Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6298/2019/1
Applicant	Santos WA Energy Limited
ACN	009 301 964
File Number	DER2019/000503
Premises	Varanus Island Hub CALM Act Leases 1902/100 and 2604/100Part Reserve 33902 (Part Lot 500 on Plan 240033) VARANUS ISLAND WA 6872
Date of Report	14 February 2020
Status of Report	Final

Table of Contents

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
Applicant	Santos WA Energy Limited
BTEX	Refers to Benzene, Toluene, Ethylbenzene and Xylene.
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CS Act	*Contaminated Sites Act 2003* (WA)
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 *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
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
Minister	the Minister responsible for the EP Act and associated regulations
MS	Ministerial Statement
MW	Megawatt
NEPM	National Environmental Protection Measure
Nitrogen Dioxide	NO_2
Occupier	has the same meaning given to that term under the EP Act.
PM	Particulate Matter
PM_{10}	particulate matter that is smaller than 10 microns (µm) in diameter
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
SO_2	Sulfur Dioxide
TJ	Terajoule
Works	refers to the Works described in Schedule 2, at the locations shown in Schedule 1 of this Works Approval to be carried out at the Premises, subject to the Conditions.
Works Approval	refers to this document, which evidences the grant of the works approval by the CEO under s.54 of the EP Act, subject to the Conditions.
Works Approval Holder	refers to the occupier of the Premises being the person to whom this Works Approval has been granted, as specified at the front of this Works Approval.

2. Purpose and scope of assessment

2.1 Application details

On 19 September 2019, Santos WA Energy Limited (hereafter referred to as 'the Applicant') submitted an application for a Works Approval for the construction of the Varanus Island Compression and Power Optimisation Project (VICPOP) infrastructure at their Varanus Island Hub. Table 2 lists the documents submitted during the assessment process.

Table 2: Documents and information submitted during the assessment process

Document / information description	Date received
Varanus Island Compression and Power Optimisation Project – Works Approval Supporting Document.	19 September 2019
Attachment 1A: Proof of Occupier Status.	19 September 2019
Power of Attorney	19 September 2019
Clarification of the purpose of the flue gas monitoring program during commissioning.	6 December 2019

The scope of this risk assessment includes potential impacts from emissions during construction and operation of the VICPOP infrastructure. This Decision Report documents the Delegated Officer's assessment and determination of the Application, consistent with DWER's Regulatory Framework.

2.2 Proposed infrastructure

The VICPOP comprises the construction and installation, pre-commissioning, commissioning and operation of additional natural gas compression equipment, power generation infrastructure and ancillary facilities. These facilities will be integrated into the existing East Spar Joint Venture (ESJV) gas plant.

This Works Approval is for two gas fuelled Solar Mars 100 gas turbine driven compressors, one gas fuelled Solar Centaur 40 power generator and the ancillary infrastructure supporting this equipment. This infrastructure is more thoroughly detailed later in this report.

Table 3: Infrastructure proposed for construction under this Works Approval

	Proposed Infrastructure	Proposed key infrastructure design and construction information
1	2 Solar Mars 100 gas turbine driven compressors	Gas fuelled, module based and including scrubbers, air cooled heat exchangers, gas / gas exchanger and Joule - Thompson gas cooling valves. Each compressor has an output of 10.5 MW.
2	1 Solar Centaur 40 gas turbine driven electrical power generator	The generator will generate approximately 3.5 MW of power which will be distributed at 11 kV.
3	Support buildings and infrastructure	These will include an electrical switch room building, a packaged instrument air enclosure and a battery room.

2.3 Works Approval boundary

The proposed Works Approval boundary is depicted in Figure 1. This boundary is consistent with that contained within Works Approval W5518/2013/1, which was granted on 19 December 2013 to Apache Energy Limited. This Works Approval approved the Varanus Island Compression Project (VICP) infrastructure, which is consistent with the proposed VICPOP infrastructure. A schematic depicting the layout of the proposed infrastructure is shown in Figure 2.

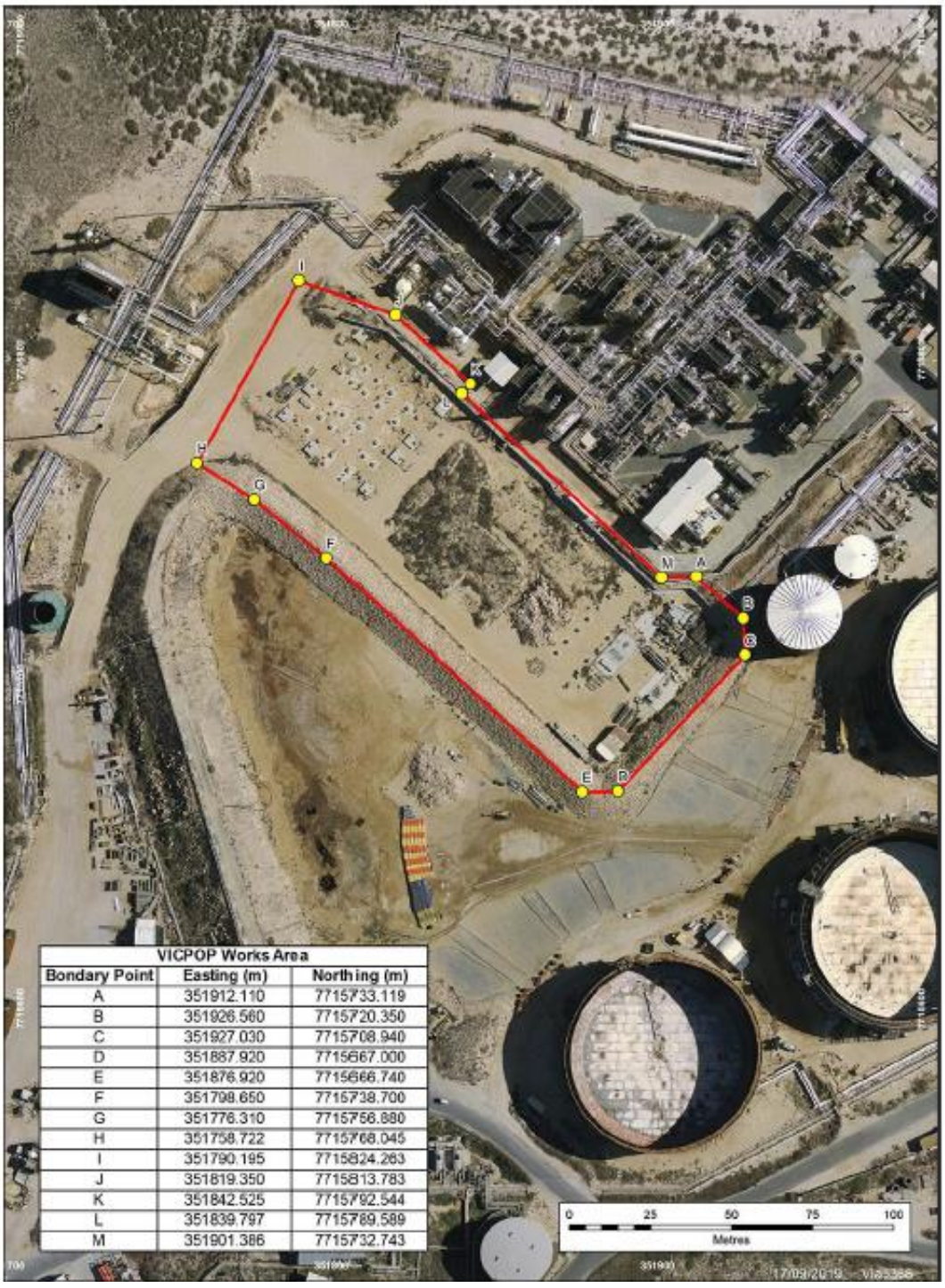

Figure 1: Spatial and coordinate representation of the Works Approval boundary

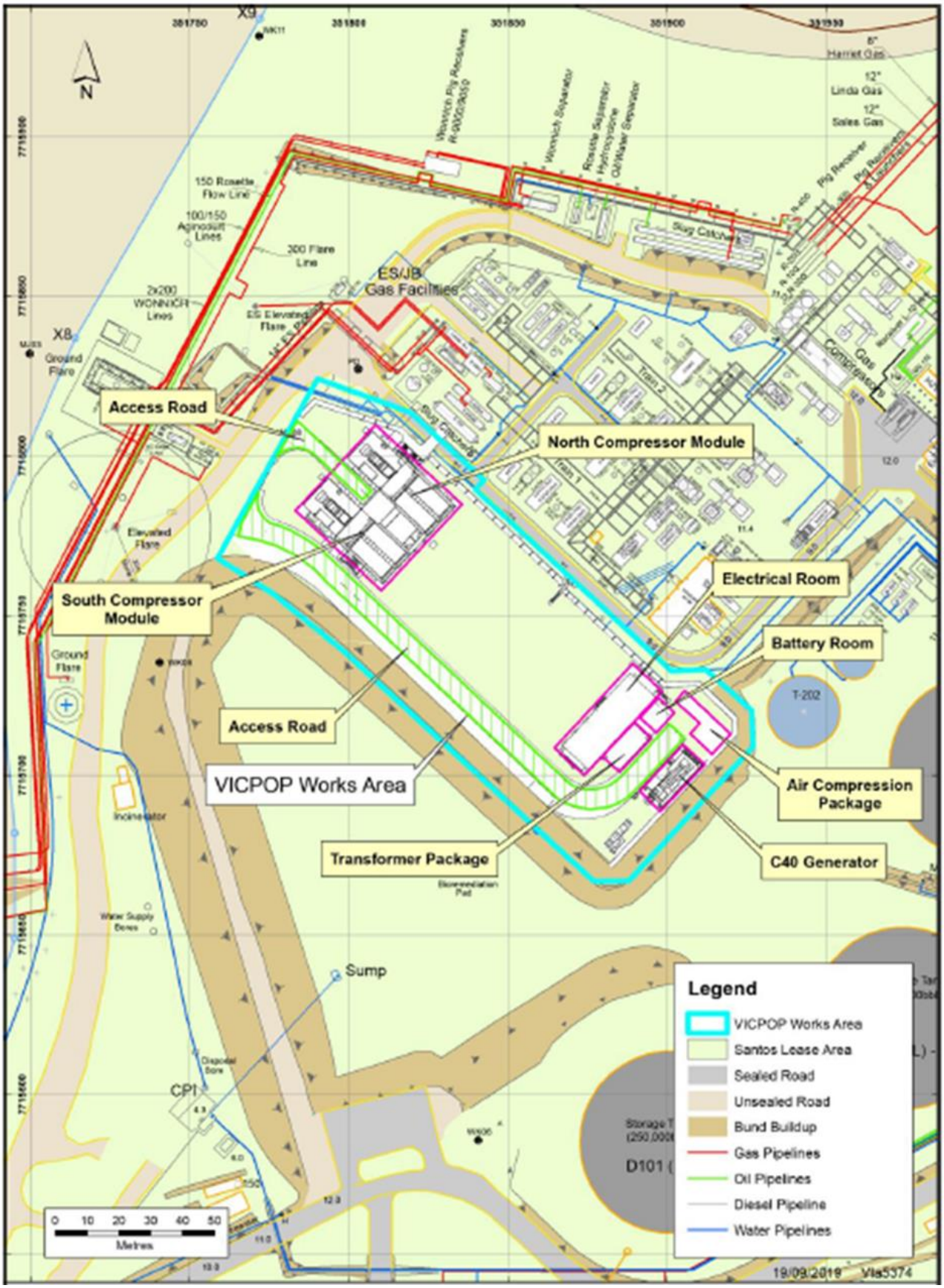

Figure 2: The layout of the proposed infrastructure

3. Background

Varanus Island is part of the Lowendal Islands, which are managed by the Department of Biodiversity, Conservation and Attractions as a nature conservation reserve (33902). In 1986, the former Department of Conservation and Land Management granted Lease 1902/100 over portions of the above conservation reserve to the Harriet Joint Venture for the operation of petroleum receiving, processing and loading export facilities. A portion of lease of 1902/100 was subsequently annexed as a new lease (Lease 2604/100), which was granted to ESJV. These leases were renewed in April 2013 and have a term concurrent with two Petroleum Pipeline Licenses (PL12 and PL29) granted by the Department of Mines, Industry Regulation and Safety to the Applicant, pursuant to the *Petroleum Pipelines Act 1969*. The Varanus Island Hub lease area held by the Applicant is depicted in Figure 3.

The Applicant operates the Varanus Island Hub oil and gas facilities on the North West shelf of Western Australia. To date, gas production within the John Brookes (JB) gas field has been achieved through the use of the gas formation's natural pressure to harvest the gas for processing into a saleable product. Gas and associated liquids flow under natural pressure from the wellhead platform through the onshore John Brookes (JB) slug catcher before being conveyed to the inlet of the amine trains. However, in recent times the pressure within the gas formation has declined. If allowed to continue un-mitigated, in the future there will be insufficient natural pressure to maintain the required production flow rates.

In order to extend the operational life of the existing John Brookes (JB) gas field, the Applicant proposes to install additional gas compression, power generation and associated utilities which are referred to as the Varanus Island Compression and Power Optimisation Project. This infrastructure will allow the declining pressure within the John Brookes gas field to be overcome.

A Works Approval (W5518/2013/1) for the VICP infrastructure (which is consistent with the proposed VICPOP infrastructure) was granted by the former Department of Environment Regulation (DER), now the Department of Water and Environmental Regulation (DWER) on 19 December 2013. At the time W5518/2013/1 was issued Apache Northwest Pty Ltd, a subsidiary of Apache Energy Limited, operated the Varanus Island Hub on behalf of its joint venture partners. The Applicant now operates the oil and gas production infrastructure on Varanus Island on behalf of its joint venture partners.

Works to support the installation of the VICP infrastructure commenced after the grant of Works Approval W5518/2013/1, however in June 2014 the project was deferred. Prior to the suspension of Works, the following was completed:

- Preparatory works which included the removal of redundant facilities, site preparation, levelling and the creation of laydown areas;
- Realignment of the existing bund wall and bund liner modification works;
- Infill, compaction, retaining wall installation and stormwater drainage works; and
- Installation of compressor module, power generation, electrical and battery room foundations and transport of the modules and power generator to a preservation facility in Henderson, WA.

On 22 December 2016 W5518/2013/1 expired. On 1 July 2019 planning for completion of the VICP commenced, with additional scope to optimise the power supply on Varanus Island. The Applicant's current schedule anticipates the VICPOP infrastructure coming online in Quarter 1 of 2021.

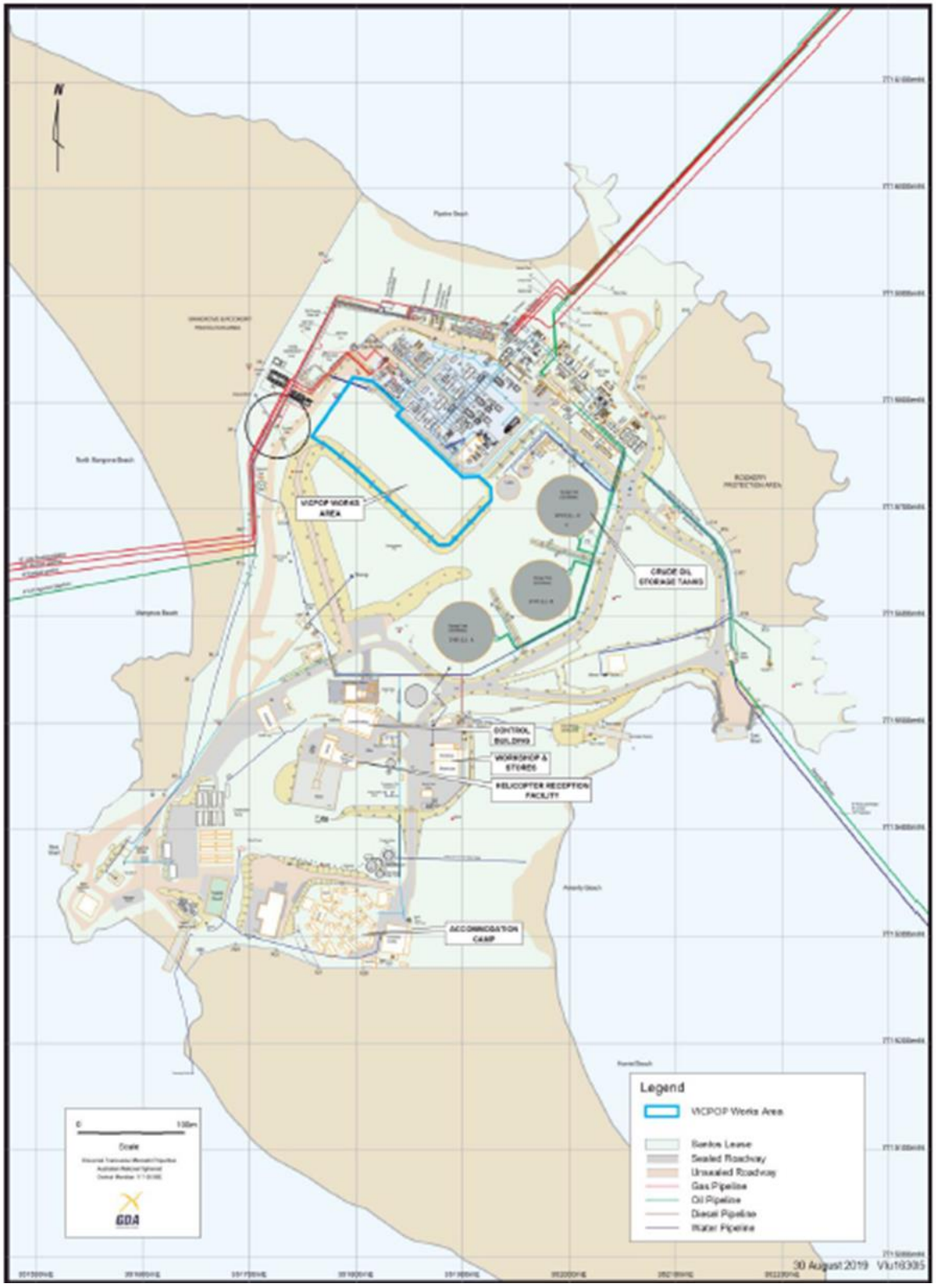

Figure 3: The layout of the Santos WA Energy Limited Lease area and the existing Varanus Island infrastructure

3.1 Current Operations

The Varanus Island Hub operations rely on gas and associated liquids flowing under natural pressure from the wellhead platform, through to the onshore John Brookes (JB) slug catcher and then to the inlet of the amine trains. Hydrocarbons from the John Brookes offshore pipeline enter the ESJV gas processing plant via the slug catcher that separates condensate and produced water from the gas stream. The slug catcher is a single vessel designed for three phase separation, with the outlet feed gas stream currently directed into the amine carbon dioxide (CO_2) exchange unit within the ESJV gas plant. Within the slug catcher, the produced water is directed to a dedicated treatment system and gas condensate is routed to the condensate stabilisation system. The two existing ESJV gas plant processing trains have a total capacity of 240 TJ/day of saleable gas production. This includes CO_2 removal, dehydration, mercury removal, dewpoint control and gas compression equipment.

The removal of the CO_2 is achieved by contacting the gas stream with lean liquid amine in a counterflow arrangement within a contactor column. The removed CO_2 within the re-boiler is vented to the atmosphere.

Following discharge from the amine plant, the gas is dehydrated to prevent ice or hydrates forming in the downstream cryogenic equipment. This also allows a saleable gas specification to be achieved. Traces of mercury which can degrade the downstream gas processing equipment are removed by a mercury guard bed situated downstream of the dehydration unit. Entrained dust is also removed by a particulate filter located downstream of the mercury guard bed.

The hydrocarbon dewpoint of the treated gas is reduced to reach saleable specifications using an auto-refrigeration process comprising gas to gas heat exchange, with the separated hydrocarbon liquids from this process directed to the condensate stabilisation train. Treated gas is then directed to the ESJV gas plant's sales gas compressors to increase gas pressure for delivery to the mainland.

Condensate recovered from the slug catcher and hydrocarbon dewpoint control works are stabilised and stored prior to shipping. Condensate stabilisation is required to reduce the condensate's vapour pressure. Liquid hydrocarbons captured in the slug catcher and hydrocarbon dewpoint low temperature separator are sent to the stabilisation train. Crude oil and stabilised condensate are currently stored in three storage tanks, each with a capacity of 250,000 barrels (39,740 m^3). Liquid petroleum (stabilised condensate and crude oil) is currently discharged from the storage tanks to offshore tankers via three diesel powered shipping pumps.

The ESJV has a flare system to accommodate and dispose of excess pressure and blowdown valve discharges, operational de-pressuring and any other hydrocarbons which require venting from within the plant in a safe manner. The ESJV's gas plant's ground flare is used for operational flaring and is fully shielded within an insulated enclosure to minimize visible light emissions.

Processing of the JB gas stream results in saline water as a by-product, known as produced formation water (PFW). The PFW removed from the slug catcher is treated to remove hydrocarbons. The PFW from the degassers is then routed to existing PFW storage tanks that have fixed roofs. These tanks have a fuel gas blanket which vents to the flare system. The tanks have the facility to skim hydrocarbon condensate, with the skimmed condensate directed to the stabilisation train. PFW is then fed to existing water disposal pumps that return the PFW to depleted petroleum reservoirs.

The Varanus Island Hub operations fall within Prescribed Premises Categories 10 and 34 as described in Table 4. The proposed infrastructure will not increase the hydrocarbon production capacity of the Varanus Island Hub from its current design capacity.

Table 4: Prescribed Premises Categories

Classification of Premises	Description	Capacity	*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 stabilised crude oil, purified natural gas or liquefied hydrocarbon gases.	5,000 tonnes or more per year	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.	Not applicable.	

3.2 Works Approval W5518/2013/1

On 19 December 2013 the Department of Environment Regulation issued Works Approval W5518/2013/1 to Apache Energy Limited to facilitate the VICP. This Works Approval approved the construction of the following:

- Two gas fueled Solar Mars 100 gas turbine driven compressors (10.5 megawatt (MW) each). These compressors are module based, including scrubbers, air cooled heat exchangers, gas/gas exchanger and Joule – Thompson (JT) gas cooling valves;
- One gas fueled Solar Centaur 40 gas turbine driven electrical power generator (3.5 MW at 11 kilovolts KV);
- One pipe rack module;
- One electrical switch room;
- One transformer compound and battery room; and
- Utility upgrades including instrument air and tie-in of demineralized water, fire water, power and data.

The approved Works were not intended to alter or modify the production throughputs currently approved under Licence L6284/1992/10 for the Varanus Island Hub. Commissioning of the VICP was to occur under this Works Approval for a period not exceeding four months.

Apache Energy Limited committed to undertake a program of turbine flue gas sampling and analysis of the turbine equipment subject to this Works Approval. The sampling program was to be conducted during the commissioning of the VICP infrastructure and comprised sampling for Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and particulate matter (10 microns or less (PM_{10})).

The works which comprised the VICP commenced in 2013, but were suspended in 2014. Works Approval W5518/2013/1 expired on 22 December 2016. The Works approved under W5518/2013/1 were not completed prior to its expiry.

4. VICPOP Infrastructure Components

4.1 Gas Turbine Driven Compressors

The VICPOP comprises the installation of two Solar Mars 100 Gas Turbine driven compressors. The turbine compressors incorporate dry-low NO_X burners using proprietary SoLoNOx technology. The compressors will discharge process gas at temperatures in excess of 100

degrees Celsius. Initial cooling of the gas will be achieved via air cooled heat exchangers which are anticipated to reduce the temperature of the gas stream to between 55 and 35 degrees Celsius, depending on the ambient temperature. Additional cooling of the gas stream will be required to meet the ESJV gas plants inlet temperature of 26 to 30 degrees Celsius. This will be achieved through:

- A gas / gas heat exchanger that cools the compressor discharge stream through cross-exchange with the incoming gas stream from the slug catcher; and
- Expansion of the over-pressurised compressor discharge stream through the JT valves, which results in a decrease in gas stream temperature.

Following cooling, the gas stream enters the ESJV gas plants amine plant to remove entrained CO_2 and then the existing gas trains for processing to achieve sales gas specification.

4.2 Electric power generator

The VICPOP also requires the installation of a Solar Centaur 40 gas turbine driven electrical power generator to supply the increased power demand associated with the aforementioned compressors and their associated utilities. The new gas turbine driven generator is rated at 3.5MW at 11kV. The turbine combustion process incorporates dry-low NO_X burners using proprietary SoLoNOx technology.

The proposed generator will also provide additional spinning reserve, enabling the existing power generators associated with the ESJV gas plant to effectively provide back-up support to the new generator and vice versa. Electrical power generated at 11kV will be conducted to the existing switchboard via above ground cables within cable trays and conduits.

4.3 Associated buildings and infrastructure

The VICPOP infrastructure will include a number of buildings to support its operation. These will include an electrical switch room building, a packaged instrument air enclosure and a battery room. Existing buildings including the control building, workshop and accommodation facilities already on situated on Varanus Island will also support the VICPOP infrastructure.

4.4 Pre-commissioning and commissioning activities

The pre-commissioning activities will overlap with the later stages of the VICPOP infrastructure's construction. The pre-commissioning activities will involve instrument and valve testing and utility start-ups. Once site construction, module installation and pre-commissioning activities are completed, the VICPOP infrastructure and all associated facilities and utilities will be commissioned. The purpose of commissioning is to confirm the proper functioning of the VICPOP's major components and to allow any potential leaks and problems to be identified and resolved prior to gas production. The commissioning phase is expected to take approximately 90 days.

The post-VICPOP block flow diagram for the JB gas field is depicted below in Figure 4.

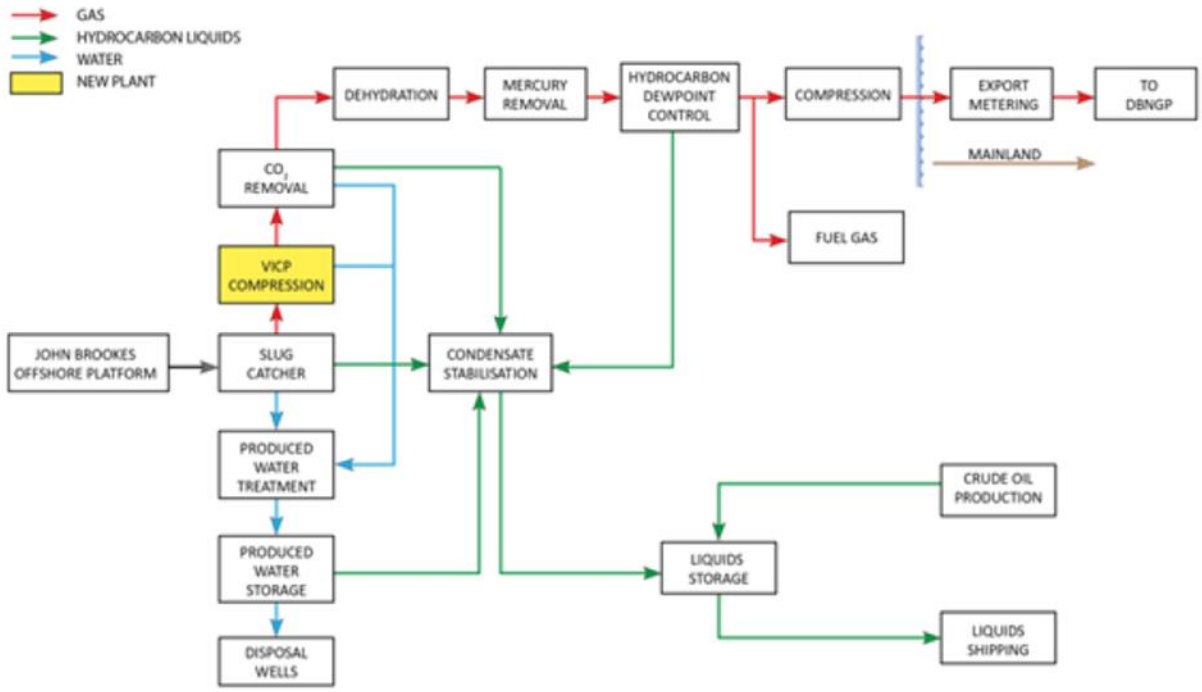

Figure 4: Post VICPOP gas processing flow diagram for the John Brookes gas field

5. Legislative context

Table 5 summarises the approvals relevant to this Works Approval assessment.

Table 5: Relevant approvals to this assessment

Legislation	Number	Agency	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.
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	EPBC 2013/6900	Department of Sustainability, Environment, Water, Population and Communities (now the Department of the Environment and Energy)	Apache Energy Limited referred the earthworks associated with the construction of kitchen and mess hall facilities, a cyclone refuge, the Varanus Island Compression Project, a bund wall realignment, the west laydown area and an access road realignment on Varanus Island to determine the status of these works as a 'controlled action'. Determined to be 'not a controlled action if undertaken in a particular manner'.
	EPBC 2013/6952	Department of the Environment (now the Department of the Environment and Energy)	Apache Energy Limited referred the construction and operation of the kitchen and mess facilities, cyclone refuge building, Varanus Island Compression Project and accommodation camp on

Legislation	Number	Agency	Approval
			Varanus Island to determine the status of these works as a 'controlled action'. Determined to be 'not a controlled action if undertaken in a particular manner'.
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	Western Australian Environmental Protection Authority	Authorised Hadson Australia Development Pty Ltd to develop a gas field near to the Harriet Oil Field on the North West Shelf, 20 kilometres northeast of Barrow Island.
	Ministerial Statement Number 395		Authorised the Western Mining Corporation Limited to develop the East Spar Offshore Gas Field development.
	Ministerial Statement Number 457		Authorised Apache Northwest Pty Ltd to develop the Wonnich Gas development, comprising a monopod and pipeline to Varanus Island.
	Ministerial Statement Number 573		Authorised Apache Northwest Pty Ltd to construct and operate two offshore oil and gas mini platforms and an undersea pipeline bundle. This infrastructure would connect the Tanami-4, Tanami-5, Simpson-1 and Simpson-3H wells to the existing facilities on Varanus Island to facilitate the Simpson Oil field development.
Part V of the EP Act (WA)	Licence L6284/1992/10	DWER	Licence for the following Prescribed Premises categories: • Category 10: Oil or gas production from wells; • Category 34: Oil or gas refining; and • Category 85: Sewage facility.
	Vegetation Clearing Permit CPS 7551/1	Department of Mines and Petroleum (now the Department of Mines, Industry Regulation and Safety)	Approves clearing for the purpose of petroleum production and associated activities on Production Licence TL/6. Clearing permit duration is from 1 July 2017 to 31 July 2027.

5.1 Part IV of the EP Act

5.1.1 Overview

The facilities comprising the Varanus Island Hub have been previously assessed under Part IV of the EP Act and approved for implementation through the Ministerial Statements detailed in the following sections.

5.1.2 Ministerial Statement 134: Harriet Gas Field to Dampier – Wagerup Pipeline, Dampier

Hadson Australia Development Pty Ltd proposed to develop a gas field near to the Harriet Oil Field on the North West Shelf, 20 kilometres northeast of Barrow Island. This included a gas pipeline to collect gas from four small gas fields and bring it to Varanus Island where it would be treated at an already approved gas processing facility before being piped to the mainland for distribution through the Dampier – Wagerup pipeline. The gas processing facility required on Varanus Island would augment the oil processing facility currently operating on the island.

Gathering facilities consisting of three platforms each with well heads and two pipelines which would be laid on the ocean floor from the gas fields to the northeast of Varanus Island, would gather the gas and bring it ashore on Varanus Island where the gas would be refined. The processed gas would then be transmitted via pipeline across 70 kilometres of open-ocean to the coast and then 29 kilometres onshore to the State Energy Commission of Western Australia compressor station situated on Mardie Station.

The assessment of this proposal undertaken by the EPA was detailed in EPA Report number 473, which was published on 30 November 1990. Ministerial Statement 134, which authorised the implementation of the above proposal was signed by the Minister for the Environment on 30 April 1991.

5.1.3 Ministerial Statement 395: East Spar Off-Shore Gas Field Development Varanus Island, North West Shelf

Western Mining Corporation Limited proposed the development of the East Spar Gas Field, situated approximately 50 kilometres west of Barrow Island. Processing facilities would be constructed and operated on Varanus Island. A new submarine pipeline would bring gas and condensate from the gas field to the processing facilities, with the existing Harriet Joint Venture export pipeline carrying gas to the mainland. Condensate would be exported from Varanus Island via tanker through the existing Harriet Joint Venture facilities. During the assessment process, the proponent modified the project to minimise the possible environmental impacts as follows:

- The processing facilities on Varanus Island would be located entirely within the largely cleared existing Harriet joint venture lease;
- The use of shared flaring infrastructure; and
- The well head would be situated in a sub-sea location and therefore there will be no production platform at the East Spar location.

The assessment of this proposal undertaken by the EPA was detailed in EPA Report number 787, which was published on 28 July 1995. Ministerial Statement 395 which authorised the implementation of the above proposal was signed by the Minister for the Environment on 8 September 1995.

5.1.4 Ministerial Statement 457: Wonnich Gas Development

Apache Northwest Pty Ltd (Apache) proposed to develop the Wonnich Gas Field, situated approximately 8 kilometres south west of the Montebello Islands. Apache proposed to drill two

wells from a single location for gas and condensate production. The development would comprise an unmanned, offshore production monopod tied back via a sub-sea pipeline to the existing gas processing facilities on Varanus Island. The pipeline would travel southwards from the Wonnich Gas field for 17 kilometres and then run parallel to the existing East Spar pipeline for 16 kilometres, with the pipeline coming ashore at Varanus Island close to the existing East Spar pipeline shore crossing.

The assessment of this proposal undertaken by the EPA was detailed in EPA report number 856 which was published on 27 June 1997. Ministerial Statement 457, which authorised the implementation of this proposal, was signed by the Minister for the Environment on 25 September 1997.

5.1.5 Ministerial Statement 573: Simpson Oil Field Development

Apache Northwest Pty Ltd proposed to develop the Simpson Development which comprised:

- The Simpson Alpha offshore mini-platform located at the Tanami–4 and Tanami-5 wells surface location;
- The Simpson Bravo offshore mini-platform located at the Simpson-1 and Simpson-3H well locations; and
- A sub-sea pipeline bundle linking the two mini-platforms to each other and to the existing facilities on Varanus Island.

The pipeline bundle consisted of a production pipeline transporting oil, PFW and natural gas, a return water pipeline for disposal of PFW into an existing deep disposal well, a return gas pipeline and an umbilical containing corrosion inhibitor chemicals and dry utilities gas. The fluids produced from the Tanami and Simpson wells would flow into a production pipeline connected to the existing processing facilities on Varanus Island.

The assessment of this proposal undertaken by the EPA was detailed in EPA Report number 1023, which was published on 30 July 2001. Ministerial Statement 573 which authorised the implementation of the above proposal was signed by the Minister for the Environment and Heritage on 21 September 2001.

A change to Ministerial Statement 573 under Section 45C of the EP Act was made on 25 August 2005. This change comprised a change to the area disturbed for the establishment of pipelines from 200m^2 to an additional 465m^2.

5.1.6 VICP Infrastructure Referral

The Ministerial Statements detailed in the previous sections pre-date the proposed installation of the VICP or VICPOP infrastructure. Apache Northwest Pty Ltd referred the VICP works to the EPA under Section 38(1) of the EP Act on 21 December 2012. The referred project comprised the installation of two Solar Mars 100 gas turbine compressors, a Solar Centaur 40 power generator, a pipe rack and equipment room. This project also comprised supporting infrastructure and services, including accommodation camp upgrades, wharf upgrades, construction of a kitchen and mess area, a cyclone refuge, upgrades to the concrete batching plant and associated bulk earthworks.

On 18 March 2013, the EPA advised that their decision on this proposal was ‘Not Assessed – Public Advice Given’. The EPA determined that the project is not likely to have a significant impact on the environment and can be adequately regulated through the decision making processes of the DMP (now DMIRS) and DEC (now DWER). The EPA noted that the proposal has the potential to increase light emissions which can potentially result in changes to the nesting behavior of marine turtles and seabirds. The EPA also noted that the project will result in some clearing of vegetation, changes to a hydrocarbon containment bund and air emissions from the compression units.

The EPA considered Apache's commitments regarding construction timing and the DMP's forthcoming assessment of the Construction Management Plan, which would consider impacts to fauna, including marine turtles and seabirds, from lighting. The EPA also noted that the monitoring of potential impacts from lighting on marine turtles will also be reviewed by the DMP and the DEC. The EPA determined that since lighting is adequately regulated on site, the impacts to turtles and seabirds can be adequately managed and does not represent a significant impact to these species.

The EPA noted that there are no declared rare flora or priority flora species on Varanus Island and considered that there are not likely to be significant impacts resulting from the clearing of vegetation. The EPA determined that the impact of such clearing can be adequately regulated under Part V of the EP Act, through the Clearing Permit process.

The EPA determined the air emissions from the VICP infrastructure can be adequately regulated under Part V of the EP Act, through the Works Approval process.

The EPA noted the design of the proposed emergency hydrocarbon containment areas and that the DMP will regulate the emergency hydrocarbon containment areas and consider the adequacy of the bunding capacity, as part of their approval process.

5.1.7 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.

DWER does not anticipate that the assessed Works will alter the Contaminated Sites status of the site, given the nature of the Works proposed and their establishment within the current operational footprint of the Varanus Island Hub.

5.2 Other relevant approvals

5.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

In 2013 Apache Energy Limited referred the earthworks associated with the construction of kitchen and mess hall facilities, a cyclone refuge, the Varanus Island Compression Project, a bund wall realignment, the west laydown area and an access road realignment on Varanus Island to the Department of Sustainability, Environment, Water, Population and Communities to determine the status of these works as 'a controlled action'. On 15 July 2013, a referral decision of 'not a controlled action if undertaken in a particular manner' was provided (EPBC 2013/6900).

This decision required that earthworks be scheduled during daylight hours during the Wedge-tailed Shearwater courtship and breeding seasons and limiting vibration impacts within Wedge-tailed Shearwater colonies during the courtship and breeding seasons to within specified limits. In addition, any visual or behavior monitoring of the Wedge-tailed Shearwater must be undertaken by or be directed by a suitably qualified burrowing bird ecologist.

Apache Energy Limited also referred the construction and operation of the kitchen and mess facilities, cyclone refuge building, Varanus Island Compression Project and accommodation camp on Varanus Island to the Department of Environment in 2013 to determine the status of these works as a controlled action. On 22 October 2013, a referral decision of 'not a controlled action if undertaken in a particular manner' was provided (EPBC 2013/6952).

This decision required that in order to mitigate lighting impacts on the Hawksbill Turtle, Flatback Turtle and Wedge-tailed Shearwater, construction activities must not be undertaken outside of daylight hours. This applied during the Wedge-tailed Shearwater breeding season and the Hawksbill and Flatback Turtle peak nesting season. Specific requirements regarding high pressure flaring and the installation and use of lighting during night time hours were also documented.

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:

- *Guideline: Industry Regulation Guide to Licensing (June 2019);*
- *Guidance Statement: Regulatory Principles (July 2015)*;
- *Guidance Statement: Setting Conditions (October 2015)*;
- *Guidance Statement: Licence Duration (August 2016)*;
- *Guidance Statement: Environmental Siting (November 2016)*;
- *Guidance Statement: Land Use Planning (February 2017)*;
- *Guidance Statement: Risk Assessments (February 2017)*; and
- *Guideline: Decision Making (June 2019)*.

The guidelines which inform this assessment are:

- National Environment Protection (Ambient Air Quality) Measure (compilation prepared on 25 February 2016).

5.3.2 Works Approval and Licence history

Table 6 summarises the Works Approval and Licence history for the premises.

Table 6: Works Approval and Licence history

Instrument	Issued	Nature and extent of Licence and Works Approval
L6284/1992/10	13/03/2019	This licence accounts for activities undertaken on the Varanus Island Hub and East Spar Facilities which fall under the following Prescribed Premises Categories: • Category 10: Oil or gas production from wells; • Category 34: Oil or gas refining; and • Category 85: Sewage facility. The grant of this licence resulted from a review of the existing licence and current operations associated with the Varanus Island Hub and East Spar facilities.
L6284/1992/10	14/01/2020	Licence amendment to allow soil vapour extraction to remediate contamination
W5518/2013/1	19/12/2013 (expired 22/12/2016)	Approved the Works associated with the VICP.
W6298/2019/1	DRAFT	Approves Works associated with the VICPOP.

5.3.3 Authorised clearing

A review of DWER's databases determined the Works Approval boundary area, along with the rest of the lease area held by the Applicant on Varanus Island is covered by Clearing Permit CPS 7551/1. The Applicant advised that no clearing will be required to be undertaken to facilitate the VICPOP Works.

6. Modelling data

6.1 Modelling of air emissions

6.1.1 Background

Apache Energy Limited commissioned Pacific Environment Limited in 2013 to determine the degree and significance of the change in Nitrogen Dioxide (NO_2) emissions at the Varanus Island Hub resulting from the VICP. This project is consistent with the VICPOP infrastructure proposed in this application. Pacific Environmental Limited modelled the emissions only from normal operations, with no modelling of upset conditions, such as emergency shutdowns, undertaken as part of this assessment. This was determined to be an acceptable course of action, since the proposed works would not alter the production capacity of the facility.

Four scenarios were modelled to assess the change in NO_2 ground level concentrations resulting from the proposed development. These scenarios are described below:

- The existing scenario: comprising current emissions from the Varanus Island Hub;
- The expansion scenario: comprising the current emissions produced by the Varanus Island Hub, together with the emissions which would result from the VICP;
- The cumulative emission scenario: where the current emissions from the Varanus Island Hub were modelled together with the existing and proposed emissions from Barrow Island; and

- The cumulative scenario, post VICP: where the emissions from the Varanus Island Hub post the installation of the VICP infrastructure were modelled together with the existing and proposed emissions from Barrow Island.

The emissions profiles of the turbines and compressor to be installed are detailed in Table 7. These emissions profile are identical to those associated with the VICPOP infrastructure.

Table 7: Calculated air emissions from VICP Infrastructure under routine operating conditions

Source	Exit velocity (m/s)	Temperature (degrees Kelvin)	NO_X (g/s)	NO_X (mg/Nm^3)	SO_2 (g/s)	Rsmog (g/s)
Solar Centaur 40 Power Generator (3.5 MW)	8.8	726	0.84	60	0	0
Solar Mars 100 Turbine Driven Compressor (10.5 MW)	16.2	772	2.27	70	0	0

The emission values depicted in Table 7 formed the basis of the air quality modelling for routine, steady state conditions in the scenarios where the VICP infrastructure was installed. It should be noted that that Sulfur Dioxide, unburned hydrocarbons, Carbon Monoxide and PM_{10} were not modelled due to their anticipated low levels within the turbine fuel gas. Benzene, Toluene, Ethylbenzene and Xylene (BTEX) arising as fugitive emissions within the VICP infrastructure were also not modelled as these potential emissions were considered to be negligible.

The model outcomes were compared to ground level concentration criteria for NO_2 contained in the National Environmental Protection Measure (NEPM).

6.1.2 Model Outcomes – Varanus Island Hub

The predicted maximum ground level concentrations of NO_2 from both the existing Varanus Island Hub and at the completion of the installation of the VICP infrastructure are contained in Table 8. Within this table it is apparent that the introduction of the additional air emission sources comprising the VICP infrastructure are predicted to result in a minor increase in the maximum predicted 1-hour and annual ground level NO_2 concentrations at the Varanus Island Hub.

Table 8: Maximum predicted ground level concentrations of NO_2 for the Varanus Island Hub

Averaging Period	Scenario	Maximum ($\mu g/m^3$)	NEPM Criteria ($\mu g/m^3$)	Percentage of Criteria
1 - Hour	Existing	213	246	86.6%
	Expansion	214	246	87%
Annual	Existing	75.3	62	121.5%
	Expansion	75.7	62	122.1%

The model predicts maximum annual ground level concentrations of NO_2 above the NEPM criteria of 62 $\mu g/m^3$ in the pre and post-VICP scenario's. This is a result of the conservative assumptions used in the model whereby all emission sources comprising the Varanus Island Hub are modelled as operating at 100 per cent utilisation. This rate of utilisation over states the true utilisation of the following emission sources within the Varanus Island Hub:

- The ESJV reciprocating gas engines would be utilised 90 percent of the time prior to the completion of the VICP, with their utilisation decreasing to 4 per cent at the completion

of the VICP;

- The black-start diesel generators utilisation will not change at the completion of the VICP, with their utilisation remaining at 2 per cent;
- The utilisation of one of the existing gas turbines will not change at the completion of the VICP, with its utilisation remaining at 12 per cent;
- The utilisation of the two Taurus T60 Gas Turbines will not change at the completion of the VICP, with their utilisation remaining at 50 per cent;
- The utilisation of the three shipping pumps will not change at the completion of the VICP, with their utilisation remaining at 2 per cent; and
- The utilisation of the two fire-water pumps will not change at the completion of the VICP, with their utilisation remaining at 2 per cent.

Based on the assumptions used by Pacific Environmental Limited in their model, the modelled NO_2 emissions resulting from the Varanus Island Hub at the completion of the VICP are well in excess of the emissions anticipated at the completion of these Works. Therefore, both the 1-hour and annual ground level concentrations were modelled as being significantly higher than those which would likely occur. It should be noted that even under the conservative modelling scenario developed by Pacific Environmental Limited, the emissions of NO_2 would be expected to increase by 1 and 0.4 µg/m^3 in the 1-hour and annual modelled scenario's respectively. Therefore, the VICP was anticipated to result in an insignificant increase in the average ground level NO_2 emissions at the Varanus Island Hub.

6.1.3 Model Outcomes – Cumulative Scenario

The maximum cumulative ground level NO_2 concentrations predicted for the combined existing Varanus Island Hub and Barrow Island operations and the Varanus Island Hub and Barrow Island operations, Post VICP, are depicted in Table 9. This modelled scenario includes the existing WA Oil operations on Barrow Island, along with the emissions from the Chevron Gorgon Project which was under construction at the time of the models creation. This model's outcomes determined that the additional emission sources associated with the VICP would result in an insignificant increase in the maximum predicted 1-hour and annual NO_2 ground level concentrations.

Table 9: Maximum predicted ground level concentrations of NO_2 for the Cumulative Scenario

Averaging Period	Scenario	Maximum (µg/m^3)	NEPM Criteria (µg/m^3)	Percentage of Criteria
1 - Hour	Existing	182	246	74%
	Expansion	183	246	74.4%
Annual	Existing	55.3	62	89.2%
	Expansion	55.6	62	89.7%

It should be noted that the reduction in ground level concentrations presented in Table 9 compared to those contained within Table 8 is a consequence of the larger and coarser grid used to undertake the cumulative modelling scenario, in comparison to the Varanus Island Hub modelling scenario.

Key finding: The expected increase in ground level NO_2 concentrations from the proposed VICP infrastructure is not anticipated to cause ground level NO_2 concentrations to exceed NEPM requirements within the Varanus Island Hub, or its surrounds.

6.2 Stack Emission Monitoring Program

The Applicant intends to undertake a program of turbine flue gas sampling and analysis during the VICPOP commissioning period. This sampling program will comprise the use of pre-fitted flue gas sampling points on the flue gas exhaust stacks for both the compressor and generator turbines, which will be utilised to collect flue gas samples on site. The Applicant will engage an independent and accredited third party consultant to develop the sampling regime, undertake the flue gas sampling and manage the analysis of samples. The samples will be analysed at a National Association of Testing Authorities approved laboratory.

The sampling program is to be undertaken to ensure the modelling results are representative of the compressor turbines and the generator turbine under normal operating conditions. The sampling program will monitor the emissions of NO_2, CO, SO_2, BTEX and particulates (PM_{10}) produced during the operation of these turbines.

7. Consultation

Varanus Island is a remote offshore island with land access restrictions due to its status as a conservation reserve and its operating oil and gas production facilities. Therefore, the relevant stakeholders for the proposed VICPOP Works are Commonwealth and State Government authorities responsible for environmental and development planning matters.

The consultation activities undertaken in support of this application by DWER and the Applicant are detailed in the following sections. The Applicant advises that they have used various consultation methods (including meetings, emails, phone conversations, public invitations and advertisements) to engage relevant stakeholders which have an interest in the VICPOP Works.

7.1 Department of Biodiversity, Conservation and Attractions

On 22 November 2019, DWER sought comment from the Department of Biodiversity, Conservation and Attractions (DBCA) regarding the VICPOP Works. The DBCA advised on 6 December 2019 that the light emission controls proposed by the applicant should be implemented in association with the existing management plans concerning lighting and illumination on Varanus Island.

The DBCA advised that the proposed management measures, if implemented, are likely to reduce the potential impacts on marine turtle nesting habitats and breeding populations of Wedge-tailed Shearwaters located on Varanus Island. The DBCA also noted that the East Spar Off-shore Gas Field Development facilities have previously been assessed and approved under Part IV of the EP Act.

The DBCA, after noting the capacity for DWER to apply appropriate regulatory measures for environmental management at the facility under Part V of the EP Act, did not have any specific comments in regards to the Works.

7.2 Department of Mines, Industry Regulation and Safety

The Applicant advises that the Department of Mines, Industry Regulation and Safety (DMIRS), formerly known as the Department of Mines and Petroleum (DMP) approved variations to Petroleum Pipeline Licence PL12 (No. STP-PLV-0024) and PL29 (No. STP-PLV-0025) for the proposed activities. A condition of these variations was that an Environmental Management Plan must be submitted to the DMP for assessment and approval under the *Petroleum Pipelines Act 1969*.

The Applicant advises that they will submit a Construction Environmental Management Plan bridging to the existing Varanus Island Hub Operations Environmental Plan for the VICPOP works. The Applicant advises that this consultation matter is ongoing and construction will not commence without the relevant approvals being in place.

In correspondence dated 12 November 2019, DMIRS advised DWER that an Environment Plan Bridging Document for this proposal is currently undergoing assessment. No other comments were provided by DMIRS in relation to this Works Approval.

7.3 Department of Water and Environmental Regulation

In October 2012 the Department of Environment and Conservation (now DWER) advised that a Part V Works Approval was required for the VICP based on a submitted application form. On the basis of an air modelling briefing note submitted by the Applicant, the DEC agreed that the emissions from the operation of the VICP works would not significantly affect regional ozone concentrations and therefore it should be acceptable to proceed with the modelling of local impacts only. In June 2013, In accordance with conditions of the Varanus Island lease, the Varanus Island Lighting Management Plan was submitted to the DEC. This plan related to existing operations and also to proposed future developments on Varanus Island. The Applicant advises the activities described within the Works Approval application meet the requirements of the Varanus Island Lighting Management Plan.

The Applicant advises that the Works Approval conditions will be managed in accordance with their internal VICPOP Commitments Register.

7.4 Environmental Protection Authority

The VICP Works were referred to the EPA under Section 38(1) of the EP Act on 21 December 2012. The outcomes of this referral is discussed in Section 5.1.6 of this report.

7.5 Department of the Environment and Energy

The construction and operation of the VICP were referred to the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999* in 2013. The outcomes of these referrals are discussed in Section 5.3.3 of this report.

8. Location and siting

8.1 Siting context

The Varanus Island Hub is situated on Varanus Island, part of the Lowendal Islands situated on the Northwest Shelf, off the northwest coast of Australia. The Lowendal Islands consist of a group of small islands comprised of limestone and sand dunes, which rise only a few metres above the sea level and comprise a cumulative area of approximately 245 hectares. The Lowendal Islands are situated approximately 7.6 kilometres to the northeast of Barrow Island, 7.7 kilometres to the south of the Montebello Islands and approximately 57 kilometres from the Western Australian mainland.

The Lowendal Islands were incorporated into the Register of the National Estate in 1978. The Lowendal Islands are also a recognised conservation reserve (known as the Lowendal Islands Nature Reserve (33902)), which is managed by the DBCA. The Lowendal Islands are recognised as an important breeding site for the Wedge-tailed Shearwater. However, a number of bird and reptile species have been recorded on these islands and Varanus Island is known to include important rookery's for seabirds and marine turtles.

8.2 Sensitive Receptors

The nearest sensitive receptors to the Varanus Island Hub are detailed in Table 10 distances to the sensitive receptors derived from a review of DWER's spatial databases.

Table 10: Sensitive receptors and their distance from the Varanus Island Hub

Sensitive receptors	Distance from the Varanus Island Hub
Barrow Island workers accommodation facility.	Situated approximately 23 kilometres southwest of the Varanus Island Hub.

The potential impacts to workers within the Varanus Island Hub does not form part of this assessment. Potential impacts to these personal resulting from the proposed Works are regulated by the *Occupational Safety and Health Act 1984* and *Occupational Safety and Health Regulations 1996*.

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 Works Approval boundary. 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 been modified to align with the *Guidance Statement: Environmental Siting.*

Table 11: Specified ecosystems and local environmental values

Specified ecosystems	Distance from the Premises
Parks and Wildlife managed lands and waters	The Lowendal Islands are situated within the Lowendal Islands Nature Reserve (33902). This nature reserve has been established for the conservation of flora and fauna. The Works Approval boundary, along with the rest of the Lowendal Islands, are situated within this nature reserve.
Biological component	**Distance from the Premises**
Migratory bird breeding habitat	The Wedge-tailed Shearwater (*Ardenna pacifica*) is a burrowing species which breeds on scattered colonies throughout the sandy regions of Varanus Island. The Applicant advises that the monitoring of the Wedge-tailed Shearwater population undertaken from 2005 to present indicates no significant change in Wedge-tailed Shearwater burrow numbers on Varanus Island over that time. The Wedge-tailed Shearwater colonies on Varanus Island appear to have remained relatively stable since 2005 - 2006, and collectively contained a total of 247 burrows. The results of the 2018 - 2019 monitoring season demonstrated that the estimated size of the Wedge-tailed Shearwater colony on Varanus Island remained within or above previously reported ranges. The nearest Wedge-tailed Shearwater rookery is situated approximately 120 metres north of the Works Approval boundary. Bridled Tern's (*Onychoprion anaethetus*) return to Varanus Island in late November to nest between late December and April. In 2012, the Bridled Tern colony on Varanus Island consisted of 20 individual nests. There were several Bridled Tern nests along the coastal cliffs adjacent to the east wharf and a single nest abutting the west wharf. Monitoring of the Bridled Tern on Varanus Island and adjacent islands has occurred since 1987. Bridled Tern's are known to only nest in very small numbers on Varanus Island and were not recorded nesting on Varanus Island in 2019. The Crested Tern (*Thalasseus bergii*), Lesser Crested Tern (*Thalasseus bengalensis*) and the Australian Pied Cormorant (*Phalacrocorax varius*) also have nesting sites on Varanus Island.
Marine turtle nesting beaches	The species of marine turtle most commonly found nesting on Varanus Island is the Hawksbill Turtle (*Eretmochelys imbricata*). Flatback Turtle's (*Natator depressus*) are also seen nesting on Varanus Island, while Green Turtles (*Chelonia mydas*) are the least common. An assessment of the preferred nesting beaches on Varanus Island conducted in 2019 found Hawksbill Turtle nesting activity was notably higher on Pipeline Beach compared to other monitored beaches, and individuals showed high site fidelity to this beach. Flatback Turtle nesting activity was also high on Pipeline Beach and Harriet Beach, but showed higher site fidelity to Harriet Beach and Tanny's Beach. The nearest marine turtle nesting beach is South Mangrove Beach, situated approximately 120 metres west of the Works Approval boundary.

8.4 Groundwater and surface water sources

In 2012, a groundwater and soil investigation determined that the groundwater table over most of Varanus Island occurs at an elevation of 1.8 metres Australian Height Datum (AHD) at low tide and 2.6 metres AHD at high tide. Groundwater contours derived from this study depict the groundwater levels around the VICPOP Works area ranging from between 1.8 to 1.9 metres AHD. The design sub-grade level for the VICPOP Works area is approximately 9 metres AHD and therefore, the ground level in the VICPOP Works area is approximately 7 metres above the identified water table.

The rocky nature and the limited extent of Varanus Island, alongside the generally arid conditions experienced by Varanus Island, inhibit the retention of surface water.

8.5 Meteorology

8.5.1 Regional climatic aspects

The climate of the Lowendal Islands is arid, subtropical with hot summer temperatures, low and unpredictable rainfall, high evaporation rates and summer rainfall associated with occasional cyclone events. The summer and winter seasons fall into the periods of September-March and May-July, respectively. The months of April and between August to September are considered transitional between summer and winter.

Average summer surface temperatures range from 34.2 degrees celsius (maximum) to 24.8 degrees celsius (minimum). Average winter surface temperatures range from 25.2 degrees celsius (maximum) and 17.1 degrees celsius (minimum). The average rainfall of the Lowendal Islands is approximately 300mm. Most of this rainfall is derived from tropical cyclone activity. Three to four tropical cyclones per year are typically experienced at Varanus Island.

Wind conditions show a marked seasonal variation. During winter, moderate to strong south-easterly and north-easterly to easterly winds are prevalent. During summer, moderate southerly, south-westerly and westerly winds dominate. April and August to September are transitional months where the wind can blow from the south-west to the south-east. While the historical trends pertaining to wind direction are acknowledged, they should not be used to predict future wind directions experienced within the Lowendal Islands.

Climatic data is monitored and recorded by an automated weather station situated on Varanus Island.

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 12 and Table 13. The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 12 and Table 13 below.

Table 12: Identification of emissions, pathway and receptors during construction

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Installation of the VICPOP infrastructure	Vehicle and equipment movements on unsealed access roads. Use of construction equipment to establish the proposed infrastructure.	Noise / Vibration	Turtle nesting beaches, the closest of which is situated approximately 120 metres west of the Works Approval boundary. A Wedge-tailed Shearwater Rookery situated approximately 120 metres north of the Works Approval boundary.	Air / wind dispersion and dispersion through the ground	None.	No	The construction activities will be short term in nature and the following control measures will be implemented to minimise noise and vibration during the construction phase: • Maintenance of mobile equipment to ensure equipment exhaust systems are operating as designed; • Limiting construction noise to daylight hours, to minimise disturbance to seabird and marine turtle nesting areas, since such fauna are likely to be active at night; and • Noise and vibration emissions are not anticipated to be significant due to the short term nature of the construction activities and the knowledge that vibration emission sources will be limited to construction vehicles and equipment. Given the above, the Delegated Officer does not consider further assessment of this risk necessary.
		Dust		Air / wind dispersion	None.	No	The construction activities will be short term in nature and the following control measures will be implemented to minimise dust emissions during construction: • Watering of unsealed roads, access tracks, work areas and soil stockpiles as required; • Application of approved dust control products; • Maintenance of low vehicle speed limits; • Reduction of traffic movements where possible; • Minimisation of on-site concrete batching through the use of off-site pre-cast concrete; and • Controlling all concrete batching activities in accordance with the *Environmental Protection (Concrete Batching and Cement Product Manufacturing) Regulations 1998*. The aforementioned controls are anticipated to mitigate the potential for adverse impacts from dust emissions to result from the construction of the VICPOP infrastructure. The Delegated Officer does not consider further assessment of this risk necessary.
Installation of the VICPOP infrastructure	Vehicle and equipment movements on unsealed access roads. Use of construction	Brine and reject water from the temporary desalination unit.	Drainage lines and near shore waters	Existing surface water drainage lines	None.	No	The construction of the VICPOP infrastructure will require a temporary desalination unit to be established to provide construction support water. This desalination unit is anticipated to produce brine and reject water requiring discharge. Surface water run-off within the VICPOP Works area is also anticipated to occur during storm events. The following control measures will be applied to these discharges: • Brine and reject water from the temporary desalination unit will be discharged at the existing Varanus Island brine

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	equipment to establish the proposed infrastructure.	Sediment from the VICPOP Works Area				No	discharge location; • Discharges from the temporary desalination unit will be recorded and reported as part of normal operations on Varanus Island; and • Temporary drainage lines incorporating silt traps will be established on the western boundary of the Works area and will be directed away from sensitive receptors such as Wedge-tailed Shearwater Rookeries. The aforementioned controls are anticipated to mitigate the potential for surface water and near shore water contamination to result from the discharge of brine and reject water and the origin of sediment from within the VICPOP construction area. The Delegated Officer does not consider further assessment of these risks necessary.
		Discharge of chemicals and hydrocarbons to the ground	Drainage lines and near shore waters	Existing surface water drainage lines	Reduction in the quality of surface water flows and near shore waters, resulting in impacts on fauna and flora.	No	The impact of discharges of chemicals and hydrocarbons to the ground surface is assessed within the decision report for Licence L6284/1992/10 and is regulated via Conditions 1, 2, 4, 6, 10 and 14 of this Licence. The Delegated Officer does not consider further assessment of these risks necessary.
			Groundwater	Seepage through the soil profile	Reduction in the quality of groundwater.	No	
			Soil profile		Soil contamination impacts.	No	
	Mobile and infrastructure based light sources	Light Spill	Turtle nesting beaches, the closest of which is situated approximately 120 metres west of the Works Approval boundary. A Wedge-tailed Shearwater Rookery situated approximately 120 metres north of the Works Approval boundary.	Air	Disorientation of nesting turtles and seabirds undermining breeding efforts. Disorientation of turtle hatchlings leaving the nesting grounds. These events could undermine the success of turtle and seabird reproduction.	Yes	Refer to Section 9.4.

Table 13: Identification of emissions, pathway and receptors during operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Operation of the VICPOP Infrastructure	Operation of the VICPOP Infrastructure	NOx emissions from the operation of the compressors and power generation infrastructure	Turtle nesting beaches, the closest of which is situated approximately 120 metres west of the Works Approval boundary. A Wedge-tailed Shearwater Rookery situated approximately 120 metres north of the Works Approval boundary.	Air / wind dispersion	None.	No	The following measures will be implemented to limit emissions during operation of the VICPOP infrastructure: • Low sulphur fuel (<8ppm) will be used to fuel the turbines; • The VICPOP infrastructure will employ SoLoNOx technology to reduce NOx emissions; • The high utilisation rate of the VICPOP infrastructure (>95 per cent annually) reduces increased emission outputs from non-steady state operating conditions; • The use of compressor and generator equipment with high combustion temperatures, resulting in reduced emissions of CO; and • Flue gas monitoring and analysis will be undertaken for the VICPOP infrastructure to ensure it meets manufacturer specifications. Based on the outcomes of the modelling undertaken by Pacific Environmental Limited, the Delegated Officer considers that the VICPOP infrastructure will not result in a significant change to ground level NO_2 concentrations at the Varanus Island Hub. The Delegated Officer does not consider further assessment of this risk necessary.
		Noise and Vibration		Air / wind dispersion, dispersion through the ground	None.	No	The VICPOP infrastructure will be situated within the existing Varanus Island Hub. In addition, this infrastructure is turbine powered, providing this infrastructure a lower vibration emissions profile in comparison to conventional reciprocating engines. The proposed turbines are also fully enclosed with integral noise attenuating lagging fitted throughout each enclosure. The Delegated Officer considers that the VICPOP infrastructure will not result in a significant increase in noise and vibration emissions from the Varanus Island Hub and does not consider further assessment of this risk necessary.
	Light sources associated with the VICPOP infrastructure's operational areas	Light Spill		Air	Disorientation of nesting turtles and seabirds undermining breeding efforts. Disorientation of turtle hatchlings leaving the nesting grounds. These events could undermine the success of turtle and seabird reproduction.	Yes	Refer to Section 9.4
	Chemical and hydrocarbon spills resulting from the operation of the VICPOP Infrastructure	Surface water contamination	Drainage lines and near shore waters.	Existing surface water drainage lines.	Reduction in the quality of surface water flows and near shore waters, resulting in impacts on fauna and flora.	No	The impact of discharges of chemicals and hydrocarbons to the ground surface is assessed within the decision report for Licence L6284/1992/10 and is regulated via Conditions 1, 2, 4, 6, 10 and 14 of the Licence. The Delegated Officer does not consider further assessment of this risk is necessary.
		Soil contamination	Soil profile.	Seepage through the soil profile	Soil contamination.	No	
		Groundwater contamination	Groundwater sources.		Reduction in the quality of groundwater.	No	

9.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 14 below.

Table 14: Risk rating matrix

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

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 15 below.

Table 15: Risk criteria table

Likelihood		Consequence		
The following criteria has been used to determine the likelihood of the Risk Event occurring.		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^ • 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 wider scale**: low 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: Environmental Siting.*

* 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 16 below:

Table 16: Risk treatment table

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.

9.4 Risk Assessment – Light Spill

9.4.1 Description of risk event

Light spill from the lighting sources employed during the construction and operation of the VICPOP infrastructure disrupting marine turtle nesting and seabird courtship rituals and nesting on Varanus Island. These light sources could also disorientate turtle hatchlings leaving the nesting grounds. Therefore, light spill from the VICPOP Works area could have adverse impacts on the success of turtle and seabird nesting efforts, with further consequences for these species conservation status.

9.4.2 Applicant controls

Light emissions from the construction phase will be minimised by scheduling the construction activities during daylight hours to negate the need for artificial lighting. Pre-commissioning activities will be short-term in duration (i.e. hours to days), however localised lighting may be required to support the pre-commissioning activities. The following controls will be applied to any lighting employed during the pre-commissioning phase:

- Localised lighting as required for pre-commissioning activities will be managed in accordance with the Varanus Island Lighting Management Plan;
- Only localised and low level lighting will be used, with no use of lighting towers employed during the pre-commissioning activities; and
- Light shields will be installed around the low-level lighting to prevent light spill during the pre-commissioning activities.

Once the VICPOP infrastructure is operational, parts of the VICPOP operational areas will feature fixed lighting to ensure personnel safety at night. Manual light switches will be installed throughout the operational areas and the electrical switch room supporting the VICPOP infrastructure has been designed without windows to prevent light spill. The following additional controls will be applied to light sources utilised to support the operation of the VICPOP infrastructure:

- Lighting installed within operational areas will be monitored and controlled via the

manned central control room;

- Filters (typically amber) will be fitted to all fluorescent lights to minimise light wavelengths below 560 nm, as light in the 450 to 500 nm range are the visible to turtles;
- Lights in elevated locations will feature diffusers and shields to prevent direct light from being visible in areas utilised for turtle and sea bird nesting;
- Lights will be installed horizontal to the ground to contain the light within the confines of the operational areas; and
- Lighting required for operations and maintenance activities will comply with the requirements of the Applicant's Lighting Management Plan (Doc. Ref: EA-60-RI-153) and the Process Facility Outdoor Illumination Plan (Doc. Ref: JB-10-RE-044).

In addition light surveys and marine turtle and seabird population monitoring on Varanus Island will be ongoing.

9.4.3 Key findings

The Delegated Officer has reviewed the information regarding Light Spill provided by the applicant and has found:

1. That lighting associated with the VICPOP infrastructure's construction phase will be used on an as-needs basis. Construction and commissioning activities will be restricted to daylight hours, unless otherwise required to be undertaken at night for safety reasons;
2. Light infrastructure installed to support the VICPOP infrastructure's operational phase will contain controls including shielding, wave length moderation and remote monitoring to minimise the impact of this lighting on turtle and seabird nesting activities; and
3. Light and turtle and seabird monitoring activities will continue to be undertaken at Varanus Island to allow the impact of the installed lighting on turtle and seabird populations to be quantified and to ensure lighting levels are as low as practicable.

9.4.4 Consequence

Light spill from the VICPOP infrastructure could disorientate nesting turtle's and seabirds, and disorientate turtle hatchlings leaving the nesting grounds. These events could adversely impact the population numbers of these species. The Delegated Officer therefore considers the consequence to be **Major**.

9.4.5 Likelihood of Risk Event

It is considered **Unlikely** that Light Spill impacts to nesting turtle and seabird populations would result from the construction and operation of the VICPOP infrastructure. This is due to the timing of construction activities and the engineering design which incorporates light spill controls. In addition, it is also considered likely that any such impacts would be identified by the Applicant during their routine light, turtle and seabird monitoring efforts. This would provide the applicant with the opportunity to address these impacts, ensuring these impacts did nor reoccur over multiple seabird and turtle nesting seasons.

9.4.6 Overall rating of Light Spill risks

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 14) and determined that the overall rating for the risk of Light Spill impacting nesting turtles and seabirds is **Medium**.

9.5 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, is set out in Table 17 below. Controls are described further in section 11.

Table 17: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	Source	Pathway/ Receptor (Impact)			
1.	Light Spill	Light sources installed to support the construction and operation of the VICPOP infrastructure.	Disorientation of nesting turtles and seabirds undermining breeding efforts. Disorientation of turtle hatchlings leaving the nesting grounds.	Construction and commissioning activities undertaken during daylight hours, except when unsafe to do so. The VICPOP infrastructure will include light filters, light shielding, and the monitoring and control of lighting within a central control room.	**Medium Risk** Major consequence Unlikely	Acceptable subject to regulatory controls

10. Regulatory controls

DWER will determine regulatory controls having regard to the adequacy of controls proposed by the applicant. The conditions of the Works Approval and Licence will give effect to the determined regulatory controls.

10.1 Works Approval controls

10.1.1 Design of infrastructure and equipment

The Works Approval will include design and construction / installation requirements for the:

a) Two Solar Mars 100 gas turbine driven compressors;

b) One Solar Centaur 40 gas turbine driven electrical power generator; and

c) Their associated support buildings and ancillary infrastructure.

The requirements reflect controls proposed by the Applicant for the control of risks associated with air emissions and light spill. The Applicant's proposed controls were assessed as reasonable and appropriate based on the risks assessment outcomes in Table 12 and 13 and the risk assessment undertaken in Section 9.4. The Works Approval holder will be required to submit an Environmental Compliance Report. This report will report on the Works Approval Holder's compliance with infrastructure specifications. The Works Approval Holder will also be required to submit a Commissioning Report, including confirmation the flue gas sampling program has been completed and advice on whether the performance of the compressors and generator met manufacturer specifications.

10.1.2 Time limited operations

The Works Approval will authorise up to 180 days of time limited operations, subject to the lodgement of the Environmental Compliance Report and Commissioning Report demonstrating compliance with infrastructure construction, installation and operational requirements.

11. Determination of Works Approval conditions

The conditions in the issued Works Approval in Attachment 1 have been determined in accordance with the *Guidance Statement: Setting Conditions*.

The *Guidance Statement: Licence Duration* has been applied and the issued Works Approval expires in 3 years from date of issue.

Table 18 provides a summary of the conditions to be applied to this Works Approval.

Table 18: Summary of conditions to be applied

Condition Ref	Grounds
Infrastructure and equipment (design and construction): 1.	This condition is based on the Works Approval holders controls proposed in the application These conditions are necessary to ensure the VICPOP infrastructure installed is consistent with the infrastructure which formed the basis for the NO_2 emissions modelling undertaken by Pacific Environmental Limited.
Compliance audit and reporting: 2 and 3.	These conditions are necessary to allow DWER to receive information on and to assess the Works Approval Holder's compliance with Condition 1.
Commissioning and monitoring of emissions: 4 and 5.	These conditions allow the Works Approval Holder to commission the infrastructure for a period of no longer than 3 months. During commissioning, the Works Approval Holder will monitor and record emissions from the infrastructure to allow the performance of the installed infrastructure against the manufacturer's specifications to be recorded.

NATA accreditation: 6.	This condition is necessary to ensure the sampling and analysis undertaken is completed in accordance with appropriate methodologies. This ensure the results of the sampling and analysis can reliably capture the emissions from the infrastructure during commissioning.
Commissioning report: 7 and 8.	These Conditions will allow information including the infrastructure's commissioning activities, emissions monitoring outcomes and any measures required to bring the installed infrastructure into line with the Conditions of the Works Approval or the manufacturer's specifications to be provided to DWER for review.
Emissions: 9.	This condition is valid, risk-based and consistent with the EP Act.
Operation of infrastructure and equipment: 10 and 11.	These conditions allows time limited operation (maximum of 180 days) of the infrastructure to occur under the Works Approval, while an amendment to licence L6284/1992/10 is sought.
Record Keeping: 12, 13 and 14.	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

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 Works Approval under the EP Act.

12. Amendment to licence L6284/1992/10

To allow operation of the VICPOP infrastructure to continue past the time limited operating period, the Works Approval holder will need to apply for an amendment to Licence L6284/1992/10. As well as updating the premises descriptions, Condition 3 will be require an update to include the emission to air points associated with the VICPOP infrastructure. The map of emission to air points in Schedule 1 of this Licence will also need to be amended to account for the VICPOP infrastructure. Other amendments considered appropriate will be made at the time of the Licence amendment.

13. Works Approval Holder Consultation

The Works Approval Holder was provided with the draft decision report and draft works approval on 15 January 2020 for comment. The Works Approval Holder provided comments which are summarised along with DWER's response in Appendix 2.

14. 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 issued Works Approval will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Carmen Standring
A/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 Facilities	L6284/1992/10	accessed at www.der.wa.gov.au
2.	Works Approval W5518/2013/1–Varanus Island Compression Project	W5518/2013/1	DWER records (A708412)
3.	National Environment Protection (Ambient Air Quality) Measure (compilation prepared on 25 February 2016).	NEPM	www.legislation.gov.au/
4.	Santos WA Energy Limited: Varanus Island Compression and Power Optimisation Project, Works Approval Supporting Document. Rev 0. Dated 30 August 2019. JB-10-BI-20001	Santos WA Energy Limited or "the Applicant"	DWER records (A1826423)
5.	Santos WA Energy Limited: Attachment 1A: Proof of Occupier Status.	N/A	
6.	Santos WA Energy Limited: Power of Attorney.	N/A	
7.	Pacific Environment Limited: Report; Varanus Island Compression Project (VICP) – Air Quality Assessment (Doc Ref: JB-10-RI-014) – Rev 0. Prepared for Apache Northwest Pty Ltd. Published 20 August 2013.	Pacific Environment Limited	
8.	Ministerial Statement 134	MS 134	accessed at www.epa.wa.gov.au/
9.	Ministerial Statement 395	MS 395	
10.	Ministerial Statement 457	MS 457	
11.	Ministerial Statement 573	MS 573	
12.	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	DER 2015a	accessed at www.dwer.wa.gov.au
13.	DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	DER 2015b	
14.	DER, May 2016. Guidance Statement: *Publication of Annual Audit Compliance Reports*. Department of Environment Regulation, Perth.	DER 2016a	
15.	DER, August 2016. *Guidance Statement: Licence duration.* Department of Environment Regulation, Perth.	DER 2016b	
16.	DER, November 2016. *Guidance Statement: Environmental Siting.* Department of Environment Regulation, Perth.	DER 2016c	
17.	DER, February 2017. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	DER 2017a	
18.	DWER, June 2019. *Guidance Statement: Decision Making*. Department of Water and Environment Regulation, Perth.	DWER 2019	

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

Condition	Summary of Works Approval Holder comments	DWER response
Condition 5(d)	The Works Approval Holder requested an amendment to Table 2 within the Works Approval document to reduce the frequency of air emissions sampling to only once during the Environmental Commissioning Period.	The Delegated Officer has considered the requirement for validation monitoring of emissions from the proposed works and agreed that one sampling event is sufficient to demonstrate design emissions specifications have been achieved. Table 2 of the Works Approval has therefore been updated to reflect this change.
Condition 8(e)	The Works Approval Holder requested Condition 8(e) be amended to provide for additional air emissions sampling campaigns to be undertaken during the Environmental Commissioning Period, if necessary. These additional air emissions sampling campaigns would only be required should the Environmental Commissioning of the proposed infrastructure determine these sampling campaigns are necessary to confirm compliance with manufacturer specifications.	The Delegated Officer agreed with this proposed change and updated Condition 8(e) to reflect this change.
Table 4, Schedule 2	The Works Approval Holder requested DWER remove references to installing flue gas sampling points on the proposed infrastructure in accordance with *AS 4323.1-1995: Stationary source emissions, selection of sampling positions.* Installing flue gas sampling points on the proposed infrastructure in accordance with this standard would present the Works Approval Holder with engineering, cost and personal safety constraints. The Works Approval holder proposed an alternate air emissions sampling program to account for the flue gas sampling points not being installed in accordance with the above standard.	The Delegated Officer has reviewed the proposed alternative emissions sampling program and has determined that the Works Approval Holder has presented an acceptable alternative emissions sampling and verification program. In accordance with Condition 7 of the Works Approval, an Environmental Commissioning Report is required to be provided within 30 days of commissioning that will detail the methodology of sampling and analysis during commissioning. This report will be reviewed by DWER to ensure results of validation monitoring are representative of actual emissions and that emissions are consistent with design specifications. DWER therefore agreed with this proposed change and updated the Works Approval documents to remove all references to installing flue gas sampling points in accordance with *AS 4323.1-1995*.