

Decision Report

Review of Existing Licence

Division 3, Part V Environmental Protection Act 1986

Licence Number	L6284/1992/10
Applicant	Santos WA Energy Limited
ACN	009 301 964
File Number	DER2013/000949-3
Premises	Varanus Island and East Spar Facilities CALM Act Leases 1902/100 and 2604/100 Part Reserve 33902 (Part Lot 500 on Plan 240033) VARANUS ISLAND WA 6872
Date of Report	13 March 2019
Status of Report	Final

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1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
AER	Annual Environment Report
CALM Act	Conservation and Land Management Act 1984 (WA)
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
СРІ	Corrugated Plate Interceptor
CS Act	Contaminated Sites Act 2003 (WA)
DBCA	Department of Biodiversity Conservation and Attractions
Decision Report	refers to this document.
Delegated Officer	an officer under section 20 of the EP Act
Department	means the department established under section 35 of the <i>Public Sector Management Act 1994</i> and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environmental Regulation
ESJV	East Spar Joint Venture
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cwth)
EP Act	Environmental Protection Act 1986 (WA)
EP Regulations	Environmental Protection Regulations 1987 (WA)
Existing Licence	The Licence issued under Part V, Division 3 of the EP Act and in force prior to the commencement of, and during this Review
GLCs	Ground Level Concentrations
HDPE	means High Density Polyethylene
HJV	Harriet Joint Venture
Licence Holder	Quadrant Energy Australia Limited

LTS	Low Temperature Separation
m³	cubic metres
mg/L	miligrams per litre
Minister	the Minister responsible for the EP Act and associated regulations
Noise Regulations	Environmental Protection (Noise) Regulations 1997 (WA)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
Occupier	has the same meaning given to that term under the EP Act
PGER Act	Petroleum and Geothermal Energy Resources Act 1967 (WA)
PGERE Regulations	Petroleum and Geothermal Energy Resources (Environment) Regulations 2012 (WA)
PFAS	perfluoroalkyl and polyfluoroalkyl substances
PFW	Produced Formation Water
Prescribed Premises	has the same meaning given to that term under the EP Act
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Primary Activities	as defined in Schedule 2 of the Revised Licence
Review	this Licence review
Revised Licence	the amended Licence issued under Part V, Division 3 of the EP Act following the finalisation of this Review.
Risk Event	As described in Guidance Statement: Risk Assessment
Specified ecosystems	As described in Guidance Statement: Environmental Siting
UDR	Environmental Protection (Unauthorised Discharges) Regulations 2004 (WA)
VI	Varanus Island
WC Act	Wildlife Conservation Act 1950 (WA)

2. Purpose and scope of assessment

This Decision Report reviews the Existing Licence (L6284/1992/10) and current operations associated with Varanus Island and East Spar Facilities (the Premises), operated by Santos WA Energy Limited (the Licence Holder).

The Existing Licence has been identified by Department of Water and Environmental Regulation (DWER) as requiring review due to the following:

- Emissions and discharges from the Premises have not been previously risk assessed in accordance with DWER's current regulatory framework for Prescribed Premises;
- The Existing Licence contains authorisation for Prescribed Premises category 73, Bulk storage of chemicals etc., which is not required for the bulk condensate tanks that are operated on the Premises, as these are assessed and authorised under category 10 (oil and gas production from wells) and category 34 (oil or gas refining) operations. As such, the category 73 authorisation has been removed;
- The Licence Holder has requested approval to re-instate a discharge point for treated stormwater from an existing oily water treatment plant on the Premises that has been offline for several years;
- The Existing Licence is due to expire on 16 October 2019. A detailed review of the Premises has been scheduled with a view to extending licence L6284/1992/10 to reflect DWER's policy on Licence Duration (DER 2016a). The Licence has been reviewed and extended for a period of 12.5 years, to reflect the terms of the CALM Act leases associated with the Premises which expire on 20 April 2032. Fees will continue to be levied annually, as prescribed by the EP Regulations; and
- The Licence Holder has applied to transfer the Existing Licence from Quadrant Energy Australia Limited to Santos WA Energy Limited as a result of a change of company name that occurred on 28 November 2018. This review also incorporates the transfer of licence associated with the company name change.

This Decision Report documents the Delegated Officer's risk assessment of emissions and discharges from the Premises consistent with *Guidance Statement: Risk Assessment* (DER 2017a) and *Guidance Statement: Decision Making* (DER 2017b).

3. Background

Varanus Island (VI) is located approximately 58km off the coast of North West Australia around 117km west of Dampier and 12km east of Barrow Island. VI is part of the Lowendal group of islands which are vested as Nature Reserves and managed by the Department of Biodiversity Conservation and Attractions (DBCA). Since 1986 a portion of VI has been leased for the operation of petroleum receiving, processing, storage, loading and export facilities.

The Prescribed Premises situated on VI forms the central gathering and processing hub for the Licence Holder's offshore oil and gas production facilities in the area. The Licence Holder operates the oil and gas production infrastructure on VI on behalf of its joint venture participants. Produced hydrocarbons are processed through two processing plants on the Premises, the East Spar Joint Venture (ESJV) and the Harriet Joint Venture (HJV), and then delivered as:

- Sales quality gas to the mainland via two subsea pipelines that tie in to the Dampier to Bunbury Natural Gas Pipeline via Compressor Station One (CS1) as shown in Figure 2; and
- Tanker specification crude and condensate, which is stored in three floating roof Bulk Storage Tanks on the Premises before being exported to tankers via a 4.2km offshore

pipeline, also shown in Figure 2.

The combined ESJV and HJV lease and licence area encompasses the central portion of VI as shown in Figure 1. It occupies an area of approximately 30ha or 35% of the land area of VI.



Figure 1: Varanus Island lease areas for oil and gas production, that form the Prescribed Premises boundary

Table 2 lists the prescribed premises categories that are approved under Existing Licence L6284/1992/10.

Classification of Premises	Description	Approved Premises production or design capacity or throughput
Category 10	Oil or gas production from wells: premises, whether on land or offshore, on which crude oil, natural gas or condensate is extracted from below the surface of the land or the seabed, as the case requires, and is treated or separated to produce stabilized crude oil, purified natural gas or liquefied hydrocarbon gases.	7 050 000 tonnes per annual period
Category 34	Oil or gas refining: premises on which crude oil, condensate or gas is refined or processed	
Category 73	Bulk storage of chemicals	120 000 cubic metres in aggregate
Category 85	 Sewage facility: premises — (a) on which sewage is treated (excluding septic tanks); or (b) from which treated sewage is discharged onto land or into waters. 	28 cubic metres per day

Table 2: Prescribed Premises Categories in the Existing Licence

As mentioned above, operation of the Bulk Storage Tanks on VI will be assessed in association with the Category 10 and 34 activities. Accordingly, Category 73 authorisation has been removed from the Revised Licence.

4. Overview of Premises

4.1 **Operational aspects**

VI is surrounded by a network of fixed offshore production platforms which feed gas, oil and condensates into the island's facilities for processing, storage and delivery or export. The Premises processes gas, oil and condensate from production wells located in both State and Commonwealth waters. Current production levels are around 5,000 barrels of oil and condensate per day (approximate equivalent to 612 tonnes (t) per day), and up to 390 terajoules of gas per day (around 7,839 t/day). Oil and condensate is stored on the Premises and transferred to tankers for direct export, while natural gas is transported via the Sales Gas Pipeline into the Dampier to Bunbury Natural Gas Pipeline and the Goldfields Gas Transmission pipeline.

The gas condensate produced from the Premises is a refinery feedstock that supplies light liquid hydrocarbons for the transport industry within Western Australia (WA). All of the produced gas from VI (and other facilities operated by the Licence Holder) supplies the domestic gas market in WA, including the resources sector and associated industries.

All offshore facilities and the sales gas pipelines associated with the Premises are shown in Figure 2. It should be noted that the offshore facilities do not form part of the Prescribed Premises and will not be considered further in this assessment report.



Figure 2: Varanus Island Offshore Facilities and Sales Gas Pipelines

The main infrastructure related to oil and gas processing and refining activities operating on VI includes:

- HJV low temperature separation (LTS) processing plant (comprising three trains, however, HJV trains 1 and 2 are currently offline and suspended from operation);
- ESJV LTS processing plant (comprising two trains);
- Carbon dioxide (CO₂) removal plant;
- Crude oil export pipeline and marine load-out terminal;
- Water injection (disposal) wells (for disposal of Produced Formation Water (PFW) and treated stormwater);
- Subsea pipelines connecting the offshore facilities and two sales gas pipelines to the mainland Metering Station;
- Varanus Island control building;
- Accommodation and amenities buildings (including sewage facility);
- Common facilities (bulk crude oil and condensate storage tanks (Bulk Storage Tanks); utilities such as power generation, PFW treatment, firewater system, workshops, offices etc.); and
- Heliport.

Category 10 and 34 operations

HJV Processing Plant

The HJV plant processes fluids from the Harriet Bravo, Linda, Agincourt, Wonnich, Simpson B, Gibson / South Plato, Victoria and Double Island offshore facilities to produce sales gas, gas condensate, crude oil and PFW.

Sales gas processing involves dehydration using molecular sieves and LTS of the natural gas

liquid prior to compression and export. The Joule-Thomson expansion method is used to cool the gas to separate (condense) the heavy hydrocarbon components. The gas is sent to sales gas compression for export.

Condensates recovered are stabilised with the light hydrocarbon ends being returned to the process and stabilised condensates sent to the Bulk Storage Tanks for export.

Crude from the oil production platforms is sent to the HJV Liquids Handling Facility which includes two stage stabilisation vessels. Crude from the First Stage Separators is further stabilised in the Second Stage Separator to minimise any cold venting from the Bulk Storage Tanks. Crude from the Second Stage Separator is transferred to the Bulk Storage Tanks for export.

Gas from the first stage separators is sent to the Overheads Compressors. Gas from the second stage separators is recovered by the Flash Gas ejectors and then sent to the Overheads Compressors. Compressed Overheads gas is either sent to the HJV sales gas LTS plant or used as lift gas. The Overheads gas can be sent to the flare system when the Overheads Compressors are not available.

PFW is processed and reinjected into a number of onshore and one offshore depleted gas/oil reservoirs via deep water injection wells.

ESJV Processing Plant

The ESJV LTS plant processes hydrocarbons received from the John Brookes and Halyard fields to produce sales natural gas, stabilised condensate and PFW. Initial separation of the gas, condensate and water occurs via slug catchers.

Sales gas processing involves CO₂ and hydrogen sulphide (H₂S) removal using methyldiethanolamine (amine), dehydration using triethylene glycol (TEG), mercury removal using activated carbon and then chilling using the Joule-Thomson expansion process.

The CO₂ and H₂S in the gas stream is absorbed in the amine contactor, which is then removed from the amine in a regenerator, producing acid gas containing around 97% CO₂ and 130ppm H₂S. The acid gas is vented to the atmosphere via a 24m high stack.

Residue vapour from the dehydration process using TEG in the glycol regenerator is released by a 16m high vent.

The condensates are separated in the LTS plant with the light hydrocarbon ends being returned to the process. Stabilised condensates are sent to the Bulk Storage Tanks for export and the gas stream is sent to the Sales Gas Compressors for export. Overheads gas from the stabilisation unit is sent to the Overheads Compressors, or to the flare system when the Overheads Compressors are not available.

PFW is processed and reinjected into a number of onshore and one offshore depleted gas/oil reservoirs.

Stormwater management

Throughout the HJV and ESJV oil/gas processing infrastructure bunding is maintained to ensure potentially contaminated stormwater is captured in bunds and sumps. Water contained in bunding is directed through oil-water separation systems prior to disposal via the onshore deep disposal wells or discharged to land via the outlet pipe from HJV Humeceptor 54.

Category 85 operations

Raw sewage is collected from the various amenity facilities on VI and directed to two package treatment plants:

1. HJV Sewage System, constructed in 1986 – Consisting of an Enviroflow system which is rated to 80 persons per day; and

2. ESJV Sewage System, constructed in 1994 – Consisting of an Durrant and Waite system (also known as Biomax system) which is rated to 100 persons per day.

The total treatment design capacity of the sewage systems has been estimated by the Licence Holder to be 54m³ per day (180 persons multiplied by an average hydraulic load of 300L per day).

The sewage treatment facilities are located at the top of the West Mallard landing area (Figure 3). Sewage from accommodation facilities flows into a single 2,650L wastewater tank where a grinder reduces the particle size of solids before transferring the sewage to the Enviroflow and Biomax systems. The treatment facilities consist of eight treatment tanks and two disinfection tanks as indicated in Figure 3.



Figure 3: Sewage Facility layout

Table 3 outlines the tank arrangements for each package plant and their storage capacities.

SYSTEM	Tank reference number	TANKS	SIZE
Biomax	T1	1 Anaerobic treatment tank – 2 internal compartments	21,820L total (14,500L and 7,320L)
	T2, T3 2 Aerobic treatment tanks - 2 stage system		2 x 20,000L
	T4, T5	2 Clarification tanks – sludge settlement and removal	8.24 m ² total surface area
	T6	1 Disinfection tank – Sanuril model 100 tablet chlorinator (chlorine tablets: 200 g trichloro- isocyanuric acid)	6,150L (design) 4,116.6L (current)
Enviroflow	T7	1 Anaerobic drop tank	7.2m ³ (7,218.6L)
	T8	1 Aerobic treatment tank (secondary holding tank)	12.4m ³ (12,411.4L)
	Т9	1 Clarification tank (below ground tank) + biofilter aerobic (above ground tank)	7.5m ³ (7,467.7L) 11.2m ³ (11,157.2L)
	T10	1 Disinfection tank (chlorinator)	4.3m ³ (4,328.2L)

Table 3: Sewage Facility tanks arrangement and capacity

Discharge volumes from the sewage facilities vary in accordance with the number of personnel on VI at any given time. The sludge tanks are pumped out as required and sludge is transported to Karratha for disposal by a licensed waste contractor. Sewage is treated by activated sludge and chlorination (tablets) then discharged to the ocean via an outlet in shallow water adjacent to the West Mallard landing. The two systems currently installed are not capable of reducing Nitrogen or Phosphorus levels in the effluent stream.

Where it has not been possible to connect ablution facilities to the sewage treatment plants small wastewater treatment systems have been installed and / or localised septic systems and leach drains. As these small systems do not meet the definition of a Prescribed Premises (less than 20m³ per day) they are not considered in this Decision Report.

4.2 Infrastructure

The Premises infrastructure, as it relates to Categories 10, 34 and 85 activities, is detailed in Table 4 and with reference to the Figures in this Decision Report and the Premises Maps attached in the Revised Licence.

Infrastructure		Reference	
Prescribed Activity Category 10 and 34			
Oil and gas is pumped from surrounding offshore platforms to Varanus Island to produce oil, gas and condensate via separation plants. LNG and condensate is exported via ship while gas is piped to the mainland for distribution to the Dampier to Bunbury Natural Gas Pipeline.			
1	HJV gas separation plant		
2	HJV oil separation plant		
3 ESJV gas separation plant		Figure 4	
4	HJV Ground Flare		
5 HJV Elevated Flare			

Table 4: Varanus Island and East Spa	oar Facilities infrastructure
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Infra	structure	Reference					
6	ESJV Ground Flare						
7	7 ESJV Elevated Flare						
8	Crude oil and condensate Bulk Storage tanks						
9	PFW Storage tanks						
10	Subsea pipeline and marine terminal for the export of hydrocarbon liquids						
11	Two sales gas pipelines to the mainland						
Pres	cribed Activity Category 85						
The office	Sewage facility (2 x package plants) treat domestic sewage from the acco e ablutions prior to discharging treated effluent to the marine environment	mmodation camp, mess facilities and					
1	Biomax Sewage system comprising 1 x anaerobic treatment tank, 2 x aerobic treatment tanks, 2 x clarification tanks and 1 x disinfection tank						
2	Enviroflow Sewage system comprising 1 x anaerobic drop tank, 1 x aerobic treatment tank, 1 x clarification tank with biofilter and 1 x disinfection tank	Figures 3 and 4					
3	Sub-sea pipeline and discharge point to marine waters	Premises Map "Sewage Facility Location and Discharge Point" shown in Schedule 1 of the Revised Licence					
Dire	ctly related activities						
Cont the f	aminated wastewater from various waste streams, including PFW and cor ollowing infrastructure for treatment and disposal	ntaminated stormwater is directed to					
1	Network of bunds and sumps on the Premises. Captured water is then directed through oil-water separation systems (eg. Corrugated Plate Interceptor (CPI) / Humeceptors) prior to disposal via deep disposal wells to oil reservoirs or discharge to land via pipeline from the Humeceptor 54.						
Othe	er activities						
1	Support infrastructure including power generation units, chemical storage, workshops, laydown areas, incinerator, wharfs, wash down bays, concrete batching plant, offices, accommodation village, potable water plant and heliport.	Figure 4					

The Premises infrastructure is shown in Figure 4.



Figure 4: Varanus Island – Premises Infrastructure

4.3 Exclusions to the Premises

The Prescribed Premises activities includes infrastructure directly related to the oil and gas production from wells, the processing and refining of oil and gas and the operation of the sewage facilities located on the Premises. This assessment does not include offshore infrastructure or subsea installations, as they do not meet the definition of Prescribed Premises.

In addition, the activities associated with the support infrastructure, including power generation units, chemical storage, workshops, laydown areas, waste incinerators, wharfs, wash down bays, concrete batching plant, offices, accommodation village, potable water (Reverse Osmosis) plant and heliport do not meet the definition of Prescribed Premises and are not considered further in this report.

The disposal of PFW is regulated under the *Petroleum and Geothermal Energy Resources (Environment) Regulations 2012 (WA)* (PGERE Regulations) and is therefore managed by DMIRS as appropriate.

Key Finding: Exclusions to the Premises

- 1. The offshore platforms, wells and subsea infrastructure associated with Varanus Island are outside of the regulatory capture of the EP Act 1986 and EP Regulations 1987. Offshore infrastructure is regulated by other agencies including DMIRS (for infrastructure located in State waters) and NOPSEMA (for infrastructure located in Commonwealth waters) in accordance with relevant legislation administered by those agencies.
- 2. The disposal of PFW to the deep disposal wells is regulated by DMIRS under the PGERE Regulations.
- 3. Support infrastructure not directly related to the Prescribed Premises activities are not regulated under the EP Act licence L6284/1992/10. This infrastructure may be regulated under legislation subsidiary to the EP Act, such as the Environmental Protection (Unauthorised Discharges) Regulations 2004, the Environmental Protection (Concrete Batching and Cement Products Manufacturing) Regulations 1998 and other legislation.

5. Legislative context

Table 5 summarises approvals relevant to the assessment.

Legislation	Number	Subsidiary	Approval
Petroleum and Geothermal Energy Resources Act 1967	Petroleum Lease	Department of Mines, Industry Regulations and Safety (DMIRS)	Titles for petroleum exploration and production in WA (onshore or internal waters) issued under this Act. Varanus Island Hub Operations Environment Plan (Rev. 6) dated 5/9/2014
Dangerous Goods Safety Act 2004	Dangerous Goods Licence Exemption applicable	Apache Energy Ltd (previous Occupier of Prescribed Premises)	Exemption granted in 1993 - letter reference 275/9051H
Part IV of the EP Act (WA)	Ministerial Statement Number 134	Hadson Australia Development Pty Ltd	Construction of pipeline connecting Harriet Gas Field to Dampier-Wagerup Pipeline

Legislation	Number	Subsidiary	Approval
			(Sales Gas Pipeline)
	Ministerial Statement Number 395	Western Mining Corporation Limited	East Spar Offshore Gas Field Development
	Ministerial Statement Number 457	Apache Northwest Pty Ltd	Wonnich Gas Development: monopod and pipeline to VI
	Ministerial Statement Number 573		Simpson Oil field development: Construction and operation of two offshore oil and gas mini platforms and undersea pipeline bundle connecting Tanami-4, Tanami-5, Simpson-1 and Simpson-3H wells to the existing facilities on VI
Part V of the EP Act (WA)	Licence L6284/1992/10	Santos WA Energy Limited	Prescribed premises licence authorising oil and gas production from wells and operation of sewage facility
	Vegetation Clearing Permit CPS 7551/1 for Installation, Upgrade, Maintenance, and Redevelopment of Petroleum Infrastructure on Petroleum Production Licence TL/6 (expires 31 July 2027)	Quadrant Northwest Pty Ltd	Clearing Permits are issued under Part V of the EP Act for the clearing of native vegetation
	Vegetation Clearing Permit CPS 6972/1 for Petroleum Production on Petroleum Production Licence TL/2 R1 (expires 30 September 2018)	Quadrant Oil Australia Pty Limited	

5.1 Contaminated sites

The site has been assessed as '*contaminated - remediation required*' under the *Contaminated Sites Act 2003* (CS Act), based on contamination assessments undertaken between 1995 and 2018. A number of site investigations have been conducted, of which the most recent was completed in February 2018.

Petroleum hydrocarbons (such as from oil and/or petroleum refining products) and perfluoroalkyl and polyfluoroalkyl substances (PFAS) (such as from firefighting foams) are present in soil and groundwater beneath the site and extend to areas of ecological significance.

This site is considered to be high priority for action to address risks to human health, the environment and environmental values. Further investigation is required to assess the risks to human health and ecological receptors (such as marine turtle nesting areas, wedge-tailed shearwater rookeries and mangrove protection areas) from contamination present at the site.

Remediation is required to mitigate unacceptable risks from petroleum hydrocarbons to the environment and human health. Active remediation of soil and groundwater on-site and within the conservation reserve has commenced and works are still in progress.

This classification is based on advice from the auditor, documented in a Mandatory Auditor's Report dated 8 May 2018. DWER accepts the auditor's conclusion, that the site is suitable for ongoing commercial/industrial use (based on the current use and layout as an oil and gas processing facility), and the auditor's recommendations for further action to progress remediation of the site.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER and as such, the usefulness of this information may be limited.

Existing Contamination:

<u>LNAPL Plumes:</u> Two light non-aqueous phase liquid (LNAPL) petroleum hydrocarbon (such as from oil and/or petroleum refining products) plumes are present on Varanus Island. The older LNAPL plume is the result of historical waste disposal practices involving reinjection of PFW, containing residual hydrocarbons, into shallow wells located on the western boundary of lease 1902.

The second LNAPL plume is the result of an underground gas condensate leak within the East Spar Joint Venture processing plant which was first identified in January 2014. Site investigations in the vicinity of the condensate leak have identified petroleum hydrocarbons in groundwater at concentrations exceeding the relevant assessment levels applicable to drinking water and marine ecosystems, as published in Contaminated Sites Guideline 'Assessment and management of contaminated sites', (DER 2014) and the Health Screening Levels (HSLs) for vapour intrusion in the 'National Environment Protection (Assessment of Site Contamination) Measure' (ASC NEPM 1999) for commercial/industrial land use.

The second LNAPL groundwater plume extends beneath Pipeline Beach. Ongoing groundwater, pore water and soil vapour investigations have been undertaken to assess potential impacts from petroleum hydrocarbons to sensitive ecological receptors (including marine turtles) at Pipeline Beach.

<u>Gas pipeline fire; and per- and polyfluoroalkyl substances (PFAS) impacts:</u> In addition to the two LNAPL plumes, PFAS, from the use of fire-fighting foams, are present in groundwater associated with a major gas pipeline fire adjacent to Pipeline Beach that occurred in 2008. The most recent investigations undertaken in June 2017 identified PFAS in groundwater at concentrations exceeding health-based guidance values for drinking water, recreational water quality and interim guideline values for marine ecosystems, as published in the 'PFAS National Environmental Management Plan' (Heads of EPAs Australia and New Zealand, January 2018). Further investigations are required to assess the potential risks to human health and ecological receptors (such as subterranean fauna, turtles and shearwaters) from PFAS associated with the use of fire-fighting foams.

<u>Bulk Storage Tanks</u>: Soil investigations were undertaken between 2014 and 2016 beneath the high density polyethylene bund liner, which acts as containment for three Bulk Storage Tanks. These investigations identified petroleum hydrocarbons in soil at concentrations exceeding the Ecological Screening Levels (ESLs) but below the relevant Human Health Investigation and Screening Levels (HILS and HSLs) for commercial/industrial land specified in the NEPM.

<u>Oil water interceptor spill</u>: Following an overspill from an oil water interceptor located on the eastern side of lease 1902/100, which was reported in January 2014, soil investigations undertaken outside of lease 1902 identified petroleum hydrocarbons in soil at concentrations exceeding the ESLs for areas of ecological significance specified in the NEPM. Although remedial works comprising removal of hydrocarbon contaminated soil and installation of six new artificial burrows was undertaken in mid-2017, the contaminated sites auditor has concluded that further monitoring and evaluation of nesting and fledging success of Wedge-

tailed Shearwaters is required.

<u>Amine Spill</u>: Following a spill of amine solution from the East Spar plant in April 2017, soil and groundwater investigations identified elevated pH (alkaline) and concentrations of methyldiethanolamine (MDEA) and piperazine in the plant area in the vicinity of the spill and drainage sump, however no assessment levels are currently available for these compounds. Following a Tier 2 human health and ecological risk assessment in October 2017, the contaminated sites auditor concluded that no significant risks to on-site workers currently exists provided that existing management measures are implemented at the site. With regard to the ecological risk assessment, the auditor concluded that a number of uncertainties remain and further assessment is required to make reliable conclusions regarding the potential risks to sensitive ecological receptors.

5.2 Other relevant approvals

5.2.1 Department of Mines, Industry Regulation and Safety

DMIRS regulates onshore petroleum activities via administration of the *Petroleum and Geothermal Energy Resources Act 1967 (WA)* (PGER Act), the *Petroleum and Geothermal Energy Resources (Environment) Regulations 2012 (WA)* (PGERE Regulations) and the *Petroleum Pipelines Act 1969* (PP Act). In accordance with this legislation, oil and gas operators must submit an Environment Plan (EP) to DMIRS for approval. An EP is a management document designed to demonstrate that all environmental risks and impacts associated with a petroleum activity are reduced to As Low As Reasonably Practicable, and at all times carried out in a manner consistent with the principles of ecologically sustainable development.

DMIRS has approved the Varanus Island Hub Operations Environment Plan (Revision 6) (Apache 2014) which is implemented by the Applicant in accordance with the above mentioned legislation.

5.2.2 Department of Biodiversity Conservation and Attractions

Department of Biodiversity and Conservation Attractions (DBCA) is responsible for administering the *Conservation and Land Management Act 1984* (CALM Act) and the *Wildlife Conservation Act 1950*. The CALM Act applies to Nature Reserves, including the Lowendal Islands Nature Reserve (Reserve 33902) within which VI is located. The Lowendal Islands Nature Reserve is gazetted as a Class C Nature Reserve for the conservation of native flora and fauna. The DBCA manages the Nature Reserve on behalf of the Conservation Commission of Western Australia.

The Conservation Commission has leased a portion of Reserve 33902 to the Licence Holder for the purposes of oil and gas production activities. These leases (1902/100 and 2064/100) are issued under the CALM Act and expire on 20 April 2032. Figure 1 shows both lease areas (1902/100 depicted by the red line and 2064/100 depicted by the orange line).

5.3 Part V of the EP Act

5.3.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations. The guidance statements which inform this assessment are outlined in Appendix 1.

6. Modelling and Monitoring data

6.1 Air Dispersion Modelling

In August 2015, the Licence Holder commissioned an independent air emissions consultant, Ramboll Environ Australia Pty Ltd, to undertake air dispersion modelling of emission sources associated with its operations on the Premises.

Air emissions from the Premises associated with oil or gas production activities on VI include:

- hydrocarbon combustion products as a result of operation of processing equipment and temporary equipment;
- carbon dioxide (CO₂), carbon monoxide (CO), sulphur dioxide (SO₂), and oxides of nitrogen (NOx) from incineration of wastes using industrial incinerators onsite:
- venting of acid gas from 24m high stacks in the amine plant;
- volatile organic compounds (VOC's)(mainly methane (CH₄)) from crude oil storage and ship loading operations, with low volumes coming from the glycol regeneration systems, pressure relief valves, thermal relief valves and sumps;
- ozone depleting substances from closed refrigeration systems (if leaking);
- fugitive emissions (mainly hydrocarbon gases) from processing plants resulting from minor leaks at pipe connections, valves, rotating shafts and during maintenance of this equipment; and
- particulate matter (dust) from vehicle movements, high pressure blasting or cement mixing operations.

The modelling used emissions information available at that time to rank contaminants based on the predicted concentrations and compared modelled ground level concentrations (GLCs) to the *National Environment Protection (Ambient Air Quality) Measure 2003* and *National Environment Protection (Air Toxics) Measure 2004* standards as well as additional ambient air quality criteria where required (such as those adopted by the WA Department of Health and the United States Environmental Protection Agency).

The assessment considered air emissions associated with routine operations as well as two non-routine scenarios, the first being concurrent use of the HJV and ESJV elevated flares in the event of a major plant blowdown, and the second being operation of the emergency generators and fire water pumps.

The modelling results indicate that GLCs predicted for normal operations are expected to comply with applicable short term and long term ambient air quality guidelines for each of the modelled pollutants. Table 6 gives a summary of the maximum GLCs predicted for each modelled compound during normal operations, and represents the predicted GLCs as a percentage of the guideline value.

Pollutant	Averaging	Guideline (µg/m³) ^[1]	Maximum Predicted GLC (µg/m ³)					% Guideline
. Chatan	Period		2009	2010	2011	2012	2013	Value ^[2]
1.2 Putadiana	1-hour	660	0.004	0.004	0.005	0.005	0.005	0.001%
1,5-Betaulene	Annual	2.0	0.0002	0.0001	0.0001	0.0001	0.0002	0.01%
Acetaldebude	1-hour	2,000	0.07	0.08	0.09	0.09	0.09	0.005%
Acetaidenyde	24-hour	50	0.02	0.02	0.03	0.03	0.03	0.1%
Acrolein	24-hour	0.08	0.002	0.003	0.002	0.004	0.003	4.4%
BaP (as marker for PAH)	Annual	275	5.1E-08	4.5E-08	3.6E-08	4.5E-08	5.8E-08	<0.001%
Benzene	Annual	9.6	0.2	0.2	0.1	0.1	0.2	1.5%
co	8-hour	10,310	276	318	295	254	405	3.9%
Cumene	Annual	400	0.004	0.004	0.003	0.003	0.004	0.001%
Cyclohexane	1-hour	19,000	1.6	1.9	2.0	2.1	2.2	0.01%
Fu	1-hour	8,000	0.3	0.3	0.4	0.4	0.4	0.005%
Ethylbenzene	Annual	300	0.02	0.02	0.01	0.02	0.02	0.01%
Formaldehyde	24-hour	49	0.2	0.4	0.3	0.4	0.3	0.8%
	1-hour	2,800	27	25	31	34	22	1.2%
H ₂ S	24-hour	150	4.2	4.2	4.2	3.1	4.2	2.8%
	Annual	2	0.4	0.4	0.4	0.4	0.5	28%
n-hexane	1-hour	3,200	38	24	26	24	37	1.2%
NO	1-hour	226	165	171	176	176	174	78%
NO ₂	Annual	56	34	32	26	29	36	56%
PM ₁₀	24-hour	46	6.1	6.0	12	14	9.2	28%
	24-hour	23	6.0	5.9	12	14	9.0	54%
PM2 5 ¹⁰¹	Annual	7	1.2	1.1	0.9	1.1	1.4	16%
	1-hour	524	0.7	0.5	0.5	0.5	0.7	0.1%
SO2	24-hour	210	0.2	0.3	0.3	0.3	0.2	0.1%
	Annual	52	0.04	0.04	0.03	0.04	0.04	0.1%
Telvers	24-hour	3,768	0.6	0.7	0.6	0.5	0.8	0.02%
Toluene	Annual	377	0.1	0.09	0.07	0.08	0.09	0.02%
Videore	24-hour	1,085	0.3	0.3	0.5	0.2	0.4	0.1%
Aylenes	Annual	868	0.07	0.07	0.06	0.07	0.08	0.01%

Table 6: Maximum predicted GCLs for air pollutants generated during normal operations of Varanus Island and East Spar Facilities

1. Referenced to 25°C and 1013.25 hPa, in line with reference conditions for model outputs.

2. Comparison of maximum predicted GLC for the five modelled years against the relevant guideline value.

The modelling for the Premises emergency generator and fire water pump use scenario indicates that predicted GLCs are expected to comply with the applicable short term ambient air quality guidelines for each of the modelled compounds. Table 7 gives a summary of the maximum GLCs predicted during this scenario. Note that predicted GLCs acrolein, cumene, cyclohexane, H₂S and n-hexane have not been reported in Table 7 as these compounds are not associated with the use of the emergency generators or fire water pumps and as such, their predicted GLCs would not vary from those predicted under normal operating conditions.

Table 7: Maximum predicted GCLs for air pollutants generated during emergency operations of Varanus Island and East Spar Facilities

Pollutant Averaging G Period (Averaging	Guideline	Maximum Predicted GLC (µg/m ³)					% Guideline
	(µg/m³) ^[1]	2009	2010	2011	2012	2013	Value ^[2]	
1,3-Butadiene	1-hour	660	0.004	0.004	0.005	0.005	0.005	0.001%
Apptoldahuda	1-hour	2,000	0.07	0.08	0.09	0.09	0.09	0.005%
Acetaldenyde	24-hour	50	0.02	0.02	0.03	0.03	0.03	0.1%
со	8-hour	10,310	276	318	295	254	405	3.9%
Ethylbenzene	1-hour	8,000	0.3	0.3	0.4	0.4	0.4	0.005%
Formaldehyde	24-hour	49	0.2	0.4	0.3	0.4	0.3	0.8%
NO ₂	1-hour	226	194	192	196	194	192	87%
PM ₁₀	24-hour	46	10	11	12	14	9.2	28%
PM _{2.5} ^[3]	24-hour	23	9.8	11	12	14	9.0	54%
80	1-hour	524	0.7	0.5	0.5	0.5	0.7	0.1%
502	24-hour	210	0.2	0.3	0.3	0.3	0.2	0.1%
Toluene	24-hour	3,768	0.6	0.7	0.6	0.5	0.8	0.02%
Xylenes	24-hour	1,085	0.3	0.3	0.5	0.2	0.4	0.1%

Referenced to 25°C and 1013.25 hPa, in line with reference conditions for model outputs.

Comparison of maximum predicted GLC for the five modelled years against the relevant guideline value.

Key finding: Air Dispersion Modelling

- 1. The Delegated Officer has reviewed the Air Dispersion modelling and methodology and notes that appropriate models, meteorological datasets and parameters have been used in the modelling. The modelling looks at routine and non-routine scenarios and incorporates relevant air emission sources for the Premises. The modelling results are likely to represent an accurate prediction of typical ground level concentrations of air emissions generated during oil and gas processing operations at the Premises.
- 2. The results of the Air Dispersion modelling indicate that GLCs for air pollutants under normal operating conditions are likely to be below relevant guideline values. The air pollutants modelled to have the highest percentage GLC of the relevant quideline value include:
 - H_2S (annual average) at 28% of the guideline value;
 - NO_2 (1 hour average) at 78% of the guideline value;
 - NO₂ (annual average) at 56% of the guideline value;
 - PM₁₀ (24 hour average) at 28% of the guideline value; and
 - $PM_{2.5}$ (24-hour average) at 54% of the guideline value. •
- 3. In accordance with the Guidance Statement: Risk Assessments (DER 2017a) the Delegated Officer has excluded employees, visitors or contractors of the Licence Holder when identifying potential receptors, as protection of these parties is provided for under other state legislation.

6.2 Monitoring of emissions to surface water

The Licence Holder conducts monitoring of emissions to surface water from the treated sewage effluent that is discharged via subsea pipeline to the ocean at the West Mallard Effluent Discharge Point. Monitoring includes monthly average volumes of wastewater

discharged from the Premises Sewage Facility as well as standard wastewater parameters including pH, Total Suspended Solids, Biochemical Oxygen Demand, Total Nitrogen, Total Phosphorus, E. Coli, free chlorine and metals.

DWER notes that the concentrations of some of the water quality parameters in the treated effluent do not comply with guidelines adopted by the Licence Holder when reporting monitoring results in Annual Environmental Reports (AERs) to DWER. In the 2017/2018 AER, and in previous AER's, the Licence Holder has adopted the *Australian Guidelines for Sewage Systems – Effluent Management* (ARMCANZ / ANZECC, 1997) as a benchmark for review of the Sewage Facility performance. Where a guideline value was not available in those guidelines, results were compared to the *Australian Water Quality Guidelines for Marine Water Quality* (ARMCANZ / ANZECC, 2000). Exceedances of the adopted guideline values were reported for each quarter during 2017/2018 as shown in Tables 8 and 9 below (exceedances are shaded grey).

Table 8: Premises Sewage Facility Treated Effluent Results 2017/2018 – Inorganic species

Analyte	PQL*	Guideline (Tier 1)	Guideline (Tier 2)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
pH (field)	NA	-	8 - 8.4^	7.18	7.82	7.28	7.55
TSS	5 mg/L	25 - 40	NA	40	27	23	55
BOD	5 mg/L	20 - 30	NA	250	18	16	14
TN	0.1 mg/L	20 - 50	NA	75	84	60	67
TP	0.01 mg/L	<mark>6 - 12</mark>	NA	11	9.2	9.9	9.7
Free chlorine (field)	NA	-	0.2 - 2.0	0.11	0.21	0.73	<0.1**
E. coli	1 CFU/100mL	10	NA	450,000	1,700	17	90

- No guideline

NT- Not Tested

NA - Tier 1 guideline available

*mg/L, unless otherwise stated

**Laboratory result utilised

[^]Guideline value for Tropical Australia – Slightly Disturbed Ecosystems - Marine Inshore Environments (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand 2000)

Table 9:	Premises Sewage	Facility Tr	eated Effluent	Results 2017/2	2018 – Meta	l species
	i iciilioco ociilage	i donity i i				1 500000

Metal	PQL	Guideline (Tier 2)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Cu	0.001	0.0013	0.005	0.005	0.007	0.004
Zn	0.01	0.015	0.045	0.044	0.082	0.047
Hg	0.00004	0.0004	<pql< td=""><td><pql< td=""><td><pql< td=""><td><pql< td=""></pql<></td></pql<></td></pql<></td></pql<>	<pql< td=""><td><pql< td=""><td><pql< td=""></pql<></td></pql<></td></pql<>	<pql< td=""><td><pql< td=""></pql<></td></pql<>	<pql< td=""></pql<>
Pb	0.001	0.0044	<pql< td=""><td><pql< td=""><td><pql< td=""><td><pql< td=""></pql<></td></pql<></td></pql<></td></pql<>	<pql< td=""><td><pql< td=""><td><pql< td=""></pql<></td></pql<></td></pql<>	<pql< td=""><td><pql< td=""></pql<></td></pql<>	<pql< td=""></pql<>
Ni	0.001	0.070	0.003	0.004	0.004	0.003
Cd	0.0001	0.0044	0.0003	0.0002	0.0003	0.0001

Exceedances of the guideline are indicated with a shaded cell. *NT- Not tested

Key finding: Emissions to surface water (ocean) from Premises Sewage Facility

1. The results from recent analysis of discharges from the Premises Sewage Facility indicate the Sewage Facility does not meet benchmark water quality treatment levels, likely due to the age and design of the facility.

2. The Licence Holder has indicated to DWER it has commenced a planning and procurement phase associated with replacing the existing Sewage Facility with a new package plant system to be installed during 2019. The planned new sewage facility will require assessment and approval by DWER via a works approval prior to construction and a licence amendment prior to operation.

6.3 Ambient Groundwater Monitoring

Monitoring of ambient groundwater conditions is conducted across the Premises to detect potential impacts to groundwater from oil and gas processing activities. 21 groundwater monitoring bores are analysed annually in accordance with conditions of Licence L6284/1992/10 for various parameters including pH, temperature, Electrical Conductivity (EC), Dissolved Oxygen (DO), Redox Potential, Total Recoverable Hydrocarbons (TRH), Polycyclic Aromatic Hydrocarbons (PAH), Benzene, Toluene, Ethyl Benzene, Xylene (BTEX), phenols, metals and natural attenuation.

The results of the 2018 groundwater monitoring were included in the Varanus Island 2018 AER, which reported that groundwater impact (hydrocarbon contamination) continues to be present in the vicinity of the former PFW disposal bores and the M4 condensate line in the ESJV plant. Contaminant concentrations above the adopted assessment levels were most significant within the vicinity of the condensate leak (MW16) and within the northern and northeastern portions of the site (MW44, MW58 and MW61). The AER reported that these results were generally consistent with results from 2017 monitoring and that the contamination plumes appear stable.

In addition to hydrocarbon contamination, it is noted that impact to groundwater has occurred as a result of the presence of Perflouroalkyl and Polyflouroalkyl Substances (PFAS) from the use of fire-fighting foams during the major gas pipeline fire that occurred adjacent to Pipeline Beach in 2008. It is also understood that periodic testing of fire monitors adjacent to the Premises Helipad has occurred over time, potentially with the use of PFAS firefighting foams that may have entered the environment. As advised by DWER's Contaminated Sites function, further investigations are required to assess the potential risks to human health and ecological receptors (such as subterranean fauna, turtles and shearwaters) from PFAS associated with the use of fire-fighting foams on the Premises.

The Delegated Officer considers this contamination to present a significant potential risk to environmental receptors and as such has determined that the minimum recommended analytical suite for PFAS compounds (as published in Table 3 of DER's "*Interim Guideline on the Assessment and Management of Perflouroalkyl and Polyflouroalkyl Substances (PFAS)*" (January 2017)) be added to the annual groundwater monitoring regime for selected monitoring bores, including MW03, MW06, MW08, MW19, MW58 and MW61. This determination is consistent with the requirements specified in the *Guidance Statement: Environmental Siting* (DER, 2016b) where a Prescribed Premises may impact a Specified Ecosystem.

Key finding: Groundwater Monitoring

- 1. The Licence Holder continues to conduct groundwater monitoring in accordance with the conditions of L6284/1992/10 to detect potential changes to ambient groundwater quality as a result of operations.
- 2. The Delegated Officer considers that annual groundwater monitoring regime should be amended to incorporate analysis of PFAS compounds to inform future risk assessments to nearby receptors and monitor spatial and temporal

trends of impacted groundwater resulting from the oil and gas operations on VI.

3. The Delegated Officer notes additional groundwater monitoring and investigations are conducted to assess the ongoing contamination status of groundwater within several areas of known contamination on VI in accordance with requirements under the CS Act (as outlined in section 5.1).

7. Consultation

A copy of the draft Decision Report and Licence were provided to the Licence Holder for comment on 18 December 2018. The Applicant provided a response on 18 January 2019, which is summarised in Appendix 2.

8. Location and siting

8.1 Siting context

VI is located in the North West Shelf of Western Australia approximately 117km west of Dampier and 12km east of Barrow Island. VI is 2.5km long, 600m wide at its widest point and reaches a height of 30m above sea level.

VI is a 'C' Class nature reserve (Reserve 33902) for the purpose of flora and fauna conservation. Areas of ecological significance, (including marine turtle nesting beaches, shearwater rookeries and mangrove protection areas) are present adjacent to the oil and gas processing facilities.

8.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 10.

Table 10: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Worker Accommodation Village on Barrow Island Oil and Gas Facility (Industrial Premises)	12km west
Mardie Station homestead	70km southeast
Residential premises (Dampier)	117km east

8.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 11. Table 11 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting* (DER, 2016b).

Table 11: Environmental values

Specified ecosystems	Distance from the Premises
DBCA Managed Lands and Waters	The Premises is located on Varanus Island which is

	part of the Lowendal Islands Nature Reserve gazetted for the conservation of flora and fauna.
Biological component	Distance from the Premises
Threatened/Priority Fauna	There are multiple reptile, bird and mammal species declared as Threatened/Priority Fauna under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwth) (EPBC Act) and <i>Wildlife Conservation Act 1950</i> (<i>WA</i>) (WC Act) that are known to use the Lowendal Islands, including VI, as habitat and / or breeding areas. These fauna are listed as critically endangered, endangered and vulnerable, and include migratory birds protected under international agreements.
	VI beaches are an important nesting and breeding habitat for Hawksbill, Flatback and Green turtles which are all classified as vulnerable under the EPBC Act and the WC Act.
	Migratory birds known to nest on VI include Wedge- tailed Shearwaters, Bridled Terns, Crested Terns and Osprey. The Great Knot is listed on Schedule 1 (Fauna that is rare or is likely to become extinct) of the WC Act.
Other relevant ecosystem values	Distance from the Premises
Mangrove community (high value ecosystem providing habitat and shelter for birds, fish and other marine species and breeding sites for a number of fish and crustaceans).	A white mangrove (<i>Avicennia marina</i>) community occurs along the southern portion of a sandy beach on the west coast of VI.
Barrow Island Marine Management Area (high value ecosystem)	The boundary of the Marine Management Area is located to the north, west and south of VI. At its closest point, the Marine Management Area is around 1.6km west of the VI lease area boundary.

8.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 12.

Table 12: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Major watercourses/waterbodies	N/A	There are no major watercourses or water bodies on VI. The Island is well drained; stormwater predominantly infiltrates into the ground and runoff is minimal.
Groundwater	The uppermost aquifer on VI is located within the Pleistocene aged sands and is unconfined. Depth to groundwater around the Bulk Storage Tanks have been recorded at approximately $11.5 - 12.2m$ below ground level at the Bulk Storage Tanks. Depth to groundwater and groundwater flows are subject to tidal influence. Groundwater	Groundwater is abstracted from bores located in the southern portion of the site, 350 metres from the processing facilities. A reverse osmosis plant treats groundwater for potable use such as for drinking and

quality is saline. showering.	
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8.5 Soil type

Table 13 details soil types and characteristics relevant to the assessment.

 Table 13: Soil and sub-soil characteristics

Groundwater and water sources	Distance from Premises	Environmental Value
Soil type classification	The limestone base of some of the larger Lowendal islands (including Varanus Island) are overlain with dunes of white Aeolian sands and depression deposits of orange sand.	VI beaches and dunes provide important nesting and breeding habitat areas for migratory birds and turtles (classified as Vulnerable) referred to in Table 11.

8.6 Meteorology

8.6.1 Regional climatic aspects

VI is located in the arid tropics, subject to high summer temperatures, seasonal cyclones and associated rainfall. Rainfall in the area is generally low with evaporation exceeding rainfall throughout the year. Intense rainfall may occur during the passage of summer tropical cyclones and thunderstorms. The summer season occurs from September to March and winter occurs from May to July. Winters are characterised by clear skies, fine weather, predominantly strong east to south-east winds and infrequent rain. Summer winds are more variable, with strong south-westerly winds dominating. Three to four cyclones per year are typical of the region, usually between December and March.

8.6.2 Rainfall and temperature

Rainfall at VI varies significantly from year-to-year and is dependent on rain-bearing low pressure systems, thunderstorms and tropical cyclone activity. The closest Bureau of Meteorology weather station to VI that has recorded statistics for wind, rainfall and temperature is located at Barrow Island (BWI) 12km west of VI. The historic annual average rainfall for BWI is 298.2mm, of which, around 48% occurs during summer months.

Summer months experience high temperatures ranging from $27 - 33.6^{\circ}$ C, while winter temperatures are more moderate ranging from $23.7 - 31.2^{\circ}$ C.

Figure 5 shows average annual rainfall and maximum temperatures for BWI, a suitable surrogate for weather statistics experienced at VI.



Figure 5: Barrow Island Aero: Mean Maximum Temperature and Mean Rainfall

9. Risk assessment

9.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 14.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 14 below.

	Risk Events					Continue to	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential Potential adverse pathway impacts		assessment	
Category 10: Oil or gas production from wells; and Category 34: Oil or gas	Production of oil and gas from wells, separation and processing of oil and gas	Discharge to Land: spills/ leaks of oil	Ecosystems, soils and groundwater on the premises. Varanus Island Reserve is a specified ecosystem supporting a diverse range of flora and fauna, including a range of priority species. Depth to groundwater is approximately 12 mbgl (at the Bulk Storage Tanks).	Direct discharge to soils, seepage to groundwater	Contamination of soils. Reduction in groundwater quality / availability for dependent fauna and/or vegetation.	Yes	See section 9.4
OII or gas refining	Separation and processing of oil and gas (sources include shipping pumps, gas compressors, generator sets, gas	Discharge to air: combustion gases (NOx, VOCs, CO, H ₂ S,	No residences or other sensitive receptors in proximity. Closest residence is 12km west and 70km southeast.	Air / wind dispersion	None	No	No receptor present. Air emissions dispersion modelling (Ramboll 2015) conducted for key pollutants of concern associated with oil and gas processing activities on the Premises

Table 14: Identification of emissions, pathway and receptors during operation

Licence L6284/1992/10

turbines; amine train vents); and Flaring of excess gas (ESJV ground flare and HJV ground flare)	particulates); Flaring (acid gas, CO, VOCs, particulates)					indicates that, under normal operating conditions, predicted Ground Level Concentrations (GLC's) are expected to comply with applicable short and long term ambient air quality guidelines (NEPM standards). Modelling was also conducted for two non-standard scenarios, namely a major plant blowdown and operation of emergency generators. The modelling indicated that predicted GLC's are expected to comply with applicable short term ambient air quality guidelines for each of the modelled compounds during the emergency scenarios. Section 6.1 summarises the Air Dispersion modelling conducted for the Premises. The Delegated Officer notes the predictions in the modelling assessment and the lack of public receptors on or adjacent to the Premises and does not consider air emissions to be a credible risk event. The point source to air discharge locations associated with the Premises have been retained on the licence to maintain transparency around what has been assessed and approved under this Licence Review.
Separation and processing of PFW	Discharge to land: spills or leaks of PFW. Injection well failure	Ecosystems, soils and groundwater on the premises. Varanus Island Reserve is a specified ecosystem supporting a diverse range of flora and fauna, including a range of priority species. Depth to groundwater is approximately 12 mbgl (at the Bulk Storage Tanks)	Direct discharge to soils, seepage to groundwater from spills / leaks. Direct injection	Contamination of soils. Reduction in groundwater quality / availability for dependent fauna and/or vegetation.	No	Outside of scope. This activity is regulated by DMIRS under the Petroleum and Geothermal Energy Resources (Environment) Regulations 2012
Operation of pumps and separators	Noise	No residences or other sensitive receptors in proximity. Closest residence is 12km	Air / wind dispersion	Public health and amenity impacts	No	No receptor present The EP Noise Regulations apply to noise emissions.

			west and 70km southeast.				
	Operation of crude oil Bulk Storage Tanks	Breach of containment causing hydrocarbon discharge to land	Ecosystems, soils and groundwater on the premises. Varanus Island Reserve is a specified ecosystem supporting a diverse range	Direct discharge, seepage to	Soil contamination inhibiting vegetation growth and survival and health impacts to fauna.	Yes	See section 9.5
	Stormwater drainage, storage and treatment	Discharge to land: contaminated stormwater	of flora and fauna, including a range of priority species. Depth to groundwater is approximately 12 mbgl at the Bulk Storage Tanks.	groundwater and marine environment.	contamination. Contaminated stormwater / groundwater discharge to marine environment.	Yes	See section 9.6
Category 85: Sewage facility	Treatment of sewage	Odour	No residences or other sensitive receptors in proximity. Closest residence is12km west and 70km southeast.	Air / wind dispersion	None	No	No receptor present
	Sewage pipes and holding tanks	Rupture of pipes / overtopping of holding tanks resulting in sewage discharge to land and / or the adjacent marine environment	Vegetation and soils adjacent to discharge area. Marine environment (high water tide mark ~ 20m south of sewage facility)	Direct discharge	Soil contamination inhibiting vegetation growth and survival. Impacts to intertidal areas and / or marine species inhabiting the area	Yes	See section 9.7
	Disposal of treated effluent to marine environment via outfall	Treated effluent discharged to the ocean via the existing outfall	Marine species inhabiting area surrounding outfall discharge pipe	Direct discharge to marine surface waters	Adverse impacts on the marine environment should effluent not meet acceptable water quality criteria	Yes	See section 9.8

Consequence and likelihood of risk events 9.2

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 15 below.

Likelihood	Consequence					
	Slight	Minor	Moderate	Major	Severe	
Almost certain	Medium	High	High	Extreme	Extreme	
Likely	Medium	Medium	High	High	Extreme	
Possible	Low	Medium	Medium	High	Extreme	
Unlikely	Low	Medium	Medium	Medium	High	
Rare	Low	Low	Medium	Medium	High	

Table 15: Risk rating matrix

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 16 below.

Table 16: Risk criteria table

Likelihood The following criteria has been used to determine the likelihood of the Risk Event occurring.		Consequen	Consequence					
		The following	The following criteria has been used to determine the consequences of a Risk Event occurring:					
			Environment	Public health* and amenity (such as air and water quality, noise, and odour)				
Almost Certain	The risk event is expected to occur in most circumstances	Severe	onsite impacts: catastrophic offsite impacts local scale: high level or above offsite impacts wider scale: mid-level or above Mid to long-term or permanent impact to an area of high conservation value or special significance ^A Specific Consequence Criteria (for environment) are significantly exceeded	 Loss of life Adverse health effects: high level or ongoing medical treatment Specific Consequence Criteria (for public health) are significantly exceeded Local scale impacts: permanent loss of amenity 				
Likely	The risk event will probably occur in most circumstances	Major	onsite impacts: high level offsite impacts local scale: mid-level offsite impacts local scale: mid-level Short-term impact to an area of high conservation value or special significance^ Specific Consequence Criteria (for environment) are exceeded	 Adverse health effects: mid-level or frequent medical treatment Specific Consequence Criteria (for public health) are exceeded Local scale impacts: high level impact to amenity 				
Possible	The risk event could occur at some time	Moderate	 onsite impacts: mid-level offsite impacts local scale: low level offsite impacts wider scale: minimal Specific Consequence Criteria (for environment) are at risk of not being met 	 Adverse health effects: low level or occasional medical treatment Specific Consequence Criteria (for public health) are at risk of not being met Local scale impacts: mid-level impact to amenity 				
Unlikely	The risk event will probably not occur in most circumstances	Minor	 onsite impacts: low level offsite impacts local scale: minimal offsite impacts wider scale: not detectable Specific Consequence Criteria (for environment) likely to be met 	 Specific Consequence Criteria (for public health) are likely to be met Local scale impacts: low level impact to amenity 				
Rare	The risk event may only occur in exceptional circumstances	Slight	 onsite impact: minimal Specific Consequence Criteria (for environment) met 	 Local scale: minimal to amenity Specific Consequence Criteria (for public health) met 				

^ Determination of areas of high conservation value or special significance should be informed by the Guidance Statement: * In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping)*

Guidelines.

"onsite" means within the Prescribed Premises boundary.

9.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment table 17 below:

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. DWER may refuse application.
High	May be acceptable. Subject to multiple regulatory controls.	Risk Event may be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk Event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk Event is acceptable and will generally not be subject to regulatory controls.

Table 17: Risk treatment table

9.4 Risk Assessment – Discharge to Land: spills/ leaks of oil

9.4.1 Description of Discharge to Land: spills/ leaks of oil

Gas, oil and condensates are piped to facilities on the Premises for processing, storage and delivery or export. Failure of oil production wellheads, pipelines carrying oil and spills or leaks from processing and separation equipment on the Premises may result in direct discharges of oil or condensate to land.

9.4.2 Identification and general characterisation of emission

Crude oil is a toxic substance, comprised mainly of hydrocarbons and other constituents including heavy metals, monocyclic aromatic hydrocarbons (BTEX) and polycyclic aromatic compounds (PAH's).

9.4.3 Description of potential adverse impact from the emission

Spills or leaks of oil / condensate as a result of abnormal operating conditions could potentially cause contamination of soils and infiltrate groundwater, degrading the quality of groundwater as well as harming dependent vegetation and / or fauna and habitat areas. There are multiple threatened and priority fauna found to inhabit VI at various times throughout the year.

9.4.4 Criteria for assessment

Relevant land, surface water and groundwater quality criteria include:

- Australian Water Quality Guidelines (ANZECC & ARMCANZ 2000) provides fresh and marine water criteria; and
- Assessment and Management of Contaminated Sites (DER 2014) provides ecological and

human health assessment levels for soil.

9.4.5 Licence Holder controls

The Licence Holder implements a number of controls to minimise the potential for leaks / spills of oil on the Premises.

This assessment has reviewed the controls set out in Table 18 below.

Table 18: Licence Holder's proposed controls for Discharge to Land: Spills / leaks of oil

Control	Description ¹
Containment facilities	Containment facilities on VI consist of:
(bunding etc.)	 bunds around all infrastructure containing hydrocarbon products (e.g. refuelling points) and for hydrocarbon and chemical processing, treatment and storage areas;
	 secondary containment for portable hydrocarbons/chemicals when used outside storage areas. Temporary bunding such as pallet bunds is provided for containerised hazardous chemicals when storage on hardstand areas is unavailable, to ensure containment and enable recovery of any spillages;
	Use of drip trays in unbunded areas where necessary to contain drips or leaks; and
	local sumps connected to bunded areas throughout VI.
	 Bunding systems (sumps, bunds, pits and open drains) on VI are inspected:
	I. monthly to ensure they are clear and empty; and
	II. annually to detect any damage or leakage and to ensure seals are intact;
	 Sumps, drains and bunds are cleaned out routinely or as required based on weather and activity to ensure no unplanned releases to the environment; and
	• Pre-Cyclone Bund and Sump Checks: The Varanus Island General Cyclone Procedure describes the steps to be taken by different work groups on the Premises to clean up and prepare the Island for possible cyclone impact. Production operators must ensure all sumps (and the humeceptors / triple traps) throughout the plant are empty.
Chemical storage facilities	 All environmentally hazardous chemicals (e.g. fuels, oil, other hydrocarbons) are stored within low permeability compounds sized to contain 110% of the largest storage container;
	 Hazardous substances are stored in compliance with the <i>Dangerous</i> <i>Goods Act 2004</i> and Quadrant's Hazardous Substances and Dangerous Goods Standards (AE-00-ZG-001D); and
	 Oil spill clean - up kits are positioned at locations of potential spills. Spill kits contents are maintained as per the maintenance management system.
	A planned maintenance system is in place to maintain the integrity of all hydrocarbon and chemical containing equipment, in particular:
	 Hydrocarbon containing equipment is inspected as specified in the performance standards/manufacturer's specifications;
	 All pipelines and risers containing hydrocarbons, including all mounted fittings, fixtures and supports are inspected every 12 months or in line with as per performance standard;

Control		Description ¹
		 Structural integrity is inspected and maintained in accordance with the performance standards/manufacturers specifications; and
		• The Bulk Storage Tanks are inspected in line with <i>API 653: Tank inspection, repair, alteration and reconstruction</i> every 20 years or more frequently as required.
	Groundwater Monitoring	The groundwater monitoring regime on VI is designed to monitor existing contamination and detect any new sources of contamination, including any potential spills or leaks from pipelines and processing areas. The groundwater monitoring regime comprises:
		 Annual monitoring of 21 monitoring wells across the Premises; Monitoring parameters include pH, temperature, EC, DO, Redox potential, TRH, PAH, BTEX, Phenols, metals and natural attenuation; and Reporting results annually to DWER

9.4.6 Key findings

The Delegated Officer has reviewed the information regarding spills / leaks of oil and has found:

The Licence Holder has comprehensive engineering and management controls to reduce the potential for direct discharges of oil or condensate to the environment during operations.

9.4.7 Consequence

The Delegated Officer considers that leaks or spills of oil have the potential to result in localised soil contamination, terrestrial vegetation impacts and groundwater impacts (mid-level on-site impacts). VI is a Class C Nature Reserve with significant conservation values. Therefore, the Delegated Officer considers the consequence to be **moderate**.

9.4.8 Likelihood of Risk Event

The Delegated Officer has determined that the impacts from hazardous materials impacting on soils and groundwater will probably not occur in most circumstances. The risk event will therefore be **unlikely** to occur.

9.4.9 Overall rating of Discharge to Land: spills/ leaks of oil

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 15) and determined that the overall rating for the risk of Discharges to land on sensitive receptors during operation is **medium**.

9.5 Risk Assessment – Breach of containment: Bulk Storage Tanks

9.5.1 Description of Breach of containment: Bulk Storage Tanks

The Bulk Storage Tanks on the Premises enable storage of processed crude oil and condensate pending load-out via a sub-sea pipeline to offshore tankers for export shipment. There are three Bulk Storage Tanks (tanks A, B and C) each with an individual storage capacity of 39,750m³. The three tanks have a combined storage capacity of up to 119,250m³. Currently, only one tank is in service.

Breach of containment of any or all of the Bulk Storage Tanks and / or associated pumps and

pipelines, may result in a significant release of hydrocarbons into the surrounding environment.

9.5.2 Identification and general characterisation of emission

Crude oil is a toxic substance, comprised mainly of hydrocarbons and other constituents including heavy metals, monocyclic aromatic hydrocarbons (BTEX) and polycyclic aromatic compounds (PAH's).

9.5.3 Description of potential adverse impact from the emission

Release of condensate / oil as a result of breach of containment from the Bulk Storage Tanks could cause significant contamination of soils and infiltrate groundwater, degrading the quality of groundwater as well as dependent vegetation and / or fauna and habitat areas. There are multiple threatened and priority fauna found on VI. The location of the Bulk Storage Tanks (~150 m from the marine environment) could also cause adverse impacts to the marine environment and associated ecosystem values as a result of direct discharge via overland spills, or through discharge of contaminated groundwater to the marine environment. Any release of condensate / oil from the Bulk Storage Tanks may exacerbate existing contamination in the area resulting in further and cumulative impacts to sensitive receptors.

9.5.4 Criteria for assessment

Relevant land, surface water and groundwater quality criteria include:

- Australian Water Quality Guidelines (ANZECC & ARMCANZ 2000) provides fresh and marine water criteria; and
- Assessment and Management of Contaminated Sites (DER 2014) provides ecological and human health assessment levels for soil.

9.5.5 Licence Holder controls

This assessment has reviewed the controls set out in Table 19 below.

Table 19: Licence Holder's controls for operation of Bulk Storage Tanks

Site infrastructure	Description
Bulk Crude Storage Tanks	 Containment infrastructure: Bulk Storage Tanks are located within a lined bunded area of permeability of less than 1x10⁻⁹ m/s; Liner system comprising 2mm HDPE liner covered with a 200mm layer of earth for protection;
	 Capacity of the bunded area is 50,040m³ (each tank has an individual storage volume of 39,750m³); and An early warning leak detection system is installed under each tank with 12mm PVC pipes running under the tank floor and out from the ring beam. The Licence Holder regularly inspects tank liners and pipelines including the following integrity checks:
	 Piping between the Bulk Storage Tanks and piping up to the transfer shipping pumps: External visual inspection of Cathodic Protection (CP) and Direct Current Voltage Gradient (DCVG) / coating survey for the buried section; and Internal inspections (non-intrusive).
	 2. Onshore section of the tanker loading pipeline downstream of the transfer shipping pumps up to the low water mark: Pressure monitoring: pressure transmitters are located downstream of the shipping pumps. Pressure is monitored manually when loading the tanker.

Site infrastructure	Description	
	 Integrity testing including: External visual inspection of the above ground section; Intelligent pigging inspection (internal inspection); and CP and DCVG/coating survey for the buried section. 	
	Stormwater management:	
	 potentially contaminated stormwater from the Bulk Storage Tank bund is treated via a Corrugated Plate Interceptor (CPI) which provides primary separation, with separated oil reporting to the Bulk Storage Tanks (to be blended and sold) and potentially contaminated water reporting to the PFW storage tanks T-201 and T-202; 	
	• The PFW storage tanks are equipped with facilities to allow oil to be skimmed and recycled back to the HJV Liquids Handling Facility Separators. The system is designed to remove oil in water to a maximum concentration of 300ppm. Processed PFW (including treated stormwater from the Bulk Storage Tanks bund) is then injected into deep disposal wells (Alkimos-1, Tanami-1).	
	Groundwater Monitoring:	
	The groundwater monitoring regime on VI is designed to monitor existing contamination and detect any new sources of contamination, including any potential leaks or discharges from the Bulk storage Tanks and associated infrastructure. The groundwater monitoring regime comprises:	
	 Annual monitoring of 21 monitoring wells across the Premises; Monitoring parameters include pH, temperature, EC, DO, Redox potential, TRH, PAH, BTEX, Phenols, metals and natural attenuation; and Reporting results annually to DWER. 	

9.5.6 Key findings

The Delegated Officer has reviewed the information regarding operation of Bulk Storage Tanks and has found:

- 1. The existing groundwater monitoring regime in the vicinity of the Bulk Storage Tanks is appropriate to detect any potential new impacts from ongoing operations;
- 2. Contaminated stormwater accumulating in the Bulk Storage Tank Bund is appropriately treated and combined with PFW for disposal via injection into deep disposal wells; and
- 3. The Licence Holder implements regular inspection and testing of flowlines associated with the Bulk Storage Tanks and Transfer Shipping Pumps.

9.5.7 Consequence

The Delegated Officer notes that if a major breach of containment from the Bulk Storage Tanks and associated pumps / pipelines was to occur, then this may cause high level onsite impacts and / or short-term impact to an area of high conservation value or special significance. Therefore, the Delegated Officer considers the consequence of breach of containment from the bulk storage tanks on VI to be **major**.

9.5.8 Likelihood of Risk Event

The Delegated Officer has determined that a breach of containment from the bulk storage tanks will probably not occur in most circumstances, due to the Licence Holder's controls outlined in Table 19 above. Therefore, the Delegated Officer considers the likelihood of

breach of containment from the bulk storage tanks to be **unlikely**.

9.5.9 Overall rating of breach of containment: Bulk Storage Tanks

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating for the risk of breach of containment from the bulk storage tanks is **medium**.

9.6 Risk Assessment – Discharge of contaminated stormwater

9.6.1 9.7.1 Description of discharge of contaminated stormwater

Stormwater falling in processing or waste storage areas on the Premises has the potential to become contaminated with hydrocarbons, sediments, hazardous chemicals and wastes. If not stored and treated / disposed of appropriately, contaminated stormwater may be discharged to land and / or the marine environment.

9.6.2 Identification and general characterisation of emission

Contaminated stormwater generated within oil processing areas, waste storage areas, bunded storage facilities would comprise mainly water containing some hydrocarbons and other substances including heavy metals, Monocyclic Aromatic Hydrocarbons (BTEX) and Polycyclic Aromatic Compounds (PAH's) which are known toxicants. Contaminated stormwater may also contain sediment.

9.6.3 Description of potential adverse impact from the emission

Discharge of stormwater containing hydrocarbons and / or sediment and may result in contamination of soils and infiltration of groundwater, degrading the quality of groundwater as well as harming dependent vegetation and / or fauna in the area and impacting habitat areas. There are multiple threatened and priority fauna found to inhabit VI at various times throughout the year. Discharge of contaminated stormwater could also cause adverse impacts to the marine environment and associated ecosystem values as a result of direct discharge via overland flows.

9.6.4 Criteria for assessment

Relevant land, surface water and groundwater quality criteria include:

- Australian Water Quality Guidelines (ANZECC & ARMCANZ 2000) provides fresh and marine water criteria; and
- Assessment and Management of Contaminated Sites (DER 2014) provides ecological and human health assessment levels for soil.

9.6.5 Licence Holder controls

Table 20: Licence Holder's controls for contaminated stormwater

Site infrastructure	Description
Stormwater infrastructure	The stormwater management system on VI is comprised of a closed drain system connected to bunds around all hydrocarbon processing and storage equipment. Sumps, drains and bunds are cleaned out routinely or as required based on weather and activity to ensure no unplanned releases to the environment.
	Contaminated stormwater collected in bunded areas is either collected via vacuum truck for treatment and disposal via the deep disposal wells or directed via drainage for treatment by a number of triple trap interceptors (Humeceptors) that have been

Site infrastructure	Description
	installed on the Premises for treatment of hydrocarbon contaminated runoff water.
	The Humeceptors have a total holding capacity of approximately 1,740L including 350L of oil and 1m ³ of sediment. Oil separation efficiency is between 65% and 99% as reported in the vendor's documentation.
	Disposal of hydrocarbon contaminated liquids is to the main Bulk Storage Tank bund disposal sump, where it is treated via the Corrugated Plate Interceptor prior to being reinjected downhole in the deep disposal bores.
	The Humeceptor located to the east of HJV (Hemeceptor 54) treats and discharges stormwater that collects in a number of sumps within the HJV bund to land east of the HJV within the Premises boundary.
	Verification of maintaining the bund system in the processing plants is performed through monthly and annual inspections and any incident reports raised during the reporting period.
	Tasks completed by the onshore production operators with assistance from other work groups are undertaken as required. When a Category 1 or greater cyclone is imminent this includes ensuring all sumps are empty, as detailed in the <i>Varanus Island Cyclone Procedure</i> .

9.6.6 Key findings

The Delegated Officer has reviewed the information regarding discharge of contaminated stormwater and has found:

The Delegated Officer has reviewed the information regarding discharge of contaminated stormwater and has found:

1. Comprehensive internal procedures have been put in place by the Licence Holder to manage oily water and contaminated stormwater generated on the Premises, in addition to appropriately constructed and maintained facilities.

9.6.7 Consequence

The Delegated Officer notes that if a discharge of contaminated stormwater was to occur, then this may cause mid-level on-site impacts and low-level off-site impacts. Mid-level on-site impacts may be experienced if the discharge was to occur within or adjacent to ecologically sensitive receptors such as Wedge-tailed Shearwater burrows or turtle nesting beaches. Therefore, the Delegated Officer considers the consequence of discharges of oily water or contaminated stormwater to be **moderate**.

9.6.8 Likelihood of Risk Event

The Delegated Officer has determined that the likelihood of contaminated stormwater discharges occurring will probably not occur in most circumstances, as a result of the Licence Holders controls. Therefore, the Delegated Officer considers the likelihood of discharges of oily water / contaminated stormwater to be **unlikely**.

9.6.9 Overall rating of discharge of contaminated stormwater

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating for the risk posed by discharge of contaminated stormwater is **medium** risk.

9.7 Risk Assessment – Discharge of sewage pipes and holding tanks

9.7.1 Description of discharge of sewage pipes and holding tanks

Sewage pipelines reporting to the sewage facility or transferring treated effluent from the Sewage Facility to the ocean outfall may fail due to a mechanical problem with the pipeline or due to damage incurred from mobile mechanical plant.

Process control errors or faults, or blocked screens due to poor maintenance may result in overtopping of individual tanks within the Sewage Facility.

9.7.2 Identification and general characterisation of emission

Sewage from the accommodation camp facilities is treated at the Premises Sewage Facility. The capacity of the sewage facility is 54m³ per day and the raw wastewater meets the typical composition of domestic sewage.

9.7.3 Description of potential adverse impact from the emission

Untreated sewage that may be released from overtopping of the Sewage Facility tanks may cause localised soil contamination. The proximity of the Sewage Facility to the marine environment (less than 20m away from the high water tide mark) may also result in an unplanned discharge to the marine environment.

Pipeline failures may also release untreated or treated sewage to land, inundating the soil. As native vegetation has adapted to thrive in low nutrient environments, the impact of a discharge to vegetation would likely be adverse as a result of high nutrient levels in the sewage.

9.7.4 Criteria for assessment

No specific criteria has been applied for this assessment.

9.7.5 Licence Holder controls

This assessment has reviewed the controls set out in Table 21 below.

Table 21: Licence Holder's controls for discharge of sewage tanks and holding tanks

Description
Licence Holder conducts routine daily checks and a weekly planned maintenance is also performed. The daily checks include but are not limited to:
 Flow meter recordings; waste water tank level inspection; aeration tank and blower operation checks; liquid level/colour/odour; surface skimmer and air-lift pump operation; chlorine-pill dispenser operation; and sewage plant site's general tidiness.
 The weekly Preventive Maintenance activities include: filter inspection/cleaning; liquid flow checks at inlet and outlet pipes; sludge return function; sludge and crust levels; and chlorine tablet dispenser re-stock.

Site infrastructure	Description
	barge schedules and tide cycle for the roll-on/roll-off of pump truck) by licensed contractor.

9.7.6 Key findings

The Delegated Officer has reviewed the information regarding discharge of sewage tanks and holding tanks and has found:

1. The Licence Holder implements regular preventative maintenance and monitoring to reduce the risk of overflows and pipeline ruptures from the Sewage Facility.

9.7.7 Consequence

If release of partially or untreated sewage effluent to land occurs, native vegetation may be affected with possible impacts to birds or other fauna if they come into contact with the effluent. The Delegated Officer has determined that the impact of the discharge will be **moderate**.

9.7.8 Likelihood of Risk Event

The Delegated Officer has determined that the likelihood of discharge of untreated, partially treated or treated effluent to land occurring will be **unlikely**.

9.7.9 Overall rating of discharge of sewage tanks and holding tanks

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating for the risk posed by failure of sewage pipelines and overtopping from the Sewage Facility is **medium risk**.

9.8 Disposal of treated effluent to marine environment

9.8.1 Description of disposal of treated effluent to marine environment

The Sewage Facility treats sewage generated from accommodation and office facilities on VI for discharge to the marine environment via an ocean discharge pipeline. The discharge pipeline extends for around 160m south of the sewage facility in marine waters. The discharge point is located approximately 20m offshore on the southwestern side of VI.

The Sewage Facility consists of two treatment plants operating in parallel; an Enviroflow plant constructed in 1986 with a design capacity of 24m³ per day, and a Biomax system constructed in 1994 with a design capacity of 30m³ per day (combined total of 54m³ per day).

9.8.2 Identification and general characterisation of emission

The average daily flow for the 2017/2018 annual reporting period was 30m³ per day. A comparison of the quality of treated wastewater discharged from the facility using sample results from 2017/2018 reporting period against guidelines listed in section 9.8.4 below can be seen in Table 22.

Table 22: Sewage facility treated effluent

Effluent Parameter	Units	VI Sewage Facility discharge quality (2016-2017 reporting period)	Australian Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZEC C 1997) Secondary Treatment	Australian Water Quality Guidelines (ANZECC/ARMCA NZ 2000) marine water criteria	Guidelines for the Non-potable Uses of Recycled Water in Western Australia, (Department of Health 2011)
pН	pH Units	7.18 – 7.82	-	8.0 - 8.4*	6.5 8.5
TSS		23 - 55	25 - 40	-	30
BOD		14 – 250	20 - 30	-	-
TN	mall	60 - 84	20 - 50	0.1*	-
TP	IIIg/L	9.2 - 11	6 - 12	0.0015*	-
Free Chlorine		<0.01 - 0.73	-	-	0.2 – 2.0
E. Coli	Organisms / 100mL	17 – 450,000	10	-	<1,000
Anionic surfactants		Not reported	<5	-	-
Oil and grease		Not reported	<10	-	-
Cu	mg/L	0.004 - 0.007	-	0.0013	-
Zn		0.044 - 0.082	-	0.015	-
Hg]	<lor< td=""><td>-</td><td>0.0001</td><td>-</td></lor<>	-	0.0001	-
Pb]	<lor< td=""><td>-</td><td>0.0044</td><td>-</td></lor<>	-	0.0044	-
Ni]	0.003 - 0.004	-	0.007	-
Cd]	0.0001 - 0.0003	-	0.0007	-

Note: 1 *Quoted values are trigger values applying to typical slightly-moderately disturbed systems.

2 LOR means Limit of Reporting

9.8.3 Description of potential adverse impact from the emission

If the Sewage Facility is not operated and maintained in accordance with design capacity and / or manufacturer's specifications, the discharge of effluent may not meet the expected water quality criteria. If effluent discharged is of poor quality there may be impacts to marine species inhabiting or passing through the area surrounding the outfall discharge pipe. Impacts may occur as a result of high nutrients in the discharge (localized eutrophication) or from high levels of bacteria (E. coli) or other toxicants (e.g. from chlorine or metals) potentially impacting marine biota.

9.8.4 Criteria for assessment

Relevant treated wastewater quality criteria include:

- Agriculture and Resource Management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council, *Australian Guidelines for Sewerage Systems – Effluent Management* (ARMCANZ/ANZECC 1997);
- Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand 2000, *Australian Water Quality Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ 2000) Marine water criteria;
- Assessment and Management of Contaminated Sites, Contaminated Sites Guidelines (Department of Environment Regulation 2014); and
- *Guidelines for the Non-potable Uses of Recycled Water in Western Australia* (Department of Health 2011).

9.8.5 Licence Holder controls

This assessment has reviewed the controls set out in Table 23 below.

Table 23: Licence Holder's controls for disposal of treated effluent to the marine environment

Site infrastructure	Description	
Sewage facility	Licence Holder conducts routine daily checks and weekly planned maintena activities at the Sewage Facility (refer Table 21).	
	The Licence Holder is aware that that the Sewage Facility is not functioning optimally as evident in quarterly treated wastewater monitoring results. The Licence Holder has committed to upgrading the Sewage Facility in 2019 to cater for the higher volumes of sewage generated by VI facilities, with engineering and procurement aspects being progressed in 2018.	

9.8.6 Key findings

The Delegated Officer has reviewed the information regarding disposal of treated effluent to the marine environment and has found:

- 1. A review of the 2017/2018 results of the treated wastewater quality indicates the Sewage Facility is not achieving benchmark treatment levels, with TSS, BOD, TN, Free Chlorine, E. Coli and zinc results exceeding guideline values at some of the time during the period. These results are consistent with previous years monitoring.
- 2. The Licence Holder is not currently required to analyse the treated wastewater discharge for anionic surfactants (found in cleaning products) or oil and grease under the Existing Licence. These potential contaminants of concern are likely to be present in the wastewater stream. The Delegated Officer therefore considers these parameters should be also be included in the discharge monitoring regime.
- 3. A new Sewage Facility is being planned for installation on 2019. Assessment and approval of the Sewage Facility will be required in accordance with section 53 of the EP Act.

9.8.7 Consequence

Should the treated wastewater discharged to the marine environment not meet Category C (secondary treatment) levels (as outlined in Table 18), then the Delegated Officer has determined that the impact of this will be low level offsite impacts at the local scale. Therefore, the Delegated Officer considers the consequence to be **moderate**.

9.8.8 Likelihood of Risk Event

The Delegated Officer has determined that the discharge from the Sewage Facility is not optimal, having not met Category C (secondary treatment) levels to marine environment for several parameters in the last few years. Therefore, the Delegated Officer considers the risk event could occur at some time and as such, the likelihood is **possible**.

9.8.9 Overall rating of disposal of treated effluent to the marine environment

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating for the risk of

disposal of treated effluent to marine environment is medium.

9.9 Summary of acceptability and treatment of Risk Events

A summary of the risk assessment and the acceptability or unacceptability of the risk events set out above, with the appropriate treatment and control, are set out in Table 24 below. Controls are described further in section 10.

	Description of Risk Event			Applicant	Risk rating	Acceptability
	Emission	Source	Pathway/ Receptor (Impact)			(conditions on instrument)
1.	Discharge to Land: spills / leaks of oil	Failure of oil production wellheads, pipelines carrying oil and spills or leaks from processing and separation equipment	Adverse impacts to ecosystems, soils and groundwater on the premises.	Infrastructure and management controls.	Moderate consequence Unlikely Medium risk	Acceptable subject to proponent controls conditioned
2.	Bulk Crude Storage Tanks – discharge of crude oil	Breach of containment	Adverse impacts to ecosystems, soils and groundwater on the premises.	Infrastructure and management controls.	Major consequence Unlikely Medium risk	Acceptable subject to proponent controls conditioned
3.	Discharge of contaminated stormwater	Oily water / contaminated stormwater from within bunds and sumps	Direct discharge to soils, seepage to groundwater	Concrete hardstands, bunded areas, impervious liners, drains and humeceptors	Moderate consequence Unlikely Medium Risk	Acceptable subject to proponent controls conditioned
4.	Discharge of untreated / partially treated sewage	Rupture of pipes, overflows from sewage treatment tanks	Direct discharge to soils and marine environment, impacts to vegetation and marine biota health from high nutrients	Concrete hardstands, bunded areas, containerised SBR system, commissioning process, regular inspections	Moderate consequence Unlikely Medium risk	Acceptable subject to proponent controls conditioned
5.	Discharge of treated effluent to marine environment	Sewage facility	Direct discharge of poorly treated effluent to marine environment causing impacts to adjacent surface water drainage systems and / or marine species inhabiting the area	Quarterly monitoring of treated effluent	Moderate consequence Possible Medium risk	Acceptable subject to proponent controls conditioned

Table 24: Risk assessment summary

10. Licence controls

10.1 Spill infrastructure and equipment (including stormwater controls)

The following environmental controls, infrastructure and equipment should be maintained and operated onsite for oil spill and contaminated stormwater management:

- The oil and gas processing areas must be bunded, drained or graded such that uncontaminated stormwater is prevented from entering processing areas;
- Oil and gas processing areas must be designed such that contaminated stormwater and liquid wastes collected within processing areas are directed to collection sump(s);
- Stormwater and liquid wastes collected in bunds, sumps and drains must be routinely pumped out and sent to an oil water separator for treatment prior to disposal via the Deep Disposal Wells or the HJV Humeceptor 54;
- All sumps must be pumped out before an impending cyclone unless unsafe to do so;
- Treated stormwater from the HJV Humeceptor 54 must be treated to ≤ 15mg/L TPH prior to discharge to land. The discharge must also be sampled at least once per year during periods of discharge to verify the discharge limit is being met; and
- Annual groundwater monitoring for Total Recoverable Hydrocarbons (TRH) and additional parameters is conducted across the Premises to detect any potential impacts from petroleum operations.

The following environmental controls, infrastructure and equipment should be maintained and operated at the Bulk Storage Tanks:

- Bulk Storage Tanks are located within a bunded, lined containment area with a hydraulic permeability of less than 1x10⁻⁹ m/s;
- The integrity of the containment infrastructure around the Bulk Storage Tanks is maintained; and
- Contaminated stormwater to be transferred to the Corrugated Plate Interceptor for treatment prior to discharge via Deep Disposal Wells.

These controls will be captured on the licence in accordance with DWER's *Guidance Statement: Risk Assessments* (DER 2017a) which specifies that a Licence Holder's controls will be conditioned as they lower the assessed likelihood of the risk event.

10.2 Sewage facility infrastructure and equipment

The Sewage Facility shall be operated and maintained such that:

- overtopping of tanks does not occur and the integrity of containment infrastructure is maintained;
- discharge of treated effluent to the marine environment shall only occur through the approved discharge point; and
- a volumetric discharge limit of $\leq 54 \text{m}^3$ / day has been applied.

10.3 Monitoring requirements

The following monitoring requirements will be required to detect potential adverse impacts to groundwater from petroleum processing operations at the premises:

 Annual monitoring of 21 monitoring wells across the Premises for parameters including pH, temperature, EC, DO, Redox potential, TRH, PAH, BTEX, Phenols, metals and natural attenuation. PFAS compounds, which have been identified as a groundwater contaminant of concern resulting from an emergency fire response to an incident that occurred in 2008, will also be added to the groundwater monitoring regime.

The following monitoring requirements are included in the licence to detect potential adverse impacts to land from operations at the premises:

• Treated stormwater shall be sampled and analysed at least once per year during periods of discharge from the outlet of the HJV Humeceptor 54.

The following monitoring requirements will be included in the licence to detect potential adverse impacts to surface water from treated effluent at the Premises:

• Treated effluent discharged from the Sewage Facility shall be sampled quarterly and analysed at a NATA registered laboratory for water quality parameters as listed in Table 22 of this Decision Report. Monthly monitoring of volumes discharged will also be required.

10.4 Monitoring reports

The following reporting to DWER will be required via an Annual Environmental Report:

- Ambient groundwater quality monitoring: Tabulated groundwater monitoring data results and an interpretation of monitoring data results including comparison of historical data to determine trends;
- Emissions to land monitoring tabulated discharge water quality results from the outlet of HJV Humeceptor 54 to determine compliance with the discharge limit set at less than 15mg/L TPH; and
- Point source emissions to surface water: Sewage Facility discharge outputs (volumetric) and tabulated surface water discharge monitoring results and an interpretation of monitoring data results including comparison of historical data to determine trends.

Reporting of the results of monitoring is required to inform future risk assessments. The Applicant will also be required to keep a record of any complaints associated with operation of the Premises and will be required to submit an Annual Audit Compliance Report each year.

11. Determination of Licence conditions

The conditions in the Revised Licence have been determined in accordance with the *Guidance Statement: Setting Conditions* (DER 2015b).

The *Guidance Statement: Licence Duration* (DER 2016a) has been applied and the issued licence expires in 12.5 years from date of review.

Table 25 provides a summary of the conditions to be applied to this licence.

Condition Ref	Grounds
Infrastructure and Equipment Condition 1	Environmental compliance is a valid, risk-based condition to ensure appropriate linkage between the licence and the EP Act.
Emissions	These conditions are valid, risk-based and contain
Conditions 2, 3 and 4	appropriate controls relevant to approved emission

Table 25: Summary of conditions to be applied

	sources.		
Ambient Groundwater Monitoring			
Condition 5			
Emissions to Land Monitoring	These conditions are valid, risk-based and consistent with		
Condition 6			
Emissions to Surface Water Monitoring	the EP Act.		
Conditions 7 and 8			
Monitoring General			
Conditions 9 and 10			
Record Keeping	These conditions are valid and are peaceany		
Conditions 11 and 12	- administration and reporting requirements to ensure		
Reporting			
Conditions 13, 14 and 15			

DWER notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, DWER may initiate amendments to the licence under the EP Act.

12. Applicant's comments

The Licence Holder was provided with the draft Decision Report and draft Licence on 19 December 2018. The Licence Holder provided comments which are summarised, along with DWER's response, in Appendix 2.

13. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this Decision Report (summarised in Appendix 1).

Based on this assessment, it has been determined that the Revised Licence will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Caron Goodbourn MANAGER, PROCESS INDUSTRIES

Delegated Officer under section 20 of the Environmental Protection Act 1986

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Licence L6284/1992/10 – Varanus Island and East Spar Facility	L6284/1992/10	Accessed at: www.der.wa.gov.au
2.	DER, July 2015. <i>Guidance Statement:</i> <i>Regulatory principles.</i> Department of Environment Regulation, Perth.	DER 2015a	
3.	DER, October 2015. <i>Guidance Statement: Setting conditions.</i> Department of Environment Regulation, Perth.	DER 2015b	
4.	DER, August 2016. <i>Guidance Statement: Licence duration.</i> Department of Environment Regulation, Perth.	DER 2016a	Accessed at:
5.	DER, November 2016. <i>Guidance Statement: Environmental Siting</i> Department of Environment Regulation, Perth.	DER 2016b	www.dwer.wa.gov.au
6.	DER, February 2017. <i>Guidance Statement: Risk Assessments.</i> Department of Environment Regulation, Perth.	DER 2017a	
7.	DER, February 2017. <i>Guidance Statement: Decision Making</i> . Department of Environment Regulation, Perth.	DER 2017b	
8.	National Environment Protection Council, July 1998. <i>National</i> <i>Environment Protection (Ambient Air</i> <i>Quality) Measure (1998)</i>	AAQ NEPM 1998	Accessed at: <u>http://nepc.gov.au/nepms/ambient-</u> <u>air-quality</u>
9.	Ramboll Environ Australia Pty Ltd (August 2015). Varanus Island Operations – Air Dispersion Modelling Assessment (Revision 3)	Ramboll 2015	DWER records (A951193)
10.	Quadrant Energy Australia Limited (August 2017). Varanus Island Hub	Quadrant 2017	DWER records (A1530141)

	Annual Environmental Report 2016- 2017 Licence L6284/1992/10. EA-60- RI-10192		
11.	DER, January 2017. Contaminated Sites Guideline: Interim Guideline on the Assessment and Management of Perflouroalkyl and Polyflouroalkyl Substaces (PFAS)" Department of Environment Regulation, Perth.	(DER 2017)	Accessed at: <u>www.dwer.wa.gov.au</u>
12.	Agriculture and Resource Management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council, Australian Guidelines for Sewerage Systems (ARMCANZ / ANZECC) (1997). National Water Quality Management Strategy Australian Guidelines for Sewage Systems – Effluent Management.	ARMCANZ / ANZECC 1997	Accessed at: http://www.agriculture.gov.au/SiteC ollectionDocuments/water/sewerag e-systems-effluent-man- paper11.pdf
13.	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) (2000). <i>Australian Water</i> <i>Quality Guidelines for Fresh and</i> <i>Marine Water Quality</i> (Marine water criteria)	ARMCANZ / ANZECC 2000	Accessed at: http://www.agriculture.gov.au/SiteC ollectionDocuments/water/nwqms- guidelines-4-vol1.pdf
14.	Department of Health (DoH) (2011). Guidelines for the Non-potable Uses of Recycled Water in Western Australia	DoH 2011	Accessed at: <u>https://www.nedlands.wa.gov.au/sit</u> <u>es/default/files/Guidelines%20for%</u> <u>20the%20Non-</u> <u>potable%20uses%20of%20Recycl</u> <u>ed%20Water%20in%20WA.pdf</u>
15.	National Environment Protection Assessment of Site Contamination Measure (ASC NEPM)	ASC NEPM 1999	Accessed at: http://nepc.gov.au/nepms/assessm ent-site-contamination

Appendix 2: Summary of Licence Holder's comments on risk assessment and draft conditions

Licence Condition / Section of the Decision Report	Summary of Licence Holder comment	DWER response
Section 3 of the Decision Report (regarding removal of category 73: Bulk storage of chemicals	Licence Holder requests DWER confirm that this rational also applies to additional chemicals stored on site which exceed 250 L (e.g. corrosion inhibitor).	DWER advises that category 73 applies only when the Premises production or design capacity exceeds the threshold of 1,000m3 in aggregate (excluding bulk condensate tanks).
approval)		Advice provided by Santos on 26/6/18 indicates chemical storage capacity of 103kL, which is roughly equivalent to 103m3. Therefore, category 73 does not apply to the Premises.
Table 14 of the Decision Report (air emissions)	Licence Holder requests DWER confirm rationale that the air emission (points and authorised emissions on current licence) have been removed as they are no longer considered a credible risk event.	As per risk assessment in Table 14 – based on modelling performed in 2015, ground level concentrations of air emissions are expected to comply with ambient NEPM standards. DWER has determined there is no credible risk of impact to the nearest public receptor being 12km away. As per Guidance Statement Risk Assessments (DER 2017) conditions imposed on licences will be proportionate to the level of risk to public health and the environment. As the risk to public health from air emissions has been determined negligible, regulatory controls (such as monitoring conditions) are not required on the licence. However, the Delegated Officer has determined it appropriate to retain the air emission points that are currently listed on the licence (condition 2.1.1) to maintain transparency regarding approved point source emissions to air associated with the prescribed premises.
Conditions 3 and 5: reinstatement of the HJV Humeceptor 54, and	Licence Holder confirms controls in place to ensure treatment and monitoring requirements under licence will be met	Noted by DWER

Licence Condition / Section of the Decision Report	Summary of Licence Holder comment	DWER response
requirement to treat discharge to <15mg/L TPH and sample discharge at least once per year while discharging		
Condition 4 : Monitoring of PFAS compounds in groundwater	Licence Holder agrees to PFAS monitoring and confirms current sampling and analysis regimes meets requirements of condition 4	Noted by DWER
Condition 6: Monitoring of anionic surfactants and oil and grease in effluent discharge from sewage facility and change of testing units for E. Coli	Licence Holder confirms that Anionic surfactants and oil and grease testing to be added to sewage testing regime. Licence Holder also confirms that the unit terminology for E Coli 'organisms/100mL' aligns with current tested units 'CFU'/100mL'	Noted by DWER
Section 9.5.4 of Decision Report	Licence Holder confirms Bulk Storage Tanks are located within a lined bunded area of permeability of less than $1x10^{-9}$ m/s. Samples of the liner tested for permeability returned values of $1x10^{-16}$ m/s which meet the $1x10^{-9}$ m/s.	Noted by DWER and incorporated into Decision Report
Licence condition 3: Reference to design capacity of existing category 85 Sewage Facility	Licence Holder requests that for Category 85 operations, the treated effluent limit as stated in Table 4 (28m³/day) be increased to accommodate the current system capacity. This is due to the existing systems (25m³/day Enviroflow System + 29m³/day Durrant & White System) having a combined capacity of up to 54m³/day.	DWER reviewed supporting documentation and notes that the sewage facility has a higher capacity than currently referenced on the Existing Licence. Licence and Decision Report updated accordingly to reflect category 85 design capacity of 54m ³ /day.
Section 4.1 of Decision Report	Licence Holder confirmed current daily production levels of oil / condensate and gas in tonnes per day.	Noted by DWER and incorporated into Decision Report