Balnaves Development Commissioning and Operations Environment Plan Summary

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1. INTRODUCTION

The Balnaves Development is situated within production licence WA-49-L (**Figure 1-1**). Apache Energy Limited (AEL) is the operator of WA-49-L (65%) along with its joint venture participant Kufpec Australia Pty Ltd (35%). The field is located in Commonwealth Waters approximately 48 km north-west of the Montebello Islands and 75 km north-west of the AEL-operated Varanus Island. Water depth over the field varies from 110 m to 160 m and the average depth of the field is 135 m (manifold).

The purpose of the Balnaves Development is to produce oil from the Balnaves field. The Balnaves field consists of a small, light oil reservoir in the Mungaroo Formation (B20 Sandstone) part of which is overlain by a separate gas bearing formation (B10 Sandstone) approximately 90 m above the oil reservoir (**Figure 1-2**).

1.1 Schedule

Commissioning is planned for 2014. The field is expected to produce oil over a planned operating life of five years. At the end of the commercial lifetime, the field will be de-commissioned, involving the removal of all infrastructure and materials above the seabed and the floating, production, storage and offloading (FPSO) facility (the latter to be taken away by the FPSO owner, Bumi Armada).

1.2 Compliance

The Balnaves Development was referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to the former Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (now the Department of the Environment) on 25 November 2011. On 10 April 2012 Apache Energy Limited (Apache) was approved – under the EPBC Act (Referral decision EPBC 2011/6188) – to develop the offshore Balnaves condensate field within the Northern Carnarvon Basin of the North West Shelf (NWS).

The Balnaves Development Commissioning and Operations Environment Plan (EP) (BL-00-RI-006.01) was prepared to comply with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS (E) Regulations) under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) (Cmlth). The EP has been reviewed and accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

This EP summary has been prepared as per the requirements of Regulation 11 (7) and (8) of the referenced OPGGS(E) Regulations.

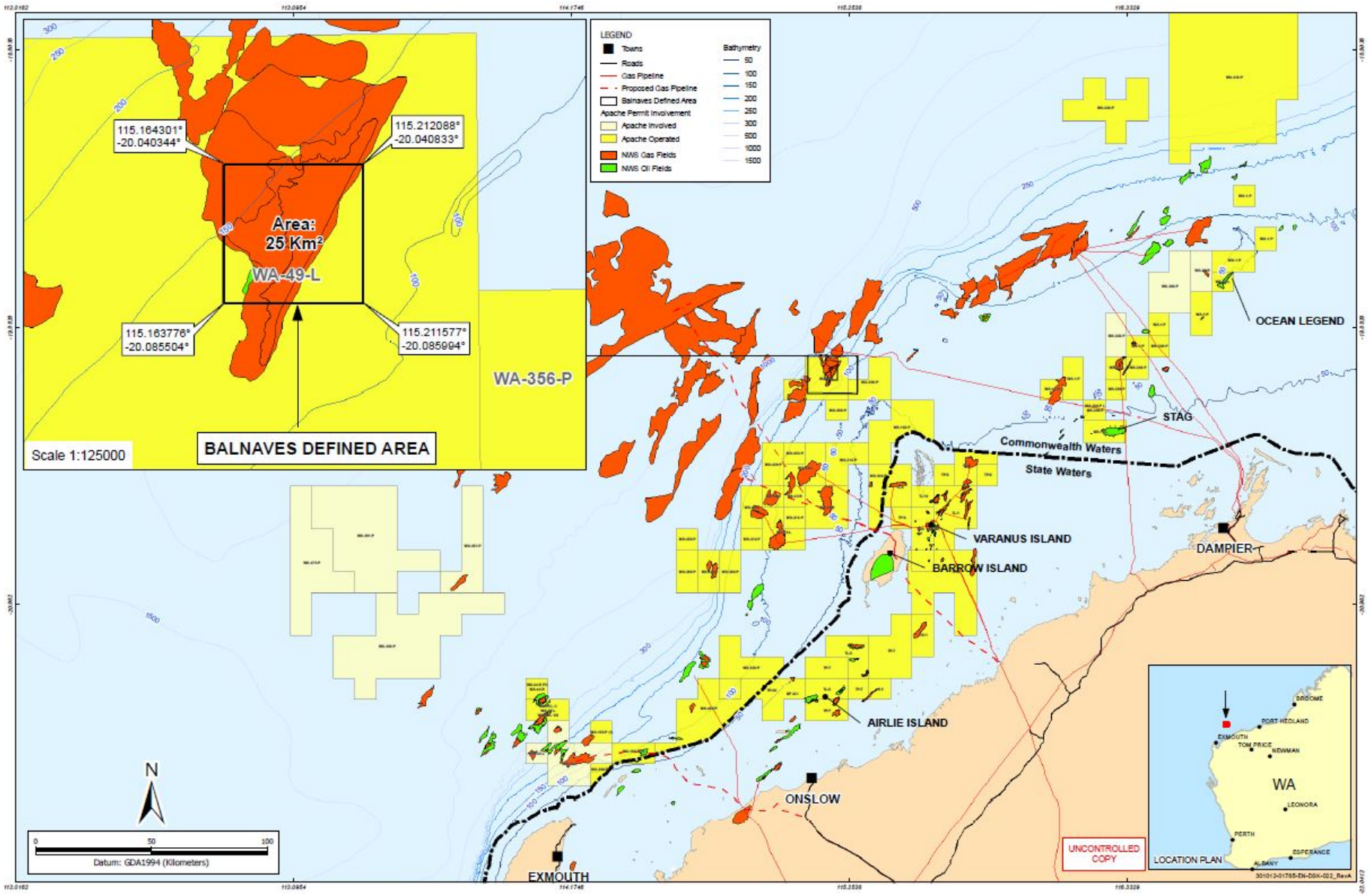

Figure 1-1: Balnaves Development project location and Defined Area

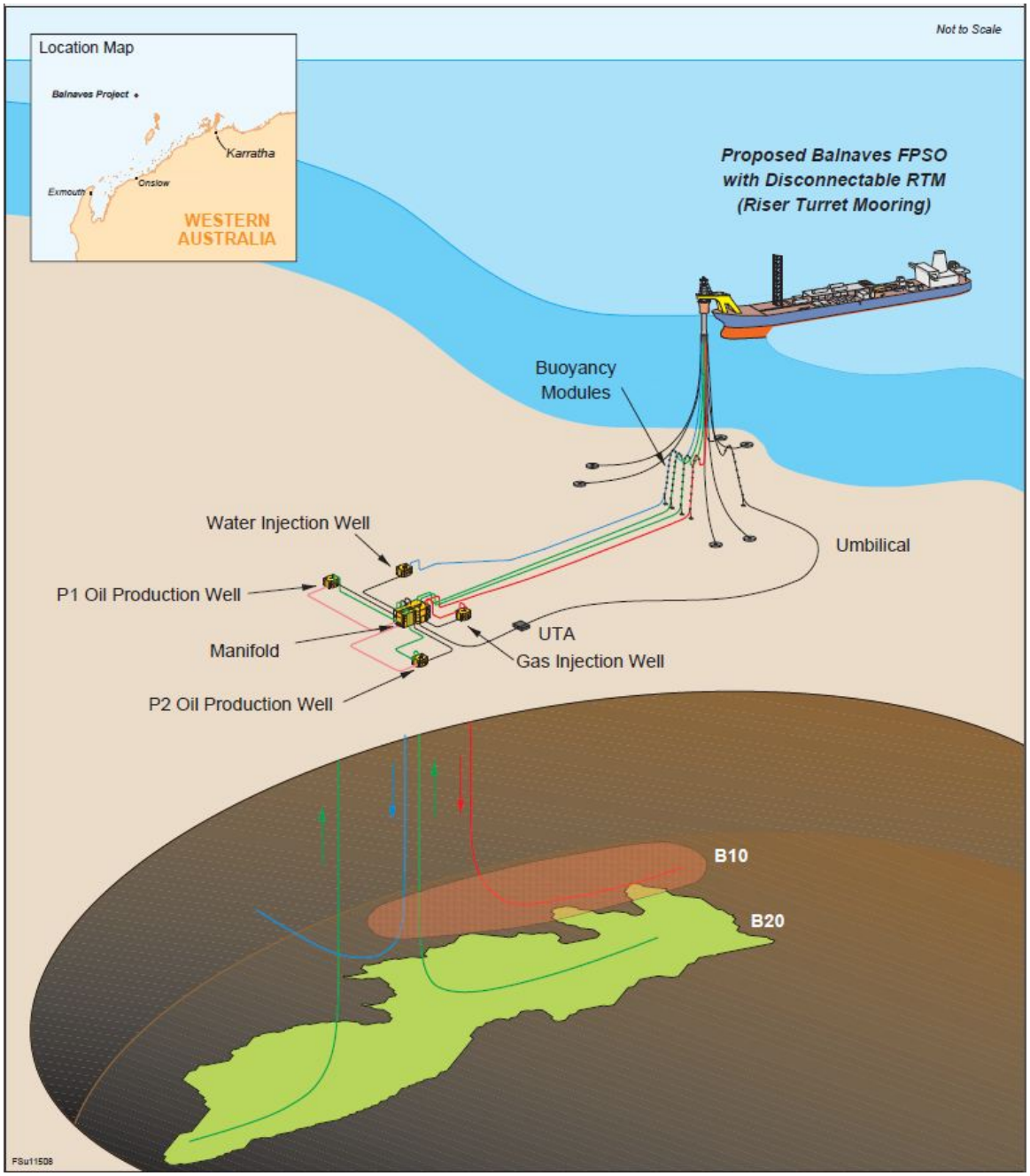

Figure 1-2: Schematic of the Balnaves operations subsea infrastructure

2. ACTIVITY LOCATION

Subsea infrastructure during the activity will be installed in production license WA-49-L. Locations of the Balnaves Development's major infrastructure components are given in **Table 2-1.**

The 'Defined Area', as shown in **Figure 1-1**, is the boundary within which activities described in the EP will occur. The Defined Area is approximately 75 km north-west from the Apache-operated Varanus Island Hub and approximately 48 km north-west of the Montebello Islands, in water approximately 135 m deep.

Table 2-1: Coordinates of the operational area

Infrastructure	Coordinates (Datum/Projection: GDA 94 Zone 50)			
	Latitude (South)	Longitude (East)	Easting (m)	Northing (m)
FPSO mooring position	-20^0 03' 31.302''	115^0 11' 31.069''	310916.00	7781000.00
Anchor leg 1	-20^0 03' 07.594''	115^0 11' 40. 561''	311183.92	7781732.02
Anchor leg 2	-20^0 03' 12.131''	115^0 11' 48.484''	311415.64	7781594.97
Anchor leg 3	-20^0 03' 51.003''	115^0 11' 48.134''	311418.38	7780399.53
Anchor leg 4	-20^0 03' 55.054''	115^0 11' 40.016''	311183.87	7780272.41
Anchor leg 5	-20^0 03' 34.704''	115^0 11' 03.942''	310128.88	7780886.83
Anchor leg 6	-20^0 03' 25.697''	115^0 11' 04.085''	310131.01	7781163.85
Production 1 well (BAL-6H)	-20^0 04' 12.639''	115^0 11' 00.641''	310044.87.	7779719.24
Production 2 well (BAL-5H)	-20^0 04' 14.438''	115^0 11' 00.267''	310035.38	7779663.79
Gas injection well (BAL-8GI)	-20^0 04' 14.007''	115^0 11' 01.756''	310078.52	7779677.53
Water injection well (BAL-7WI)	-20^0 04' 12.867''	115^0 11' 01.552''	310072.21	7779712.51
Balnaves manifold	-20^0 04' 13.624''	115^0 11' 00.813''	310051.00	7779689.00

The Defined Area (5 x 5 km), as defined in the EPBC Referral 2011/6188, incorporates the physical footprint of the commissioning and operational activities including the FPSO, subsea infrastructure, disconnectable riser turret mooring (RTM) and topside facilities. The Defined Area lies immediate around the offshore facilities, largely within Block WA-49-L.

3. DESCRIPTION OF THE ACTIVITY

3.1 Commissioning

The commissioning period is expected to take approximately six months. Commissioning is the preparation of a production system for start-up, or the preparation of start-up, and testing of non-production (utility) systems to verify their functional and operational performance is in accordance with project design and specification.

3.2 Operations

3.2.1 RTM buoy connection and disconnection

The disconnectable RTM buoy's main function is to collect the risers, moor them to the FPSO and provide the mooring system for the FPSO (and tandem-moored offload tankers). The FPSO can disconnect from the RTM when a cyclone is forecast to impact the Defined Area.

3.2.2 Crude oil production

During operations, in addition to extraction of crude oil from reservoirs, subsea infrastructure will reinject water and gas. Chemicals are also injected into various stages of the production system to ensure safe operation.

3.2.3 Offloading

The offloading operations take place on average every 21 to 40 days. The maximum offloading parcel size is 650,000 bbl and takes approximately 26 hours to offload, excluding mooring and disconnection time off the offtake tanker. As such, offtake tankers are expected to be in the field approximately 5% of the project life. Associated tugs for the offtake tankers are expected to be in the field for similar timeframes.

3.3 Vessels and helicopters

Several vessel-based support activities are undertaken from time to time to ensure the efficient day-to-day operation of the Balnaves FPSO. The vessel used for these activities depends on the specific requirements of the proposed activity, water depth and availability of vessels. The vessels are vetted by Apache to ensure these are appropriate to the required activities.

Helicopter operations are restricted to daylight hours; night landing will only be permitted in the case of an emergency. The helicopter flight time from Karratha to the FPSO is approximately 40 minutes. There will be approximately one helicopter flight per week for normal crew changeover. An additional 15 to 20 non-routine flights per year are anticipated.

4. DESCRIPTION OF ENVIRONMENT

4.1 Physical environment

The Defined Area lies in the arid tropics experiencing high summer temperatures and periodic cyclones. Rainfall in the region is low with evaporation generally exceeding rainfall throughout the year, although intense rainfall may occur during the passage of summer tropical cyclones and thunderstorms (Condie et al., 2006).

Salinity is relatively uniform at 34–35 ppt throughout the water column and across the North West Shelf (NWS). Due to the low average rainfall in the region there is little freshwater run-off from the adjacent mainland (Blaber et al., 1985). 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). Vertical gradients are correlated to sea surface temperatures and are greatest during the warm-water season (SSE, 1991).

Wind shear on surface waters generates local-scale drift currents that can persist for extended periods (hours to days). During September–March, the prevailing non-storm winds are from the southwest ranging up to a maximum speed of ~30 knots. Winds from the southwest direction are generally strongest between September and January with wind speed frequently reaching 24 knots and weaker between February–March with wind speed generally less than 16 knots (APASA, 2013). During April–August, winds are generally lighter and more variable in direction. Non-storm winds prevail from the east-south quadrant and can attain a maximum speed of up to 30 knots, but are generally less than 16 knots, particularly during April and May (APASA, 2013). Extreme wind conditions in the area may be generated by tropical cyclones, strong easterly pressure gradients, squalls, tornados and water spouts.

The wave climate is generally composed of locally generated wind waves (seas) and swells that are propagated from distant areas (WNI, 1995; 1996). In summer, seas typically approach from the west and southwest, while in winter, seas typically approach from the south and east. Mean sea wave heights of less than 1 m with peak heights of less than 2 m are experienced in all months of the year (WNI, 1995). Mean swell heights are low at around 0.4–0.6 m in all months of the year. Tropical cyclones have generated significant swell heights of up to 5 m in this area, although the predicted frequency of swells exceeding 2 m is less than 5 per cent (WNI, 1995).

The dominant offshore sea surface 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 (CMAR, 2007; Condie et al., 2006). The Indonesian Throughflow is the other important current influencing the upper 200 m of the outer NWS (Woodside, 2005; CMAR 2007). Modelling indicates that significant east–west flows occur across the NWS to the north of the North West Cape, possibly linking water masses in the area (Woodside, 2005; Condie et al., 2006). Due to the complex oceanography of the NWS offshore drift currents comprise 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).

4.2 Biological environment

The Defined Area is situated within Commonwealth waters of the North-west Marine Region (DSEWPaC, 2008). Low density benthic communities of bryozoans, molluscs and echinoids are supported within the bioregion. Sponge communities are also sparsely distributed on the shelf and are found only in areas of hard substrate.

The expected benthic habitats within the area are soft sediments and outcropping cemented sediments (hard substratum). Benthic primary producer habitat (e.g. areas of hard corals, seagrass, macroalgae or mangroves) is unlikely to be present. The minimum depth of the water is approximately 50 m; at this depth benthic primary production, which relies on photosynthesis for energy production is limited due to

insufficient light availability. Soft sediment benthic fauna comprises predominantly mobile burrowing species including molluscs, crustaceans (crabs, shrimps and smaller related species), polychaetes, sipunculid and platyhelminth worms, asteroids (sea stars), echinoids (sea urchins) and other small animals. Cemented sediments provide hard substrate which can be used as attachment points for sessile filter feeding invertebrates such as soft corals, gorgonians and sponges. These areas are also likely to be used by mobile invertebrates such as molluscs, crustaceans (crabs, shrimps and smaller related species), polychaetes, sipunculid and platyhelminth worms, asteroids (sea stars) and echinoids (sea urchins).

A biological seabed survey of the Defined Area was undertaken in October 2011 by RPS Environment and Planning Pty Ltd (RPS, 2012). This survey included the proposed Balnaves FPSO turret mooring centre, the FPSO anchor locations and the production flowline and umbilical routes from the proposed manifold location to the FPSO. They survey found that the seabed comprised homogeneous fine, bioturbated sediments that were predominantly bare, with less than 5% epibenthic biota cover (RPS, 2012).

Key ecological features (KEFs) are components of the marine ecosystem that are considered to be important for biodiversity or ecosystem function (DSEWPaC, 2012a; DSEWPaC, 2012b). In a search of EPBC Act Protected Matters Database, the following KEFs were identified that may be impacted by planned or unplanned (e.g. hydrocarbon spill) activities:

- **Ancient coastline at 125 m contour**. This is a unique seafloor feature. The shelf of the Northwest Marine Region contains several terraces and steps which reflect the gradual increase in sea level across the shelf that occurred during the Holocene. The most prominent of these occurs episodically as an escarpment through the Northwest Shelf Province and Northwest Shelf Transition, at a depth of approximately 125 m. It has been suggested that humpback whales, whale sharks and other migratory pelagic species may use this escarpment as a guide as they move through the region. Although the ancient coastline adds additional habitat types to a representative system, the habitat types would not be unique to the coastline as they are widespread on the upper shelf (Falkner et al., 2009).
- **Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula**. The canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula include the Cape Range Canyon and the Cloates Canyon. They are believed to be associated with upwelling as they channel deep water from the Argo Abyssal Plain up onto the slope, where it mixes with the overlying water layers at the canyon heads. The upwelling zones at the canyon heads are sites of species aggregations such as sweetlip emperor fish. The soft bottom habitats within the canyons themselves are likely to support important assemblages of epibenthic species. The canyons are thought to be significant contributors to the biodiversity of the adjacent Ningaloo Reef, as they channel deepwater nutrients up to the reef, stimulating primary productivity. These canyons occur in water depths of between 1800 m and 4800 m (Falkner et al., 2009).
- **Commonwealth Waters adjacent to Ningaloo Reef**. Ningaloo Reef is globally significant as the only extensive coral reef in the world that fringes the west coast of a continent. Ningaloo Reef extends for more than 260 km along the Cape Range Peninsula. The Commonwealth Waters around Ningaloo Reef are a Commonwealth Marine Reserve. As the reef is located next to an arid hinterland and receives very little terrestrial runoff, it is almost entirely dependent on processes in the marine environment for nutrient input and maintenance of its ecology. The waters of the reef are a site of enhanced biological productivity, due to upwelling associated with the adjacent canyons on the slope and interactions between the Ningaloo Current and Leeuwin Current (DSEWPaC, 2012a).
- **Continental slope demersal fish communities with high species biodiversity and endemism**. Demersal slope fish assemblages in the Timor Province, the Northwest Transition and the Northwest Shelf Province are characterised by high endemism and species diversity. The level of endemism of demersal fish species in these bioregions is high compared with anywhere else along the Australian continental slope. The Northwest Shelf Province, specifically the continental slope

between North West Cape and the Montebello Trough, has more than 500 fish species, 76 of which are endemic, making it the most diverse slope bioregion in Australia. The slope of the Timor Province and the Northwest Transition also contains more than 500 species of demersal fish, of which 64 are considered to be endemic, and is the second-richest area for demersal fish species across the entire Australian continental slope (DSEWPaC, 2012a).

- **Exmouth Plateau**. The Exmouth Plateau covers an area of approximately 50,000 km^2 and consists of a generally rough and undulating surface at water depths of approximately 500 m to more than 5000 m. The plateau is thought to be dotted with numerous pinnacles. It is an important geomorphic feature that modifies the flow of deep waters, and has been identified as a site where internal waves are generated by internal tides. The plateau also receives settling detritus and other matter from the pelagic environment (DSEWPaC, 2012a; Falkner et al., 2009).
- **Glomar Shoals**. This a unique seafloor feature of highly fractured molluscan debris, coralline rubble and coarse carbonate sand that occurs approximately 30 to 40 km offshore of Dampier in Commonwealth Waters between depths of 26 and 70 m. Anecdotal evidence indicates this area has localised increased biological productivity which attracts fish such as Rankin cod, brownstripe snapper, red emperor, crimson snapper and frypan bream, all of which are caught in large numbers by commercial fisheries in this area (DSEWPaC, 2012a; Falkner et al., 2009).
- **Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals**. Mermaid Reef is surrounded by waters that extend to a depth of more than 500 m. It is the most north-easterly of the three reef systems forming the Rowley Shoals. It has national and international significance due to its pristine character, coral formations, geomorphic features and diverse marine life including important areas for sharks, marine turtles, whales, dolphins, tuna, billfish and migratory seabirds (DSEWPaC, 2012a).
- **Western Demersal slope and associated fish.** Provides important habitat for demersal fish communities with a high level of diversity and endemism. A diverse assemblage of demersal fish species below a depth of 400 m is dominated by relatively small benthic species such as grenadier, dogfish and cucumber fish. Many of these species display unique physical adaptations to feed on the sea floor unlike other Australian slope communities, and many do not appear to migrate vertically during feeding (DSEWPaC, 2012b).
- **Wallaby Saddle.** Forms a broad (100 km) area of seafloor in 4,000-4,700 m water depth that connects the northwest margin of the Wallaby Plateau with the outboard margin of the Carnarvon Terrace on the upper continental slope. It represents almost the entire area of this type of geomorphic feature in the North-west Marine Region. It is shallower than adjoining abyssal areas to the north and south and is believed to be associated with upwelling as deeper more nutrient-rich waters are pushed up onto the saddle (Falkner et al. 2009). Aggregations of sperm whales are known to occur on the Wallaby Saddle and it is believed that they feed on aggregations of baitfish that are attracted to the productive waters (DSEWPaC, 2012a).
- **Ancient coast line at 90 to 120 m depth.** Contains several terraces and steps reflecting a gradual increase in sea level across the shelf that occurred during the Holocene. The most prominent of these occurs close to the middle of the continental shelf off the Great Australian Bight at a depth of approximately 90–120 m. The area has important conservation value due to its potential for high productivity, biodiversity and aggregations of marine life. Benthic biodiversity and productivity occur where the ancient coastline forms a prominent escarpment of exposed hard substrates, where it is dominated by sponge communities of significant biodiversity and structural complexity (DSEWPaC, 2012b).
- **Commonwealth marine environment surrounding Houtman Abrolhos Islands.** The commonwealth marine environment surrounding the Houtman Abrolhos Islands has conservation value as an area of high biodiversity and ecologically unique benthic and pelagic habitats. The high biodiversity of the islands is attributed to the mix of temperate and tropical species, resulting from the southward

transport of species by the Leeuwin Current. The Leeuwin Current allows the Houtman Abrolhos Islands to support the highest latitude corals reefs in the Indian Ocean. The reefs comprise a number of species of coral that support species of demersal fish, molluscs, sponges, echinoderms and benthic algae. The area is also an important habitat for rock lobsters and the islands are the largest seabird breeding area in the eastern Indian Ocean (DSEWPaC, 2012b).

- **Commonwealth marine environment within and adjacent to the west-coast inshore lagoons**. Important areas for benthic productivity (including macroalgae and seagrass communities) and breeding and nursery aggregations for many temperate and tropical marine species. Also important areas for the recruitment of commercially and recreationally important fish species. Large schools of migratory fish visit the area annually, including herring, garfish, tailor and Australian salmon (DSEWPaC, 2012b).
- **Perth Canyon and adjacent shelf break and other west coast canyons.** The West Coast Canyons are characterised by higher productivity and species diversity as a result of deep ocean currents upwellings creating nutrient-rich, cold-water habitats that attract aggregations of deep-diving mammals and large predatory fish. The Perth Canyon is the largest ocean canyon on the Australia margin marking the southern boundary for numerous tropical species groups on the shelf, including sponges, corals and decapods. The Perth Canyon is a seasonally important aggregation area for krill and attracts many species of krill feeders, in particular pygmy blue whales. The complex topography of the canyon is also believed to provide more varied habitat that supports higher levels of epibenthic biodiversity than adjacent shelf areas (DSEWPaC, 2012b).
- **Western rock lobster.** The Western rock lobster (*Panulirus cygnus*) importance is primarily due to its presumed ecological role as an abundant and wide-ranging consumer on the west coast continental shelf. This species is the dominant large benthic invertebrate in this bioregion and is the target of WA's largest and most valuable fishery. The lobster plays an important trophic role in many inshore ecosystems of the southwest marine region, particularly when they are juveniles, as they are preyed upon by octopus, cuttlefish, baldchin groper, blue groper, dhufish, pink snapper, wirrah cod and breaksea cod. The high biomass of western rock lobsters and their vulnerability to predation suggest that they are an important trophic pathway for a range of inshore species that prey upon juvenile lobsters (DSEWPaC, 2012b).

The EPBC Act Protected Matters Database identified 16 species of marine fauna found in the Defined Area which are listed as threatened species (endangered or vulnerable) and/or migratory under the EPBC Act. The list included seven marine mammals, five turtles, one seabird and three fish. The database identified an additional 67 threatened and/or migratory species present in the broader area that may be impacted in the unlikely event of a worst-case hydrocarbon spill.

Some operational activities will overlap the March–June period when whale sharks are likely to be most abundant on the NWS; however, given the distance to the Ningaloo Marine Park where they aggregate (approximately 180 km southwest), large numbers are not expected to be encountered.

The Department of Fisheries has indicated (through stakeholder consultation) that seven fisheries species may spawn within or in the vicinity of the Defined Area (**Table 4-1**).

Table 4-1: Key fish species spawning/aggregation times in the vicinity of the Defined Area

Species	Spawning/Aggregation times
Goldband snapper (*Pristipomoides multidens*)	January – April
Spanish mackerel (*Scomberomorus commerson*)	October – January
Rankin cod (*Epinephelus multinotatus*)	August – October

Species	Spawning/Aggregation times
Red emperor (*Lutjanus sebae*)	October – March
Pink snapper (*Pagrus auratus*)	May – July
Blacktip shark (*Carcharhinus melanopterus*)	November – December
Sandbar shark (*Carcharhinus plumbeus*)	October – January

The activity will also coincide with humpback whale (north and south) migration, although based on the shallower depth range of the southern migration (30–100 m), whales are more likely to be encountered at the Defined Area (approximately 110–160 m) during the northern migration peaking in July. There are no resting areas that have been identified nearby, with the closest sensitive area likely to be Exmouth Gulf. There is the potential for pygmy blue whales to migrate through the Defined Area during their northern migration period (April–August). However, the width of the blue whale migration corridor in the region (greater than 200 km) suggests that it is highly unlikely that there will be significant interactions with pygmy blue whales.

The nearest turtle nesting sites are the Montebello Islands, Lowendal Islands and Barrow Island (greater than 48 km southeast). Most specimens of the short-nosed seasnake (*Aipysurus apraefrontalis*) have been collected from Ashmore and Hibernia reefs (Minton and Heatwole, 1975), which are not within the area. The Southern giant petrel (*Macronectes giganteus*) may occasionally over-fly the Defined Area or greater potential spill trajectory area when in transit or during foraging, but are not expected to be encountered in significant numbers.

4.3 Socio-economic environment

The operational area is located approximately 175 km offshore from the Port of Dampier. Smaller regional settlements are at Onslow, Point Samson and Exmouth. Socio-economic activities that may occur within the area include commercial fishing and oil and gas exploration and production; and to a lesser extent, recreational fishing and tourism.

Offshore and coastal waters in the North-west Marine Region support a valuable and diverse commercial fishing industry, dominated by Pilbara fisheries. Of the State commercial fishing boundaries, the Pilbara Trap Managed Fishery and Pilbara Line Fishery were identified as potentially interacting with the operational activities. The Pilbara Trap Managed Fishery is seaward of the 30 m isobath and landward of the 200 m isobath. The Pilbara Line Fishery licensees are permitted to operate 'anywhere' in Pilbara waters. The North West Slope Trawl Fishery (NWSTF) is the only Commonwealth fishery with historical effort within the area, targeting scampi and prawns. The NWSTF is restricted to depths of greater than 200 m.

Water-based tourism activities undertaken across the NWS include whale watching, recreational boating and fishing, charter boat fishing, snorkelling and diving, and surfing. Given the considerable distance of the operational area from the nearest population centre at Dampier (approximately 175 km away) and the nearest shoreline at Montebello Islands (approximately 48 km away) there is unlikely to be any tourism based activities in the area.

The Defined Area is approximately 2 to 3 km south of the Brunello gas field and approximately 13 km north-east of the Julimar gas field (**Figure 1-1**). Both of these fields will be developed by AEL to supply gas to Chevron's Wheatstone Project. The Defined Area for the activity is located approximately 1.5 km north-west of the proposed 44" (1.1 m) diameter gas pipeline from the Wheatstone offshore facilities to the proposed LNG plant at Ashburton on the mainland.

There are no recognised shipping routes in or near the operational area with the nearest recognised shipping routes located 43 km northwest and 56 km east.

There are no World Heritage properties, National Heritage places, wetlands of international importance or Aboriginal heritage sites located within the Defined Area. The closest known historic shipwreck location is at Trial Rocks (approximately 35 km south-southeast of the operational area) where the wreck of the vessels *Trial* and *Tanami* are believed to occur.

5. STAKEHOLDER CONSULTATION

Apache maintains a comprehensive stakeholder database containing fishing interest groups, government and non-government authorities and other stakeholder parties including the community. This database was used to identify stakeholders located, or operating, in the proximity of the activity. Apache has maintained relationships to assist information sharing with key stakeholders for many years and regularly communicates with stakeholders on a variety of activities, always seeking comment and fielding enquiries.

Relevant interested parties for consultation directly relating to the installation activities were identified on the basis of the operational area. Stakeholders identified are listed in **Table 5-1**.

Table 5-1: Summary of stakeholders consulted

Group	Stakeholder
Commercial fisheries	• Australian Fisheries Management Authority (AFMA) • Department of Fisheries (DoF) • Western Australian Fishing Industry Council (WAFIC) • Commonwealth Fisheries Association (CFA) • A Raptis and Sons • Austral Fisheries • WestMore Seafoods • Shark Bay Seafoods • MG Kailis • Pearl Producers Association • State commercial fishing licence holders
Recreational fisheries	• Recfishwest • Marine Tourism WA
Marine conservation	• Department of Parks and Wildlife (DPaW)
Tourism	• Marine Tourism WA (formerly Charter Boat Association)
Shipping safety and security	• Australian Maritime Safety Authority (AMSA) • Department of Defence
Hydrocarbon spill response	• Australian Marine Oil Spill Centre (AMOSC) • Department of Transport (DoT)
Adjacent regulators	• Commonwealth Department of the Environment (DoE)* • Department of Mines and Petroleum (DMP)

*Department consulted with as part of the EPBC Act referral and assessment.

5.1 Consultation Summary

The move to operating status is the final step in the development of the Balnaves oil field, and there has been extensive consultation at every prior stage, including that required for the approval processes of the Phase I and II drilling campaigns, and the installation of seabed infrastructure.

Prior to preparing the *Balnaves Development Commissioning and Operations EP*, an Information Pack was distributed to stakeholders on 6 June 2013, outlining the Balnaves Development proposal, and highlighting AEL's intent to deploy the *Armada Claire* FPSO to process crude oil from the Balnaves Field.

Stakeholders have received regular updates regarding the Balnaves Development through Apache's Quarterly Project Updates. These are provided in response to stakeholder requests for a more streamlined consultation process, and include information previously requested by stakeholders.

At each contact point, stakeholders are urged to contact AEL should they require more information or have concerns with any activities showcased. While correspondence was received in response to a number of the Quarterly Updates, no specific concerns with the Balnaves Development have been raised.

Quarterly Updates in October 2012, December 2012, March 2013, June 2013 and September 2013 refer specifically to the Balnaves Development, with the most recent updates in June and September 2013 specifically notifying stakeholders of the five-year life cycle of the *Armada Claire* FPSO.

No major concerns were raised by stakeholders between distribution of the Balnaves Operations consultation package and the submission of this EP. The most extensive consultation included the provision of oil spill modelling to DMP at request, verification of the *Armada Claire's* IMO number with AMSA, and the inclusion of the detailed advice provided by DPaW and DoF into the development of this EP.

As Balnaves will move to an operating facility, Apache recognises that continued consultation will be required on the project with the established stakeholder set, albeit at a different level and with a different purpose. After commissioning, Apache will apply its standard approach for ongoing stakeholder consultation for established facilities.

6. ENVIRONMENTAL HAZARDS AND CONTROLS

Identification of hazards and assessment of risks was determined using a qualitative assessment process defined by the *Apache Environmental Risk Identification Procedure*. The Environmental Risk Assessment (ERA) identifies potential and expected hazards and environmental impacts and determines the risk of the impact occurring. For each impact the risk is determined prior to implementation of proposed management controls (inherent risk), and again after management controls have been implemented (residual risk). The control measures adopted are designed to eliminate the risk, or reduce the risk to a level that is tolerable or as low as reasonably practicable (ALARP). This assessment process was undertaken at risk assessment workshops held on 8, 28 and 29 May 2013. This workshop was attended by relevant technical, operational and environmental personnel within Apache and key contractor companies.

The environmental risk assessment identified 11 planned environmental risks and 10 unplanned environmental risks. The key environmental hazards and control measures to be applied are provided in **Section 9**. These are consistent with Apache corporate and project specific performance objectives, standards and criteria. All commitments associated with these will be used to reduce environmental risk to ALARP and will be of an acceptable level.

7. MANAGEMENT APPROACH

The activity will be managed in compliance with the *Balnaves Development Commissioning and Operations EP (BL-00-RI-006.01)* accepted by NOPSEMA under the OPGGS(E) Regulations, other environmental legislation and Apache's Management System (e.g. Apache Environmental Management Policy).

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

The EP details, for each environmental impact identified (and assessed in the Environmental Risk Assessment) specific performance objectives, standards and procedures and identifies the range of controls to be implemented (consistent with the standards) to achieve the performance objectives. The EP also identifies the specific measurement criteria and records to be kept to demonstrate the achievement of each performance objective.

The goals of the environmental implementation strategy as detailed in the EP are to direct, review and manage activities so that environmental impacts and risks are continually being reduced to ALARP, and performance objectives and standards are met. The implementation strategy includes the following elements:

1. Systems, practices and procedures;
2. Key roles and responsibilities;
3. Training, competencies and ongoing awareness;
4. Monitoring, auditing, management of non-conformance and review;
5. Records management;
6. Incident response and preparedness including oil spill contingency planning; and
7. Reporting.

The reporting requirements for routine activities and environmental incidents (recordable and reportable) and reporting on overall compliance of the activity with the EP (e.g. annual performance reports submitted to NOPSEMA) are also detailed.

8. CONTACT DETAILS

Further information about the Balnaves Development Commissioning and Operations activity can be obtained from:

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9. ENVIRONMENTAL IMPACTS AND CONTROLS

The following tables (refer to **Table 9-1** and **Table 9-2** below) provide a summary of potential environmental impacts that could be expected from the commissioning and operations activity for planned activities and unplanned events. It lists the activities which might give rise to environmental impacts and the subsequent controls and measures which eliminate or ensure the environmental risk is reduced to ALARP.

Table 9-1: Environmental risk summary for planned activities

PLANNED ACTIVITIES			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
FPSO and vessel presence and movements	The physical presence of the FPSO and vessel in the Defined Area.	Behavioural and physiological effects on marine fauna; Interference with other marine users.	• Apache Marine Fauna Sighting Datasheets are completed and submitted to DSEWPaC. • Compliance with Part 8 of the EPBC Regulations 2000. • 500 m petroleum safety zone around the wells flowlines and FPSO. A wider cautionary zone extends to a 2.5 nautical mile radius of the FPSO. • Liaison with commercial fisheries and shipping stakeholders to advise of field development plans. • All crew attend an environmental induction with information on managing interactions with marine fauna. • Australian Hydrographic Office (AHO) notified of the activity, to issue a Notice to Mariners. • Australian Maritime Safety Authority (AMSA) Rescue Coordination Centre (RCC) notified of the activity, to issue an AusCoast Warning.
Release of hydraulic control fluid from subsea valves	Operation of subsea valves.	Reduction in water quality and potential toxicity to marine species and benthic marine biota.	• AEL Chemical Approval Procedure used to select hydraulic fluid: - Chemical must be on the PLONOR list or have Offshore Chemical Notification Scheme (OCNS) rating 'D' or 'E' or 'Silver' or 'Gold', or its use justified on risk assessment basis. • Control hydraulic fluid used in Balnaves commissioning and operations is water based.
Artificial light	Deck and navigational lighting on FPSO and vessels.	Potential attraction/ disturbance to marine biota including, most relevantly, marine turtles and seabirds.	• All vessels in Australian waters adhere to the navigation safety requirements contained within the *Navigation Act 2012* and subordinate Marine Orders with respect to navigation and workplace safety equipment (e.g. lighting). • Non- essential lights as identified by an authorised auditor and agreed by the Vessel Master will not be directed onto marine waters. • FPSO operations lighting are specific for safe working practices with levels between 50 and 100 lux at 1 m above deck as per the Electrical Design Basis.
ROV and diving operations	Physical presence and emissions of divers and ROV.	Seabed disturbance Potential attraction/ disturbance to marine biota from ROV light and sonar.	• The installation and use of landing rails under the ROV to minimise 'footprint' of contact with seabed.
Release of marine growth	Minor periodic cleaning of FPSO hull and RTM will	Reduction in water quality.	• The use of anti-fouling coating on the hull of FPSO and RTM will reduce the need for cleaning during inspections.

PLANNED ACTIVITIES			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
	result in release of small quantities of marine growth and trace quantities of paint and anti-foulant.		• Anti-fouling system will comply with the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006*, • A vessel is to hold a current Anti-fouling System Certificate.
Discharge of produced formation water (PFW)	At times when PFW reinjection is not available, PFW (<30 mg/L oil) will be discharged.	Reduction in water quality; Potential toxicity to marine biota.	• At least 90% of PFW to be re-injected back into the reservoir on an annual basis. • Facilities and equipment have been designed and selected to reduce chemical use (e.g. corrosion-resistant alloys). • The water processing system is designed to treat PFW to less than 30 mg/L OIW prior to discharge. • Off-specification PFW can be automatically diverted to the FPSO slops tank or a cargo tank for re-processing if required. • Chemicals will be selected using the AEL Chemical Approval Procedure. • OIW concentrations will be measured continuously by an oil water analyser. • Manual sampling of PFW OIW content is also undertaken during periods of discharge and provides a more accurate reading of OIW concentration. • All equipment is maintained in compliance with manufacturer's specifications and Apache operating procedures and maintenance management system. • Personnel are trained and competent.
Discharge of sewage and putrescible waste	FPSO and support vessels will generate sewage and putrescible wastes.	Reduction in water quality; Behavioural effects of marine biota.	• An STP is installed, certified and operated in accordance with Regulation 9.1.2 of MARPOL/ AMSA Order 96. • The STP will be maintained in compliance with Regulation 9 of MARPOL 73/78 Annex IV and in accordance with manufacturer's specifications. • Maximum carrying capacity of the sewage system on vessels is not exceeded. Any support vessel carrying more than 15 people is required to have an International Sewage Pollution Prevention Certificate (IPPC). • The food macerator on the FPSO, support vessels or offtake tankers, will be certified as required by Annex V MARPOL 73/78/97 or AMSA Order 95 and maintained in accordance with manufacturer's specifications. • Vessel food waste processed in accordance with the vessel's garbage or waste management plan (if required under MARPOL Annex V / AMSA Marine Order 95). Placards will be displayed on vessels to provide guidance on vessel garbage disposal requirements. • All onshore and offshore disposed food waste will be recorded in the vessel's Garbage Record Book (if required under MARPOL Annex V / AMSA Marine Order 95).

PLANNED ACTIVITIES			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
			• Food waste will be processed in accordance with the FPSO's Waste Management Procedure.
Liquid discharges	Deck drainage and bilge water; Desalination brine; Cooling water; Slops tank water; Boiler blowdown; Ballast water.	Reduction in water quality; Potential toxicity to marine biota.	• All bilge water and deck washdown water on the FPSO will be processed through the slop tank system during normal operations. • Offtake tankers and support vessels oil filtering equipment is designed and operated in compliance with AMSA Marine Order 91 or MARPOL 73/78 Annex I, which requires: - oily water discharged to sea not to exceed an oil content of 15 ppm; and - on detection of an OIW content greater than 15 ppm, automatically shut-in stream or direct in-board for further treatment or storage. • Oily water on support vessels is discharged while proceeding en route (as per AMSA Marine Order 91 / MARPOL 73/78 Annex I). • Support vessels' Oil Detection Monitoring Equipment on the discharge stream will be certified, and maintained in accordance with the manufacturer's specifications via the vessel's Planned Maintenance System. • Vessels without oil filtering equipment will hold oily bilge water onboard and dispose of the oily water on return to port. • Oily filtration residue (sludge) separated in the treatment system will be collected in a dedicated onboard tank and will be disposed of onshore. • MARPOL registered vessels will obtain Current International Oil Pollution Prevention Certificate (IOPP). • Contamination of deck water (from rainfall events) will be prevented via the correct storage of hydrocarbons on support vessels and the FPSO. • Hydrocarbon containers and any temporary equipment containing hydrocarbons will be packaged, marked, labelled and stowed in accordance with MARPOL 73/98 Annex I, II and III regulations. • Drip trays will be used in unbunded areas on the FPSO where necessary to contain drips or leaks. • FPSO and support vessels have Shipboard Oil Pollution Emergency Plan (SOPEP) or Shipboard Marine Pollution Emergency Plan (SMPEP). Oil spill clean-up kits will be positioned in proximity of locations of potential spills, maintained and stocked and personnel will be trained in their use. • Chemical selection process has preference for chemicals with least potential for environmental harm. • Operating and maintenance procedures to restrict leakages and spills and ensure effective operation of all equipment. • All FPSO commissioning fluids and slops tank contents will be removed prior to sail-away from Singapore (excluding the water used for hydrotesting).

PLANNED ACTIVITIES			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
			• Only clean slops water that does not exceed OIW content of 30 mg/L will be discharged. An oily water analyser will be installed and operated to ensure oil water content. All off-spec fluid will be circulated to the dirty slops tank and re-treated. • Manual sampling of OIW content will be undertaken during periods of discharge providing a more accurate reading of OIW concentration. • The slops tank will be discharged in batches of between 1,000 m^3 and 2,000 m^3 at a time. • Temperature gauges will be available at various heat exchangers. Cooling water outlets on the facility are not expected to discharge water exceeding 50°C. • Boiler blowdown water volumes are limited to the minimum necessary for operational requirements.
Air emissions	Power generation; Gas compression; Process heating; Flaring; Engine exhausts; Fugitive emissions; Venting of inert gas.	Reduction in air quality; Greenhouse gas emissions.	• 90% of produced associated gas will be compressed and re-injected into the reservoir. • Use of low sulphur fuel types in accordance with regulation 14 of MARPOL 73/78 Annex VI. • Refrigerants on board the FPSO have been replaced with non-ozone depleting refrigerants. • The flaring volume will not exceed 1.9 BCF per year or on average 5.3 MMSCF per day over a calendar year. • Production and flaring volumes are monitored daily. Air emissions are reported in compliance with the National Pollution Inventory, Energy Efficiency Opportunities and National Greenhouse and Energy Reporting. • Vessel engines meet nitrogen oxide (NOx) emissions levels as required by regulation 13 of MARPOL 73/78 Annex VI / AMSA Marine Order Part 97. • MARPOL registered vessels will have a current International Air Pollution Prevention Certificate as required under of MARPOL 73/78 Annex VI. • Ozone-depleting substance (ODS) management undertaken in accordance with AMSA Order 97/ MARPOL 73/78 Annex VI, Regulation 12 by qualified personnel. All support vessels will maintain an ODS Record Book (if equipment on board contains ODS). • Combustion and process equipment, flaring system and gas injection systems are properly maintained as per the manufacturer's requirements, to ensure equipment operating efficiently. • Design controls to minimise flaring on the FPSO include: - control and protection systems on the fuel treatment system to prevent generation of black smoke from fuel gas usage; - efficient flare tips designed for smokeless flaring under normal operations; and - flare tip with a 95% minimum efficiency rating.

PLANNED ACTIVITIES			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
Noise emissions	Noise generated by the FPSO, support vessels and helicopters	Physiological or behavioural effects to fauna.	• Enclosures are installed around solar turbines on FPSO to reduce noise emitted. Noise emitting equipment is stored on FPSO topsides to minimise noise impacts to marine fauna. • Use of the FPSO thrusters is minimised by the FPSO's ability to weathervane on the RTM. • Testing and maintenance of noise-generating equipment are conducted in accordance with the manufacturer's specifications, facility planned maintenance system and/or regulatory requirements. • Vessels movements will adhere to EPBC Regulation 8. • Helicopter flight procedures include the following requirements, which apply if they do not compromise safety within the Defined Area: - Except for landing and take offs, helicopters must not be operated at a height lower than 1650 feet or within a horizontal distance of 500 metres from a cetacean; and - Flight procedure will be in palace and will be approved as per the CASA Operations Manual.
Release of hydrocarbons, hydraulic fluids and chemicals during intervention activities	If required, intervention activities (e.g. spool replacement) would result in release of hydrocarbons or chemicals	Reduction in water quality; Potential toxicity to marine fauna.	• Double-valve isolations used to isolate the line before disconnection. • Subsea infrastructure inventories will be flushed to the FPSO or treated before injecting into the reservoir to achieve a residual hydrocarbon concentration of less than 30 mg/L prior to opening up of the system. • Dry break connections (apart from Christmas tree) used for disconnecting components from the manifold, which will limit the potential loss of control fluid. • Prior to intervention activities being undertaken a risk assessment will be conducted in accordance with AEL's Environmental Risk Identification Procedure. • Hydraulic fluid and chemicals are selected in accordance with AEL Chemical Approval Procedure.

Table 9-2: Environmental risk assessment summary for unplanned events

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
Hydrocarbon/ chemical spill during commissioning	RTM equipment failure; Topside equipment failure; During topside	Reduction of water quality; Potential toxicity to marine biota.	• Bunds are provided on the FPSO process skids and on the main deck to collect spills. • All commissioning activities involving the RTM will be continuously manned (the operator will be conducting manual observations to prevent any significant discharges to the marine environment). • Chemicals added to flowline laydown fluids are selected in accordance with the AEL Chemical Approval Procedure.

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
	spool (RTM) changeover due to inadequate flushing.		• Hydrotesting of topside piping systems using seawater is conducted to ensure functionality and integrity of the piping systems prior to hookup. • The temporary spools used for cleaning the gas injection and water injection wells will be flushed with treated seawater to minimise potential for release of crude. • Detailed pre-commissioning and commissioning procedures will be developed and implemented through the Permit To Work System as described in Balnaves Project Safety Case to ensure the potential risks of hydrocarbon release are identified and adequately mitigated.
Surface spill of crude oil	Collision involving FPSO or tanker; Spill during offtake operations; Topside equipment failure.	Reduction of water quality; Potential toxicity to marine biota.	• Ongoing inspection and maintenance of all hydrocarbon containing equipment and facilities (including function testing of shutdown systems) via the Maintenance Management System. • FPSO location is to be marked on the relevant marine charts which alert mariners to the existence of the FPSO in the region. • A 500 m safety zone is to be in place around the facility. Entry to this Safety Zone is controlled/managed by the FPSO. A wider cautionary zone extends within a 2.5 nautical mile radius of the FPSO. • The FPSO is fitted with an automatic radar plotting aid (ARPA) System which interfaces with the ship borne Automatic Identification System (AIS), and navigational aids to SOLAS requirements. • In the event of navigational aid failure the FPSO will contact the errant vessel using radio communications, to alert the vessel to the FPSO's location. • FPSO is double hulled, hence significant impacts have to occur in order for cargo to be released. • Fire and Gas Detection, gas, smoke, heat, flame detectors all provide rapid warning of an ensuing event. • Use of a self-sealing marine breakaway coupling in the hose string and a low pressure switch during offloading. As a backup, a low-pressure alarm, actuated by a switch in the pipeline just upstream of the floating hose connector, will provide a warning of an unexpectedly low pressure in the line. • A new floating hose is provided for the offloading operations, and hose sections are pressure tested routinely to their design pressure and full vacuum. • Bunds on the vessel deck prevent oil from spilling into the sea. Large volumes of spilled oil would be pumped into the slop tank; small volumes would be covered with oil absorbent material and taken ashore for disposal. • All offload operations will be conducted in accordance with the Berthing and Terminal Handbook. • Appropriate equipment design for all hydrocarbon processing systems, including material selection. Appropriate design also includes the process control and monitoring system which initiates emergency shutdown when abnormal operating conditions occur. • Response strategies will be implemented in accordance with the Balnaves Commissioning and Operations Oil

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
			Spill Contingency plan (OSCP) (BL-00-RI-006.02) or relevant vessel SOPEP/SMPEP.
Subsea release of crude oil	Loss of well integrity; Leak in the rigid spool; Damage to subsea infrastructure.	Reduction of water quality; Potential toxicity to marine biota.	• Ongoing inspection and maintenance of all hydrocarbon containing equipment and facilities via the Maintenance Management System. • FPSO and support vessel navigation equipment is compliant with SOLAS/AMSA Marine Orders Part 30 and Part 21. • Consultation with stakeholders including the commercial fishing industry undertaken to ensure awareness of operations and infrastructure within the Defined Area. • All lifting procedures will follow Lifting Equipment Integrity Management procedure. • Inspections of lifting equipment and loading and unloading operations will be carried out in accordance with Lifting Equipment Integrity Management procedure. • FPSO location is marked on the relevant marine charts which alert mariners to the existence of the FPSO in the region. • A 500 m safety zone is to be in place around the facility and subsea infrastructure, a wider cautionary zone extends within a 2.5 nautical mile radius of the FPSO. Entry to Safety Zone is controlled/managed by the FPSO. • Christmas trees can withstand collision or dropped/dragged object of most the credible sized object. • Should any heavy lifts be planned to occur close to the wells/manifold area the wells will be shut-in. • No workover drilling intervention is proposed under this EP. • Each production well is completed with a subsea Christmas tree incorporating hydraulic controls for opening and closing the fail safe Christmas tree valves to isolate the flow. The wells have a surface controlled failsafe sub-surface safety valve (SCSSV) installed in the production tubing. A Permanent Down-hole Gauge will also be provided to monitor downhole pressure in all wells. • The completion tubing & production casing are manufactured from corrosion resistant material. • The production casing is designed to withstand the pressures associated with any tubing or wellhead leak. • Reconnection of the FPSO to the RTM is only performed in good weather. • Spill response strategies will be implemented in accordance with the Balnaves Commissioning and Operations OSCP (BL-00-RI-006.02).
Release of marine diesel	Vessel collision; Other damage to storage tanks; Spill during	Reduction of water quality; Potential toxicity to marine biota.	• Dry-break refuelling hose couplings and hose floats installed on the refuelling hose assembly to limit the volume of diesel released to the marine environment. • Pressure relief valves are installed on support vessel.

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
	transfer.		• Adequate bunding beneath the refuelling hose connections to contain any small spills. • Balnaves Bunkering Operations Operational Procedure Guide will be adhered to when conducting refuelling activity. • Spill exercises/drills are conducted as per Armada Claire SOPEP and Balnaves Commissioning and Operations OSCP [BL-00-RI-006.02]. • In line with MARPOL 73/78 Annex 1, support vessels over 400 gross tonnage will have a current SOPEP and a valid International Oil Pollution Prevention certificate (IOPP). • Vessel hulls are built and inspected as per Class requirements ensuring that hulls withstand impacts as designed. • Communication and navigational aids on vessels (e.g. ARPA on the FPSO) allows identification and communication with potential collision threats. The testing schedule of critical navigational aids on the FPSO provides assurance that they are working as designed and available for use to prevent a collision. • The presence of the FPSO and cautionary zones on nautical charts and consultation with stakeholders provides assurance that other sea users are aware of the location of the FPSO and Defined Area. • For vessels engaged in activities within the Defined Area (offtake tankers and support vessels), procedures for entering the exclusion zone and berthing at the FPSO reduce the potential for collisions. • Offtake tanker will follow the procedures outlined within the Balnaves Berthing and Terminal Handbook to prevent collision between offtake tanker and FPSO during berthing and cargo loading. • Spill kits on FPSO and vessels are inspected and restocked after use. • The Lifting Equipment Register is maintained updated for fixed and portable lifting equipment ensures that all FPSO lifting equipment has required maintenance, testing and certification. • Inspections of lifting equipment and loading and unloading operations will be carried out in accordance with the Balnaves Lifting Equipment Integrity Management procedure. • Spill response strategies will be implemented in accordance with the Balnaves Commissioning and Operations OSCP (BL-00-RI-006.02) or relevant vessel SOPEP/SMPEP.
Release of Heavy Fuel Oil (HFO)	Vessel collision with offtake tanker.	Reduction of water quality; Potential toxicity to marine biota.	• Support vessel, FPSO and offtake tanker marine radio equipment and navigational aids/equipment and the operation of this equipment complies with AMSA Marine Orders 21, 27 and 30. • The Balnaves Development is included on Australian Hydrographic Service (AHS) Navigational charts • Radar watch will identify vessels approaching the Balnaves Defined Area and VHF radio communication will advise shipping traffic of the 500 m exclusion and 2.5 nautical mile cautionary zones. Radar and VHF radio on the FPSO is constantly manned.

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
			• Offtake Tanker crew must be qualified to the requirements of the International Convention on Standards of Training Certification and Watch Keeping for Seafarers (STCW). • An OCIMF Ship Report (SIRE) inspection of the Offtake Tanker will have been completed in the past 12 months – the SIRE contains information on crew management and crew qualifications. • Seagoing qualifications of crew on the FPSO and supply vessels comply with AMSA Marine Order 3. • Berthing procedures will follow the Berthing and Terminal Handbook. • Vessels must comply with the 5 knot speed restriction within the Exclusion Zone as described in the Berthing and Terminal Handbook. • As per MARPOL Annex 1 requirements, all offtake tankers have SOPEP or SMPEP. • Spill response strategies will be implemented in accordance with the Balnaves Commissioning and Operations OSCP (BL-00-RI-006.02) or relevant vessel SOPEP/SMPEP.
Hydrocarbon Spill Response	Implementation of hydrocarbon spill response strategies.	Hydrocarbon spill response activities can exacerbate or cause further environmental harm.	• All response activities will be implemented in accordance with the Balnaves Commissioning and Operations OSCP [BL-00-RI-006.02], which contains numerous control measures to reduce the environmental impacts of all response strategies. • All response activities will be selected based on an ongoing Net Environmental Benefit Analysis (NEBA).
Release of hazardous liquids	Equipment malfunction or damage; Incorrect storage; Human error; Incorrect operation of machinery and equipment.	Reduction of water quality; Potential toxicity to marine biota.	• FPSO and offtake tankers have segregated ballast water tanks. Contaminated ballast water will be transferred to the slops tank. • Continuous gas monitoring system installed in ballast tanks to detect contamination with hydrocarbons or hydraulic fluid. • Chemical management will be in accordance with the Chemical Management Procedure. The AEL ChemAlert System is used to provide a Workplace Register of specific information relating to hazardous chemical substances in respect of Balnaves Operations. • Drip trays are to be provided where required. • All machinery and equipment containing hydrocarbons are to be maintained in accordance with manufacturer's specifications and FPSO Computer Managed Maintenance System (CMMS). • Ballast tank inspection and maintenance conducted in accordance with the CMMS inspection prior to mobilisation and prior to discharge. • The functionality of FPSO drainage systems is to be maintained via mechanical integrity review and visual inspections. • Lifting Equipment Register for fixed and portable lifting equipment is maintained to ensure that all FPSO lifting

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
			equipment has required maintenance, testing and certification in accordance with the Lifting Equipment Integrity Management procedure. • As per MARPOL Annex 1 requirements, all vessels over 400 gross tonnage will have SOPEP or SMPEP and an International Oil Pollution Prevention Certificate. • In the event of a release of oil to the marine environment, the Balnaves Commissioning and Operations OSCP [BL-00-RI-006.02] will be implemented. • Spill kits will be present onboard the FPSO and support vessels, located near high spill risk areas for prompt response in the event of a spill or leak and stocked as per the vessel's SOPEP. • All shipboard chemical and hydrocarbon spills will be managed in accordance with the SOPEP. • Spill exercises and drills are conducted as per Balnaves Commissioning and Operations OSCP [BL-00-RI-006.02] and relevant SOPEP/SMPEP. • All personnel are trained in oil spill equipment usage and response as per the Balnaves Commissioning and Operations OSCP [BL-00-RI-006.02] or relevant SOPEP/SMPEP. • Personnel involved in the chemical and hydrocarbon transfer must adhere to Safe work Procedure and complete JSA/PTW as appropriate. • Unplanned chemical or hydrocarbon release to the marine environment is reported, investigated and managed in line with AEL Hazard Reporting, Incident Notification and Investigation Procedure.
Release of hazardous solids	Equipment malfunction or damage; Incorrect storage; Human error; Incorrect operation of machinery and equipment.	Reduction of water quality Potential toxicity or impact to marine biota	• All production wells have downhole sand screens installed to minimise production of sands and sludges. • Solid wastes will be managed in accordance with relevant regulations, including: - *Navigation Act 2012* (Division 12B): Marine Order 94 and Marine Order 95. - *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Part III). - MARPOL Convention ANNEX III, Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (enforced in Australia under Marine Order 94). - MARPOL Convention ANNEX V, Prevention of Pollution by Garbage from Ships (enforced in Australia under Marine Orders 95). • FPSO Armada Claire Waste Management Procedure and FPSO Armada Claire Garbage Management Plan implemented. • Shipboard Garbage Management Plans required for offtake tanker or vessels licensed to carry more than 15 persons or over 400 gross tonnage. • AEL Controlled Waste Procedures implemented.

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
			• Solid wastes will be segregated at source into recyclable and non-recyclable wastes and stored in clearly marked containers prior to transfer onshore to AEL's Waste Management Contractor in Dampier for recycling wherever practicable or disposal at a licensed waste disposal site. • The waste management practices will be subject to an annual audit by AEL HSE. • Accidental release of wastes to the marine environment will be reported and investigated and corrective actions implemented. • Produced sand samples will be routinely monitored on the FPSO for radiation exposure and if radiation detected samples will be sent to a NATA accredited radiology laboratory to determine the level of radioactivity. • Should material be recovered from the production process expected to contain low activity naturally occurring radioactive material (NORM) (based on monitoring on the vessel), a sample will be sent to the Environmental Radioactivity laboratory of the DoE's Supervising Scientist Division (Darwin) to determine its level of radioactivity. • Offsite NORMs testing (U- and Th- series elements) of FPSO produced sands is conducted annually at a NATA accredited lab. • Records of controlled waste receipts retained for at least 3 years • Any NORMs contaminated waste is to be handled, stored and disposed of as per Apache Radiation and NORMs Procedure and Apache Controlled Waste Procedures. • All wastes from the FPSO and support vessels will be manifested/tracked with volumes/weights recorded. • Training of RSOs and certification of radioactive sources reduces risk of radioactive contamination.
Introduced marine species	Non-native species introduced to the Defined Area through discharge of ballast water or biofouling on vessels and equipment.	Establishment of invasive marine species.	• New anti-fouling coating is applied to the FPSO when in dry dock prior to deployment to Balnaves field. • A working marine growth prevention system is installed on the FPSO. • An independent marine pest inspection will be undertaken of the FPSO hull and internal niches, dry docked in Singapore (immediately prior to departure for Australia). • Within seven days of return to the sea the Armada Claire will either depart Singapore coastal waters for Western Australian waters (in line with documented guidance from the Western Australian Department of Fisheries) or follow other requirements as defined post direct consultation with the Department of Fisheries. • The potential for the introduction of marine species will be managed in accordance with relevant regulations and guidelines, including: - *Quarantine Act 1908* - National Biofouling Management Guidance for the Petroleum Production and Exploration Industry • AEL Ballast Water Management Plan has been developed in accordance with these regulations and guidelines,

UNPLANNED EVENTS			
Hazard	**Cause**	**Potential Impacts**	**Risk Treatment** **Avoidance, Mitigation & Management Controls**
			to be applied to the commissioning and operations of the Armada Claire FPSO. • All vessels that have travelled from international waters are obligated to assess and manage their ballast water in accordance with the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) Biosecurity requirements. • AEL has developed a Vessel Risk Assessment Score Sheet (VRASS) in line with National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009), which will assist in determining mitigating actions. • Support vessels used by AEL are generally sourced from local contractors. • For vessels sourced internationally, a VRASS will be completed by an independent marine pest inspector prior to departure from last foreign port. • Current International Anti-fouling System Certificates are obtained by the FPSO, offtake tanker and support vessels as required under the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006*. • Any support vessels not locally sourced will also comply with the DAFF Biosecurity requirements.
Vessel collision with marine fauna	Physical presence and movement of vessels.	Injury or death of marine fauna.	• Fauna observation materials will be available on the FPSO and support vessels to ensure crew have the necessary equipment available to record observations. • All cetacean and whale shark sightings will be recorded on the AEL Marine Fauna Sighting Datasheet with data submitted to DoE. • Injury/ mortality of EPBC listed species or matter of National Environmental Significance (NES) from vessel interaction within the Defined Area is reported to DoE. • Support vessel masters and crew will have completed an induction in line with Part 8 of the EPBC Regulation (2000) regulations. • No fishing from the vessels whilst in the Defined Area.

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