Halyard and Spar Development

Construction Environment Plan (CEP): Public Summary February 2011

This summary has been submitted to comply with Regulation 11(7)(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) (OPGGS(E)) Regulations 2009

Introduction

Apache Energy Limited (Apache), on behalf of its joint venture participant Santos Offshore Limited, is proposing to develop the Halyard and Spar gas fields in Commonwealth waters off the coast of Western Australia. Export from these fields is initially proposed from two subsea production wells; Halyard-1 and Spar-2 which will be tied-back to the existing East Spar and Varanus Island infrastructure for processing and exporting domestic gas. Well control and conditioning chemicals will be supplied through an umbilical connected from the existing John Brookes Platform to a new pipeline end manifold (PLEM) to be installed adjacent to the existing East Spar Manifold. The project is referred to as the Halyard and Spar development.

Apache prepared a Construction Environment Plan (CEP) for the Halyard and Spar Development, which was approved by the Department of Mines and Petroleum (DMP) on the 4th of February 2011. This document provides a summary of the CEP for the Halyard and Spar Development and includes the proposed environmental controls to address the construction activities.

Location

The Halyard and Spar field is located in the offshore Carnarvon Basin, in Commonwealth waters, northwest of Western Australia, about 185km west of Dampier. The field is approximately 28 km southwest of the John Brookes Platform in WA-29-L and 16 km northwest of the East Spar Manifold. Barrow Island is located about 50 km to the south-east of the Halyard-1 well, with Lowendal Islands and Montebello Island groups about 65 km to the east (**Figure 1**).

Halyard and Spar subsea construction activities will take place in blocks WA-13-L and WA-4-R. The proposed flowline joining the Halyard and Spar fields to the existing East Spar Manifold is located within WA-13-L, whereas the proposed umbilical from the existing John Brookes platform (WA-29-L) passes through adjoining blocks WA-214-P(2) and WA-355-P, with all other elements of this proposal restricted to blocks WA-13-L and WA-4-R (**Figure 1**). The location of the components of the Halyard and Spar development are provided in **Table 1**.

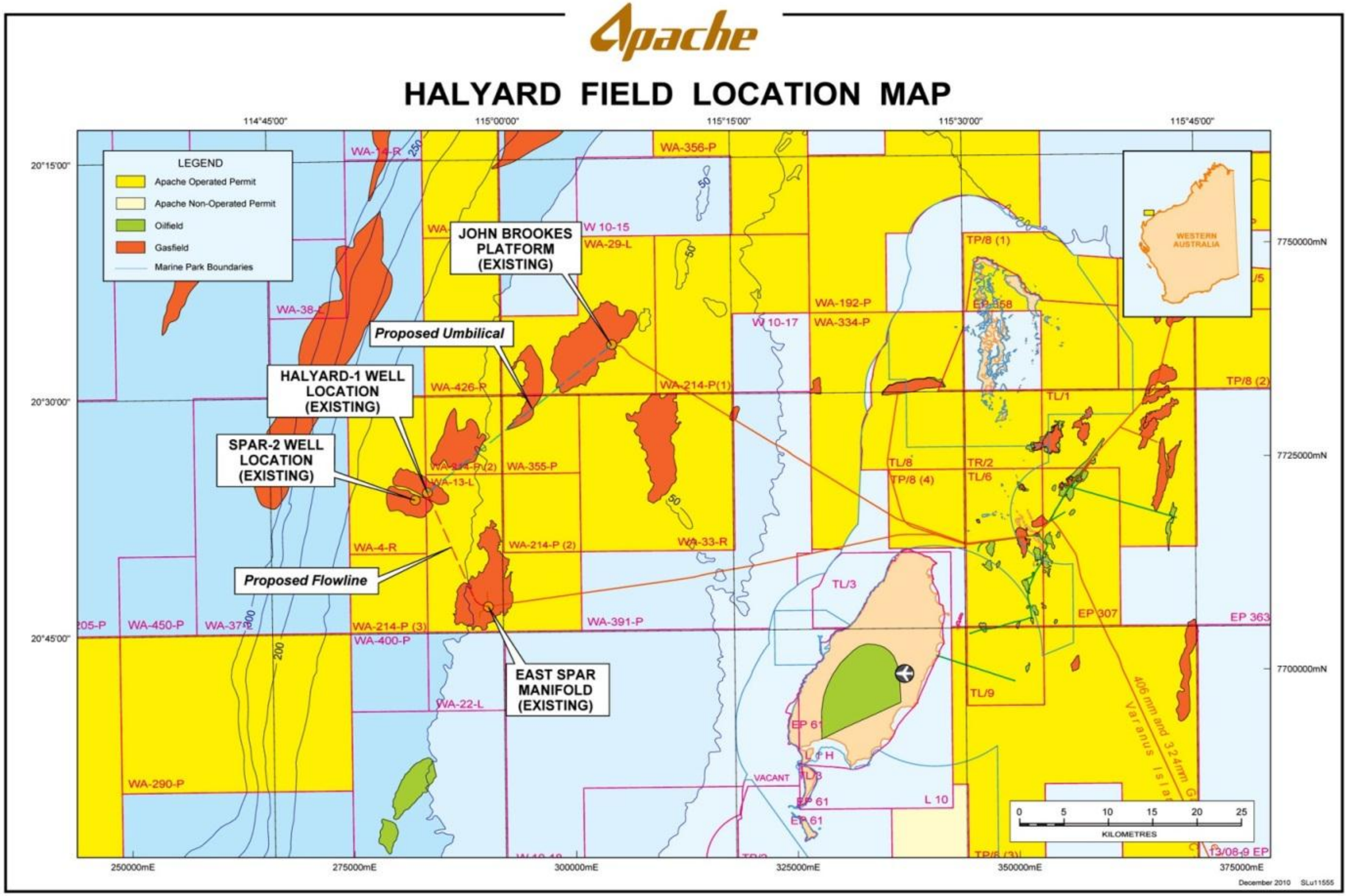

Figure 1: Location of the Halyard and Spar Fields relative to the existing John Brookes Platform and existing East Spar Manifold

Table 1: Location details of the Halyard and Spar Development infrastructure

Infrastructure	Location (GDA 94, Zone 50)		Water depth (m) approx.
Halyard-1 Well	7 720 611 N	283 156 E	105 m LAT*
Halyard EHU – Start (John Brookes Platform)	7 737 890 N	303 892 E	46 m LAT*
Halyard EHU – End (Halyard 1 Well)	7 720 611 N	283 156 E	105 m LAT*
Halyard Flowline – Start (Halyard 1 Well)	7 720 611 N	283 156 E	105 m LAT*
Halyard Flowline – End (East Spar PLEM (New))	7 707 278 N	290 092 E	92 m LAT*
East Spar Tie-in Spool - Start (East Spar PLEM (New))	7 707 278 N	290 092 E	92 m LAT*
East Spar Tie-in Spool - End (East Spar Manifold (Existing))	7 707 291 N	290 101 E	92 m LAT*
Spar-2 Well	7 719 729 N	281 787 E	105 m LAT*
Spar EHU - Start (Subsea Distribution Unit (New Phase II))	TBA – will be within 50m radius of Halyard 1 Well		105 m LAT*
Spar EHU - End (Spar-2 Well)	7 719 729 N	281 787 E	105 m LAT*
Spar 2 Flowline – Start (Spar-2 Well)	7 719 729 N	281 787 E	105 m LAT*
Spar 2 Flowline – End (Halyard PLEM (New Phase II))	TBA – will be within 50m radius of Spar 2 Well		105 m LAT*

*Lowest Astronomical Tide

Receiving Environment

The following is a brief summary of the information provided in the CEP for the Halyard and Spar Development.

Physical Environment

The climate of the region is arid subtropical with hot summer temperatures and low and unpredictable rainfall, high evaporation, occasional cyclones and associated summer rainfall. The summer and winter seasons fall into the periods October-March and May-August, respectively. Summer winds are more variable, with strong south-westerly's dominating. Three to four cyclones per year are typical, primarily between December and March.

A seabed survey was undertaken over the flowline and umbilical alignments using an observational class remote operated vehicle (ROV). The proposed flowline route runs approximately 16 km between the proposed Halyard xmas-tree and the existing East Spar facilities in 90 to 110m water depth (**Figure 2**). Substrata along the midline of this route was flat or gently sloping and was covered with deep sands and a component of finer, silty sediments. No significant features were noted.

The proposed umbilical route between the proposed Halyard xmas-tree and the existing John Brookes Platform was observed genrally consist of gently sloping sand and silt, showing medium to dense bioturbation. Coverage by epibenthic biota along the western third of the umbilical route was low and limited to occasional invertebrates such as sea whips and crinoids. An exception to the typical soft sediment substrate was about 7-9 km from the John Brookes platform, where an area of exposed limestone pavement with shallow sand veneers, approximately 400 m in length and 100 m wide, supported communities of benthic filter feeders, predominantly comprised of sponges. Sea whips and soft corals were also relatively common. Whilst this habitat is not unique and has no particular regional conservation significance, it does however enhance local species diversity and will therefore be avoided by aligning the umbilical to the south, avoiding any impact to it.

With a corresponding decrease in depth near the John Brookes platform, the substrata gradually became more sloped. At approximately 1.3 km north east of the platform, the substrata tended to be dominated by limestone pavements with occasional thin veneers of coarse sand. Mixed assemblages of unidentified low-lying (turf) macroalgal species and various benthic invertebrates (sponges, sea fans) were supported. Assemblages tended to be low to sparse in cover. Associated fish species included acanthurids, carangids, apogonids and pomacanthids.

Closer observation around the south western side of the John Brookes platform revealed similar community structure to the midline transects. Low turfing algal species tended to colonise the exposed limestone pavements, however, where the limestone pavements were covered with thin sand veneers, a low to sparse cover of benthic invertebrates were generally observed, with sponges and sea whips most commonly observed.

Marine Environment

A search of the EPBC Act Protected Matters Search Tool identified that a total of nine listed threatened marine species may occur within the proposed Halyard and Spar development area, with 15 species listed as migratory (nine of these being the same as the threatened species). All 15 species, with the exception of the humpback whale (*Megaptera novaeangliae*), are widely distributed and/or oceanic species and would most likely occur as vagrant transients through the Halyard and Spar development area. The proposed Halyard and Spar development area is not considered a habitat that is critical to the survival of any listed species. Similarly, there are no listed threatened ecological communities as defined in the EPBC Act in the vicinity of the development. There are, however, numerous listed marine species and whales and other cetaceans listed as other matters protected by the EPBC Act that may be found within the region.

The fauna listed as threatened or migratory marine species under the EPBC Act may transit through the vicinity of the Halyard and Spar Development area during installation activities, however, there are no known breeding or nesting grounds within the area. The proposed timing of the installation activities is outside of the peak northward and southward migration (**Table 2**). Seabirds and whale species are mostly unlikely, while turtles and shark species have a higher possibility of being present in the development area.

Table 2: **North West Shelf biological resources, breeding cycles and human activity seasons**

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Hawksbill turtle nesting												
Flatback turtle nesting												
Green turtle nesting												
Loggerhead turtle nesting												
Whale migration						Nth				Sth		
Whale shark aggregation			Main aggregation period									
Seabird nesting												
Halyard Installation		Phase I Stage 1 & 2 (2011) Phase II expected 2012										)

Key

Peak activity, presence reliable and predictable

Low level of abundance/activity/presence

Activity not occurring within the area

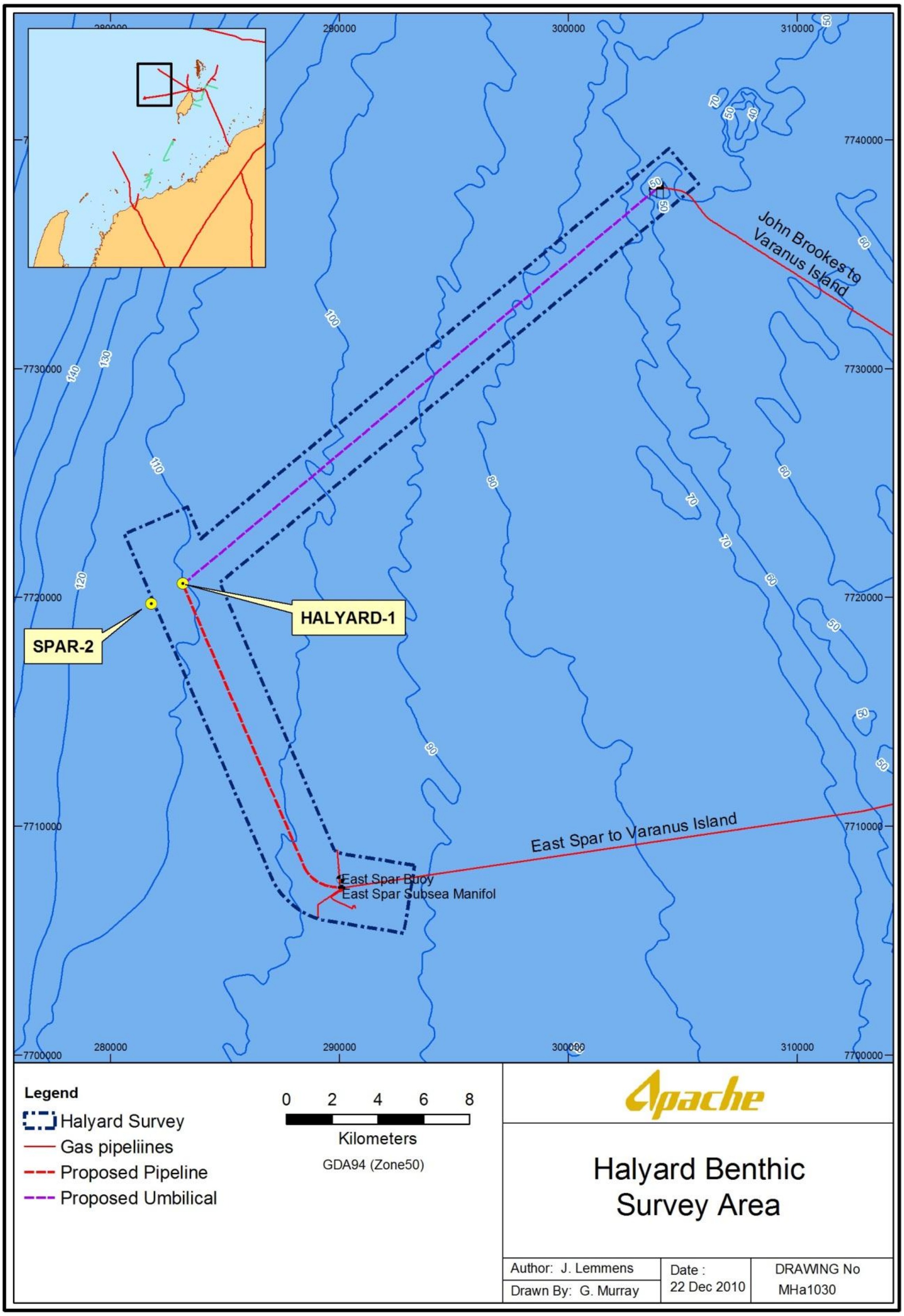

Figure 2: Seabed Survey of the Halyard and Spar development area

Project description / Overview

The Halyard and Spar construction and installation will consist of two phases:

- Phase I consists of the Halyard subsea installation (**Figure 3**). This Phase has also been broken into two separate stages being the initial diving preparatory work (Stage 1), followed by the subsea installation component (Stage 2).
- Phase II consists of integrating the Spar development (estimated a year later) into the installed Halyard subsea infrastructure (**Figure 4**).

The key characteristics of the Halyard and Spar Development are presented in **Table 3**.

The timing from first production from Halyard-1 is expected in the first half of 2011, with Spar-2 likely to follow a year later. Production life of the fields is expected to be around 15 years.

Phase I – Stage 1 Initial Diving Preparatory Works

The initial diving preparatory work, using the 'Geosea' diver support vessel (DSV) and 'Mermaid Voyager' handling and support vessel (HSV), includes:

- Installation of the 3-slot East Spar pipeline end manifold (PLEM).
- Installation of the 355 mm (14") piggable rigid tie-in spool connecting the East Spar PLEM to the existing East Spar manifold.
- Installation of the J-tube (to containing the electro-hydraulic umbilical or EHU) for connection to the John Brookes platform

Phase I – Stage 2 Halyard Flowline and Umbilical Installation

Phase I Stage 2 work involves the installation of the flexible flowline connection from the Halyard-1 well to the newly installed East Spar PLEM and the installation of the EHU from the Halyard-1 well to the John Brookes platform and connection via the J-tube (**Figure 3**). The offshore installation work, using the B104 Southern Ocean as the primary installation support vessel (ISV), includes:

- Installation of one 250 mm (10") diameter, 16 km long flexible flowline from the East Spar PLEM to the Halyard-1 well.
- Installation of the 3 level cantilever deck on the John Brookes platform housing the new power generation package and topsides control unit for the Halyard/Spar subsea infrastructure (including a hydraulic power unit, master control system and chemical injection skid).
- Tie-in of the flowline to the Halyard subsea wellhead and the East Spar PLEM using Cameron vertical connectors (CVC's).
- Installation of one 120 mm diameter, 28 km long EHU from the John Brookes platform to the Halyard-1 well.
- Pull-in and securing the EHU to the John Brookes platform.
- Installation of two electrical flying leads (EFL's) from the umbilical termination head (UTH) of the EHU to the Halyard subsea wellhead.
- All associated pre-commissioning and function testing of the installed equipment.

Note that all vessels associated with the Halyard/Spar development are dynamically positioned vessels and therefore do not require anchoring on the seabed.

Phase II – Spar Flowline and Umbilical Installation

As part of Phase II (Spar-2 tie-back), further subsea hardware will need to be installed (**Figure 4**) including:

- A Subsea Distribution Unit (SDU) between Halyard-1 well and the EHU.
- An umbilical connection (approximately 10 m in length) from the newly installed SDU to the Halyard-1 well.
- A new Halyard PLEM and 25 m tie-in spool between the Halyard-1 well head and the Halyard PLEM
- A EHU (2 km approx.) between Spar-2 well and the SDU
- A flowline (2 km approx.) between Spar-2 wellhead and Halyard PLEM

Construction activities associated with the tie-back of the Spar-2 well, whilst not yet finalised, are expected to occur in early 2012, subject to equipment procurement and vessel availability.

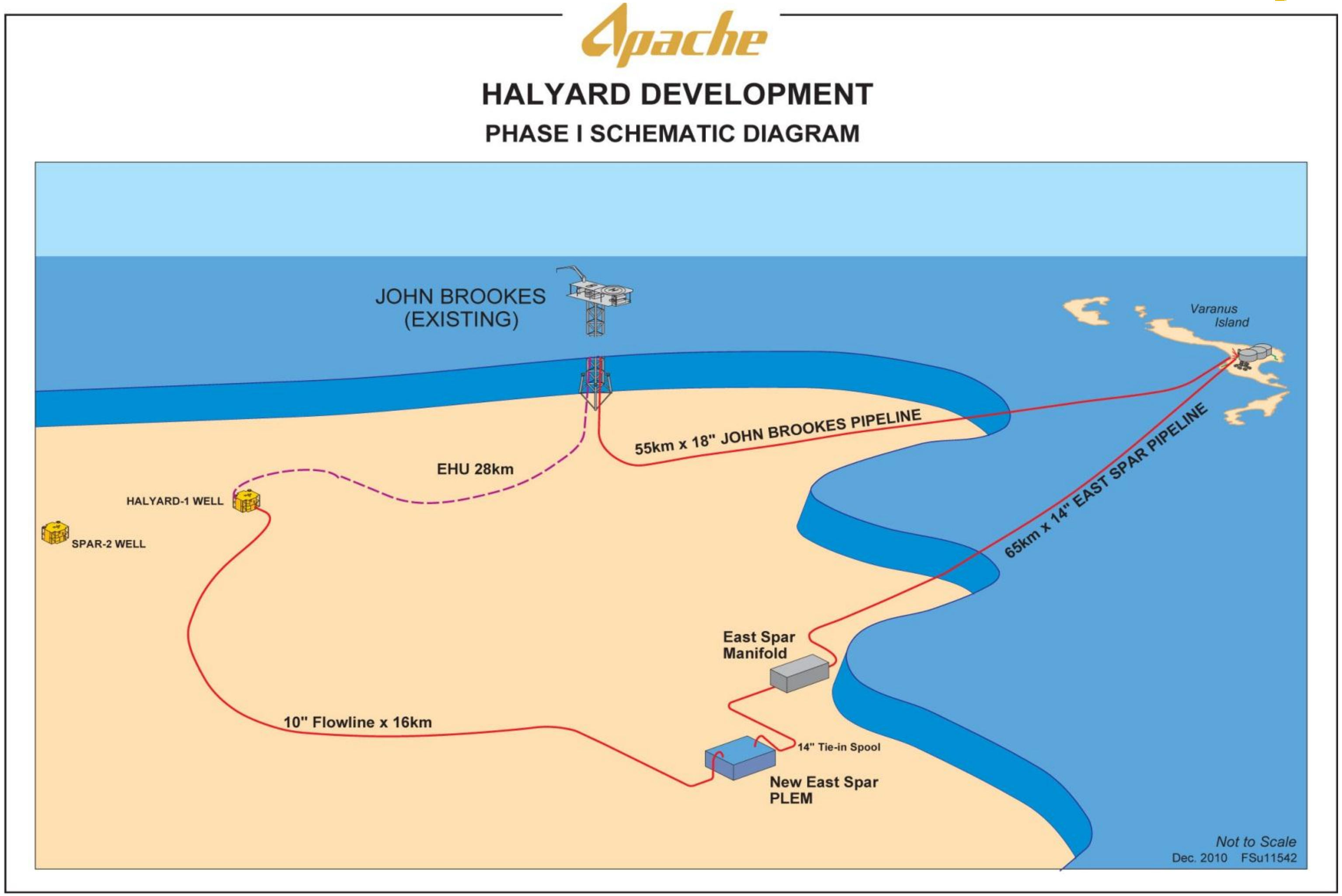

Figure 3: Phase I - Schematic of the proposed Halyard/Spar Development with one well scenario (Halyard-1) in relation to existing infrastructure: John Brookes Platform, East Spar Manifold, and pipelines to Varanus Island

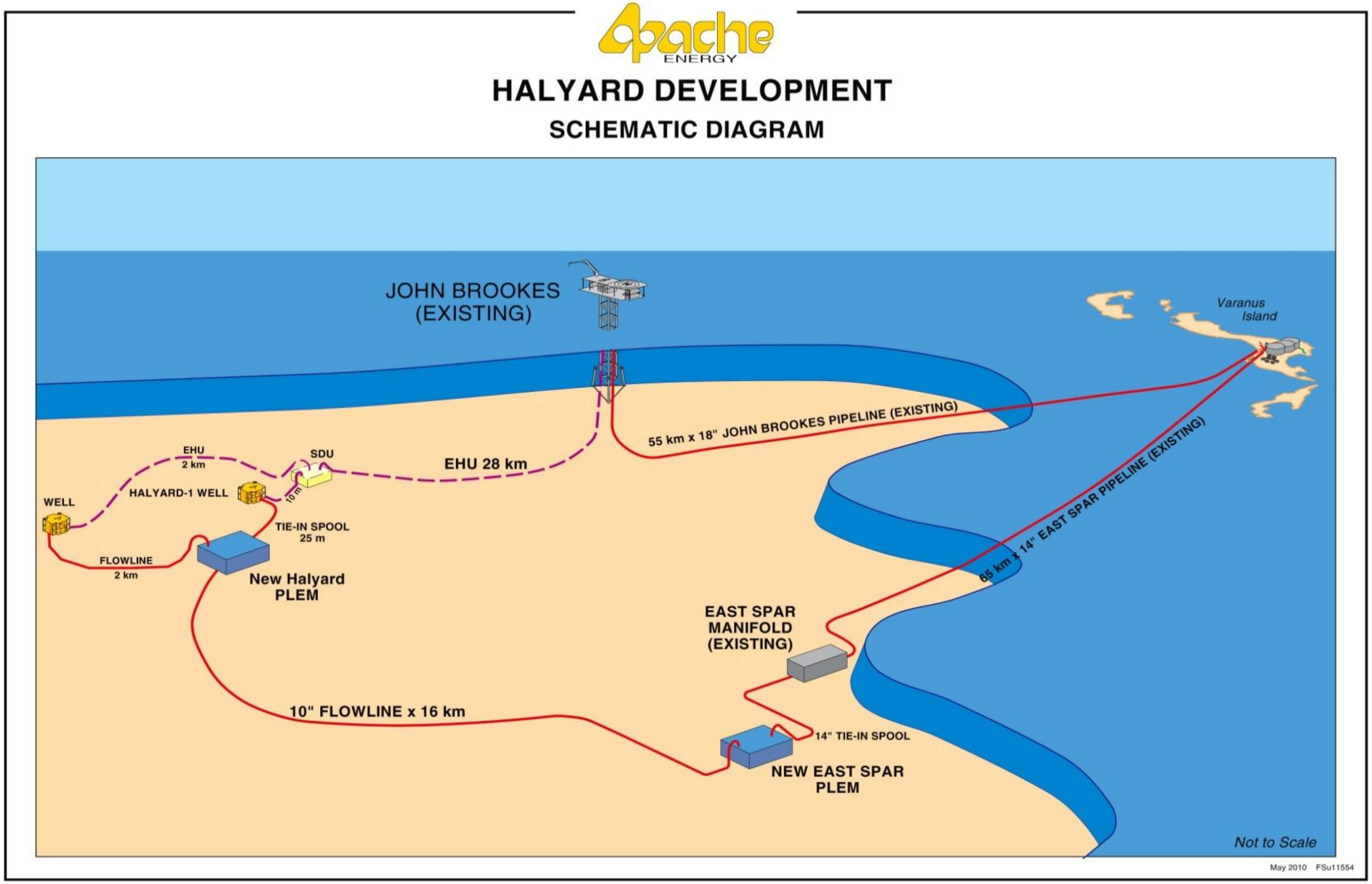

Figure 4: Phase II - Schematic of the proposed Halyard/Spar Development with two well scenario (Halyard-1 and Spar-2)

Table 3: Key Characteristics of the completed Halyard and Spar Development

Element	Description
Export flowline	250 mm (10-inch) internal diameter (ID), approximately 16 km long flexible flowline between Halyard PLEM and new East Spar pipeline end manifold (PLEM), Halyard-1 and Spar-2 xmas trees. The new East Spar PLEM will be connected to the existing East Spar manifold via a rigid spool. A 2km flowline will be connected from the Halyard PLEM to the Spar-2 xmas-tree. Processing and export of gas will be through the existing Varanus Island hub.
Umbilical (EHU)	Approximately 28 km long Electro-hydraulic umbilical (EHU) between the existing John Brookes Platform in WA-29-L and new Halyard-1 & Spar-2 wellhead within block WA-13-L & WA-4-R.
Area of subsea footprint	Up to 47ha, including Umbilical right of way (ROW) (2.80 ha), Flowline ROW (1.55 ha), EHU stabilisation mattresses near John Brookes platform (0.3 ha, based on 20 mattresses), and East Spar Pipeline End Manifold (PLEM), the SDU (Subsea Distribution Unit) and Halyard PLEM will be installed when the Spar-2 well will be tied-back to the development in 2012.
Production Wells	Production from the development is initially from the Halyard-1 well, which was drilled during February – March 2008. Subsequent production will be from Spar-2, which was drilled in October – November 2010. A number of other nearby prospective fields are possible candidates for being tied back to the Halyard and Spar development at a later stage.
Halyard manning	Halyard and Spar is an unmanned subsea facility, controlled from the unmanned John Brookes platform, which is in turn controlled and maintained from the Varanus Island Hub.
Sales gas production	Initially up to 2,265 ksm^3/d (~80 MMscf/d) from the Halyard-1 Well, to be delivered into the Varanus Island Hub via the existing East Spar pipeline followed a year later by production from Spar-2, doubling this rate.
Condensate production	The production fluid is predominantly gas with low volume of condensate. Gas and condensate will be processed at the Varanus Island Hub.
Produced formation water	The production fluid will contain traces of sea water or produced formation water. Produced water to be processed at the Varanus Island Hub, for deep well injection into existing disposal wells on Varanus Island.
Power	Primary power from newly installed microturbines on John Brookes platform. Standby diesel powered generator.
Chemical Injection	Chemical Injection from John Brookes platform: Methanol (during start-up and restart): 292 L/hr @ 278.1 Bar Corrosion Inhibitor (continuous): Max: 100 L/day @ 244.5 Bar; Min: 10 L/day @ 124.8 Bar.
Availability	97% (proportion of time that the system is available to operate)
First gas	Second quarter 2011
Design life	Minimum design life of 20 years

Modeling of oil spills

Oil spill modelling is undertaken as a standard component of Apache's environmental risk assessment process prior to undertaking any offshore activity. The results of the oil spill modelling process are used in conjunction with the environmental description and the description of the construction, installation, hook-up and commissioning activities to identify the risks associated with an accidental discharge of hydrocarbons. Apache commissioned Asia Pacific ASA (APASA) to undertake condensate and diesel spill modelling for the Halyard and Spar development. The oil spill modelling was performed using three-dimensional oil spill trajectory and weathering model, SIMAP, which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces.

Halyard and Spar Field Hydrocarbon Spill Risk Assessment

Three scenarios were considered in the modelling study. They included:

1. A surface diesel spill during the construction phase with a volume of 80,000 L at the Halyard-1 Well location.
2. A moderate sized surface condensate spill at the East Spar Manifold location. The modelled spill volume was 100,000 L.
3. An uncontrolled subsea blowout at the Halyard-1 well location, for a period of 10 weeks. The modelled condensate release rate was 392 kL/day (2,464 bbls/day) or 10,176 kL (172,480 bbls) over 10 weeks.

Threshold levels of oil concentration were used to judge the risk of contact with the surrounding shorelines. Indicative thresholds of oil mass per surface area were applied for surfaced oil - equivalent to oil films displaying dull metallic colours, rainbow sheen and silver sheen. Thresholds for entrained oil and dissolved aromatic hydrocarbons were applied based on the available literature. The main findings of this study are:

- For all three spill scenarios, surface slicks were predicted to spread to the northwest and to the southwest during all seasons. A slightly greater bias to the south is predicted during transitional periods with the opposite being the case during winter.
- Simulations of the diesel spill indicated very low probabilities (≤ 2%) of exceeding the thresholds for surface condensate (0.15 g/m^2), entrained condensate (10 ppb) and dissolved aromatic hydrocarbons (5 ppb) at any nearby shorelines during any of the seasons.
- The minimum drift time for contact by surface diesel of any concentration at any nearby shoreline were predicted to be 110 hours, which was predicted for a spill during summer.
- Simulations of the condensate spill indicated low probabilities (≤ 7%) of exceeding the thresholds at any nearby shorelines during any of the seasons. Maximum entrained hydrocarbon concentrations in a worst case scenario were predicted to be greatest during winter, potentially reaching 1,570 ppb and 2,620 ppb at the Muiron Islands and North West Cape respectively.
- The shortest time for shoreline impact predicted for the condensate simulations was 90 hours, resulting from a spill during winter.

- Simulations of the blowout scenario indicated surface slicks > 0.15 g/m^2 had some chance (up to 35%) of contacting shorelines during each of the seasons.
- The highest likelihood (35%) of surface slicks of any concentration contacting any shoreline was predicted during transitional periods. The earliest predicted time to impact any shoreline was 430 hours during winter.
- The blowout results indicated entrained condensate was likely to be spread over a relatively large area after a 70 day release.
- Results for the blowout scenario indicated dissolved aromatic hydrocarbons were likely to follow a similar trajectory to entrained condensate during each of the seasons, but cover a smaller area.

Halyard and Spar Leak Frequency Analysis

As part of the Halyard and Spar development, Bureau Veritas (2010) undertook a leak frequency analysis. This study calculated the frequencies for a range of leak sizes due to loss of containment from the Halyard and Spar subsea development.

The results of the leak frequency analysis (probability of a spill occurring) were combined with the outcomes of the spill scenarios modelled. The predicted probability of a blowout occurring at the Halyard-1 well is 2.6×10^{-5} per year (or once every 38,461 years). Applying this probability reduces the risk of most of the outcomes of the spill simulations to less than 1×10^{-5} per year (or once every 100,000 years).

Potential Environmental Hazards, Impacts and Proposed Management Controls

This section describes the potential environmental hazards and impacts during the construction, installation, commissioning and hook-up phase of the project. Management actions to mitigate these are incorporated into the assessments for both routine and non-routine activities. Apache's management actions aim to reduce the environmental impacts of construction, installation, commissioning and hook-up activities to as low as reasonably practical.

The key activities with the potential to cause significant environmental impacts include:

- Seabed disturbance.
- Interactions with marine fauna (noise, light, physical disturbance).
- Interactions with other marine activities (fishing, recreational activities and transport).
- Routine waste discharges from the installation vessels.
- Accidental fuel and oil spills from the installation vessels.
- Vessel collisions.
- Introduction of non-indigenous marine species from ballast water discharge and vessel hulls.
- The establishment of artificial habitat.
- Underwater noise and light emissions from construction vessel operations.

These are assessed in the following sections. A summary of all potential environmental hazards, impacts associated with the Development and the proposed mitigation measures is provided in **Table 4**.

Seabed Disturbance

Physical disturbance of the seabed during construction, installation, hook-up and commissioning will mainly be associated with laying of the flowline and umbilical, installation of PLEM(s), tie-in spools and EHU stabilisation mats, SDU (Phase II) and the localised smothering of the seabed by the subsea infrastructure once it is installed. There is likely to be some minor localised turbidity as a result of disturbing seabed sediments. Flowlines and umbilicals will be laid directly onto the sandy seabed rather than trenched, again minimising impacts to the sparse benthic communities. All subsea hardware associated with the Halyard and Spar development has been designed for full removal during decommissioning.

Artificial Habitat

The environmental impacts associated with the provision of artificial habitat are locally increased biological productivity and diversity. Removal of the infrastructure during decommissioning will result in a loss of the habitat associated with the underwater structures and a return to original levels of biota over time. No specific measures are proposed to mitigate the presence of the associated infrastructure providing artificial habitat.

Interference with Commercial and Recreational Fisheries

Conducting the subsea installation may cause some inconvenience to other marine users however this is considered unlikely. Potential impacts on commercial fisheries are largely due to navigational conflicts, given that fishers often deploy trawl nets or long lines over large areas. However, the minimal usage of this area by commercial fisheries and effective communication and up to date notification of the activities to commercial fishermen in the region will assist in avoiding any impacts. Communications with fishing groups known to be operating in the area will be maintained throughout the duration of the activities. Recreational fishing activity is unlikely to be affected by the proposed subsea installation activities, as there would be little interaction with this activity.

Lighting

Lighting will be used for safe illumination on the ISV and DSV during subsea installation activities. Night-time lighting will be reduced to that required for safe operation, and non-essential lights will be turned off or shielded.

Installation activities are expected to coincide with the end of turtle breeding season, however, since this area is far away from known turtle breeding and nesting sites, impacts are expected to be minimal. Therefore, the risk of any light from the offshore activity having any negative impact on nesting or hatching sea turtles is considered to be “negligible”.

Underwater Noise

Underwater noise will be generated during the subsea construction, installation, hook-up and commissioning activities associated with the development. Sources of underwater noise include vessel motors and thrusters, subsea installation works, ROV’s, acoustic transducer signals and helicopters. The levels of noise that are expected to occur during the installation, construction, hook-up and commissioning phases are unlikely to cause any significant physiological effects to marine fauna due to the short duration of any such construction noise, the timing of the activity and the transitory nature of the fauna.

Interference with whales and dolphins

Marine species (cetaceans/sharks/pinnipeds) injuries or death from collision with vessels or contact with propellers/bow thrusters is considered to be unlikely due to:

- The installation activities occurring outside the whale migration period.
- The facility not being located within any whale aggregation areas; and
- Vessels will be required to comply with Regulation 8 (pertaining to interactions with cetaceans) of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, 1999) as well as DMP's (formerly DoIR) "Guidelines on Minimising Acoustic Disturbance to Marine Fauna" (2007).

Routine waste discharges from the ISV, DSV and support vessels

Routine solid wastes will be generated during all stages of the construction, installation, hook-up and commissioning phases. These wastes will be produced in relatively small amounts and consist largely of non-hazardous materials. The routine solid wastes expected to be produced during all construction phases will consist of food scraps and general non-hazardous solid wastes.

Food scraps and other putrescible wastes will be disposed of in accordance with MARPOL 73/78 Annex V. The risk of adversely affecting water quality within the development area is considered negligible based on the constant movement of the vessel, the short duration of the subsea installation activity, the highly dynamic and extensive receiving water and the small quantity and concentration of pollutants within treated waste-waters discharged from the vessels.

Accidental fuel and oil spills from the ISV, DSV and support vessel

There is the potential for vessel traffic transiting from and to the Port of Dampier to pass through the Halyard and Spar development area. The potential for a hydrocarbon spill resulting from the collision of the ISV, DSV and support vessels with another ocean going vessel is considered negligible for the following reasons:

- Radio communication will be maintained with any vessels observed transiting the area.
- Information on the location and timing of the Installation activities will be communicated to vessels via AMSA through a Notice to Mariners.
- Notification of the position of the vessels associated with the Development and the area proposed to be working in will be communicated to fishing industry representatives and forwarded to respective members (vessel owners).

Introduction of non-indigenous marine species from ballast water discharge and vessel hulls

The introduction of marine pests may occur through the discharge of ballast water taken up overseas in Australian waters. The DSV, ISV, heavy lift vessel (HLV) and support vessels for the subsea installation activities will be travelling to the Development area from either Australian waters or from overseas. The development is in Commonwealth Waters, away from sensitive coastal ecosystems. However, vessel entry into Dampier or sheltered WA State Waters is likely to be required. All vessels associated with the installation phases will comply with the National Biofouling Management Guidelines. Supply vessels are expected to be sourced locally, if they are not then they will undergo a biofouling risk assessment.

Consultation

The proposed Halyard and Spar development is not covered by any Native Title claim, and there are no Aboriginal Heritage areas in the vicinity of the proposed development.

Consultation with DSEWPC has been ongoing since the Halyard and Spar development was referred to the Department back in August 2010.

Notifications to Commonwealth fisheries and State fisheries organisations were sent out the week commencing the 31st January 2011. A notice to AMSA (and the release of a “Notice to Mariners”) and the Australian Hydrographic office were notified on the 17 January, 2011. No issues were identified from the consultation/notification process.

Further Details

For further information about the Halyard and Spar Development Construction Environment Plan (HL-00-RI-002), please contact:

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Table 4: Potential Environmental Hazards, Impacts and Associated Mitigation Measures

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation Measures	Standards
Grey water / sewage disposal & disposal of food scraps	Expected to occur.	Localised pollution/nutrient enrichment.	Maintain marine water quality.	Negligible Low volumes of treated discharge only. Sewage treatment system operational and includes maceration and disinfection. Discharge offshore in deep water with high dispersion-dilution factor. Temporary input of nutrients to any area.	Negligible Adherence to MARPOL 73/78 Annex IV requirements. Use of biodegradable detergents only. No discharge of sewage within the Montebello Islands Marine Park.	Halyard and Spar CEP Environmental Requirements for Offshore Marine Vessels (AE-91-IQ-202). MARPOL 73/78 Annex IV (Sewage) & V (Garbage). OPGGS Act Schedule Specific Requirements as to Offshore Petroleum Exploration and Production (consolidated 2005), clause 222(4).
Discharge of oily water from bilges	Unlikely to occur.	Localised and temporary toxic effects.	Maintain marine water quality.	Negligible Bilge discharges treated to <15 ppm hydrocarbons.	Negligible Oily water separator (set at 15 ppm) operational with discharge quality continuously monitored. Ability to store >15ppm water in sludge tank.	Environmental Requirements for Offshore Marine Vessels (AE-91-IQ-202). MARPOL 73/78 Annex I (Regulation 16). Oil Record Book.
Accidental hydrocarbon & chemical spills < 80 litres e.g. leaks from onboard equipment, spillage of hydrocarbons and chemicals from transfers or usage	Unlikely to occur	Adverse effect to environment from hydrocarbons & chemicals.	Minimise occurrence of fuel, chemical and oil spills	Negligible. Small volumes only. Localised deterioration of water quality	Negligible Fuel spill contingency procedures are in place and operational. Clean up spill kits on vessels and available for use	Apache Environmental Management Policy Survey Vessel SOPEP (Shipboard Oil Pollution Emergency Plan) Apache's North West Shelf Oil Spill Contingency Plan, AE-00-EF-008/1 Rev. 16 CEP

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation Measures	Standards
Disposal of solid wastes including putrescible galley wastes	Expected to occur.	Localised pollution/nutrient enrichment.	Minimise environmental effects from waste disposal.	Negligible No disposal into marine environment of solid wastes except macerated food wastes. Collection and disposal onshore to landfill site	Negligible Adherence to MARPOL 73/78 Annex V requirements. Onshore waste disposal by licensed operators as per waste management plan.	MARPOL 73/78 Annex V. Vessel Waste Disposal Register & Contract Plan. Environmental Requirements for Offshore Marine Vessels (AE-91-IQ-202). CEP. Waste Management Plan. OPGGSA Schedule 222: Housekeeping (3), (4) & (5).
Waste Oil storage and disposal	Expected to occur.	If spilled to marine environment, localised toxic effects	Minimise risk of adverse effect to environment from hydrocarbons.	Negligible Small volumes only. All waste oils collected and stored for onshore recycling/disposal.	Negligible Adherence to MARPOL 73/78 Annex 1 requirements. All waste oils collected and returned to shore for recycling/disposal	Environmental Requirements for Offshore Marine Vessels (AE-91-IQ-202). MARPOL 73/78 Annex I. Oil Record Book. Vessel Waste Disposal Register & Contract Plan.
Atmospheric emissions (vessel engines and waste incinerator)	Expected to occur.	Increase in greenhouse effect	Maintain air quality.	Negligible Small volumes/emissions.	Negligible Engines maintained to operate at optimum efficiency to minimise emissions. Waste incinerator operates under optimal controlled conditions for complete combustion of wastes.	Maintenance system for machinery and waste incinerator.
Artificial lighting	Expected to occur.	Disturbance to marine biota and seabirds.	Minimise risk of adverse effect to marine biota.	Negligible Survey is significant distant from shore	Negligible Lighting minimum required for navigation and safety requirements.	Halyard and Spar CEP Environmental Requirements for Offshore Marine Vessels (AE-91-IQ-202).

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation Measures	Standards
Anchoring activity	Unlikely to Occur	Localised disturbance to benthos.	Maintain abundance and diversity of benthic flora and fauna.	Negligible No significant seabed features or reefs known within survey area.	Negligible Anchoring is not required as DP vessels.	Halyard and Spar CEP Environmental Requirements for Offshore Marine Vessels (AE-91-IQ-202).
Seabed disturbance	Expected to occur.	Localised disturbance to benthos.	Maintain abundance and diversity of benthic flora and fauna.	Negligible No significant seabed features or reefs known within survey area.	Negligible Disturbance restricted to footprint of subsea structures, flowlines and umbilical	Halyard and Spar CEP
Interference with Whales and Dolphins	Unlikely to occur	Negligible	Minimise interference with Whales and Dolphins	Negligible Activity outside whale migration season.	Negligible Standard whale interaction procedures to be followed	Environmental Requirements for Offshore Marine Vessels. (AE-91-IQ-202). EPBC Part 8: Interacting with Cetaceans and Whale Watching
Underwater Noise	Expected to Occur	Negligible	Minimise interference with Whales and Dolphins	Negligible Activity outside whale migration procedure. Underwater noise is of limited duration and impacts are restricted to limited extend around subsea facilities	Negligible Minimise underwater noise	CEP Environmental Requirements for Offshore Marine Vessels. (AE-91-IQ-202).
Liquid Waste Disposal (including ballast water, hydro test water, produced formation water, sewage and grey water, bilge water, desalination brine, cooling water & subsea hydraulic control fluids)	Expected to Occur	Negligible	Minimise environmental impact from any liquid waste disposal	Negligible Small volumes of low toxicity liquids	Negligible Disposal of liquids as per CEP. Hydrotest water discharges through Varanus Island Hub to deep disposal wells	CEP Ballast Water Management Procedures MARPOL OPGGSA Schedule 222: Housekeeping Varanus Island Hub EP (EA-60-RI-186)

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation Measures	Standards
Spill during fuel transfer at sea	Unlikely to occur.	Toxic effects on marine biota from liquid hydrocarbons.	Minimise risk of adverse effect to marine ecology from hydrocarbon loss.	Moderate Majority of survey in deep water and distant from shorelines. Rapid dispersion and weathering of hydrocarbons in deeper water, distant from coastlines.	B No refuelling within Montebello Marine Park Refuelling only during suitable weather and sea-state conditions, discretion of both skippers, integrity checks on equipment etc.). Oil spill modelling can be used to predict trajectory and fate of hydrocarbons.	Refuelling and Chemical Transfer Management Procedure (AE-91-IQ-098). Vessel bunkering procedures. Shipboard Oil Pollution Emergency Plan (SOPEP)
Subsea Oil Spill	Rare	Toxic effects on marine biota and coastal areas from liquid hydrocarbons.	Minimise risk of adverse effect to marine ecology from hydrocarbon loss.	Significant	B Spill Modelling and leak frequency studies confirm that an uncontrolled well blowout or major subsea leak is unlikely to occur during Halyard Installation. Adequate contingencies are in place	CEP Halyard and Spar development subsea system basis of design (HL-35-AG-009) Apache North West Shelf Oil Spill Contingency Plan Volume 1 – Operations (AE-00-EF-008/1). Apache North West Shelf Oil Spill Contingency Plan Volume 2 - Environmental Atlas (AE-00-EF-008/2).
Displacement of other users of marine environment	Unlikely to occur.	Reduction to recreational and/or commercial access.	Minimise disturbance to other users.	Minor	B Consultation with commercial fishers prior to offshore Installation Notice to Mariners issued	APPEA Code of Practice 2008. AMSA Notice to Mariners CEP Environmental Requirements for Offshore Marine Vessels. (AE-91-IQ-202).

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation Measures	Standards
Introduction of Marine Pests	Unlikely to occur	Impact on diversity of marine biota.	Minimise risk of introducing marine pests into Australian waters	Moderate	B Full ballast water exchange of vessel at sea prior to entry into Australian waters. Biofouling risk assessment and in-water inspections and cleaning if necessary of vessel hulls.	AQIS Australian Ballast Water Management Requirements National Biofouling Management Guidelines for Commercial vessels. National biofouling management guidance for the petroleum production and exploration industry.
Accidental hydrocarbon spills > 80 litres e.g. leak from Construction/Installation vessel following collision with other vessels etc.	Unlikely to occur	Adverse effect to environment from hydrocarbons.	Minimise occurrence of fuel and oil spills	Moderate	B Fuel spill contingency procedures are in place and operational Functional navigational lighting in place and in use. Vessel meets Classification Society and Statutory inspection requirements Activities carried out in a manner that does not interfere with navigation to a greater extent than is necessary Marine notices broadcast according to requirements. Rescue Coordination Centre (RCC) of AMSA notified of survey. Radar and Radio monitoring undertaken (AIS).	Apache Environmental Management Policy MARPOL 73/78 Annex I AMSA Marine Notice 36/2002 Survey Vessel SOPEP (Shipboard Oil Pollution Emergency Plan) Apache's North West Shelf Oil Spill Contingency Plan, AE-00-EF-008/1 Rev. 16 CEP