.
Mechanical dispersion	No	No	Mechanical dispersion will not be applied to a diesel or condensate release because of the nature of the hydrocarbons—preferentially relying on evaporation rather than dispersing toxic components of the fuel into the water column.
Surface chemical dispersion	No*	No	Surface chemical dispersant application is not considered a suitable response strategy due to the nature of condensate (high volatility, the ability to significantly disperse in the water column naturally and, evaporate/weather/biodegrade rapidly naturally). The preferred strategy is to allow natural evaporation and biodegradation to occur at the surface. Application of a chemical dispersant would significantly reduce the ability to naturally reduce the spill volumes via surface evaporation and biodegradation. Instead, this would increase the hydrocarbon volumes in the water column. *However, this option may become a beneficial response strategy in the event the condensate weathers differently than expected, and produces a weathered product amenable to dispersants. Chemical dispersion will only be considered when there is a net environmental benefit. Applicability of chemical dispersant is limited to the conditions and circumstances described in the OPEP.

STRATEGY	Applicability		Justification and Description
	Condensate	Diesel	
Protection and deflection	Yes	No	Booms can be used to create physical barriers on the water surface to protect sensitive receptors in nearshore environments in close proximity to the area requiring protection and/or in deeper water further from the protection priority with the intent of taking the oil plume off its trajectory path to the sensitive receptors. Booms can also deflect the oil spill to easier locations for other response strategies. 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. The diesel spill is not predicted to impact shorelines.
Containment and recovery	No*	No	Containment and recovery is not considered a suitable response strategy due to the nature of condensate (high volatility, the ability to significantly disperse in the water column naturally and, evaporate/weather/biodegrade rapidly naturally). Due to the extremely low viscosity of the condensate, it will not be containable behind booms to a level (thickness) that allows recovery through skimmers; skimmers will not recover the oil. The preferred strategy is to allow natural evaporation and biodegradation to occur at the surface. Due to the highly volatile nature of condensate, there are also safety implications from operating equipment. *However, this option may become a beneficial response strategy in the event the condensate weathers differently than expected, and produces a weathered product amenable to containment and recovery.
Shoreline clean-up	Yes	No	The preferred strategy to shoreline clean-up is to allow natural evaporation and biodegradation to occur on the shoreline because of the nature of condensate (high volatility and the ability to significantly evaporate/weather/biodegrade rapidly naturally). Contaminated debris and sand profiles may be removable. Clean-up of the oiled shorelines will be implemented using suitable methods, provided it will be beneficial to the environment based on the NEBA being undertaken. Shorelines will be assessed for their shoreline clean-up potential based on aerial surveillance reconnaissance, Oiled Shoreline Response Team (OSRT) observations and NEBA in the shoreline clean-up assessment. High volume, low pressure flushing may be considered if the condensate enters high priority/ slow recovery habitats such as mangroves, permanently emerged reefs or wetlands. A diesel spill is not predicted to impact shorelines.
Oiled wildlife response	Yes	Yes	Due to the nature of condensate, it is commonly thought that this light oil does not cause problems for wildlife due to the lack of visible oiling, however contact may be toxic (WAOWRP, 2014) Wildlife onshore are unlikely to be coated, however, some degree of contact via entrained and floating oil may result. The main risk to wildlife, especially birds and turtles, is likely to be from contact of the condensate from entrained and oil afloat.

STRATEGY	Applicability		Justification and Description
	Condensate	Diesel	
			As various hotspots with importance for marine wildlife have been identified to be threatened by the spill, mobilisation of a wildlife response will likely be necessary. Options for wildlife management have to be considered and a strategy determined guided by the Western Australian Oiled Wildlife Response Plan (WAOWRP).
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. 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. Extent/impact of spill to determine the extent of operational and scientific monitoring. Resources are available to implement operational and scientific monitoring as required.
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 and as diesel and condensate spills tend to have high evaporation rates and spread into very thin films this strategy is not applicable for this activity. 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.

8.1 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.

8.2 Oil Spill Response Resources

Oil spill response equipment and resources are a combination of Quadrant, AMOSC, AMSA, DoT, National Plan (NatPlan), OSRL, and other operator resources available through the AMOSPlan mutual aid arrangements. Under the MOU between AMSA and Quadrant, AMSA will provide all resources available through NatPlan to support a Quadrant spill response. The DoT coordinates the State Response Team (SRT)

oil spill response personnel and equipment resources. The DoT will work with Quadrant 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 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 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 is able to access:

- AMOSC core group responders;
- DPaW staff and approved volunteers/SMEs;
- 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 and include specialist technical capabilities. Quadrant has contracts in place for obtaining primary control support agency for scientific response monitoring activities. If additional support is required, Quadrant has Master Service Agreements with other service providers to support scientific response monitoring activities.

9. CONTACT DETAILS

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