Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6332/2019/1
Applicant	Woodside Burrup Pty Ltd
ACN	120 237 416
File Number	DER2019/000559-1
Premises	Pluto LNG (Pluto Train 2) Burrup Road BURRUP WA 6714 Legal description - Lot 384 on Deposited Plan 220146 and Lots 572 and 574 on Deposited Plan 28209 As defined by the coordinates in Schedule 1 of the Works Approval
Date of Report	26 May 2021
Status of Report	Final

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Definitions of terms and acronyms

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

Table 1: Definitions

Term	Definition
AACR	Annual Audit Compliance Report
ACN	Australian Company Number
AHD	Australian Height Datum
API650	American Petroleum Institute Standard 650: Welded Tanks for Oil Storage
AS 1940	Australian Standard AS 1940 – 2004: The storage of flammable and combustible liquids
AS 4323.1	Australian Standard AS 4323.1 – 1995: Stationary source emissions selection of sampling positions
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DG Regulations	*Dangerous Goods Safety Regulations 2007* (WA)
DG Act	*Dangerous Goods Safety Act 2004* (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.
EPA	Environmental Protection Authority
EP Regulations	*Environmental Protection Regulations 1987* (WA)
Existing Licence	The Licence L8752/2013/2 issued under Part V, Division 3 of the EP Act for Pluto LNG Facility (Train 1)
GE	General Electric
Minister	the Minister responsible for the EP Act and associated regulations
NEPM	National Environmental Protection Measure
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
NO_2	Nitrogen dioxide
NOx	Oxides of nitrogen
Occupier	has the same meaning given to that term under the EP Act.
PM_{10}	used to describe 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
Primary Activities	as defined in Schedule 2 of the Revised Licence
Risk Event	As described in *Guidance Statement: Risk Assessment*
SO_2	Sulfur dioxide
TAPM-GRS	The Air Pollution Model – Generic Reaction Set
UDR	*Environmental Protection (Unauthorised Discharges) Regulations 2004* (WA)
VOCs	Volatile organic compounds
Works Approval Holder	Woodside Burrup Pty Ltd
$\mu g/m^3$	micrograms per cubic metre
µg/L	micrograms per litre

1. Purpose and scope of assessment

Woodside Burrup Pty Ltd (the Applicant) submitted an application (the Application) on 17 October 2019 to the Department of Water and Environmental Regulation (DWER) for a works approval in accordance with Part V, Division 3 of the *Environmental Protection Act 1986* (EP Act).

The Applicant is seeking approval to expand the Pluto Liquefied Natural Gas (LNG) Facility (Pluto LNG Facility) with the addition of a second LNG Train (Pluto Train 2) and Domestic Gas (Domgas) export facilities (the Premises). Construction and Commissioning of Pluto Train 2 (the Premises) triggers the requirement for a works approval in accordance with section 53 of the EP Act.

This Decision Report documents the Delegated Officer's risk assessment of emissions and discharges and determination of the Application consistent with DWER's *Guidance Statement: Risks Assessment* (DER, 2017) and *Guideline: Decision Making* (DWER, 2019) respectively.

1.1 Application details

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
Email titled '*Pluto Train 2 – Works Approval 3 (Train 2 Construction)*' including the following attachments: • Pluto T2 Works Approval 3 APPLICATION FORM – T2 Construction FINAL; and • Pluto T2 Works Approval 3 SUPPORTING DOC – T2 Construction FINAL	17 October 2019 (DWERDT213114)
Email titled 'RE: APPLICANT NOTIFICATION – WORKS APPROVAL APPLICATION, REQUEST FOR FURTHER INFORMATION' including the following attachments: • PT2 Construction WA – DWER 8 Nov Comments and Responses; • Pluto T2 Works Approval 3 SUPPORTING DOC T2 Construction 28 Nov CLEAN; • 26221-100-G01-GEH-00002 – Noise Management Plan IFR; • 26221-100-G01-GEH-00006 – Dust Management Plan IFR; • 26221-100-G01-00005 – Erosion and Sedimentation Management Plan IFR; • Pluto lng project---treated-waste-water-marine-discharge-management-plan; • Pluto T2 Works Approval Application Form – T2 Construction 28 Nov Signed	28 November 2019 (DWERDT228693)

2. Background

Pluto LNG Facility is located approximately 7 km northwest of the town of Dampier on the Burrup Peninsula.

Figure 1 depicts the location of Pluto LNG Facility in relation to nearby townships as well as protected and sensitive areas.

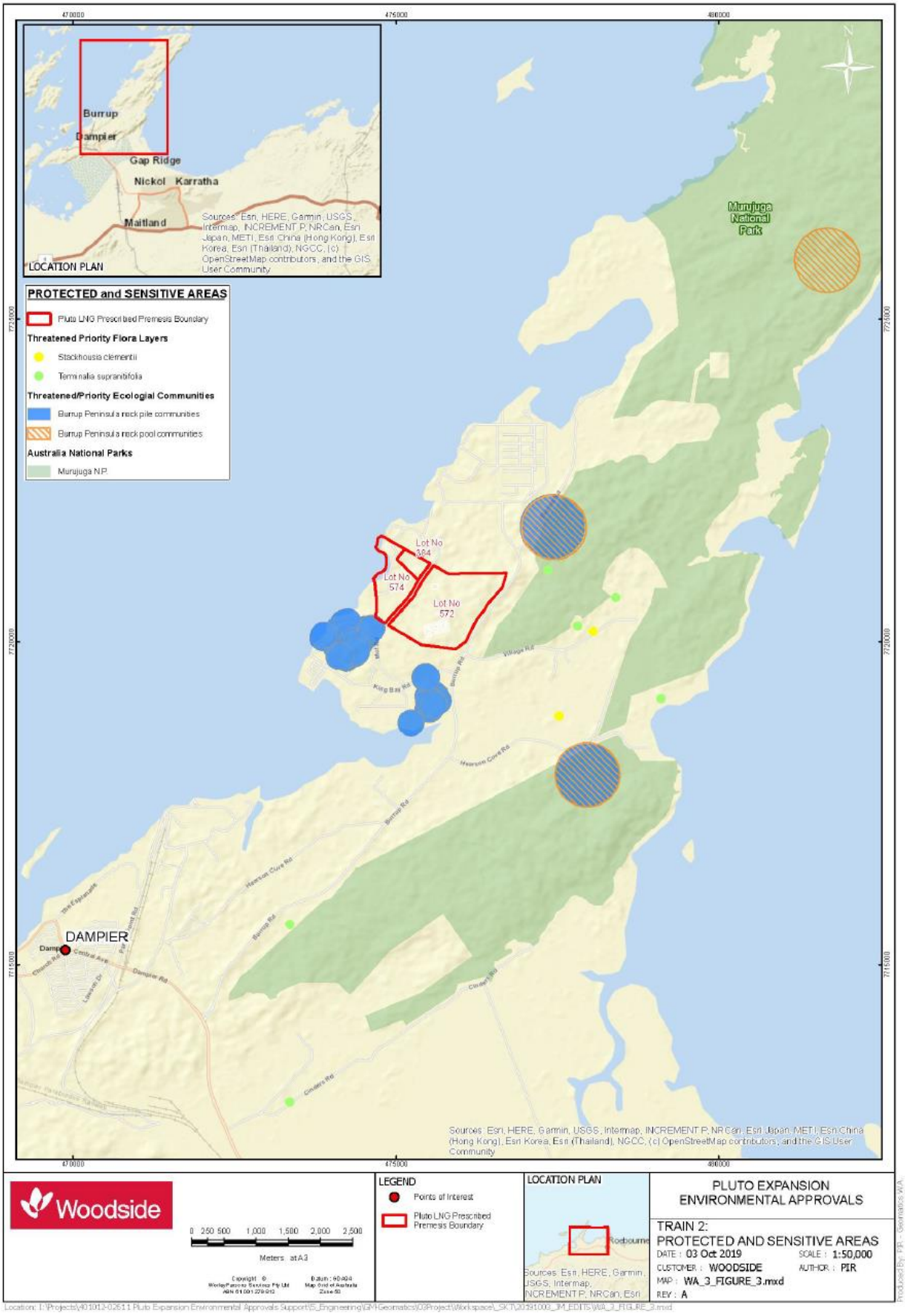

Figure 1: Pluto LNG Facility location (red line depicts Premises boundaries)

Existing Licence L8752/2013/2 was issued to the Applicant in July 2014 for the Pluto LNG Facility, which consists of a single processing train with a design capacity of 4.9 million tonnes per annum (Mtpa) of loadable LNG. The Pluto LNG Facility (Train 1) has been previously assessed and authorised under L8752/2013/2 and is not within the scope of this assessment.

The works approval application in relation to the Premises is for Prescribed Premises Categories 10, 34 and 52 and includes the construction, commissioning and (time-limited) operation of a second LNG train (Pluto Train 2) with a nominal capacity of 5.3 Mtpa, Domgas Plant with a nominal capacity of 225 terajoules per day (TJ/day) and common utilities and general facilities associated with the Premises.

Table 3 lists the Prescribed Premises Categories that have been applied for in the works approval application.

Table 3: Prescribed Premises Categories applied for

Classification of Premises	**Description**	***Assessed Premises production or design capacity***
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.	6.5 million tonnes per year
Category 34	Oil or gas refining: premises on which crude oil, condensate or gas is refined or processed.	5.3 million tonnes per year of LNG, and 82,125 terajoules per year of domgas
Category 52	Electric power generation: premises (other than premises within category 53 or an emergency or standby power generating plant) on which electrical power is generated using a fuel.	43 MW in aggregate

The application of Category 10 is related to the initial inlet facilities where the feed gas is "treated or separated to produce stabilised crude oil, purified natural gas or liquefied hydrocarbon gases" per the description in Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations). Although the feed gas is expected to be mostly dry with minimal separation required during normal operations, the inlet separator will enable separation and removal of minor amounts of water and condensate vapour should it be required. The current design capacity for the Scarborough upstream (offshore) facilities is 6.5 Mtpa meaning that the onshore inlet facilities will be capable of receiving 6.5 Mtpa of feed gas. This exceeds the design capacity of the Pluto Train 2 LNG processing plant (Category 34) which has a nominal design capacity of 5.3Mtpa. Excess feed gas may be used to backfill other operations such as Pluto Train 1 or, in the future, the Karratha Gas Plant via the Pluto-KGP Interconnector. The introduction of additional feed gas into these plants will be balanced with the reduction in existing feed meaning that the total overall throughput will not change.

3. Overview of Premises

3.1 Operational aspects

Pluto Train 2 will process natural gas from the Greater Scarborough gas fields located approximately 375 km west-northwest of the Burrup Peninsula in the Carnarvon Basin. Natural gas will be transported by a 430 km pipeline to the Premises. A beach valve and associated pipeline will be installed parallel to that of the existing Pluto LNG Facility pipeline to

transfer the gas from the shore crossing to the Premises.

The Domgas Plant will produce natural gas for export to the Dampier-Bunbury Natural Gas Pipeline (DBNGP) for domestic gas supply.

Power generation for the Premises will be integrated into the existing Pluto LNG Facility. A 43 megawatt (MW) Gas Turbine Generator (GTG) will provide additional power required for Pluto Train 2 (including the Domgas Plant). A 2 MW diesel generator will be installed to provide emergency standby power for essential equipment if the prime GTG is unavailable.

The major components of the Premises include:

- single nominal 5.3 Mtpa LNG processing train including gas conditioning, mercury removal, acid gas removal, dehydration, liquefaction and refrigerant compression, including nitrogen rejection and heavy hydrocarbon removal / condensate recovery and fractionation;
- single Domgas Plant with a nominal design capacity of 225 TJ/day production; and
- common utilities and general facilities including a 43WW GTG

Further information on each component of the Premises is detailed in the sections below.

Some infrastructure required to support the operation of the Premises has already been constructed and operates as part of the existing Pluto LNG Facility (Train 1), regulated under Existing Licence L8752/2013/2. This includes the pressure relief / liquids disposal and flare systems, LNG and condensate product storage and export facilities and the sewage and effluent treatment systems.

As such, construction of the Premises will require integration with some of the existing infrastructure and an amendment to Existing Licence L8752/2013/2 will be required to allow ongoing operations post the commissioning and time-limited operations authorised under works approval W6332/2019/1. Modifications to some of the supporting and utility units will be required during the construction process to allow integration with the existing Pluto LNG Facility.

3.2 Pluto Train 2 LNG plant

Natural gas will be processed through Pluto Train 2 to produce LNG and condensate. The Pluto Train 2 LNG process units include:

- inlet gas conditioning and condensate stabilisation;
- mercury removal;
- acid gas removal;
- dehydration; and
- liquefaction and refrigerant compression, including nitrogen rejection and heavies removal and inlet air chilling.

The treatment process is illustrated in Figure 2 and a description of each treatment stage is included in the following sections.

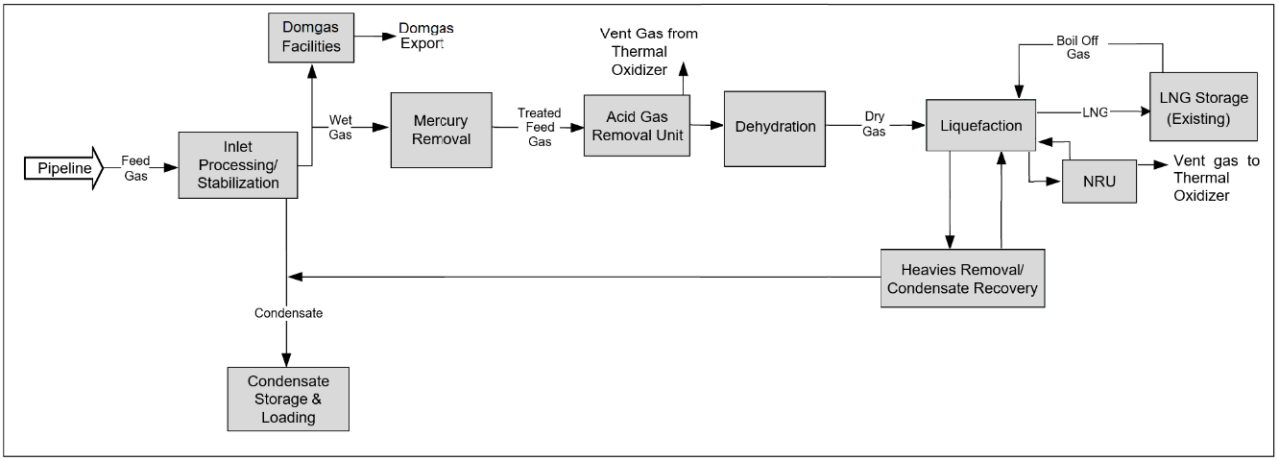

Figure 2: Pluto LNG Train 2 simplified treatment process

3.2.1 Inlet Gas Conditioning and Condensate Stabilisation

Feed gas from Scarborough feed pipeline entering through the inlet pig receiver and inlet separator is separated into process gas and wastewater streams. The stripped gas is transferred to the main gas feed line to Pluto LNG and Pluto Train 2 for processing and also to the Domgas facility.

3.2.2 Mercury removal beds

Feed gas progresses through the mercury removal beds to remove traces of mercury. This is essential to prevent corrosion of the aluminium heat exchangers used in the liquefaction process. The removal of mercury upstream to the Acid Gas Removal Unit (AGRU) is beneficial in that it reduces the requirement for flaring to dry out the mercury beds during upset conditions and post maintenance activities.

3.2.3 Acid Gas Removal Unit

The AGRU removes carbon dioxide (CO_2) and hydrogen sulfide (H_2S) gases (known as acid gas) from the feed gas using conventional activated methyl diethanolamine (aMDEA) technology. Removal of acid gas is required to prevent it from freezing out in the cryogenic sections of the processing train and to meet LNG product specifications.

The stripped acid gas containing approximately 93% CO_2, water and trace amounts of benzene, toluene, ethylbenzene and xylene (BTEX) and H_2S is destructed through the Acid Gas Recuperative Thermal Oxidiser (AGRTO), which achieves a typical destruction efficiency of more than 99%.Hydrocarbons and sulfur compounds will be oxidised to CO_2, oxides of sulfur (SOx) and water (H_2O). H_2S emissions are expected to be negligible as the feed gas contains less than 0.5 ppmv H_2S equivalent.

3.2.4 Dehydration

From the AGRU, feed gas is then sent to the dehydration system comprised of a molecular sieve that removes traces of water in the feed gas to prevent it freezing in the liquefaction unit. Water recovered from this process is recycled to the inlet facilities and the AGRU.

3.2.5 Liquefaction and Refrigerant Compression, including Nitrogen Rejection Unit, Heavies Removal Unit and Inlet Air Chilling

The ConocoPhillips Optimised Cascade® process is based on three multi-staged, cascaded refrigerant circuits using pure refrigerants, brazed aluminium heat exchangers and insulated cold box modules. ConocoPhillips has optimised the heat integration to closely approach the

natural gas and refrigerant cooling curves, resulting in a highly efficient process. Pure refrigerants of propane, ethylene and methane are utilised, since their physical properties are ideal for heat integration.

The feed gas is first treated to remove trace BTEX, before it is routed to the liquefaction section of the plant. The treated gas is then chilled and condensed to approximately -162°C in successively colder heat exchangers, using pure propane, ethylene, and methane as refrigerants. The LNG product is then pumped into insulated storage tanks where it remains until shipment. Boil-off gas and ship return vapours are captured and recycled through the ConocoPhillips Optimized Cascade® Process for efficient reliquefaction or directed to the storage and loading flare.

For each of the above refrigeration loops, two 50% compressors are used in parallel, driven individually by a General Electric LM6000PF+ DLE aero-derivative gas turbine, giving a total of six turbines across the process.

An Inlet Air Chilling (IAC) system is provided to chill the ambient air fed to each of the six liquefaction/refrigeration compressor gas turbine drivers. Chilling the inlet air not only increases the driver horsepower but also makes the driver less vulnerable to the fluctuations in the ambient air conditions; it has the added benefit of reducing emission rates.

A cryogenic Nitrogen Rejection Unit (NRU) is used in the LNG trains to remove excess Nitrogen. The NRU vent stream may contain up to 1.6 mol% of methane, as such this stream is routed to an NRU Recuperative Thermal Oxidiser (RcTO) to combust residual methane prior to venting to atmosphere. This is done to convert remaining methane in the vent gas to carbon dioxide thus lowering the equivalent greenhouse gas emissions, as methane is a higher potential greenhouse gas than carbon dioxide. In the event that the NRU is not available, the NRU vent gas is directed to the flare.

3.3 Domgas Plant Process Units

Figure 3 shows the simplified Domgas treatment process and a description of each treatment stage is included in the following sections.

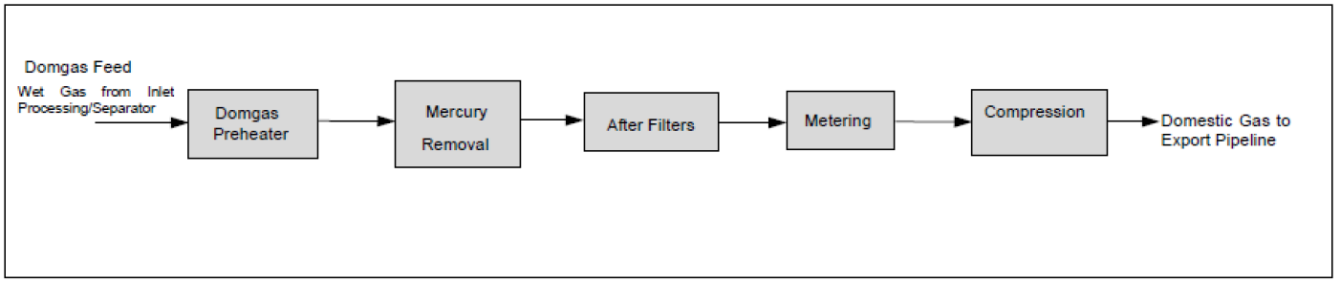

Figure 3: Domgas simplified treatment process

3.3.1 Inlet facilities

Feed gas will flow to the Domgas Plant from the inlet separator for preheating prior to further treatment.

3.3.2 Mercury removal

The Domgas Plant will employ mercury removal beds in a similar manner to the Pluto LNG Train 2 to remove traces of mercury to meet Domgas sales specifications. The mercury removal units (MRU) are closed circuit systems to prevent mercury emissions from the process.

3.3.3 Compression and metering

Treated Domgas is then compressed via an electric drive compressor, metered and sent to the DBNG pipeline.

3.4 Utilities and general facilities

Common utilities and general facilities to be constructed under W6332/2019/1 include:

- fuel gas and recycle gas systems;
- power generation;
- heating media system;
- refrigerant storage;
- plant and instrument air system;
- turbine inlet air chilling system; and
- pentane storage.

Facilities associated with the operation of Pluto Train 2 that are already constructed and authorised under Existing Licence L8752/2013/2 include:

- pressure relief / liquids disposal, flare and vent systems;
- diesel storage and distribution;
- LNG and condensate storage and export facilities;
- nitrogen system;
- firewater system;
- water supply systems; and
- water management (stormwater and effluent treatment systems).

The Delegated Officer notes that as part of the construction activities, Pluto Train 2 will be integrated with some of the above existing infrastructure as required. The connection of Pluto Train 2 to existing pollution control infrastructure presently servicing Pluto LNG Project will require assessment by the Delegated Officer to ensure existing infrastructure has design capacity to cope with increased loads associated with operation of Pluto Train 2. Potential impacts to the environment and human health as a result of the emissions and discharges of wastes associated with Pluto Train 2 will also be assessed to determine the risk of such emissions and the acceptability of proposed controls.

3.4.1 Utilities and general facilities to be constructed under W6332/2019/1

A description of the significant utilities and general facilities to be constructed under W6332/2019/1 is provided below.

Fuel gas and recycle gas systems

These systems provide a reliable supply of fuel gas to various components of the Premises. The fuel gas system comprises a high pressure system that supplies fuel gas to the GTCs and the GTG and a low pressure fuel gas system for the thermal oxidisers and other miscellaneous users.

The Pluto Train 2 fuel gas system recovers and processes all recycled gas streams for reuse, reducing the requirement for venting or flaring. Venting or flaring only occurs in the event of process upsets or off specification quality fuel gas.

Power generation system

The Premises power generation will be integrated to the existing Pluto LNG facility power generation system. A 43MW GE Frame 6B GTG will generate power to meet electricity requirements for Pluto Train 2, the Domgas Plant and common utilities. A 2MW emergency standby diesel generator will also be installed to power essential equipment in the event the GTG is offline. The standby diesel generator is expected to operate for approximately 50 hours per year.

Heating medium system

Waste heat recovery units (WHRU) will be installed in the exhaust ducts of each of the ethylene refrigeration compressor GTCs to meet plant heat demands. A closed-loop, hot oil heating medium is used to provide heat from the WHRUs to major users, including condensate stabilization facilities, AGRU regeneration and fractionation reboiler. The WHRUs will also supply heat required for the molecular sieve dehydrators in Pluto Train 2.

Refrigeration storage unit

The refrigeration storage unit is required to store the ethylene and propane used in the Pluto Train 2 refrigerant systems. Ethylene is stored in three pressurized, double walled, vacuum-jacketed, horizontal drums. Propane is stored in two propane storage drums. Refrigerants are trucked to the Premises, and any excess vapours generated during the offloading process will be directed to the dry flare.

Plant and instrument air systems

The plant and instrument air system produces dry air at an adequate pressure for process control and safeguarding instruments, and plant air for miscellaneous needs, including the nitrogen generation system. Two electric motor-driven air compressor packages, with discharge coolers and controls will be constructed for Pluto Train 2. Compressed air is sent to the Plant Air Receiver which provides surge control and helps maintain a constant header pressure, as well as to knock out any water present in the air. From there, the air is distributed to the plant air header for utility use. An Air Inlet Chilling system chills ambient air fed to each of the six GTCs to increase horsepower, provide stabilised air intake temperatures and reduce emission rates.

Pentane storage

Pentane is required for the HRU in the dry feed gas. Minor venting of pentane to the atmosphere will be required during the initial transfer of pentane to the HRU. However, once this process has been stabilised, pentane will be recycled and there will be minimal requirements for pentane make up from the storage tank.

3.4.2 Existing utilities and general infrastructure to Pluto Train 2

A description of existing utilities and general infrastructure that will incorporate Pluto Train 2 operations is provided below.

Pressure relief / liquids disposal, flare and vent systems

The existing Pluto LNG facility has a pressure relief and liquids disposal system, including wet and dry flares, which will be used for start-up, shutdown, emergency and maintenance depressurisation requirements of Pluto Train 2 facilities. An existing marine flare will be used to oxidise vapour from the LNG storage tanks and excess boil-off gas generated during LNG ship loading.

LNG bulk storage and loading

Pluto Stage 2 will utilise existing LNG storage tanks and loading facilities already constructed for Pluto LNG facility. Due to increased production rates, Pluto Train 2 will require additional boil off gas (BOG) compression to compress and return vapours to the Pluto Train 2 methane circuit for further processing. The LNG Product storage facility consists of two cryogenic LNG tanks each with a capacity of up to 160 000 cubic metres (m^3), and three condensate tanks with a combined capacity of up to 130 000m^3.

Nitrogen system

Nitrogen is required for Pluto Train 2 for use as a blanket gas for storage tanks, purge gas for the cold boxes, compressor gas seals and buffer, purge gas for repair and maintenance and other general uses. The existing liquid nitrogen system associated with Pluto LNG facility is sufficient to meet additional Pluto Train 2 requirements. A unidirectional take-off and tie-in will be installed from Pluto Train 2 to Pluto LNG for use across the Premises.

Firewater system

The existing Pluto LNG Facility has capacity to support the additional firewater requirements of Pluto Train 2. The existing fire water ring main will be extended to provide a new ring covering all Pluto Train 2 equipment and areas as required.

Water management

Process wastewaters and surface runoff will be generated during construction, commissioning and operation of Pluto Train 2. All water treatment processes will utilise existing systems and disposal methods at Pluto LNG facility authorised under Existing Licence L8752/2013/2. No new wastewater treatment systems are required to be constructed to manage wastewaters associated with the operation of Pluto Train 2.

Treated wastewater from the Premises will continue to be discharged to an existing effluent discharge outfall (the Water Corporation Multi User Brine Line (MUBRL)) which is regulated via Ministerial Statement (MS) 594. The disposal of treated wastewater from Pluto LNG is also authorised under MS 757 and managed via the approved Pluto LNG Project Treated Wastewater Marine Discharge Management Plan (TWWMDMP).

Further details of the handling, treatment and discharge of wastewaters and stormwater from the Premises is detailed in sections 6.3 and 10.6.

3.5 Infrastructure

The Pluto Train 2 infrastructure, as it relates to Category 10, 34 and 52 activities, is detailed in Table 4 and with reference to the Site Plan (attached in the Works Approval).

Table 4 lists infrastructure associated with each prescribed premises category.

Table 4: Pluto LNG Train 2 Category 10, 34 and 52 infrastructure

	Infrastructure	**Site Plan Reference (Refer to Figure 4)**
	Prescribed Activity Category 10 and 34	
Pluto Train 2 processes natural gas from the offshore Scarborough gas fields that is transported via a 430km long subsea pipeline to the onshore LNG processing facility on the Burrup Peninsula. Feed gas is processed via Pluto Train 2 to produce LNG and domestic gas which is then exported via ship or for domestic supply via the DBNGP. Feed gas may also be routed from the inlet facilities to Pluto Train 1 or KGP for processing (future).		

	Infrastructure	Site Plan Reference (Refer to Figure 4)

1	1 x 5.3 Mtpa LNG Train (includes three multi-staged refrigerant circuits driven by 6 x GE LM6000PF+ DLE aero-derivative GTCs with Dry Low NOx emissions reduction control
	Train 2 includes:
	Mercury Removal Unit installed upstream of Acid Gas Removal Unit
	Acid Gas Removal Unit including:
	• Utilisation of aMDEA technology to reduce hydrocarbon absorption and subsequent venting through the AGRU;
	• Flash gas recovery and reuse in the process, to maximise efficiency of resource use; and
	• Acid Gas Recuperative Thermal Oxidiser with:
	  • Designed to reduce BTEX emissions by at least 99% of incoming levels
	  • Closed drainage system
	Molecular sieve Dehydration Unit
	Heavies removal unit (HRU)
	Liquefaction unit
	Air Inlet Chilling system for compressor gas turbines (increases driver horsepower, make more stable and reduces emission rates)
	Nitrogen Removal unit (NRU) with NRU Recuperative Thermal Oxidiser
	Ethylene refrigerant GTCs to have Waste Heat Recovery Units (WHRUs) with closed loop, hot oil heating medium for heat supply elsewhere in the process.
		Train 2 boundary depicted by purple line

2	1 x Inlet gas conditioning and condensate stabilisation system including inlet pig receiver and inlet separator.	
3	1 x 225 TJ/day Domgas Plant including pre-heating unit, mercury removal unit, after filters, electric drive compressor and metering unit.	Domgas
	Prescribed Activity Category 52	
Electrical power is provided by one GTG which provides 43 MW of power for Pluto Train 2, the Domgas Plant and common utility and offsite areas.		
1	1 x 43 MW GE Frame 6B GTG with Dry Low NOx emissions reduction control	A22
2	1 x 2 MW Standby diesel generator including inbuilt diesel day tank contained within skid.	A23
	Directly related activities	

1	Utilities and general facilities including:
	• Fuel gas and recycle gas systems;
	• Refrigerant storage unit, including:
	  • 3 x ethylene storage drums that are pressurised, double walled and vacuum jacketed; and
	  • 2 x propane storage drums;	

	Infrastructure	Site Plan Reference (Refer to Figure 4)
	• Fire water protection system; • Pentane storage (required for HRU in the dry feed gas); • 2 x Boil Off Gas Blowers for compression and return of vapours during ship loading to the Train 2 methane circuit for further processing; • Premises surface water drainage systems to ensure segregation and direction to appropriate treatment / disposal facilities as required; • Open surface water systems designed to collect and direct clean away from premises infrastructure and processing areas; and • Bunding / kerbing around process areas and tank storage areas.	

The location of infrastructure associated with Pluto Train 2 and Domgas Plant is shown in Figure 4 below.

3.6 Commissioning

Construction of Pluto Train 2 and the Domgas Plant is expected to occur in parallel over a four-year period. Hydrostatic and pneumatic testing of piping systems will occur once construction of various equipment is complete.

The Applicant has advised that commissioning of the plant will occur in three stages: pre-commissioning, commissioning and environmental commissioning. Pre-commissioning will include individual component testing and function checking to verify that individual components are functioning correctly prior to testing them together as a whole system during the commissioning phase. Pre-commissioning will include activities such as flushing, chemical cleaning, calibration and testing of instruments, filling refrigerant storage tanks and testing of valve tightness. Emissions to air are not generally expected during pre-commissioning however there is likely to be small isolated flaring events associated with the filling of the refrigeration bullets.

After pre-commissioning, the plant will move into start-up phase (commissioning) which includes the introduction of feed gas and other process fluids to bring the plant into an operational state. Commissioning is the process of initial operation and testing to verify that equipment and systems are installed correctly and functional. The GTG is the first component to be commissioned and will undergo initial start-up approximately six months prior to the introduction of feed gas into the LNG Plant allowing sufficient time for the GTG to be integrated into the existing power supply network. Once integration is complete, the GTG may be shut down until required for start-up of the LNG processing train. Commissioning of the LNG processing train following introduction of feed gas is expected to occur over a period of 18 months.

Environmental commissioning is the final phase which occurs once the plant has achieved operational state. It is the first year of steady state operation and involves performance testing to verify system operational parameters against design. Emissions verification testing is conducted during environmental commissioning to validate actual environmental performance against predicted performance. A period of 12 months has been requested to ensure that performance testing captures fluctuations associated with seasonal atmospheric conditions.

Timeframes for the various stages of commissioning are detailed in Table 5.

Table 5: Commissioning Timeframes

Commissioning phase	Duration
Pre-commissioning	Completed progressively following construction of individual components
Commissioning	24 months Includes initial start-up of the GTG six months prior to the introduction of feed gas to the LNG processing train.
Environmental commissioning (emissions verification during steady state)	12 months

Hydrostatic testing

Approximately 600m^3 of water will be required for hydrostatic testing of pipework; 160m^3 for carbon steel and stainless steel pipework, and 440m^3 for high density polyethylene (HDPE) piping.

Hydrostatic testing of all pipework will occur intermittently over a 15-18 month period with the total volume of any individual event not exceeding 5m^3.

Wastewater generated during hydrostatic testing of carbon and stainless steel piping will be assessed for contamination prior to discharge to the onsite stormwater network. The assessment will consider the pH and electrical conductivity of wastewater, as well as presence of an oily sheen (indicating hydrocarbon contamination). If wastewater is considered contaminated, it will be removed from site by a licensed contractor or directed to the ETP

Wastewater generated during hydrostatic testing of HDPE pipework is not expected to contain contaminants and will be discharged directly to the onsite stormwater drainage network.

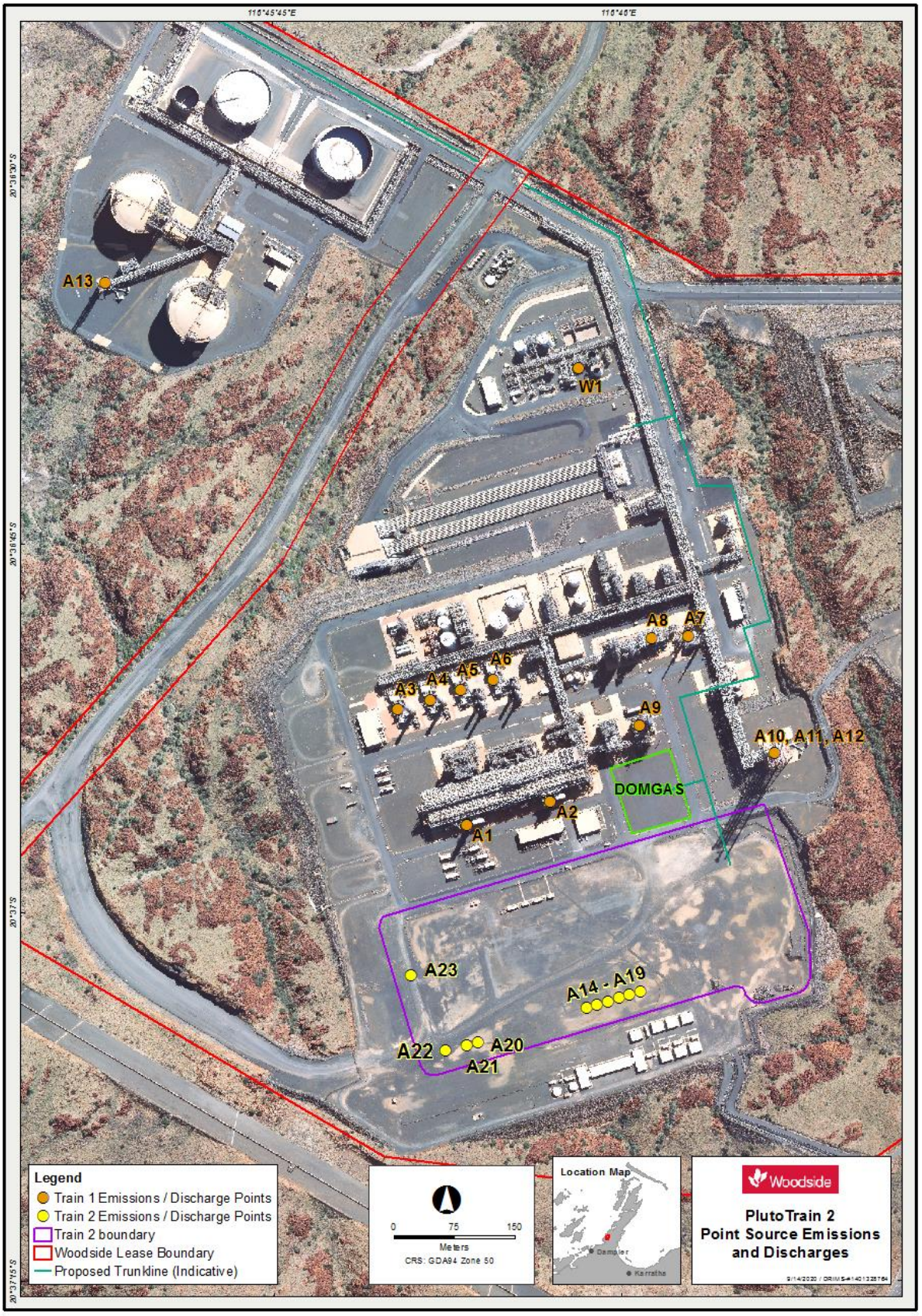

Figure 4 Pluto Train 2 layout location, including Domgas Plant

3.7 Exclusions to the Premises

The existing Pluto LNG (Train 1) Facility, including LNG and bulk condensate storage tanks, pressure relief / liquids disposal, flare and vent systems, diesel storage tanks and distribution systems, and sewage and effluent treatments systems have been previously assessed and is regulated under Existing Licence L8752/2013/1. The operation of, and discharges from, Pluto LNG (Train 1 Facility) has therefore been excluded from this assessment.

The Delegated Officer notes however, that some of the Premises infrastructure (Pluto Train 2) will be integrated with the existing Train 1 infrastructure, some of which will serve as essential pollution control or safeguarding equipment required to allow Pluto Train 2 and the Domgas Plant operations.

Where required, the Delegated Officer has reviewed the capacity and design specifications of existing infrastructure to support the operation of the existing Pluto LNG facility as well as the proposed new Premises comprising Pluto Train 2 and Domgas Plant operations. Where applicable, the Delegated Officer has considered other regulatory approvals and legislative frameworks that are already in place to regulate specific discharges from the Premises. These are discussed further in section 5. In line with DWER's *Guidance Statement: Setting Conditions* (DER 2015b), works approval and licence conditions will not unnecessarily duplicate requirements imposed on an Applicant directly by the EP Act or another written law.

In line with State government policy, greenhouse gas emissions (in addition to other environmental factors) are regulated) under Part IV of the EP Act via Ministerial Statement (MS) 757. Further detail on aspects of Pluto LNG project that are regulated under MS 757 is provided in section 5.1 below. In addition, works approval applications have been submitted to DWER for construction and operation of a crushing and screening plant (category 12 prescribed premises) and a concrete batching plant (category 77 prescribed premises) that will be used to support the construction of Pluto Train 2. These Prescribed Premises have been assessed and authorised under works approvals W6299/2019/1 and W6307/2019/1 respectively and are not considered in this assessment.

4. Legislative context

Table 6 summarises approvals relevant to the assessment.

Table 6: Relevant approvals and tenure

Legislation	Number	Approval
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	Decision Notice 2006/2968	EPBC 2006/2968 is the existing approval for Pluto LNG. This approval also covers proposed expansion activities.
Dangerous Goods Safety Act 2004 (WA)	Dangerous Goods Licence DGS021370	Approval for the storage of dangerous goods on the Premises
City of Karratha Town Planning Scheme No. 8. Administered in accordance with the provisions of the *Planning and Development Act 2005* (WA).	Development Application DA21052	The project was referred to the Regional Joint Development Assessment Panel (JDAP). The City of Karratha recommended approval subject to conditions.
Part IV of the EP Act (WA)	Ministerial Statement (MS) 757	Ministerial Approval granted on 24 December 2007. See section 5.1 for a summary of MS 757.

Legislation	Number	Approval
	MS 850	Amendment to MS 757 was granted via MS 850 on 19/1/2011. Conditions 6-12 to 6-14 were amended (benthic community health survey to be repeated annually for three years after completion of marine works and report to EPA annually.
Part V of the EP Act (WA)	W4368/2007/1	Category 85 (Sewage facility)
	W4444/2008/1	Works approval authorising construction of Pluto LNG Train 1 (categories 10, 52 and 73)
	W4466/2008/1	Category 61 and 85 – drainage infrastructure and Effluent Treatment Plant
	L8299/2008/1	Category 12 (Screening etc. of material) and category 85 (Sewage facility) licence. Was revoked on 5/9/2013
	L8752/2013/1	Categories 10, 34, 62, 61 and 85 licence (Pluto LNG Train 1)
	L8752/2013/2	Licence reissue: categories 10, 34, 62, 61 and 85 licence (Pluto LNG Train 1)
	W6332/2019/1	Works approval application to authorise construction, commissioning and time limited operations of Pluto LNG Train 2
Aboriginal Heritage Act 1972 (WA)	55346	Consent to disturb heritage under section 18 for Site A and other locations not relevant to the proposal
	11-8877	Consent to disturb heritage under section 18 for Site B

4.1 Part IV of the EP Act

4.1.1 Background

The proposal to construct and operate Pluto LNG Facility (Train 1 and Train 2) was referred to the EPA under Part IV of the EP Act in April 2006. As the proposal involves issues which fall under both State and Commonwealth jurisdictions, the Environmental Impact Assessment was carried out jointly by the EPA and the Commonwealth's (then) Department of the Environment and Heritage. The level of assessment was set at Public Environmental Review under the EP Act and Public Environmental Report under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A common ten-week public review period was set and a Draft PER was published in December 2006 to satisfy both State and Commonwealth government jurisdictions under the

joint assessment process. The public review period commenced on 11 December 2006 and closed on 19 February 2007.

In July 2007, the EPA released its report and recommendations on the project (Report Number 1259), and Ministerial Approval was granted on 24 December 2007 subject to the conditions outlined in MS 757.

MS 757 was granted for two gas treatment trains with a capacity of 12 Mtpa. Pluto LNG Facility is currently a 4.9 Mtpa single-train LNG plant processing gas from Pluto and Xena gas fields with the first cargo shipped in 2012. The Applicant has recently submitted several updated management plans required under MS 757 to the EPA incorporating the Pluto Train 2 for EPA assessment and Ministerial approval.

4.1.2 Ministerial Statement 757

MS 757 authorises development of the Pluto LNG facility including the following key proposal characteristics:

- two LNG processing trains with a total nominal capacity of 12 million tonnes per year of LNG;
- each train to have a liquefaction plant;
- Domgas plant with nominal capacity of about 4 million tonnes per annum;
- two cryogenic LNG storage tanks (each with capacity of 160,000m^3);
- three condensate storage tanks (each with capacity of up to 130,000m^3);
- 4 x flares (storage and loading flare, wet flare, LNG flare and common spare flare);
- gas trunkline from gas filed to LNG plant;
- dredging of up to 14 million m^3 to allow for navigation channel, turning basin, berth pocket and nearshore trunkline trench;
- marine disposal of spoil in three approved locations;
- 500m long export jetty; and
- Wastewater treatment plant and marine outfall for discharge of up to 1,000m^3 per day.

MS 757 contains conditions that have been considered by the Delegated Officer in the assessment of emissions and discharges from the Premises and the imposition of regulatory controls. These are summarised in Table 7.

Table 7: Consideration of MS 757 conditions relevant to this application

Condition(s)	Overview	Delegated Officer considerations
7-1 to 7-9	7 - Deepwater Marine Outfall Condition 7-1 requires that any wastewater discharged to the marine environment occurs at a depth greater than 30m outside the Dampier Archipelago, unless otherwise authorised by the CEO under Part V of the EP Act. Condition 7-2 requires the development of a Treated Wastewater Marine Discharge Management Plan (TWWMDMP) for wastewater generated by Pluto LNG that is discharged to the marine environment. The Plan must address a range of requirements, including setting of environmental values, environmental quality objectives (EQO's) and levels	The Delegated Officer has considered the requirements of MS 757 and has reviewed the TWWMDMP. The TWWMDMP includes management measures for the treatment and disposal of produced formation water (PFW), water from process equipment (such as hot water loops), contaminated stormwater, demineralised water and treated sewage and greywater. The Delegated Officer also notes that the discharge of treated wastewater to marine environment are regulated via

Condition(s)	Overview	Delegated Officer considerations
	of ecological protection to be achieved around the discharge outfall. Whole of Effluent Toxicity (WET) testing is required to determine the toxicity of wastewater, evaluation of potential risks to the marine environment from the discharge and determination of the number of dilutions required to meet a high level of ecological protection (99% species protection level). The TWWMDMP also requires a monitoring and reporting program be implemented to determine whether these objectives are being met. Conditions 7-5 to 7-6 require the applicant to characterise the physical and chemical compositions and contaminant discharge loads of wastewater streams, demonstrate that the wastewater discharge will meet "best practicable technology" and waste minimisation principles for contaminants. Condition 7-7 requires design and subsequent operation of plant and equipment on the site such that: 1. the contaminant concentrations in the wastewater effluent from the site, just prior to entry to the wastewater discharge system, meet (in order of preference): • the ANZECC/ARMCANZ (2000) 99% species protection level; or • the ANZECC/ARMCANZ (2000) 99% species protection level at the edge of an approved mixing zone; 2. the concentrations of contaminants in the wastewater effluent which can potentially bio-accumulate / bio-concentrate meet the ANZECC/ARMCANZ (2000) 80% species protection trigger levels just prior to entry into the wastewater discharge system; and 3. mass balances and inventories of toxicants can be maintained throughout the life of the plant so that their fate can be traced. Condition 7-9 requires the applicant to develop a Contingency Wastewater Management Plan that considers alternative options for wastewater disposal if EQO's are not met. The Proponent is required to implement the approved plan as well as make it publicly available, review the plan on an annual basis and undertake specified reporting.	conditions on the Pluto LNG Project Existing Licence L8752/2013/2, which: • authorises the discharge of treated effluent from the ETP to Water Corporations discharge pipe to King Bay via the Multi-user Brine Return Line (MUBRL); and • requires quarterly monitoring and annual reporting for a range of pollutants (hydrocarbons, metals, process additives, nutrients and other physico-chemical parameters) in the treated effluent discharged via the MUBRL. The proposed additional discharge to marine environment from Pluto Train 2 (and the Existing Licence conditions) will require review and assessment of by the Delegated Officer to ensure the proposed discharge volumes and monitoring regimes remain environmentally acceptable. The proposed discharge and existing management controls will be therefore be assessed in section 9.6 of this Decision Report. The Applicant will be required to apply for an amendment to L8752/2013/2 or a new licence to allow discharges to occur from Pluto Train 2 operations. Licence conditions relating to the discharge will be reviewed to assess duplication with commitments made in the TWWMP and Part IV requirements.
9-1 to 9-5	Condition 9 – Turtle Management and Monitoring Condition 9-1 requires the Applicant prepare a Turtle Management Plan (TMP) to the requirements of the Minister for the Environment. The objectives of the TMP are: • to provide a management framework to enable the proponent to manage the project so as to	The Primary instrument for regulating the impact on marine turtles from light and noise emissions is MS 757 and the TMP. The TMP includes management strategies for minimising light and noise/vibration emissions during construction of Train 2 operation on both Trains 1 and 2.

Condition(s)	Overview	Delegated Officer considerations
	detect and mitigate as necessary any impact upon marine turtles from the project; and • to identify darkness strategies to reduce as far as possible lights or light glow interfering with nesting female turtles and hatchlings. The TMP shall: 1. identify project-related stressors, causes of environmental impacts and potential consequences for marine turtles (including impact of noise, vibration, light overspill and glow, vessel strike, and changes to coastal processes); and 2. identify and demonstrate the effectiveness of proposed management measures to mitigate project-related impacts and consequences for marine turtles. The Proponent is required to implement the approved TMP as well as make it publicly available, review the plan on an annual basis and undertake specified reporting.	Monitoring specified in the TMP includes a marine turtle monitoring program to detect changes to the turtle population and apply mitigation measures should noise or light emissions from Pluto LNG Project impact on marine turtles. The Delegated Officer notes that light and noise emissions from the Premises that potentially impact on turtles is regulated via MS 757 and the TMP. The Risk event of noise and light impacting on turtles is therefore not within the scope of the Application.
11-1 to 11-4	Condition 11 – Air Emissions Condition 11-1 requires the Applicant to submit a detailed Front End Engineering Design (FEED) Report demonstrating that the proposed works adopt best practice pollution control measures to minimise emissions from the gas plant, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority. This Report shall: 1. set out the base emission rates for major sources for the plant and the design emission targets; and 2. address normal operations, shut-down, and start-up, and equipment failure conditions. Condition 11-2 requires the Applicant to prepare an Air Quality Management Plan (AQMP) to the requirements of the Minister for the Environment at least three months prior to commencement of operations. The objective of the AQMP is to ensure that best available practicable and efficient technologies are used to minimise and monitor air emissions from the gas plant. This Plan shall include: 1. cumulative air quality modelling which uses data from the FEED Report and includes emissions from approved industrial sources at Cape Preston and Barrow Island; 2. proposed targets and standards; 3. an emissions monitoring program, which includes nitrogen compounds, butene, toluene, ethylene, xylene, ozone, acrylene and hydrogen sulfide emissions from the gas plant;	The AQMP requires the use of Best Available Technologies to minimise and monitor air emissions from the gas plant, using targets and limits to implement a specified monitoring and reporting program. The Delegated Officer has reviewed the AQMP and the FEED report and considers that the works approval is a suitable instrument to confirm the works associated with Pluto Train 2 meet emission design specifications. Commitments made in the AQMP and FEED report will be considered as part of this Decision Report to determine the acceptability of emissions to air from Pluto Train 2. The Delegated Officer will review the adequacy of proposed monitoring regimes and adopted targets and limits for Pluto Train 2 and conduct a risk assessment in line with DWER's Regulatory Framework to determine acceptability of emissions and proposed management measures. The Delegated Officer notes Existing Licence L8752/2013/2 contains conditions authorising emissions to air from Pluto LNG Project, and imposes discharge limits (for NOx) from the generators and (for dark smoke) the flares. Regular monitoring is also required for NOx emissions from the GTCs and GTG as well as dark smoke monitoring during flaring events. The proposed air emissions from Pluto Train 2 and existing management

Condition(s)	Overview	Delegated Officer considerations
	4. an ambient air monitoring program and a nitrogen deposition monitoring program; and 5. annual reporting. The Proponent is required to implement the approved AQMP as well as make it publicly available.	controls will be therefore be assessed in section 10.3 of this Decision Report. The Applicant will be required to apply for an amendment to L8752/2013/2 or a new licence to allow emissions to occur from Pluto Train 2 operations. Licence conditions relating to the air emissions will be reviewed to assess duplication with commitments made in the AQMP and Part IV requirements.

Key Finding:

The Delegated Officer notes that there is potential for regulatory duplication between Part IV and Part V of the EP Act. In setting regulatory controls, the Delegated Officer will consider the requirements of MS 757, and commitments made in Management Plans and Programs required by MS 757, and will avoid duplication in Licence conditions.

The Delegated Officer has determined not to duplicate the following matters in accordance with the Guidance Statement: Setting Conditions

1) Turtle Management and Monitoring. Conditions 9-1 to 9.5 of MS 757 are sufficient for regulating potential impacts of light and noise to turtles in the vicinity of the Premises.

The Delegated Officer considers that the following matters require assessment under Part V of the EP Act:

2) Discharges of treated wastewater to the marine environment to ensure treatment infrastructure and monitoring regimes are adequate for incorporation of additional wastewater streams generated by Pluto Train 2; and

3) Air emissions associated with the commissioning and operation of key gas treatment infrastructure associated with Pluto Train 2, including the cumulative ambient emissions expected in the region, the proposed monitoring regimes and targets and limits to be adopted.

These matters relate to altered emissions from an existing prescribed premises that may cause a material change to the assessed emissions profile of that premises, and therefore require assessment.

4.2 Legislative framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs

Murujuga (the Dampier Archipelago, including the Burrup Peninsula and surrounds) is a unique ecological and archaeological area containing one of the largest collections of Aboriginal engraved rock art (petroglyphs) in the world. The rock art is of continuing cultural, archaeological and spiritual significance for Aboriginal people and also has significant state, national and international heritage value. The Western Australian Government is committed to the ongoing protection of Murujuga's rock art and is working in partnership with the Murujuga Aboriginal Corporation (MAC), representing the Traditional Custodians of Murujuga, to protect and manage this important area.

In 2002, the Western Australian Government established the Burrup Rock Art Monitoring Management Committee (BRAMMC) in response to concerns about possible adverse impacts on the rock art from industrial air emissions. BRAMMC commissioned a number of independent scientific studies to investigate the possible effects of current and future industrial emissions on rock art. These studies included measurements of air quality, assessment of microclimate, dust

deposition, colour change, mineral spectrometry, microbiological analyses, accelerated weathering studies and air dispersion modelling studies. The scientific reports from these studies were independently peer reviewed by international experts in relevant disciplines.

In 2009, subsequent to the review of the investigation findings, BRAMMC concluded there was no scientific evidence of any measurable impact of industrial emissions on the rate of deterioration of the Burrup rock art and recommended establishing a technical working group to replace BRAMMC, and for annual monitoring of colour contrast and spectral mineralogy monitoring of rock art for a period of ten years (subject to review after five years). The Burrup Rock Art Technical Working Group (BRATWG) was established to oversee the colour change and spectral mineralogy monitoring program and other studies between September 2010 and June 2016. The monitoring program was funded with contributions from industry on the Burrup Peninsula. The then Department of Environment Regulation managed the monitoring program from the expiry of BRATWG's tenure in June 2016 until the formation of DWER on 1 July 2017.

The methodology used and conclusions of some of the research studies and monitoring undertaken since 2004 has been subject to criticism. Independent reviews of the monitoring programs conducted on the Burrup Peninsula were subsequently commissioned by DWER which recommended redesign of the rock art monitoring program based upon well-established principles of experimental design to provide more robust, replicable and reliable information about the impacts of air emissions on the rock art.

In September 2017, the Western Australian Government released the draft Burrup Rock Art Strategy for public comment. The draft strategy established a long-term framework to protect Aboriginal rock art on the Burrup Peninsula. In September 2018 the Minister for Environment established the Murujuga Rock Art Stakeholder Reference group (MRASRG) to facilitate engagement between MAC and key government, industry and community representatives on the development and implementation of the renamed Murujuga Rock Art Strategy. The reference group is currently chaired by Dr Ron Edwards and includes representatives from MAC, the Australian Government and state government departments, the Pilbara Ports Authority, the Western Australian Museum, the City of Karratha, industry and scientists.

In February 2019, the Minister for Environment released the Murujuga Rock Art Strategy which was finalised in consultation with the MRASRG. The purpose of the strategy is for the protection of aboriginal rock art located on Murujuga from the potential impacts of anthropogenic emissions.

The strategy establishes long-term framework for the management and monitoring of environmental quality to protect the rock art on Murujuga from the impacts of anthropogenic emissions. The framework outlined in the strategy is intended to address the shortcomings in the design, data collection and analysis of the rock art monitoring program that were identified by independent reviewers. The strategy builds on previous studies and provides a transparent, risk-based and adaptive approach to deliver a scientifically rigorous approach to the monitoring and management to protect the rock art.

The scope of the strategy is to:

1. establish an Environmental Quality Management Framework, including the derivation and implementation of environmental quality criteria that are based on sound scientific information;
2. develop and implement a robust program of monitoring and analysis to determine whether change is occurring to the rock art on Murujuga;
3. identify and commission scientific studies to support the implementation of the monitoring and analysis program and management;
4. establish governance arrangements to ensure that:
    a. monitoring, analysis and reporting are undertaken in such a way as to provide

confidence to the Traditional Owners, the community, industry, scientists and other stakeholders about the integrity, robustness, repeatability and reliability of the monitoring data and results; and

b. government is provided with accurate and appropriate recommendations regarding the protection of the rock art, consistent with legislative responsibilities; and

5. develop and implement a communication strategy in consultation with stakeholders.

DWER is responsible for the day-to-day implementation of the Murujuga Rock Art Strategy in partnership with MAC and in consultation with the MRASRG. DWER and MAC are working in partnership to oversee the development and implementation of a scientific monitoring and analysis program (Murujuga Rock Art Monitoring Program) under the strategy that will determine whether the rock art on Murujuga is subject to accelerated change. MAC is the central organisation for developing and managing all research within Murujuga. The Murujuga Research Protocols have been developed by MAC as a set of governing principles and guidelines to ensure that research is conducted in a respectful and culturally appropriate manner.

The Murujuga Rock Art Monitoring Program will be undertaken in close consultation with a team of national and international experts in relevant disciplines and MAC will be involved in all aspects of the monitoring program. The development and implementation of the monitoring program will be informed by the findings and lessons from scientific studies and monitoring of the rock art on Murujuga, as well as information available in the scientific literature to deliver a scientifically rigorous approach to monitoring and analysis.

The scientific monitoring and analysis program will monitor, evaluate and report on changes and trends in the condition of the rock art and whether the rock art is showing signs of accelerated change to determine if anthropogenic emissions are accelerating the natural weathering/alteration/degradation of the rock art. Independent peer review processes will provide assurance that the best scientific information is available to guide management actions. A contract was awarded to Puliyapang Pty Ltd, a joint venture between Calibre Ventures Pty Ltd and Tocomwall Pty Ltd, for the Murujuga Rock Art Monitoring Program in February 2020. Funding for the monitoring program is being provided by Woodside, Rio Tinto and Yara Pilbara.

In addition to the Murujuga Rock Art Monitoring Program, the strategy provides for establishment of an atmospheric deposition network which will be established to provide data on the composition and concentration of contaminants that are potentially transferred from the atmosphere to the rock surfaces. The strategy also acknowledges that the Western Australian Government is considering establishment of a long-term coordinated ambient air quality network on Murujuga and the surrounding areas to inform decision making relating to ambient air quality in the region.

Through implementation of the Murujuga Rock Art Strategy, DWER has engaged a consultant to provide advice to support the development of an ambient air quality network suitable for monitoring human health impacts at Murujuga and neighbouring population centres. The study will takes into consideration the existing and future emissions from industry, shipping, vehicles, port operations and other anthropogenic activities in the region. The study scope includes making recommendations on suitable locations for monitoring stations, key pollutant sources to be monitored, instrument types required, meteorological monitoring requirements and ensuring compliance with Australian standards for air monitoring equipment. The outcomes of the study will inform decision making on establishment of a long-term coordinated ambient air quality network on Murujuga. Information on monitoring and analysis of the Murujuga rock art will be published on DWER's website. This will include the strategy, annual reports detailing the results of data collection and analysis, reports from scientific studies, the reports of independent peer reviewers and annual reports on the implementation of the strategy.

Table 8 below includes a summary of current legislative framework relevant to the Murujuga

rock art.

Table 8: Summary of State and Commonwealth legislation targeted at protecting rock art

Mechanism **(and responsible government)**	**Date**	**Protections**
Murujuga National Park (WA)	17 January 2013	Murujuga National Park is owned in freehold by MAC. The land is leased back to the Western Australian Government as national park and is jointly managed by MAC and DBCA in accordance with the policy direction provided by the Murujuga Park Council (MPC). MPC comprises representatives from MAC, DBCA and a representative appointed by the Minister for Aboriginal Affairs. Increased protection of rock art is provided by applying the provisions of the *Conservation and Land Management Act 1984* (CALM Act) to formally protect the park's values. The Park is operated in accordance with the Murujuga National Park Management Plan 78 (2013) and the Murujuga Cultural Management Plan (2016) which focuses on protection and awareness of the cultural and natural values of the area. The Rangers of Murujuga Land and Sea Unit (MLSU) conduct the practical management of the Park and the surrounding sea country and islands along with DBCA staff.
Aboriginal Heritage Act 1972 (WA)	NA	Specific localities on the Burrup have been declared Protected Places under the *Aboriginal Heritage Act 1972*. Consent is required from the WA Minister for Aboriginal Affairs for any activity which will negatively impact Aboriginal heritage sites.
Burrup and Maitland Industrial Estates Agreement (WA)	January 2003	The State Government entered into the Burrup and Maitland Industrial Estates Agreement (the BMIEA) with three native title claimant groups (Ngarluma-Yindjibarndi, Yaburara-Mardudhunera and the Woon-Goo-Tt-Oo). This agreement enabled the State Government to compulsorily acquire native title rights and interests in the area of the Burrup Peninsula and certain parcels of land near Karratha. The BMIEA allows for industrial development to progress across southern parts of the Burrup Peninsula and provides for the development of a conservation estate (Murujuga National Park). The Department of Jobs, Tourism, Science and Innovation is the lead agency for the development of the Burrup Strategic Industrial Area and LandCorp is the estate manager.
Burrup and Maitland Industrial Estates Agreement Additional Deed (WA)	16 January 2003	The State Government committed to organise and fund a minimum four-year study into the effects of the industrial emissions on rock art within and in the vicinity of part of the industrial estate on the Burrup Peninsula. The four-year scientific rock art monitoring program, included: • Two studies for the monitoring of ambient concentrations of air pollutants and microclimate and deposition undertaken by CSIRO Atmospheric Research; and • Two further programs for artificial fumigation of rock surfaces and fieldwork on rock surface colour changes undertaken by CSIRO Manufacturing and Infrastructure Technology. Following completion of these studies, in 2009 the Burrup Rock Art Monitoring Management Committee recommended that the studies

Mechanism (and responsible government)	Date	Protections
		on ambient air quality and rock microbiology monitoring be suspended and only recommenced if warranted by a major increase in emissions or if evidence becomes available to require further monitoring.
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) – Listing of the Dampier Archipelago (which includes the Burrup Peninsula) as a National Heritage place (Cth)	3 July 2007	The Dampier Archipelago was assessed by the Australian Heritage Council in 2007 and found to meet five of the eight criteria for national heritage listing under the EPBC Act. The listing of the Dampier Archipelago 'recognised the extraordinary extent, diversity and significance of petroglyphs, standing stones and circular stone arrangements of the place'. National heritage listing means that any proposed action that could have a significant impact on the National Heritage listed portion of the Burrup Peninsula must be referred to the Commonwealth Minister for the Environment as a matter of national environmental significance for assessment and decision. The Pluto LNG Facility (Trains 1 and 2) was referred to the Department of the Environment and Heritage in April 2006 for assessment under the EPBC Act. Section 5.1.1 details the outcome of this referral.
EPBC Act Conservation Agreements (Cth)	2007	At the time of listing on the National Heritage List, EPBC Act Conservation Agreements were signed by the then Commonwealth Minister for the Environment and Water Resources with Woodside Energy Ltd, and Rio Tinto (Hamersley Iron Pty Ltd and Dampier Salt Ltd). Under the Conservation Agreements, these companies provide funding for research, management and monitoring of the National Heritage values of the place.
The Deep Gorge Joint Statement (DGJS) (Cth)	July 2017	The DGJS, signed by the Australian Government, Woodside and Rio Tinto, reaffirms the commitments made under each of the bilateral Conservation Agreements to support the ongoing protection, conservation and management of the National Heritage values of Murujuga and the wider Dampier Archipelago.
Woodside Energy Ltd approval for Pluto Liquefied Natural Gas Development (WA)	December 2007	Offsets package for Pluto LNG required the rehabilitation/ restoration of degraded areas that fall both outside of the lease and outside of areas of potential industrial development. The program initiated as a result of this requirement aims to rehabilitate and restore degraded areas on the Burrup Peninsula. The program includes rock art site rehabilitation and restoration.

In addition to the legislative framework described in Table 9, a recent inquiry conducted under section 46 of the EP Act included recommendations relating to ambient air quality and the rock art on Murujuga. In April 2018, the Minister for Environment requested the EPA to review MS 870 (granted for the construction and operation of the TAN Plant). The request was to "*inquire into and report on the matter of changing implementation condition 5-1: Air Quality in Ministerial Statement 870 for the above proposal to protect rock art*".

As an outcome to the inquiry the EPA concluded that "*the Murujuga Ambient Air Quality Monitoring Network and Murujuga Rock Art Monitoring Program (once established) would be the most appropriate overarching systems through which the monitoring on Murujuga should be coordinated regarding ambient air quality monitoring and rock art monitoring. This would ensure that the responsibility for such monitoring is shared amongst all existing and future industrial emitters in an equitable manner*". Key recommendations of the EPA resulting from the inquiry included:

- Prior to the Murujuga Ambient Air Quality Monitoring Network and Murujuga Rock Art Monitoring Program being established, and when the opportunity arises, the ministerial conditions of other existing industrial facilities located on Murujuga should be changed via section 46 of the EP Act, to include a requirement to reduce the risk of impacts to rock art from air emissions.
- When the Murujuga Ambient Air Quality Monitoring Network and Murujuga Rock Art Monitoring Program have been established the ministerial statements of existing industries should be changed via section 46 of the EP Act to remove any requirements for the proponents to undertake their own individual ambient air quality monitoring and / or rock art monitoring where necessary and include a requirement for the proponent to contribute to the airshed monitoring activities.

4.3 Contaminated sites

There are currently no sites registered under the *Contaminated Sites Act 2003 (CS Act)* within the Premises.

4.4 Other relevant approvals

4.4.1 Planning approvals

The Premises is located within the City of Karratha, which is responsible for administering Town Planning Scheme No. 8, gazetted in August 2000.

The Pluto LNG Project site (including Pluto Train 2) and surrounding area is zoned as 'Strategic Industry' in accordance with City of Karratha Town Planning Scheme No. 8.

An application for planning and development approval (DA21052) was submitted to the City of Karratha on 17 February 2021 and referred to the JDAP. The City of Karratha recommended approval subject to conditions which include the requirement to develop management plans addressing noise, light, stormwater management, dust and waste management.

4.4.2 Department of Mines, Industry Regulation and Safety (DMIRS)

The Premises includes infrastructure for the storage and processing of hydrocarbons. The premises is considered a Major Hazard Facility and is subject to the requirements of the *Dangerous Good Safety (Major Hazard Facilities) Regulations 2007*.

A Dangerous Goods Licence (DGS021370) for the storage of dangerous goods on the Premises has been obtained under the *Dangerous Goods Safety Act 2004*.

4.4.3 *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

Pluto LNG Facility was referred to the Commonwealth Department of the Environment and Heritage on 1 August 2006 for assessment under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Assessment was conducted in parallel with the assessment under the EP Act. Approval for Pluto LNG under the EPBC Act was granted on 12 October 2007 (EPBC 2006/2968).

4.5 Part V of the EP Act

4.5.1 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 listed in Appendix 1.

4.5.2 Works approval and licence history

Table 9 summarises the works approval and licence history for the premises.

Table 9: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
Letter	24/9/2007	WBPL requested approval for the construction of the LNG and Condensate tanks. Due to the long lead time associated with construction of the tanks, it was necessary for WBPL to commence construction of these facilities prior to the LNG plant and associated infrastructure. Prior to the commissioning of the LNG tanks and associated pipes, WBPL were required to submit a pre-commissioning activities plan.
W4368/2007/1	27/9/2007	Works approval for Sewage Treatment Plant (category 85).
W4444/2008/1	1/9/2008	Works approval for 1 LNG processing train (categories 10 and 34).
W4466/2008/1	3/9/2009	Works approval for Effluent Treatment Plant (category 61 and 85).
L8299/2008/1	5/3/2009	Licence for WWTP (category 85).
L8299/2008/1	19/05/2011	Licence amendment to change the premises boundary and include categories 12 and 13
L8299/2008/2	22/03/2013	Amendment to remove category 13.
W4444/2008/1 (amendment)	22/10/2010	WBPL applied for an amendment to the works approval on 22 September 2010 to incorporate a temporary warm wet flare to conduct initial commissioning activities of the project until the permanent flare infrastructure was completed WBPL applied for an amendment to this works approval on 9 October 2010 to incorporate crushing and screening operations. This was previously conducted by mobile plant operating under mobile plant licenses which were no longer being issued. Thus, WBPL was required to hold the approval to conduct these activities at the Pluto LNG Project.
L8299/2008/1 (amendment)	19/5/2011	The premises boundary was amended and categories 12 and 13 were added.
W4444/2008/1 (amendment)	9/08/2012	WBPL applied for an amendment to the works approval on 29 May 2012. Due to unforeseen delays associated with commissioning, the project Plant was not estimated to be fully operational until early 2013. WBPL also advised they were unable to install a sampling point on one of the emergency vent stacks. As a solution, a single sampling point was installed on the pipe upstream of the particular emergency vent stack. This sampling point is located in an accessible location and allows gas sampling to be undertaken.
W4444/2008/1 (amendment)	14/02/2013	WBPL applied for an amendment to the works approval on 20 December 2012 to extend the expiry date to 31 July 2013. Due to unforeseen issues and delays associated with commissioning, the Pluto Gas Plant was not estimated to be fully operational until early 2013. The works approval was to expire on the 31 March 2013 (and was extended during 2012 from 23 August 2012 to this date). The extension allowed WBPL to complete commissioning of the facility and required environmental studies for approval closeout.
L8752/2013/1	25/07/2013	New Licence issue for operation.
L8299/2008/1	8/09/2013	Licence revoked to facilitate all prescribed premises categories being managed under Licence L8752/2013/1.

L8752/2013/2	24/07/2014	Licence reissue.
L8752/2013/2	16/04/2015	Licence amendment to change nitrogen and phosphorous targets from concentrations to annual loading rates.
L8752/20132	21/01/2016	Amendment to remove ambient air quality monitoring.
W6332/2019/1	DRAFT	Works approval for the construction and commissioning of Pluto Train 2.

4.5.3 Clearing

The Premises will be constructed on an existing developed lot therefore no clearing of native vegetation is required.

4.6 Key findings for Pluto Train 2 legislative context

Key findings: The Delegated Officer has reviewed the legislative context for the Pluto Train 2 and has found:

1. There are multiple industries (including shipping within the Dampier Port) located on the Burrup and surrounds with discharges to air which could potentially have an adverse impact on the rock art on the Burrup Peninsula.
2. The Murujuga Rock Art Strategy has been finalised and is being implemented. The strategy establishes a long-term framework for the monitoring and analysis of changes to rock art on Murujuga and describes the management responses which will be triggered in the event adverse impacts on the rock art are identified.
3. Monitoring for impacts to the rock art will be implemented through the Murujuga Rock Art Monitoring Program. A contract has been awarded for the implementation of the monitoring program.
4. The monitoring program will be subject to independent peer review and information on monitoring and analysis of the Murujuga rock art will be made publicly available via DWER's website.
5. The regulatory framework described is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long-term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.
6. The Western Australian Government is considering establishment of a long-term coordinated ambient air quality network on Murujuga (Murujuga Ambient Air Quality Monitoring Network) and the surrounding areas for monitoring human health impacts and has commenced a study, through the Murujuga Rock Art Strategy, designed to investigate and make recommendations regarding the establishment of such a program.
7. The EPA considers the Murujuga Ambient Air Quality Monitoring Network and the Murujuga Rock Art Monitoring Program to be the most appropriate overarching systems through which the monitoring of ambient air quality and rock art should be coordinated. The EPA has made recommendation to the

Minister for Environment that the ministerial conditions of other existing industrial facilities on Murujuga should be changed to reduce the risk of impact to rock art from air emissions to remove requirements for individual monitoring networks and instead contribute to air shed monitoring.

8. DMIRS is the primary regulatory authority for regulating public health risks associated with the storage and handling of dangerous goods and major hazard facilities.

5. Modelling and monitoring data

5.1 Air Quality Impact Assessment

Condition 11 of MS 757 requires the Applicant to conduct cumulative air quality modelling of the Pluto LNG Project. In support of the Pluto Train 2 design and construction activities, a revised Air Quality Management Plan (AQMP) and Air Quality Impact Assessment (AQIA) was prepared by the Applicant. The AQMP provides a framework for management of emissions to air that have the potential to impact human health as a result of operation of the Pluto LNG Project and Pluto Train 2. The AQIA incorporates cumulative ambient air quality modelling to identify potential air quality impacts under various emissions scenarios, including existing and proposed industrial developments on the Burrup Peninsula.

The CSIRO air dispersion model, TAPM-GRS was used for the AQIA. Air emissions inventories for inputs were developed by the Applicant based on emissions estimates considering available datasets, design data, monitoring data and Pluto Train 2 preliminary design data.

Historical air quality monitoring data obtained from the Applicant's Burrup Ambient Air Quality Monitoring Program (BAAQMP)that ran from 2008 to 2011 was used in the AQIA to inform existing (background) air quality for the Burrup Peninsula.

Determination of pollutants and emission sources

The construction and operation of Pluto Train 2 will comprise major emission to air sources including six GTCs, one GTG, and two Recuperative Thermal Oxidisers (RcTOs). The GTCs and the GTG are combustion engines that emit air pollutants such as CO and NOx while the RcTOs are used for destruction of VOCs (or hydrocarbons, specifically BTEX) and CH_4 in waste streams from the AGRU and NRU. The operation of Pluto Train 2 will also require integration and utilisation of existing flares at Pluto LNG Project, which are sources of NOx and CO. Flaring is required for pressure relief and liquids disposal and is limited to start-up, shutdown, upset, emergency and maintenance conditions. Black smoke (soot) can be generated during flaring events as a result of incomplete combustion of hydrocarbons. The production of ozone (O_3), which occurs as a result of emissions of NOx and other pollutants such as VOCs and CO in the presence of ultraviolet light, is also considered a significant secondary pollutant from operation of Pluto Train 2.

A screening method was employed to risk assess the pollutants of most concern from expansion of the Pluto LNG Project and inform the air emissions modelling study. The secondary pollutant O_3 was considered to present the highest risk of adverse air quality impact (in terms of potential impact to human health). The requirement for modelling of O_3 as a secondary pollutant was determined by reviewing previous air quality monitoring data and also by calculating the potential for production of O_3 as a result of 70% of NO_x emissions by mass.

Ambient air quality monitoring conducted as part of the BAAQMP has shown that benzene is consistently well below relevant standards and is therefore unlikely to pose a credible human health risk. CO concentrations from point source emissions are readily dispersed from exhaust stacks and are typically mixed well below criteria concentrations within exhaust plumes. The results of previous air quality studies for CO identified that all scenarios were less than 1% of the NEPM (Ambient Air Quality) assessment criteria. As such these pollutants were excluded from additional modelling and ambient monitoring programs. The screening method also determined that, given the feed gas has a very low content of sulfur, and the Burrup Peninsula has no known history of H_2S odour complaints, and H_2S was not identified as a key pollutant by any previous air quality studies, H_2S was not considered an emission of interest.

Airborne particulate matter (PM) as PM_{10} and $PM_{2.5}$ from Pluto Train 2 was not modelled. Although exceedances of ambient air quality standards for PM does occur on the Burrup

Peninsula, they are primarily due to events such as smoke from bushfires and controlled burns, raised dust, and other industrial sources. Modelling performed for the original works approval for Pluto LNG Project did not predict any increase in PM_{10} emissions above the existing ambient levels during operation of both treatment trains. Emissions of PM from Pluto Train 2 are therefore considered negligible in relation to these other sources.

CO_2 is considered a greenhouse gas and is not considered further in this Decision Report. The Applicant has developed a Greenhouse Gas Abatement Program (Woodside, 2011) to manage greenhouse gas emissions in accordance with the requirements of MS 757 (conditions 12-1 to 12.4) which is being updated to include Train 2.

Four air emissions scenarios were modelled in support of Pluto LNG expansion (including operation of Pluto Train 2) as detailed in Table 10.

Table 10: Modelled scenarios included in AQIA

Modelling type	Scenario	Description and emission sources
Current and expansion	Current Baseline (CBM)	This scenario represents the existing air emissions mostly applicable to the Burrup Strategic Industrial Area (BSIA) and the region to use as a baseline assessment. The CBM scenario incorporates existing emissions from: • Karratha Gas Plant; • Pluto LNG Plant; • Yara Technical Ammonium Nitrate Plant; • Yara Liquid Ammonium Plant; • Pilbara Iron Yurralyi Maya Power Station; • Santos Devil Creek Power Station; • ATCO Karratha Power Station; • EDL West Kimberley Power Plant; and • All shipping berths on the Burrup Peninsula.
	Pluto Future State (PFS)	CBM emissions plus the operation of Pluto Train 2.
Sensitivity	Future BSIA (FBSIA)	CBM emissions plus the operation of Pluto Train 2 as well as other potential future proposals such as the Urea and Methanol plant proposals. This scenario represents the best estimate of future air quality.
	Pluto operational upset condition (PUC)	A worst-case operational upset condition based on the FBSIA with abnormal operations to include concurrent elevated flare operations.

Current and expansion modelling scenarios (Current Baseline and Pluto Future State) and sensitivity modelling scenarios (Future BSIA and Pluto Operational Upset Condition) were run by the model. The two primary scenarios associated with the Application to construct and operate Pluto Train 2 include the CBM and PFS. The FBSIA represents the best estimate of the future air emissions scenario, while the PUC scenario represents a 'worst case' scenario for testing short-term emissions.

Current and expansion modelling scenarios

The modelling results for the predicted maximum ground level concentrations (GLCs) for the current and expansion scenarios for relevant air pollutants NO_2, O_3 and SO_2 in comparison to the NEPM (Ambient Air Quality) standards and are summarised in Table 11, Table 12 and Table 13 below.

Table 11: Summary of modelled results for NO_2 (maximum grid point result) for CBM and PFS scenarios

	GLC for NO_2 (ppb)			
Averaging Period	**Max 1-hour**		**Annual**	
NEPM Criteria	**120**	**% criteria**	**30**	**% criteria**
CBM	42.6	36%	5.0	17%
PFS	42.6	36%	5.2	17%

Note 1: GLC values include background concentrations modelled.

There were no predicted NO_2 exceedances of the NEPM (Ambient Air Quality) standards of 120 ppb and 30 ppb for the CBM and PFS scenarios.

Table 12: Summary of modelled results for O_3 (maximum grid point result) for CBM and PFS scenarios

	GLC for O_3 (ppb)			
Averaging Period	**Max 1-hour**		**Max 4-hour**	
NEPM Criteria	**100**	**% criteria**	**80 (rolling)**	**% criteria**
CBM	61.8	62%	58.2 (step-wise)	73%
PFS	62.3	62%	58.6 (step-wise)	73%

Note 1: GLC values include background concentrations modelled.

The modelled 4-hour average O_3 is not a 'rolling average' that would be needed for comparison with the NEPM (Ambient Air Quality) standard (80 ppb). Therefore the 4-hour average results have not been provided in this report. However, the step-wise 4-hour average O_3 results provided in the standard TAPM output should provide a reasonable indication of the rolling 4-hour averages.

There were no predicted exceedances of the corresponding NEPM (Ambient Air Quality) standard of 100 ppb for either of the scenarios modelled. The results for 4-hour average O_3 GLCs indicate a low likelihood of exceedance of the corresponding NEPM (Ambient Air Quality) standard (80 ppb).

Table 13: Summary of modelled results for SO_2 (maximum grid point result) for CBM and PFS scenarios

	GLC for SO_2 (ppb)					
Averaging Period	**Max 1-hour**		**Max 24-hour**		**Max 1-year**	
NEPM Criteria	**200**	**% criteria**	**80**	**% criteria**	**20**	**% criteria**
CBM	18.1	9%	7.0	9%	4.5	23%
PFS	18.1	9%	7.0	9%	4.5	23%

Note 1: GLC values include background concentrations modelled.

There were no predicted SO_2 exceedances of the NEPM (Ambient Air Quality) standards for the CBM and PFS scenarios modelled.

Sensitivity modelling scenarios

The modelling results for the predicted maximum GLCs for the sensitivity scenarios for relevant air pollutants in comparison to the NEPM (Ambient Air Quality) standards and are summarised in Table 14, Table 15 and Table 16 below.

It should be noted the PUC sensitivity scenario modelling is conservative. The modelled emission sources have been defined to identify the worst potential impact(s) accounting for time-varying meteorological conditions.

Table 14: Summary of modelled results for NO_2 (maximum grid point result) for FBSIA and PUC scenarios

	GLC for NO_2 (ppb)			
Averaging Period	**Max 1-hour**		**Max 1-year**	
NEPM Criteria	**120**	**% criteria**	**30**	**% criteria**
FBSIA	43.9	37%	5.8	19%
PUC	43.6	36%	5.8	19%

Note 1: GLC values include background concentrations modelled.

There were no predicted NO_2 exceedances of the NEPM (Ambient Air Quality) standards of 120 ppb and 30 ppb for any of the scenarios.

Table 15: Summary of modelled results for O_3 (maximum grid point result) for FBSIA and PUC scenarios

	GLC for O_3 (ppb)			
Averaging Period	**Max 1-hour**		**Max 4-hour**	
NEPM Criteria	**100**	**% criteria**	**80 (rolling)**	**% criteria**
FBSIA	63	63%	59.7 (step-wise)	75%
PUC	63.2	63%	59.4 (step-wise)	74%

Note 1: GLC values include background concentrations modelled.

There were no predicted O_3 exceedances of the NEPM (Ambient Air Quality) standard of 100 ppb for either of the sensitivity scenarios modelled.

Table 16: Summary of modelled results for SO_2 (maximum grid point result) for FBSIA and PUC scenarios

	GLC for SO_2 (ppb)					
Averaging Period	**Max 1-hour**		**Max 24-hour**		**Max 1-year**	
NEPM Criteria	**200**	**% criteria**	**80**	**% criteria**	**20**	**% criteria**
FBSIA	18.1	9%	7.0	9%	4.5	23%
PUC	18.1	9%	7.0	9%	N/A	N/A

Note 1: GLC values include background concentrations modelled.

There were no predicted SO_2 exceedances of the NEPM (Ambient Air Quality) standards for the scenarios FBSIA and PUC. Note the modelled results shown in Table 15 compared to

Table 12 show no significant differences in predicted maximum grid point GLCs. The reason is there were insignificant differences in the SO_2 emissions between the four scenarios.

Results of modelling and previous ambient monitoring indicate:

- there were no predicted exceedances of ambient air quality standards for NO_2, O_3, and SO_2 for any of the scenarios modelled.
- the predicted effects from emissions of PM_{10} and $PM_{2.5}$ were slight in comparison with background levels. It is acknowledged that exceedances of ambient air quality standards for PM_{10} and $PM_{2.5}$ occur on the Burrup Peninsula, but these are mainly due to smoke from bushfires and controlled burns, raised dust, and other industrial sources.

Further assessment of the outcomes of the modelling of GLCs of NO_2, O_3 and SO_2 at nearest receptors is detailed in section 10.3.

5.2 Monitoring of local ecosystem

A range of environmental management plans and monitoring and reporting regimes are in place for the existing Pluto LNG facility to identify potential impacts as a result of its operations. Ecosystem monitoring relevant to the Application include monitoring of emissions to surface water and air during operation of Pluto LNG Project. The Applicant has committed to continuation of existing monitoring regimes which will incorporate operations from Pluto Train 2.

5.3 Monitoring of emissions to surface water

In accordance with MS 757, the Applicant is required to implement a Treated Wastewater Management Plan (TWWMP) for treated water from the Effluent Treatment Plant (ETP) and the Sewage Treatment Plant (STP) that is discharged to the marine environment. Both the ETP and the STP are existing facilities that have been assessed and authorised under Existing Licence L8752/2013/2. Treated wastewater that is not able to be re-used or recycled is disposed of via an ocean outfall, the Water Corporation's Multi-User Brine Return Line (MUBRL) that discharges to King Bay within Mermaid Sound. The MUBRL is authorised under MS 594. Average discharge volumes from the MUBRL (from other sources external to Pluto LNG) are approximately 16,000 ML/annum.

The TWWMP outlines how disposal of treated process wastewater from operation of the Pluto LNG Project, and stormwater runoff from process areas, is undertaken and managed in a way that reduces the environmental impacts to as low as reasonably practical (ALARP) and in accordance with State and Federal approvals. Whole effluent toxicity testing of treated wastewater and analysis of performance trends has enabled a selection of site specific discharge standards to be applied during operations. Ongoing water quality monitoring throughout operation of the water treatment plants, and regular repeats of the whole effluent toxicity monitoring for the life of the Pluto LNG Project, ensures the discharge standards remain appropriate and continue to be met.

The Existing Licence L8752/2013/2 requires quarterly monitoring of a range of water quality parameters relevant to the wastewater discharge stream, which includes process wastewater and treated domestic wastewater (sewage). Reporting of results is required annually via an Annual Environmental Report.

5.4 Monitoring of emissions to land

The Existing Licence L8752/2013/1 authorises discharge of treated domestic wastewater (sewage) to a dedicated irrigation field on the Premises and requires quarterly monitoring of treated wastewater, including flow rates, nutrients (nitrogen and phosphorus), 5 day biochemical oxygen demand, Total Suspended Solids, E. coli and pH. Reporting of results is

required annually via an Annual Environmental Report.

5.5 Monitoring of emissions to air

Ambient Air monitoring

The Applicant has an ambient air monitoring program in place, which was establish on the Burrup Peninsular (including monitoring at locations on the Burrup Peninsular and at Dampier and Karratha) in 2008 and continued until 2015.. Prior to this program, the Pilbara Air Quality Study (PAQS) was undertaken by the Government of Western Australia in the early 2000s including investigations of monitoring data.

In accordance with MS 757, the Applicant has committed to continuing its ambient air monitoring program until a coordinated approach under the State Murujuga Rock Art Strategy is established. The Applicant has made publically available the Pluto LNG Air Quality Management Plan (AQMP) that outlines how emissions to air from Pluto LNG (including Pluto Train 2) will be managed and monitored during operations.

Point Source Air Emissions monitoring

Monitoring of point source emissions to air is required under Existing Licence L8752/2013/2. NOx stack emissions tests from the Pluto LNG Project GTCs, GTGs and Regenerative Thermal Oxidiser is required annually, and monitoring of dark smoke emissions is required during flaring events. Reporting of results is required annually via an Annual Environmental Report.

5.6 Key findings for Pluto Train 2 modelling and Pluto LNG Project (historical) monitoring data

Key findings: The Delegated Officer has reviewed the modelling and monitoring for Pluto Train 2 and has found:

1. Predictive modelling of cumulative ambient air emissions within the Burrup, Dampier and Karratha airsheds indicate there is unlikely to be exceedance of the NEPM (Ambient Air Quality) criteria during operation of Pluto Train 2 under normal operating conditions as well as during short term upset conditions.
2. Existing monitoring and reporting of emissions and discharges to air, land and water (marine environment) are required under Existing Licence L8752/2013/2.
3. The Applicant has committed to continuation of existing monitoring regimes which will incorporate operations from Pluto Train 2.

6. Consultation

The application for a Works Approval was made available on DWER's website for public comment from 13 January 2020 to 3 February 2020.

Four letters were also sent to direct interest stakeholders inviting submissions.

A summary of comments received from direct interest stakeholders is contained in Appendix 2.

7. Location and siting

7.1 Siting context

The Premises is located on the Burrup Peninsula approximately 7 km northeast of the town of Dampier. Surrounding land uses are predominantly industrial, with Karratha Gas Plant, Dampier Cargo Wharf and Yara Pilbara Fertilisers / Yara Technical Ammonium Nitrate Plant located nearby. Additional land uses include tourism, public recreation and heritage conservation.

7.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 17.

Table 17: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Hearson's Cove (public recreational beach popular for swimming, fishing and picnic)	3 km southeast of Premises boundary
Residential Premises (within Dampier)	6.3 km south west of Premises boundary
Town of Karratha	14 km southeast

7.3 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 18. Table 18 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.*

Table 18: Environmental values

Specified ecosystems	Distance from the Premises
Parks and Wildlife Managed Lands and Waters	Murujuga National Park is located 300m east of the Premises boundary. The Park encompasses eastern areas and the majority of the northern portion of the Burrup Peninsula. Murujuga National Park is jointly managed by the representatives of Murujuga Aboriginal Corporation (MAC) and the Department of Biodiversity and Conservation Attractions (Parks and Wildlife Service). The park lies within a larger National Heritage Listed place, created in July 2007 over the Burrup Peninsula and the Dampier Archipelago. The area contains one of the densest concentrations of rock engravings (petroglyphs) in Australia with some sites containing thousands or tens of thousands of images estimated to be as old as 40,000 years. The majority of the Burrup Peninsula and Dampier Archipelago are also being nominated for inscription on the World Heritage List, to have its unique cultural, spiritual and archaeological values internationally recognised at the highest level.
Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs)	• Priority 1 PECs (multiple): Burrup Peninsula Rock Pile Communities located adjacent to southwestern Premises boundary; • Priority 1 PECs (multiple): Burrup Peninsula Rock Pile Communities located 275m south of Premises boundary • Priority 1 PEC: Burrup Peninsula Rock Pile Communities located 520m north east of Premises boundary; and • Priority 1 PEC: Burrup Peninsula Rock Pool Communities located 520m north east of Premises boundary

Biological component	Distance from the Premises
Threatened/Priority Flora	• *Terminalia supranitifolia (*Priority 3 flora listed under the *Biodiversity Conservation Act 2016* (WA) (BC Act) and the EPBC Act) located approximately <1km east of Premises boundary; and • *Stackhousia clementi (*Priority 3 flora listed under the BC Act and the EPBC Act (Cwth)) located approximately 1.6km and 1.8km from Premises boundary.
Threatened/Priority Fauna	Sea Turtles: the Dampier Archipelago and its beaches form a large area of 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. Most nesting occurs on offshore islands, however, Holden Beach, situated immediately south of the existing Pluto LNG jetty, also supports smaller numbers of nesting turtles most years. Holden beach is a north-west facing beach, approximately 590m in length. Other specially protected fauna (mammal) listed under the BC Act recorded 50m west of Premises boundary (at jetty).
Other relevant ecosystem values	**Distance from the Premises**
Mermaid Sound and the Dampier Archipelago	Located directly to the north east. The western boundary of the premises is defined by a section of the Mermaid Sound coastline. Mermaid Sound is located within the Dampier Archipelago, a chain of 42 islands that form the richest area of marine biodiversity known in Western Australia, with coral reefs, shoals, sponge gardens, seagrass and more than 650 fish species. The Dampier Archipelago holds significant conservation, recreation and cultural values for local people.

7.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 19.

Table 19: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Major watercourses/ waterbodies	There are no significant surface water courses or waterbodies in the vicinity of the Premises. No major catchments drain through the Premises. An existing internal stormwater drainage system with appropriate sediment controls discharges clean stormwater to natural drainage lines away from the premises.	N/A
Groundwater	Depth to groundwater is encountered at approximately 11m below ground level (BGL). Based on the location of Pluto LNG in relation to Mermaid Sound, the direction of the groundwater flow is considered likely to occur to the west and north west. Groundwater conditions were identified as generally neutral, anaerobic, and saline in nature (Woodside, 2019) Potential groundwater use throughout the Pluto LNG Development area is severely constrained due to the high salinity (in excess of 70 000 µg/cm). This precludes the groundwater from a range of uses including human or livestock consumption and stock, domestic and industrial purposes.	Water is not used for potable or industrial use. Groundwater system linked to marine ecosystem.

8. Meteorology

8.1.1 Regional climatic aspects

The Burrup Peninsula experiences a hot, wet summer with periodic heavy rains from October to April and a mild winter season with occasional rain from May to September.

Intense rainfall may occur during the passage of summer tropical cyclones and thunderstorms. Three to four cyclones per year are typical of the region, usually between December and March. 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. Figure 5 shows the 9am and 3pm rose of wind graphs for Dampier Salt. Predominant annual wind directions are easterly, south-easterly and westerly winds in the mornings and north-easterly, north-westerly and westerly in the afternoons.

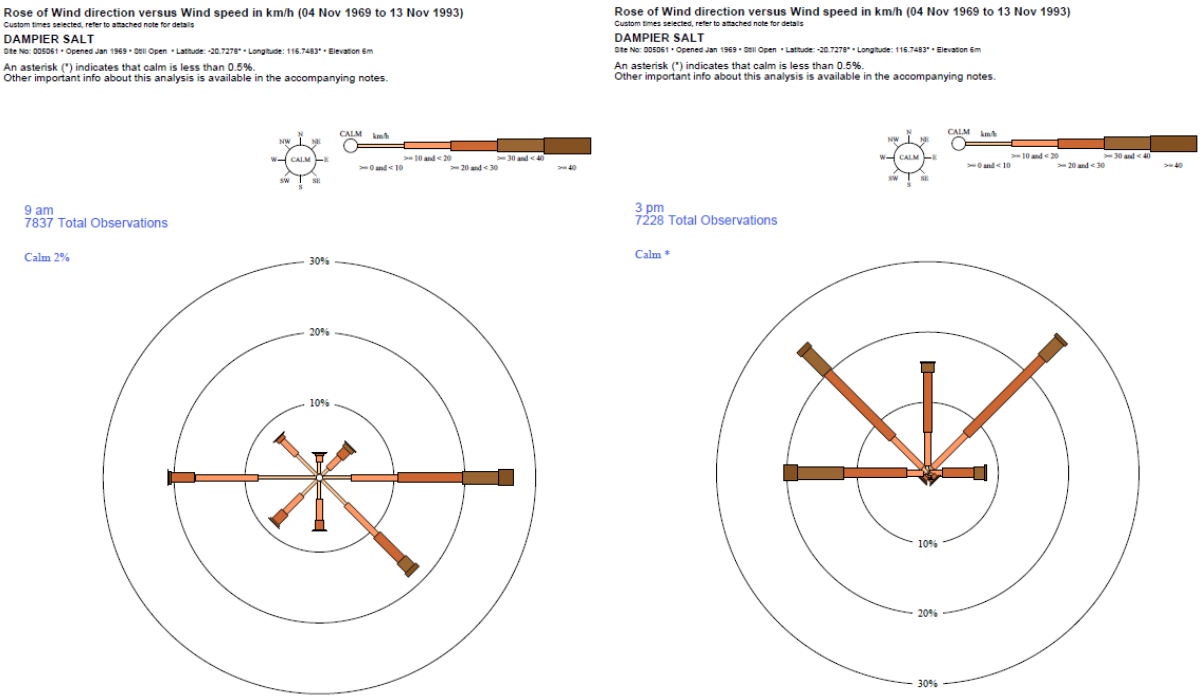

Figure 5: Dampier Salt BOM Station 9am and 3pm rose of wind

It is important to note that these wind roses show historical wind speed and wind direction data for Dampier Salt weather station and should not be used to predict future data.

8.1.2 Rainfall and temperature

Rainfall on the Burrup Peninsula 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 the Premises that has recorded statistics for wind, rainfall and temperature is located at Dampier Salt located approximately 7km east of the Premises. The historic annual average rainfall for Dampier Salt 265.8mm, of which, around 69% occurs during summer months (October to April).

Summer months experience high temperatures ranging from 32.7 – 36.2°C, while winter temperatures are more moderate ranging from 26.2 – 30.5°C. Figure 6 shows average annual rainfall and maximum temperatures for Dampier Salt, a suitable surrogate for weather statistics experienced at Pluto LNG Project.

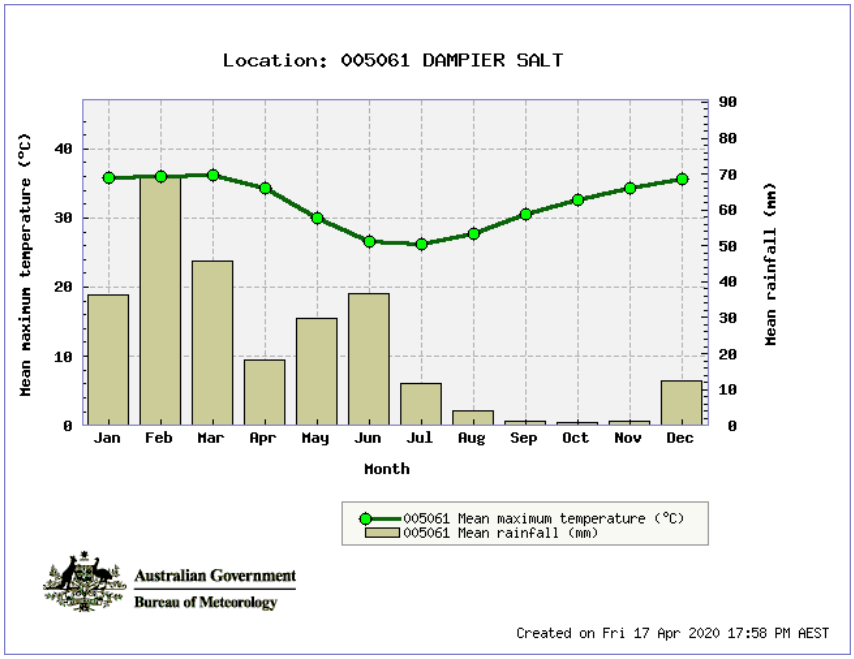

Figure 6: Dampier Salt: Mean Maximum Temperature and Mean Rainfall

9. 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 20 and Table 21.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 20 and Table 21 below.

Table 20: Identification of emissions, pathway and receptors during construction (including commissioning)

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Construction, mobilisation and positioning of Pluto Train 2 infrastructure	Construction of new plant and infrastructure including earthworks, drilling and blasting, vehicle movements, operation of machinery and equipment etc.	Noise	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Amenity impacts	No	A Construction Noise Management Plan (CNMP) will be implemented during the construction and commissioning phases of Pluto Train 2. The CNMP identifies all likely sources of noise and outlines associated mitigation and monitoring measures to be used during construction activities that will eliminate or control potential impacts to nearby sensitive receptors from noise emissions. Significant noise emissions may be generated from the GTCs, the GTG and from existing flares during commissioning. The Applicant has committed to conducting noise monitoring and verification of Pluto Train 2 infrastructure to ensure the design noise levels are met. The *Environmental Protection (Noise) Regulations 1997* prescribe allowable noise levels at various receptors at various times of the day, including during construction activities (Regulation 13).

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	Construction of new plant and infrastructure including from earthworks, drilling and blasting, vehicle movements, operation of machinery and equipment etc.						The Delegated Officer considers that appropriate management of noise emissions has been considered by the Applicant and no controls are required on the works approval to manage noise during the construction phase.
		Dust	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Health and amenity impacts	No	A Dust Management Plan (DMP) will be implemented during construction on Pluto Train 2, which identifies dust sources and outlines how dust will be managed during the construction period. Monitoring and management measures and responsible parties are outlined in the DMP. The Delegated Officer considers that appropriate management of dust emissions has been considered by the Applicant and no controls are required on the works approval to manage dust during the construction phase.
Construction, mobilisation and positioning of Pluto Train 2 infrastructure		Potentially contaminated stormwater	Soils on the Premises. Groundwater located ~11 m bgl. Marine environment located along north-western boundary of the Premises.	Direct discharge to land. Infiltration through soil to groundwater and marine environment. Discharge to the marine environment via overland flow.	Soil and groundwater contamination. Contamination of the marine environment, impacting intertidal areas and / or marine species inhabiting the area, including turtle nesting beaches.	No	An Erosion and Sedimentation Control Management Plan (ESCMP) will be implemented during the construction and commissioning phase. The ESCMP identifies mitigation measures to be used to minimise or control potential environmental risks associated with erosion and sedimentation. Examples include the use of controls such as sediment fences where required, regular inspection of drainage areas / control features and repairing or replacing sediment / erosion controls as required. The Delegated Officer has reviewed the ESCMP and considers it sufficient to prevent and control the risk of erosion and sediment emissions during construction and commissioning of Pluto Train 2. No controls are required on the works approval.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Construction, mobilisation and positioning of Pluto Train 2 infrastructure	Construction of new plant and infrastructure including from earthworks, drilling and blasting, vehicle movements, operation of machinery and equipment etc.	Potentially contaminated hydrostatic testing water	Soils on the Premises. Groundwater located ~11 m bgl. Marine environment located along north-western boundary of the Premises.	Direct discharge to land. Infiltration through soil to groundwater and marine environment. Discharge to the marine environment via overland flow.	Soil and groundwater contamination. Contamination of the marine environment, impacting intertidal areas and / or marine species inhabiting the area, including turtle nesting beaches.	No	The Delegated Officer considers that likelihood of contaminated hydrostatic test water entering the environment is low and that appropriate management measures are in place to manage the risk. Discharge of hydrocarbons and other contaminants is adequately regulated under the UDR.
			Marine environment located along north-western boundary of the Premises	Discharge to the marine environment via ETP.	Contamination of the marine environment, impacting intertidal areas and / or marine species inhabiting the area, including turtle nesting beaches.	Yes	See detailed risk assessment in section 10.6.
Category 10 and 34: **Commissioning of Pluto LNG Train 2**	LNG and condensate processing and storage – commissioning activities	Point source discharges to air. Fuel combustion gases from the GTCs: NOx, SOx, CO, VOCs (including BTEX), PM. Combustion gases from the RcTOs: Primarily NOx and CO, with residual SOx, VOCs (including	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	Yes	See detailed risk assessment in section 10.3 (combustion gases) and 10.4 (ozone). Mercury emissions are not considered within the assessment as mercury is removed from the feed gas via the MRU prior to the gas entering the LNG train.
			National Heritage Listed place – Dampier Archipelago 300 m east of the premises		Acceleration of natural weathering/ alteration/ degradation of the rock art	No	The Delegated Officer has determined that the regulatory framework described in section 4.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		BTEX), PM.O_3 (secondary pollutant)					potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.
	Flaring	Point source emissions to air: NOx, CO, CO_2, PM and VOCs Dark smoke associated with incomplete combustion during flaring	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	Yes	See detailed risk assessment in section 10.3 (combustion gases).
		Noise emissions	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	No	The existing flares at Pluto LNG Project will be used for Pluto Train 2 operations. Flaring is only expected to occur during upset and emergency conditions which should be infrequent under normal steady-state operations. The existing Pluto LNG flare system has a maximum flow rate limit to prevent significant noise emissions based on learnings from historical commissioning and field testing. Given the distance to the residential areas and the infrequent nature and management controls, the Delegated Officer has determined no further controls required.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Noise emissions Light emissions	Turtle nesting beaches – Holden Beach located on the north-western boundary of the Premises	Air dispersion	Disruption to turtle nesting behaviour	No	The Delegated Officer has determined that potential impacts to marine turtles from noise emissions is regulated under MS 757 (conditions 9-1 to 9-5). Managing and monitoring of noise impacts to turtles utilising Holden Beach will be undertaken in accordance with the Pluto LNG Project Sea Turtle Management Plan.
Category 52: Commissioning of Electric power generation	Power generation through operation of GTG – commissioning activities	Point source discharges to air: Combustion gases from the GTG: NOx, SOx, CO, VOCs (including BTEX), PM. O_3 (secondary pollutant)	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	Yes	See detailed risk assessment in section 10.3 (combustion gases) and 10.4 (ozone).
			National Heritage Listed place – Dampier Archipelago 300 m east of the premises		Acceleration of natural weathering/ alteration/ degradation of the rock art	No	The Delegated Officer has determined that the regulatory framework described in section 4.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.

Table 21: Identification of emissions, pathway and receptors during operation (time-limited steady state operations)

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Category 10 and 34: **Pluto LNG Train 2**	LNG and condensate processing and storage	Point source discharges to air. Fuel combustion gases from the GTCs: NOx, SOx, CO, VOCs (including BTEX), PM. Combustion gases from the RcTOs: Primarily NOx and CO, with residual SOx, VOCs (including BTEX), PM. Combustion gases from flaring: Primarily NOx and CO, with residual SOx, VOCs, PM O_3 (secondary pollutant)	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	Yes	See detailed risk assessment in section 10.3 (combustion gases) and 10.4 (ozone). Mercury emissions are not considered within the assessment as mercury is removed from the feed gas via a MRU prior to the gas entering the LNG train.
			National Heritage Listed place – Dampier Archipelago 300 m east of the premises		Acceleration of natural weathering/ alteration/ degradation of the rock art	No	The Delegated Officer has determined that the regulatory framework described in section 4.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Fugitive emission of gaseous compounds (VOCs) escaping from valves, flanges, pump seals, connectors and condensate or LNG storage tanks.	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	No	No new condensate or LNG storage tanks will be constructed for Pluto Train 2. Existing storage infrastructure is authorised under the existing Licence. Pluto Train 2 has been designed to incorporate contemporary emission controls, which are detailed in the Assessment of Best Practice for Minimising Emissions to Air from Major Plant – Pluto Train 2 (Woodside 2019). This Report was developed to meet requirements of MS 757. Infrastructure and operational controls intended to prevent and/or minimise the release of fugitive gaseous emissions include the design of the new Boil Off Gas Blowers to be constructed for Pluto Train 2, for compression and return of vapours during ship loading to the Train 2 methane circuit for further processing. Where unable to be returned to the process, vapours are flared rather than vented as the treatment train has been designed to exclude the need to vent process gas A fugitive leak inspection program will be conducted as part of environmental commissioning once hydrocarbons are introduced and the plant is operational.
		Discharge of environmentally hazardous materials due to loss of containment (spills, leaks, uncontrolled discharge). Environmentally hazardous materials include	Soils on the Premises. Groundwater located ~11 m bgl. Marine environment located along north-western boundary of the Premises	Direct discharge to land. Infiltration through soil to groundwater and marine environment. Discharge to the marine environment via overland flow.	Soil and groundwater contamination. Contamination of the marine environment, impacting intertidal areas and / or marine species inhabiting the area, including turtle nesting beaches.	Yes	Major storage containment facilities for condensate, LNG, diesel, oil and waste oil, are existing infrastructure currently in use as part of Pluto LNG Project operations. Existing infrastructure has been previously assessed and authorised under Part V of the EP Act via the approvals listed in Table 8. The Delegated Officer notes that environmentally hazardous chemicals will be stored in accordance with the *Dangerous Goods and Safety Act 2004*, and the Applicant has Dangerous Goods Licence

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		condensate, LNG, diesel, oil, waste oil, aMDEA, refrigerants (propane, ethylene, and methane) and miscellaneous process chemicals					DGS021370. Pluto Train 2 infrastructure will be integrated into major containment facilities which have been designed to cater for a 12 Mtpa LNG processing plant. New containment facilities yet to be constructed for Pluto Train 2 for storage of environmentally hazardous materials include: • aMDEA; • refrigerants (ethylene and propane); • pentane; and • miscellaneous process chemicals. These new containment facilities will require assessment by the Delegated Officer. See detailed risk assessment in section 10.5.
Category 10 and 34: **Pluto LNG Train 2**	LNG and condensate processing and storage	Noise emissions associated with operation of the GTCs	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Amenity impacts	No	The Delegated Officer notes that the Part IV Ministerial Approval was granted for a 12 Mtpa LNG gas processing plant in December 2007. The Applicant's PER included noise modelling undertaken to assess potential noise emissions associated with Pluto LNG Project. Noise modelling performed indicated noise emissions during operations of Train 1 and Train 2 were likely to comply with the *Environmental Protection (Noise) Regulations 1987*. The Delegated Officer notes the Applicant has committed to conducting noise monitoring and validation to ensure designed noise levels are met for major noise sources. This is an important step in validating the noise modelling predictions and also ensuring compliance with the Noise Regulations. As such, the Delegated Officer has included conditions in the works approval requiring a report detailing the results of the noise validation monitoring to be submitted to DWER within 3 months of commencing time

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
							limited operations.
			Turtle nesting beaches – Holden Beach located on the north-western boundary of the Premises		Disruption to turtle nesting behaviour	No	The Delegated Officer has determined that potential impacts to marine turtles from noise emissions is regulated under MS 757 (conditions 9-1 to 9-5). Managing and monitoring of noise impacts to turtles utilising Holden Beach for nesting activities will be undertaken in accordance with the Pluto LNG Project Sea Turtle Management Plan.
		Light emissions associated with operation of Pluto Train 2	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air dispersion	Amenity impacts	No	Light emissions from operation of Pluto Train 2 are not expected to result in significant additional levels of light than what is currently emitted from the existing Pluto LNG Project. Due to the separation distance, the Delegated Officer does not consider that the additional light emissions from the operation of Pluto Train 2 will impact on amenity of residential areas. The amenity of public access / recreation areas is not considered likely to be significantly impacted from light emissions due to the short timeframes that people are expected to spend in these areas.
			Turtle nesting beaches – Holden Beach located on the north-western boundary of the Premises		Disruption to turtle nesting behaviour	No	The Delegated Officer has determined that potential impacts to marine turtles from light emissions is regulated under MS 757 (conditions 9-1 to 9-5). Managing and monitoring of light impacts to turtles utilising Holden Beach for nesting activities will be undertaken in accordance with the Pluto LNG Project Sea Turtle Management Plan.
Category 10 and 34: **Pluto LNG Train 2**	LNG and condensate processing and storage	Potentially contaminated (process) wastewater and	Soils on the Premises. Groundwater located ~11 m bgl. Marine environment located	Direct discharge to land. Infiltration through soil to groundwater and	Soil and groundwater contamination. Contamination of the marine environment, impacting intertidal	Yes	See detailed risk assessment in section 10.6.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		potentially contaminated stormwater.	along north-western boundary of the Premises	marine environment. Discharge to the marine environment via overland flow.	areas and / or marine species inhabiting the area, including turtle nesting beaches.		
Category 52: **Electric power generation**	Power generation through operation of 1 x gas turbine generator	Point source discharges to air: Combustion gases from the GTG: NOx, SOx, CO, VOCs (including BTEX), PM. O_3 (secondary pollutant)	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	Yes	See detailed risk assessment in section 10.3 (combustion gases).
			National Heritage Listed place – Dampier Archipelago 300 m east of the premises		Acceleration of natural weathering/ alteration/ degradation of the rock art	No	The Delegated Officer has determined that the regulatory framework described in section 4.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Category 52: Electric power generation	Power generation through operation of 1 x gas turbine generator	Noise emissions associated with operation of the GTG	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	No	The Delegated Officer notes the Applicant has committed to conducting noise monitoring and validation to ensure designed noise levels are met for major noise sources. This is an important step in validating the noise modelling predictions and also ensuring compliance with the Noise Regulations. As such, the Delegated Officer has included conditions in the works approval requiring a report detailing the results of the noise validation monitoring to be submitted to DWER prior to the expiry of the works approval.
			Turtle nesting beaches – Holden Beach located on the north-western boundary of the Premises	Air / wind dispersion	Disruption to turtle nesting behaviour	No	The Delegated Officer has determined that potential impacts to marine turtles from noise emissions is regulated under MS 757 (conditions 9-1 to 9-5). Managing and monitoring of noise impacts to turtles utilising Holden Beach will be undertaken in accordance with the Pluto LNG Project Sea Turtle Management Plan.
		Light emissions associated with operation of the GTG	Turtle nesting beaches – Holden Beach located on the north-western boundary of the Premises	Air dispersion	Amenity impacts	No	Light emissions from operation of Pluto Train 2 are not expected to result in significant additional levels of light than what is currently emitted from the existing Pluto LNG Project. Due to the separation distance, the Delegated Officer does not consider that the additional light emissions from the operation of Pluto Train 2 will impact on amenity of residential areas. The amenity of public access / recreation areas is not considered likely to be significantly impacted from light emissions due to the short timeframes that people are expected to spend in these areas.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
					Disruption to turtle nesting behaviour	No	The Delegated Officer has determined that potential impacts to marine turtles from light emissions is regulated under MS 757 (conditions 9-1 to 9-5). Managing and monitoring of light impacts to turtles utlising Holden Beach for nesting activities will be undertaken in accordance with the Pluto LNG Project Sea Turtle Management Plan.
Category 52: **Electric power generation**	Power generation through operation of 1 x gas turbine generator	Potentially contaminated washdown water or stormwater from the GTG	Soils on the Premises. Groundwater located ~11 m bgl. Marine environment located along north-western boundary of the Premises	Direct discharge to land. Infiltration through soil to groundwater and marine environment. Discharge to the marine environment via overland flow.	Soil and groundwater contamination. Contamination of the marine environment, impacting intertidal areas and / or marine species inhabiting the area, including turtle nesting beaches.	Yes	See detailed risk assessment in section 10.6.
Category 10 and 34: **Pluto LNG Train 2**	Flaring	Point source emissions to air: NOx, CO, CO_2, PM and VOCs Dark smoke associated with incomplete combustion during flaring	Public access / recreation areas: • Murujuga National Park 300 m east: and • Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.	Air / wind dispersion	Public health impacts	Yes	See detailed risk assessment in section 10.3 (combustion gases).
	Flaring	Noise emissions	Public access / recreation areas: • Murujuga National Park 300 m east: and	Air / wind dispersion	Public health impacts	No	The existing flares at Pluto LNG Project will be used for Pluto Train 2 operations. Flaring is only expected to occur during upset and emergency conditions which should be infrequent under normal steady-state

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
			• Hearson's Cove 3 km southeast. The town of Dampier is 7 km southwest and Karratha is 14 km southeast.				operations. The existing Pluto LNG flare system has a maximum flow rate limit to prevent significant noise emissions based on learnings from historical commissioning and field testing. Given the distance to the residential areas and the infrequent nature and management controls, the Delegated Officer has determined no further controls required.
Category 10 and 34: **Pluto LNG Train 2**	Flaring	Noise emissions Light emissions	Turtle nesting beaches – Holden Beach located on the north-western boundary of the Premises	Air dispersion	Disruption to turtle nesting behaviour	No	The Delegated Officer has determined that potential impacts to marine turtles from noise and light emissions is regulated under MS 757 (conditions 9-1 to 9-5). Managing and monitoring of noise and light impacts to turtles utilising Holden Beach will be undertaken in accordance with the Pluto LNG Project Sea Turtle Management Plan.

9.1 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 22 below.

Table 22: 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 23 below.

Table 23: 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.

9.2 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 24 below:

Table 24: 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.

9.3 Risk Assessment – emission of combustion gases (NOx, SOx, VOCs, CO and PM)

9.3.1 Description of Risk Event (Commissioning and Operation)

Combustion gases including NOx, CO, SO_2, VOCs and PM are emitted from the premises as a result of the combustion of natural gas, diesel and recovered acid gases within the gas treatment train. The combustion gases are released to air through emission stacks and are transported through the atmosphere via dispersion. The released gases can impact on local air quality potentially causing adverse health impacts to sensitive receptors. It is recognised that during commissioning, emission rates may be observed higher than those expected during normal operating conditions in the short term until the plant has stabilised. Flaring of gas within the treatment train will be required during the commissioning period (expected to be around 12 months). During normal operations flaring of gas is expected to be intermittent, occurring primarily during times of maintenance, shut downs, ship loading and during upset conditions. The risk assessment below considers emissions during commissioning as well as emissions expected during normal operations.

9.3.2 Identification and general characterisation of emission

The primary emissions from the Premises are NOx, CO, CO_2 and volatile organic compounds (VOCs) with the principal sources being the refrigerant gas turbine compressors (GTCs), the power GTG, flaring (via integration with Train 1), and the RcTOs that treat vent streams from the acid gas and nitrogen rejection units.

The ratio and rate of pollutants produced are dependent on fuel type and combustion efficiency. Pluto Train 2 will produce point source emissions of combustion gases and PM as a result of the combustion of natural gas, diesel and recovered acid gases. Additionally, the fuel gas for the GTCs and the GTG will be primarily obtained from process gas which has been treated via the AGRU to remove the majority of H_2S. The fuel gas sulfur content is

therefore expected to have minimal H_2S.

The primary point source of PM emissions from Pluto Train 2 is from incomplete combustion during flaring generating dark smoke (soot). Flaring is only expected to occur during commissioning, plant start-up and shut-downs, process upsets, maintenance and emergencies. Flaring may also occur during ship loading activities when boil-off gas and vapour rates exceed the capacity of boil off gas compressors. Particulate emissions from the GTCs and GTG are not considered significant. VOC emissions from the GTCs and GTG are also expected to be low due to their high combustion efficiency.

Acid gases (containing approximately 93% CO_2) together with some water, VOCs (including (BTEX) and H_2S are recovered from aMDEA solution within the AGRUs. The recovered gases are disposed via an RcTO. The RcTO oxidises hydrocarbons (including VOCs) and sulfur compounds within the gas to CO_2, SO_2 and water which are emitted from the RcTO stack. When the RcTO is shutdown for maintenance, repair or a process trip, the gases are diverted to the existing flare stack where they are combusted. In the event of high flare back pressure and route to flare is not feasible these streams will be vented to atmosphere. This is expected to be an extremely rare event.

Diesel combustion occurs infrequently when back-up diesel generators are required to be operated. This is only expected to occur when the main power supply system (GTG) has tripped, is offline or otherwise unavailable.

Emission design criteria

A detailed summary of the emissions expected from Pluto Train 2 during normal operations is presented in Table 25. These estimates are based on Front End Engineering Design data and assumes steady state operations based on the nominal design capacity with average feed gas consumption and average ambient temperature flow rates.

Table 25: Pluto Train 2 emissions design criteria (normal operating conditions) (from Application)

Source and number (in brackets) [1, 2, 3, 4]	NO_x (g/s)	CO (g/s)	SO_2 (g/s)	VOC (g/s)	BTEX (g/s)	PM (g/s)
Refrigeration Compressor Gas Turbines (6) [5]	24.52	41.78	0.00	0.59	0.16	1.85
Power Generation Gas Turbine (1)	3.99	6.81	0.01	0.09	0.05	0.28
Acid Gas Recuperative Thermal Oxidiser (1)	0.05	0.09	0.15	0.00	0.00	0.00
NRU Vent Recuperative Thermal Oxidiser (1)	1.23	2.14	0.00	0.00	0.00	0.02
Compressor Vents to Site B flare (1)	0.38	3.25	0.00	0.05	0.00	0.08
Total Fugitives LNG Plant	-	-	-	2.15	0.00	-
Total LNG Plant Routine Emissions	**30.17**	**54.06**	**0.16**	**2.88**	**0.21**	**2.23**
DomGas fugitive emissions	-	-	-	0.044	0.01	-
Total Domgas Plant Routine Emissions				**0.044**	**0.01**	
Total Train 2 Routine Emissions	**30.17**	**54.06**	**0.16**	**2.954**	**0.22**	**2.23**

Note 1: Emission estimates give in Application, based on vendor provided data are preliminary and subject to change. Emissions represent total emissions from machine category.
Note 2: Emissions based on Front End Engineering Design and provide a conservative average case in g/s. Refrigerant Gas Turbines may vary by up to 10% higher than average.
Note 3: Basic Plant data and operational availability for the LNG train and where available data is based on operating load

assumptions.
Note 4: Total H_2S is estimated to be negligible, therefore not included in the emissions summary.
Note 5: Refrigerant gas turbine emissions rates are the total of the 6 gas turbines.

As can be seen in Table 25, the emissions of most significance from Pluto Train 2 are CO and NO_2.

Emission rate estimates

A summary of the estimated emissions during upset conditions requiring flaring (including during commissioning) is presented in Table 26.

Table 26: Pluto Train 2 emissions estimates (non-routine flaring) (from Application)

Source [1, 2]	NO_x (g/s)	CO (g/s)	SO_2 (g/s)	VOC (g/s)	BTEX (g/s)	PM (g/s)
Dry Gas Flare (Upset scenario: emergency PSV relief)	320	1,743	1	297	0	61
Wet Gas Flare (Upset scenario: Ethylene Compressor Blocked outlet)	304	1,654	1	282	0	58

Note 1: HP flares have been designed for handling catastrophic failures. These events may not happen during the lifetime of the facility, therefore, non-routine emissions are not included in the emissions summary.
Note 2: Non-routine emissions provided are worst case relief scenarios currently identified during Front End Engineering Design, these may be subject to change. Both are within the existing Pluto Train 1 relief scenarios.

An estimate of expected start-up emissions during commissioning and operations is shown in Table 27. It is noted that

Table 27: Pluto Train 2 emissions estimates (start-up conditions)

Source	Volume to flare (kg/hr)	Indicative duration (hrs)	NO_x (g/s)	CO (g/s)	SO_2 (g/s)	VOC (g/s)	BTEX (g/s)	PM (g/s)
Purging	35,000	24 – 72	14.49	78.86	0.04	13.43	0.00	2.77
Dryout – Regenerate Beds (initial flowrate – Phase 1)	35,000	10 – 30	14.49	78.86	0.04	13.43	0.00	2.77
Dryout – Regenerate Beds (secondary flowrate - Phase 2)	66,000	36 - 108	27.33	148.71	0.07	25.32	0.00	5.22
Defrost	85,000	48 – 144	35.20	191.52	0.09	32.61	0.00	6.73
All refrigerant circuits	70,000	96 – 288	28.99	157.72	0.07	26.86	0.00	5.54
Propane – charge and purge	4,000	48 - 144	0.63	3.43	0.00	0.58	0.00	0.12
Ethylene – Charge purge	500	48 - 144	0.32	1.75	0.00	0.30	0.00	0.06
Plant Cooldown	70,000	24 – 48	28.99	157.72	0.07	26.86	0.00	5.54

Note 1: Air emissions estimates that are based on vendor provided data are preliminary and subject to change. Emissions represent total emissions from machine category.
Note 2: Durations of these activities are preliminary and will be subject to operational constraints to maintain plant stability and minimise potential for smoke events.
Note 3: Given the nature of start-up activities, these activities cannot occur simultaneously.

Emission targets and limits

Pluto Train 2 design emissions targets and limits for major plant during normal operating

conditions are detailed in Table 28 below.

Table 28: Pluto Train 2 NOx performance targets and point source air emission targets and limits

Performance criteria	NOx	Target	Limit	Limit (operating in low load)
GTCs (x 6)	NOx (mg/Nm^3) @ 15% O_2	50	100	N/A
GTG (x 1)		50	100	140
RcTOs (x 2)	NOx (mg/Nm^3) @ 3% O_2	70 (NOx as NO_2)	100 (NOx as NO_2)	N/A

Where design emission targets have been set, these have been taken from the *NSW EPA Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2010* (NSW Clean Air Regulation).

Ambient Air Quality Modelling

As detailed in section 6.1, the Applicant performed predictive ambient air emissions modelling to determine the GLCs of selected pollutants associated with the operation of Pluto Train 2. A summary of the modelled GLCs for NO_2 and SO_2 at the nearest receptor locations (Burrup, Dampier and Karratha) are shown in Table 29 and Table 30. All modelled scenarios are shown, including the Current Baseline Model (CBM), the Pluto Future State (Current Baseline Model plus Pluto Train 2 expansion) (PFS), the Future Burrup Strategic Industrial Area (includes all sources in the Pluto Future State and reasonably foreseeable future proposals including proposed urea and methanol plants)(FBSIA) and Pluto Upset Condition (PUC).

Table 29: Summary of Modelled Ambient NO_2 Concentrations at Sensitive Receptors against Assessment Criteria

		GLC for NO_2 (ppb) at receptor			
Averaging Period		**Max 1-hour**		**Annual**	
NEPM Criteria		**120**	**% criteria**	**30**	**% criteria**
CBM	Burrup	33.4	27.8%	3.2	10.7%
	Dampier	24.8	20.7%	1.7	5.7%
	Karratha	24.8	20.7%	0.9	3%
	Max on grid	42.6	35.5%	5	16.7%
PFS	Burrup	33.8	28.2%	3.5	11.7%
	Dampier	25.8	21.5%	1.7	5.7%
	Karratha	25.9	21.6%	0.9	3%
	Max on grid	42.6	35.5%	5.2	17.3%
FBSIA	Burrup	34.2	28.5%	4	13.3%
	Dampier	25.8	21.5%	1.8	6%
	Karratha	28.3	23.6%	1	3.3%
	Max on grid	43.9	36.6%	5.8	19.3%
PUC	Burrup	33.2	27.7%	N/A	N/A
	Dampier	24.9	20.8%	N/A	N/A

		GLC for NO_2 (ppb) at receptor			
	Karratha	27.5	22.9%	N/A	N/A
	Max on grid	43.6	36.6%	5.8	19.3%

Note 1: GLC values include background concentrations modelled.

Ambient ground-level concentrations of NO_2 at the local townships of Dampier and Karratha as well as the Burrup Peninsula monitoring station are all predicted to be below the NEPM criteria for both 1-hour maximum (short term impacts) and annual average (long term impacts). The maximum annual average values calculated for the PUC sensitivity scenario was 5.8ppb (maximum recorded anywhere on the model grid) and therefore the annual average NO_2 GLCs at the sensitive receptors are expected to be well below NEPM criteria.

Table 30: Summary of modelled ambient SO_2 Concentrations at Sensitive Receptors against Assessment Criteria

		GLC for SO_2 (ppb) at receptor					
Averaging Period		**Max 1-hour**		**Max 24-hour**		**Annual average**	
NEPM Criteria		**200**	**% criteria**	**80**	**% criteria**	**20**	**% criteria**
CBM	Burrup	11.3	5.7%	4.7	5.9%	2	10%
	Dampier	12.9	6.5%	4.6	5.8%	1.6	8%
	Karratha	3.6	1.8%	1.7	2.1%	0.9	4.5%
	Max on grid	18.1	9.1%	7	8.8%	4.5	23%
PFS	Burrup	11.4	5.7%	4.8	6%	2	10%
	Dampier	12.9	6.5%	4.6	5.8%	1.6	8%
	Karratha	3.6	1.8%	1.7	2.1%	0.9	4.5%
	Max on grid	18.1	9.1%	7	8.8%	4.5	23%
FBSIA	Burrup	11.4	5.7%	4.8	6%	2	10%
	Dampier	12.9	6.5%	4.6	5.8%	1.6	8%
	Karratha	3.6	1.8%	1.7	2.1%	0.9	4.5%
	Max on grid	18.1	9.1%	7	8.8%	4.5	23%
PUC	Burrup	11.4	5.7%	4.7	5.9%	N/A	N/A
	Dampier	12.9	6.5%	4.6	5.8%	N/A	N/A
	Karratha	3.6	1.8%	1.7	2.1%	N/A	N/A
	Max on grid	18.1	9.1%	7	8.8%	4.5	23%

Note 1: GLC values include background concentrations modelled.

SO_2 GLCs are expected to be well below the NEPM (Ambient Air Quality) standards at the nearest receptors. There is minimal variation between concentrations for all scenarios modelled.

9.3.3 Description of potential adverse impact from the emission

Combustion emissions and PM can potentially have adverse impact on human-health, dependent on the level of exposure and length of time exposed. Both short-term exposure and long-term exposure to increased levels of NO_2 may cause respiratory irritation and associated effects. NO_2 can affect humans both directly and indirectly; directly, by irritation that leads to an inflammatory reaction in the lungs, and indirectly by affecting the immune system.

The short term effects of NO_2 are mainly associated with the respiratory system, generally in

combination with other pollutants such as irritant gases and particulates. The effects include wheezing, cough, sputum production in asthmatics and people with chronic inflammatory lung disease. At higher concentrations it can contribute to illness (morbidity) and mortality of especially sensitive sub groups, such as children, asthmatics and people with chronic lung disease such as chronic bronchitis.

NO_2 can also react with VOCs in the presence of sunlight to form photochemical smog.

VOCs can impact neurological and respiratory systems cause symptoms such as eye and respiratory tract irritation, headaches, dizziness and visual disorders. Symptoms experienced are dependent on the type of VOC and level and length of time of exposure. Some organics (such as Benzene) are also known to be carcinogenic.

Short-term and long-term exposure to increased levels of SO_2 may also cause respiratory irritation. SO_2 is highly soluble in water and is quickly absorbed in the moist environment of the upper or lower airways of the respiratory tract, which it exerts its adverse effects. It can cause a reduction in the diameter of airways and a reduction in airflow by acting on cells that cause inflammation, constriction and create mucus. Short term exposures to SO_2 are most pronounced in people with asthma and other respiratory conditions and the elderly.

PM has the potential to impact human health as it can affect the respiratory and cardiovascular systems following both long and short-term exposures. Long term repeated exposure to PM is more detrimental than short term sporadic exposure. The most severe effects being reduced life expectancy due to long-term exposures. PM_{10} and $PM_{2.5}$ pose greater health risks as they may be drawn deep into the lungs, while larger particles are typically trapped on the nose, mouth or throat. In addition to particle size, the health impacts of particulate matter are influenced by the chemical composition of the particles, mass concentration of airborne particles and duration of exposure.

Exposure to CO at high concentrations for short periods may affect the amount of oxygen in the bloodstream resulting in vital organs such as the brain, nervous tissues and heart not functioning properly. Common symptoms of exposure to high concentrations of CO include fatigue, loss of concentration and dizziness. Children and babies are at greater risk because their bodies are smaller and still developing.

The nearest residential receptors that may be affected by combustion gas emissions from Pluto LNG Train 2 are the towns of Dampier located 7 km southwest and Karratha located 14km southeast, however the Delegated Officer notes that the Premises is close to a number of public recreational areas and the Murujuga National Park. The highest ground level concentrations (GLCs) at either Dampier or Karratha were used to make comparisons against guidelines at these residential receptors and the maximum recorded GLC on the modelled grid used to assess GLCs at other areas frequented by the public.

9.3.4 Criteria for assessment

Point Source Emission Standards

A comparison between the Pluto Train 2 emission design criteria and NSW Clean Air Regulation can be seen in Table 31.

Table 31: Pluto Train 2 point source emission standards comparison

Pollutant	Applicability	NSW Standard	Pluto Train 2 Design Criteria
NOx	Gas Turbines (@ 15% O_2)	185 ppm (350 mg/Nm^3)	25 ppm (50 mg/Nm^3)
	Thermal Oxidisers	N/A	35 ppm

	(@ 3% O_2)		(70 mg/Nm^3)
Particulate Matter (PM)	All other combustion equipment	50 mg/Nm^3	50 mg/Nm^3
SO_2	All other combustion equipment	N/A	N/A
CO	Gas Turbines (@ 15% O_2)	N/A	83 mg/Nm^3
	All other combustion equipment	125 mg/Nm^3	125 mg/Nm^3
VOC	All other combustion equipment	40 mg/Nm^3	40 mg/Nm^3

Ambient Air Quality Standards

The NEPM sets ambient air quality standards for CO, NO_2, SO_2 and PM for the protection of human health and well-being. These standards are outlined in Table 32. The NEPM also sets monitoring investigation levels, for ambient air toxics including Benzene, Toluene and Xylene.

The applicable monitoring investigation levels are outlined in Table 33. The goal of the NEPM (Air Toxics) is to collect sufficient data to facilitate development of a standard. The NEPM criteria are considered by the Delegated Officer to be relevant to the assessment of risk to public health and therefore apply to human receptors located outside the Premises.

Design emission rates, concentrations and targets for the point source emissions have been described in section 8.9.2 (Tables 25 - 28).

Table 32: NEPM (Ambient air) assessment criteria for CO, NO_2 and SO_2 and PM

Pollutant	Averaging period	Maximum concentration		Goal (maximum allowable exceedances)
		ppb	µg/m^3	
NO_2	1-hour	120	246	1 day a year
	Annual	30	62	None
CO	8-hour	9000	11,240	1 day a year
SO_2	1-hour	200	571	1 day a year
	24-hours	80	229	1 day a year
	Annual	20	57	None
Particulates as PM_{10}	24-hours	-	50	Exceptional events (as per NEPM)
	Annual	-	25	None
Particulates as PM2.5	24-hours	-	25	Exceptional events (as per NEPM)
	Annual	-	8	None

Table 33: NEPM (Air Toxics) monitoring investigation levels

Pollutant	Averaging period	Maximum concentration	
		ppb	µg/m³
Benzene	24-hours[1]	9	29
	Annual	3	9.6
Toluene	24-hours	1000	3780
	Annual	100	380
Xylenes	24-hours	250	1085
	Annual	200	870

Note 1: Taken from the *NSW EPA Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 201*6.

9.3.5 Applicant controls

Commissioning

Commissioning of the gas processing plant and associated systems is required for the system integrity, function testing and adjustment of equipment, introduction of reservoir fluids and start-up of production. Standard onshore pipeline commissioning techniques will be applied, including hydrotesting to determine the strength and leak tightness of test sections. Initial operation and testing will be performed to verify that all relevant systems, plant, machinery and equipment have been installed and are functional.

Environmental commissioning and start-up phase will include the introduction of feed gas and other process fluids required to bring the various plant systems into an operational state. Performance testing will confirm infrastructure meets manufacturer specified emission levels and design emission rates.

During start-up, which is a non-routine event, plant throughput can vary from 15% to 50%. Flaring of gas will be continuous during this period as the system will be too warm to produce LNG product.

Emissions will be calculated based on fuel usage and emission factors to determine if manufacturer specified emissions performance levels are being achieved. Results from the monitoring will be assessed to determine the need for any refinement or amendments to the monitoring regime throughout the commissioning of Pluto Train 2. The commissioning testing program will include emissions, flare and vent and fugitive emissions verification.

Operations

Once steady-state operations have been achieved (post commissioning and start-up phase), the Applicant proposes to monitor all major point sources of air emissions quarterly for important parameters to ensure proper functioning of the equipment for the first year of steady state operations. This is planned to involve quarterly source testing, using Australian Standards and/or US EPA methods or equivalent. Point source air emissions testing will be conducted on selected sources during the first year of steady-state operations, to ensure ongoing equipment performance across a range of operational states. When consecutive sets of tests during steady state operation are satisfactory with respect to criteria, the Applicant proposes to align source testing frequency to that of the annual Pluto LNG operations testing required under Existing Licence L8752/2013/2.

Performance testing of the Predictive Emission Monitoring Systems (PEMS) installed on Pluto Train 2 gas turbines will occur during the first year of operations. PEMS is a software-based monitoring tool able to provide a reliable and real-time estimation of emission properties

(including NOx, CO and CO_2) by means of a model, using process values (temperature, flow, pressure) as input variables. Stack testing will remain as the primary source of validating stack emissions for reporting purposes, however PEMS will be available to assist in reviewing steady state operations against relevant criteria.

For the design of Pluto Train 2 the Applicant has adopted the Optimised ConocoPhillips (COP) process for liquefaction using aero-derivative drivers for the refrigeration compressors. The COP process achieves a higher efficiency compared to the more common C3-MR liquefaction process by the use of highly efficient GTCs as compressor drivers in a 2-in-1 configuration for each refrigerant loop. This allows higher thermal efficiency in the process with lower emissions. It also reduces the need to flare given the load balancing achieved via the 2-in-1 configuration relative to the use of a single turbine to drive the compressor.

Flaring can occur via 2 existing flare systems; Site A and Site B. The storage and loading flare (Site A flare) includes a continuous small pilot light and is designed for occasional flaring under certain circumstances including the flaring of boil-off gas to maintain low pressure in the storage tanks or flaring gases from the LNG and condensate tanks prior to ship loading. The pressure relief and liquids disposal flare system (Site B) are designed to safely collect and dispose of hydrocarbon containing streams that are released during start-up, shutdown, plant upsets and emergency conditions. The system consists of:

- Warm wet flare design designed to dispose of wet vapour and warm blowdown and includes a knock-out drum to separate any liquids from the gas prior to it being routed to warm wet flare stack, which currently has a permanently lit pilot light system and an ignition monitoring system;
- Cold dry flare designed for dry vapour and cold blowdown and also includes a knock-out drum and other systems as per the warm wet flare; and
- Common spare flare designed so that it is interchangeable between the cold dry and warm wet flare systems whilst the plant is operational.

Emission controls for Pluto Train 2 are detailed in Table 34 below.

Table 34: Applicant's proposed controls for point source combustion emissions

Site infrastructure	Description
GTCs	• The use of 6 x GE LM6000PF+ aero-derivative GTCs used in a 2+2+2 string as driver for main refrigeration compressors. These GTCs have low NOx emissions over a wide range of loads, a higher thermal efficiency, lower turndown, greater operational flexibility allowing the process to be optimised for maximum energy efficiency and lower emissions. • The use of inlet air chilling (IAC), which lowers and regulates the temperature of the air entering the gas turbines, reducing the flame temperature and therefore NOx emissions. • The use of Dry Low Emissions (DLE) combustor system technology on the refrigeration GTCs. This includes improved combustor control with extra fuel metering and staging valves, making it more robust to variations in ambient temperature and fuel properties. • Waste Heat Recovery Units (WHRUs) will be installed on the ethylene refrigeration GTCs to supply energy to key utilities while avoiding the need for fired heaters and their associated additional emissions. Recovered heat will be used to provide heat to the process instead of gas-fired heaters eliminating both additional NOx, CO and greenhouse gases. The recovered heat will be used to heat the hot oil system and the dehydration system regeneration gas.
GTG	• Additional power generation is minimised through the integration with

Site infrastructure	Description
	Pluto LNG Train 1. • A single GE Frame 6B GTG will be used to generate the 30 MW of auxiliary power required for Train 2. • Dry Low NOx emissions combustion technology will be used on the GTG. • Use of the same technology as Pluto LNG Train 1 allows maximum energy efficiency and sparring across the entire facility, maintaining reliability and availability, and avoiding possible shutdowns resulting in a large emission event.
RcTOs	Pluto Train 2 will install RcTOs to treat the AGRU and NRU waste streams consisting of BTEX and H_2S (AGRU) and CH_4 (NRU). RcTOs are typically able to achieve destruction efficiency of more than 99% of incoming levels.
Flaring	• The re-positioning of the mercury removal bed to upstream of the AGRU unit. This improvement is based on experience from Train 1 operations and will reduce the flaring required following plant upsets or maintenance when drying out the mercury guard bed. • Flaring during normal operations is expected to be low due to the inclusion of high integrity valves and control systems, gas recovery where practicable, fuel gas balancing and advanced process control. Maximisation of the reliability and stability of the gas processing plant is expected to minimise process and safety trips causing depressurisation of the facility to flare. • The boil-off gas compressor is sized to recover boil-off gas from the LNG tanks during holding mode and for full recovery of vapours during ship loading (that is, vapours from both the LNG tanker and LNG storage tanks). • Flaring during plant commissioning, start-up and shutdown will be reduced through operational controls including management plans and procedures such as regular monitoring. • The Pluto LNG flares have been designed to minimise dark smoke production, as follows: ▪ Storage and loading flare system (Site A) - single stage flare with air assist; ▪ Cold dry flare (Site B) – single stage flare with sonic flare tip; and ▪ Warm wet flare and common spare flare (Site B) – two stage flare with air assist. • Pluto Train 2 will be integrated with the existing Pluto LNG flare system for pressure relief and liquids disposal when required; no new flare equipment will be installed. • Stack heights for the cold dry flare, warm wet flare and spare flare are all located more than 130 metres above ground level to aid dispersion and mixing reducing GLCs. • These flaring technologies allow improved air-fuel mixing promoting sufficient oxygen for complete combustion and reducing smoke production. Air assist systems achieve better mixing via enhancing air supply to the flare tip. A multi-stage flare allows the fuel flow at each flare tip to be optimised to the size and design of the tip, promoting better mixing and combustion. Sonic flare tips generate greater energy at sonic velocities which promotes better mixing (this does however result in higher noise emissions). • The use of nitrogen to maintain the continuous purge of the flare piping (as opposed to the use of fuel gas) to prevent explosive air/gas mixtures forming in the flare piping systems. The use of nitrogen to purge the flare

Site infrastructure	Description
	systems results in reduced GHG and NOx emissions. The nitrogen system is designed to supply the maximum requirement of nitrogen continuously to purge the four flare systems on site. • Acid gas removal technology is utilised in the gas treatment process to remove CO_2 and H_2S which also assists in dark smoke reduction.
Emissions metering and monitoring	• Sample points throughout Pluto Train 2 will be located in accordance with AS 4323.1 on all exhaust and vent stacks. • Atmospheric emissions instrumentation will enable automated calculation and control of emissions and will have a measurement accuracy of +/- 15%. • Major emission sources from Pluto Train 2 (GTCs and the GTG) will have PEMS enabling live emissions monitoring based on fuel gas consumption, fuel flow and ambient conditions. • Reliability centred maintenance programs for equipment and process systems. • Risk based inspection of equipment and pipework. • Operational fuel gas composition monitoring. • Scheduled turbine maintenance (e.g. water wash, major/minor overhaul). • Routine inspection of valves and flanges. • Energy efficiency opportunity reviews. • Point source emissions monitoring will focus on validating emission performance under normal operation against performance targets specified in Table 31. As per existing operations, internal targets are set based on design criteria for normal operations, as well as upper emission limits, any excursions above this will be investigated by the Applicant. • Investigation practices and actions taken towards rectification back within the emission targets. Target exceedances and responses will be summarised in an Annual Environmental Report. Limit exceedances are also investigated and expected to be reported as per Existing Licensing arrangements for limit exceedances and summarised in Annual Audit Compliance Reports.
Targets and Limits	• Setting internal targets for NOx production lower than the limits specified in the Existing Licence. • For Pluto Train 2, the project design criteria was benchmarked against International Finance Corporation (IFC) Guidelines (IFC, 2007) and NSW emission standards for equipment. The targets set align with the equipment vendors' performance targets and criteria to be verified during commissioning, and monitoring during normal operations. Limits are provided to cover abnormal or upset situations and are set to ensure outcomes associated with environmental risk assessment are not exceeded for prolonged periods.

9.3.6 Key findings

The Delegated Officer has reviewed the information regarding combustion gases from Pluto Train 2 and has found:

1. Emissions to air are expected to be higher during commissioning as equipment has not yet reached a steady operational state. Flaring will be required during commissioning which may generate combustion emissions (NOx and CO), dark smoke and some particulate emissions. Emissions are expected to reduce as a steady operational state is reached. Emission rates modelled

under the PUC sensitivity scenario are considered to be overly conservative (due to modelling an extreme scenario of 12 months of continuous flaring) to capture upset conditions that occur during all commissioning activities.

2. Validation monitoring during commissioning and time-limited operations under the works approval will allow assessment and fine tuning of infrastructure to bring the plant and all emission sources into steady state operations as per infrastructure emissions design criteria
3. Pluto Train 2 is designed to maximise recycling of hydrocarbon emissions into the process, or recovery for use as fuel or product therefore flaring events under normal operations are expected to be infrequent.
4. The Applicant has committed to installing a PEMS on Pluto Train 2 major air emissions sources to enable live emissions monitoring based on fuel gas composition, fuel flow, operating load, and ambient conditions. This will enable refinement or amendments to the monitoring program and operating procedures as required.
5. Applicant controls will be conditioned on the issued works approval as they lower the risk of emissions impacting on key receptors.

9.3.7 Consequence

The Delegated Officer has determined that the health criteria for combustion emissions (NOx, SOx, VOCs and CO) are likely to be met at all receptors (including Hearson Cove and Deep Gorge (Ngajarli)) and that there will be minimal off-site health impacts. Dark smoke emissions generated during flaring are considered to have a low level impact on amenity. Therefore, the Delegated Officer considers the consequence of combustion gases from Pluto Train 2 to be **Minor.**

9.3.8 Likelihood of Risk Event

The Delegated Officer has considered the emission design criteria and the modelling performed for Pluto Train 2 and has determined combustion gases from Pluto Train 2 impacting human health will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of combustion gases from Pluto Train 2 to be **Unlikely**.

9.3.9 Overall rating of emission of combustion gases

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of combustion gases from Pluto Train 2 impacting human health is **Medium**.

9.4 Risk Assessment – ozone

9.4.1 Description of ozone emissions

Ozone (O_3) is a secondary pollutant produced by the reaction of NOx and VOCs in the presence of sunlight. Sources of NO_X and VOCs from Pluto Train 2 include the GTCs, GTG, flares and RcTOs, which will contribute to the creation of ground level O_3 within the local area. O_3 is also a naturally occurring pollutant. Contribution to increased GLCs of O_3 can potentially cause adverse health impacts to sensitive receptors.

9.4.2 Identification and general characterisation of emission

The Applicant modelled ambient air emissions to determine the GLCs of selected pollutants

associated with the operation of Pluto Train 2. A summary of the modelled GLCs for O_3 at the nearest receptor locations (Burrup, Dampier and Karratha) is shown in Table 35.

Table 35: Summary of modelled ambient O_3 Concentrations at Sensitive Receptors against Assessment Criteria

		GLC for O_3 (ppb) at receptor			
Averaging Period		**Max 1-hour**		**Max 4-hour Average (rolling)**	
NEPM Criteria		**100**	**% criteria**	**80**	**% criteria**
CBM	Burrup	58.7	58.7%	54.3	67.9%
	Dampier	55.4	55.4%	52.5	65.6%
	Karratha	57.9	57.9%	56.3	70.4%
	Max on grid	61.8	61.8%	58.2	72.8%
PFS	Burrup	59.1	59.1%	54.1	67.6%
	Dampier	55.9	55.9%	52.9	66.1%
	Karratha	59.6	59.6%	57.8	72.3%
	Max on grid	62.3	62.3%	58.6	73.3%
FBSIA	Burrup	58.4	58.4%	53.7	67.1%
	Dampier	56.5	56.5%	53.6	67%
	Karratha	61.2	61.2%	59.1	73.9%
	Max on grid	63	63%	59.7	74.6%
PUC	Burrup	58.5	58.5%	53.9	67.4%
	Dampier	56.2	56.2%	53.5	66.9%
	Karratha	60.8	60.8%	58.8	73.5%
	Max on grid	62.9	62.9%	59.4	74.3%

Note 1: GLC values include background concentrations modelled. Assumed background concentration of O_3 is 25 ppb.
Note 2: The modelled 4-hour average O_3 is not a 'rolling average' that would be needed for comparison with the NEPM (Ambient Air Quality) standard (80 ppb). However, the step-wise 4-hour average O_3 results provided in the standard TAPM output should provide a reasonable indication of the rolling 4-hour averages.

There were no predicted exceedances of the NEPM (Ambient Air Quality) O_3 1-hour standard of 100 ppb at the nearest receptors for any of the scenarios modelled. The results for 4-hour average O_3 GLCs indicate a low likelihood of exceedance of the corresponding NEPM (Ambient Air Quality) standard of 80 ppb. The maximum O_3 GLCs were predicted to occur in Karratha under the Future Burrup Strategic Industrial Area scenario, with the maximum 1-hourly GLC predicted to be around 61.2%, and the maximum 4-hour average (step-wise) GLC predicted to be around 73.9% of the NEPM (Ambient Air Quality) criteria.

The Pluto LNG Expansion AQIA reviewed historical ambient O_3 concentrations recording as part of the BAAMP. The monitoring results showed that O_3 is overall a high risk air pollutant compared to NO_x based on comparisons with the corresponding NEPM (Ambient Air Quality) standards. Additionally, BAAMP monitoring showed higher O_3 concentrations in Dampier and Karratha compared to Burrup Road which is located closer to the sources (industry). Contradictory, Burrup Road monitoring station recorded higher concentrations of NO_x compared to Dampier and Karratha. A plausible explanation for this may be that NO_x, assumed to be emitted primarily by the LNG Projects on the Burrup, was dispersed to lower concentrations by the time it reached the townships of Dampier and Karratha. Therefore, there was less NO_x in the townships to destroy the O_3 that built up to higher concentrations there.

A review of ambient monitoring data between 2010 and 2013 identified four exceedances of the NEPM (Ambient Air Quality) standard for maximum 4-hourly average O_3 concentration (80

ppb), which all occurred on 24 and 26 October 2012. The source of this anomaly is unknown.

The modelling summarised in the AQIA indicated that, for the Pluto Future State scenario, GLCs of O_3 could reach 62% of the 1-hour, and 73% of the 4-hour assessment criteria (NEPM Ambient Air Standard). There was negligible change to the maximum GLCs predicted anywhere on the model grid between the Pluto Future State scenario and the Pluto Upset Condition scenario, which was 63% of the 1 hour O_3 NEPM criteria and 75%of the 4 hourly O_3 NEPM criteria. This indicates that the impact of Pluto Train 2 (Pluto Current State Operations) on regional O_3 levels is minimal.

The regional modelling predicted moderate O_3 concentrations at Dampier (closest sensitive receptors) for Pluto Future State scenario, at 56% of the 1-hour, and 66% of the 4-hour assessment criteria. O_3 concentrations at Karratha for under this scenario were predicted at 60% of the 1-hour, and 72% of the 4-hour assessment criteria.

For the Pluto Upset Condition scenario, O_3 concentrations at Dampier were 56% of the 1-hour and 67% of the 4-hourly O_3 NEPM criteria. For Karratha, O_3 concentrations during upset conditions were modelled at 61% of the 1-hour and 74% of the 4-hourly O_3 NEPM criteria.

9.4.3 Description of potential adverse impact from the emission

O_3 is a powerful oxidant which can irritate airways. O_3 can be toxic with potential health effects including eye and throat irritation, shortness of breath, inflammation and damage to airways, and exacerbation of existing respiratory problems (WHO 2000). People most at risk of impact include those with asthma, children and the elderly. Impact can also occur to vegetation from O_3 exposure which includes visible foliage injury, growth retardation, and increased sensitivity to stress (WHO 2000).

9.4.4 Criteria for assessment

The NEPM sets ambient air quality standards for O_3 for the protection of human health and well-being. These standards are detailed in Table 36.

Table 36: NEPM standards for ozone

Pollutant	Averaging period	Monitoring investigation level		Goal (Maximum allowable exceedance)
		ppm	µg/m^3	
O_3	1 hour	0.10	214	1 day a year
	4 hours	0.08	171	1 day a year

9.4.5 Applicant controls

The exhaust stack height / dimensions and anticipated flow rates of exit gas from the various combustion emission sources dictate the dispersion of pollutants (NOx and VOCs) which contribute to the formation of ground level O_3. A summary of controls for reducing NOx and VOC emissions has been provided in section 10.3.5. Reducing emissions of pollutants which contribute to the formation of O_3 will minimise the Premises contribution to O_3 concentrations within the local area.

9.4.6 Key findings

The Delegated Officer has reviewed the information regarding ozone and has found:

1. O_3 is not a direct emission from Pluto Train 2 but is created by the reaction of

NOx and VOC emissions in the presence of sunlight.

2. Ambient monitoring is a suitable measure to detect if O_3 impacts are occurring at sensitive receptors.
3. Monitoring of NO_2 and VOC emissions from key sources will provide information on the potential contribution of emissions from the Premises to measured O_3 concentrations.

9.4.7 Consequence

The Delegated Officer has determined that the air quality criteria are likely to be met at all receptors (including Hearson Cove and Deep Gorge (Ngajarli)) and that there will be minimal off-site health impacts. Therefore, the Delegated Officer considers the consequence of O_3 gases from Pluto Train 2 to be **Minor**.

9.4.8 Likelihood of Risk Event

Considering the maximum measured and modelled O_3 concentrations for Pluto Train 2 operations, the Delegated Officer has determined that the likelihood of health impacts to sensitive receptors occurring will be **Unlikely**.

9.4.9 Overall rating of ozone

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of ozone emissions causing adverse health impacts is **Medium.**

9.5 Risk Assessment – release of environmentally hazardous materials from containment or transfer infrastructure

9.5.1 Description of release of environmentally hazardous materials

Environmentally hazardous materials could potentially be released from storage areas, transfer activities or pipelines, or leaks from connections/joins and discharged to land causing contamination of soil, groundwater, surface water or the marine environment via direct contact, runoff or infiltration.

9.5.2 Identification and general characterisation of emission

Various types and volumes of hazardous materials are stored on the Premises including hydrocarbons and other process chemicals. Large quantities of hazardous materials stored within the Premises are described in Table 37. Releases of hazardous materials from storage infrastructure, transfer lines, connections or fill points can impact the surrounding environment. Aromatic hydrocarbons such as BTEX are likely to be the most toxic hazardous materials stored on the Premises.

The closest storage infrastructure to the marine environment is the LNG storage tanks which are approximately 150 m east of the intertidal area of Mermaid Sound. Released LNG is likely to largely evaporate therefore a release is not expected to travel a large distance. Condensate storage is approximately 300 m east of the marine environment.

The Premises is underlain by a generally neutral, anaerobic, and saline water table and is largely a groundwater discharge zone with groundwater flow direction predominantly to the northwest towards Mermaid Sound. Groundwater monitoring indicates the depth to groundwater is approximately 11 mbgl.

There are no significant water courses within the Premises boundary. The stormwater system

designed for Pluto Train 2 will segregate surface runoff to minimise volumes of water requiring treatment. Management of stormwater is discussed further in section 8.12.

Table 37 summarises the bulk storage infrastructure for environmentally hazardous materials on the Premises.

Table 37: Types and quantities of significant volumes of environmentally hazardous materials stored within the premises

Material description	Construction status	Quantity
Condensate (existing)	Existing	130,000 m^3 (3 x tanks)
LNG (existing)	Existing	320,000 m^3 (2 x tanks)
Dilute amine (aMDEA) solution	To be constructed for Pluto Train 2	371 m^3
Ethylene	To be constructed for Pluto Train 2	288 m^3 (3 x vessels)
Propane	To be constructed for Pluto Train 2	1,160 m^3 (2 x vessels)

9.5.3 Description of potential adverse impact from the emission

Release of environmentally hazardous materials such as hydrocarbons and process chemicals may result in localised or offsite contamination of soils, groundwater and the marine environment. Runoff of hazardous materials outside the Premises is considered unlikely to occur as spilled materials will report to the stormwater system. The most likely pathway for offsite contamination to occur is therefore via spills or leaks becoming mobilised in groundwater flow and discharge. The discharge of wastewater may result in marine physical and ecological effects including reduced water quality and toxicity effects to marine biota.

Groundwater at the Premises has no beneficial use due to salinity levels, but is likely to flow towards the marine environment of Mermaid Sound. Altered groundwater quality could potentially lead to a decline in health of the intertidal areas, including turtle nesting beaches (Holden Beach).

If hydrocarbons or process chemicals enter the marine environment in high concentrations they may cause degradation of water and sediment quality, and toxic contaminants could potentially bio-accumulate within the water and sediments. Contact with, or ingestion of contaminated water or sediments could be potentially toxic for marine fauna. Mermaid Sound and the wider Dampier Archipelago has significant environmental, cultural and social values as detailed in Table 18.

9.5.4 Criteria for assessment

Relevant land, surface water and groundwater quality assessment criteria include:

- ANZECC 2000 Guidelines for Fresh and Marine Water Quality (99% level of protection);
- NEPM Assessment of Site Contamination 1999 as amended (2013) Schedule B1 – Guideline on Investigation Levels for Soil and Groundwater; and
- Assessment and Management of Contaminated Sites (DER, 2014) provides ecological and human health assessment levels for soil, groundwater, surface water and sediment.

The ANZECC 2000 Guidelines for Fresh and Marine Water Quality (99% level of protection) do not directly apply to emissions to groundwater; however, they are considered relevant assessment criteria to assess ecological risks associated with the discharges to groundwater, given the proximity of the marine environment, which is the closest environmental receptor for groundwater discharging from beneath the Premises.

General provisions of the EP Act make it an offence to cause or allow pollution. The *Environmental Protection (Unauthorised Discharges) Regulations 2004* specifies hazardous materials, including acids, alkalis and hydrocarbons that must not be discharged to the environment.

9.5.5 Applicant controls

The Applicant controls which are in place to prevent release of environmentally hazardous materials from storage and handling areas are outlined in Table 38. These controls have been reviewed as part of this assessment.

Table 38: Applicant's proposed controls for storage of hazardous materials

Site infrastructure	Design details/ Description
General	• Regular infrastructure inspections, monitoring and maintenance is undertaken in accordance with operating procedures and the premises safety management system to identify and rectify potential integrity issues in accordance with the requirements of the Premises' Major Hazard Facility licence. • Spills report to collection sumps on the Premises and are removed through sump vacuum truck extraction points and will be investigated and reported per site operational procedures. • Clean up of spillage in accordance with the Premises Spill Response Procedure. • Training for employees in appropriate spill response.
Propane and ethylene storage vessels	• Storage vessels are designed and constructed in accordance with API650 standards • Ethylene is stored within three pressurised, double walled, vacuum jacketed horizontal vessels • Propane is stored within two pressurised storage vessels with level alarms. Vessels are located within a bunded area
Amine (aMDEA) storage	• Amine storage will have high level alarm, over pressure protection and overflow siphon break. • Storage complies with the applicable requirements of the DG Regulations, AS 1940; • The storage tanks are located within concrete bunds with a capacity of 110% of the largest storage tank, or 25% of the total storage volume if multiple tanks occur within a bund; • The concrete bunds drain to sumps to recover any released material. Spilt material can be recovered from the sumps via vacuum truck extraction points;

9.5.6 Key findings

The Delegated Officer has reviewed the information regarding release of environmentally hazardous materials and has found:

- Existing infrastructure controls implemented in the design and construction of the Premises in accordance with Works Approval W4444/2008/1 significantly reduce the likelihood of environmentally hazardous materials being released

and associated impacts occurring.

- The Premises is registered as a Major Hazard Facility and storage of environmentally hazardous materials above placard quantities is regulated under the DG Act by the DMIRS.
- Unauthorised discharges of environmentally hazardous materials are subject to the UDR and the general provisions of the EP Act relating to causing pollution and environmental harm also apply.

9.5.7 Consequence

The Delegated Officer has had regard to the nature and quantity of hazardous materials used on the Premises, the engineering / infrastructure controls in place and the distance to the nearest sensitive receptors including the marine environment and groundwater.

If minor quantities of environmentally hazardous materials are discharged to land, the Delegated Officer has determined that low-level on-site impact may occur and there is unlikely to be any offsite impact. Therefore, the Delegated Officer considers the consequence of the release of minor quantities of environmentally hazardous materials to be **Minor**.

If a large quantity of environmentally hazardous material is released to the environment as a result of a large containment breach or a leak which is undetected for an extended period of time, then this may cause high level on-site impacts to the area directly affected and short term impact to an area of high conservation value or special significance if groundwater flow or surface runoff transports the released material to the marine environment. Therefore, the Delegated Officer considers the consequence of such an event to be **Major.**

9.5.8 Likelihood of Risk Event

With consideration of the Applicant's controls to prevent and/or capture hazardous material releases the Delegated Officer has determined that minor quantities of environmentally hazardous materials being discharged to land could occur at some time. Therefore, the Delegated Officer considers the likelihood of minor discharges to be **Possible**. The Delegated Officer has also determined that the likelihood of a large quantity of environmentally hazardous material being discharged to land is **Rare**.

9.5.9 Overall rating of release of hazardous materials from containment or transfer infrastructure

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of release of environmentally hazardous materials from containment or transfer infrastructure to land is **Medium** for small releases and **Medium** for large volume releases.

9.6 Risk Assessment – discharge of contaminated water

9.6.1 Description of discharge of contaminated water

Process wastewater and stormwater generated on the premises has the potential to be contaminated, primarily from contact with hydrocarbons but also with other hazardous process chemicals and sediments. If stormwater is not appropriately segregated and treated prior to discharge, contaminated water could be discharged to the environment. Process wastewater could also potentially escape from containment, transfer and treatment infrastructure resulting in a discharge of contaminated water to the environment. Release of contaminated water could lead to contamination of soil, groundwater, surface water or the marine environment via direct contact, runoff or infiltration.

9.6.2 Identification and general characterisation of emission

Process wastewater requiring treatment and disposal via discharge will be produced from water collected from process equipment (e.g. hot water loops).

In addition, the following treated wastewater streams (where these are to be discharged with the above wastewater streams and thus may influence discharge water quality) include:

- Potentially contaminated water generated from hydrostatic testing activities;
- Potentially contaminated stormwater runoff from process areas;
- Demineralised water, where the supply to the plant is sourced from the effluent treatment plant; and
- Domestic wastewater (treated sewage and grey water).

Treated wastewater streams from Pluto Train 2 that cannot be re-used onsite will be discharged into Water Corporation's existing multi-user brine return line (MUBRL) with the outfall located in King Bay.

The MUBRL is regulated via MS 594; the Applicant has confirmed that the MUBRL outfall and mixing zone has sufficient line capacity to receive surplus treated wastewater streams from Pluto Train 2.

The Pluto LNG Project Treated Waste Water Marine Discharge Management Plan (TWWMDMP), required to be implemented under MS 757, provides a management framework for the monitoring and reporting of discharges. Reporting of quarterly monitoring of discharges to the MUBRL are also required to be reported annually under the Existing Licence L8752/2013/1.

Volumes of treated wastewater discharged to the MUBRL is expected to be highly variable depending on rainfall and the amount of water being used (and re-used) on site. Annual volumes of treated wastewater discharged to the MUBRL as a result of Pluto LNG Project have ranged between 102,163 m^3 (2016-2017) and 60,586 m^3 (2018-2019) (Woodside 2019). The volumes authorised to be discharged to the MUBRL from the Pluto LNG (Trains 1 and 2) are 146,000 m^3 per year. The Applicant has advised that the authorised volume of 146,000m^3 will be sufficient to cater for increased total volumes discharged as a result of Pluto Train 2 start-up in addition to the existing Pluto LNG operations.

9.6.3 Description of potential adverse impact from the emission

Uncontrolled discharge of process wastewater and stormwater streams to the environment that are not appropriately treated may be contaminated with hydrocarbons, process chemicals and/or sediment. Such discharges may result in localised or offsite contamination of soils, groundwater, surface water and the marine environment through direct discharge, runoff or infiltration.

Groundwater at the Premises potentially discharge to the marine environment. Altered groundwater quality, or runoff of contaminated or sediment laden stormwater could potentially lead to a decline in health of the intertidal areas and conservation significant fauna in Mermaid Sound (e.g. turtles). Fauna in the area could also experience toxic effects from contaminants within stormwater or process water.

Stormwater or process water containing hydrocarbons, process chemicals or sediment (high turbidity) which enters the marine environment may cause degradation of water and sediment quality, and toxic contaminants could potentially bio-accumulate within the water and sediments. Contact with, or ingestion of contaminated water or sediments could be potentially toxic for marine fauna. The premises is located in a semi-arid region that can experience intense rainfall during the passage of summer tropical cyclones and thunderstorms, therefore stormwater systems can receive significant volumes in a short period of time.

9.6.4 Criteria for assessment

Controlled discharge of wastewater via the MUBRL is managed by Water Corporation and is subject to requirements of MS 594. The *Burrup Peninsula Desalinated Water and Seawater Supplies Project: Operational Marine Environmental Management Plan* (OMEMP) developed by Water Corporation, as required by MS 594, outlines the approach for managing the discharge of combined effluent to the MUBRL to achieve specified environmental objectives via a program of in-field and field-based monitoring.

The specified ecological objectives in the OMEMP are based on the Pilbara Coastal Water Quality Consultation Outcomes (DoE 2006) report which recommended setting a high level of ecological protection for King Bay in areas outside of the MUBRL's 40 m outfall mixing zone, and an area of low ecological protection within the mixing zone (1 ha).

End-of-pipe trigger levels have been set through the OMEMP and act as initial indicators that the environmental objectives may not being met. The triggers were back calculated from the high protection trigger levels (ANZECC 99% level of protection) and take into consideration the predicted dilutions achieved by the outfall at the current discharge rate.

Table 39: Trigger levels for discharges via the MUBRL

Parameter	Units	Water Corp OMEMP Triggers
pH	pH units	6.3 - 8.3
Conductivity	µS/cm	75,000
Ammonia	µg/L	32,141
Total Phosphorus	µg/L	179
Arsenic	µg/L	140 - As(III) 275 - As(V)
Cadmium	µg/L	36
Chromium	µg/L	459 - Cr(III) 8.5 - Cr(VI)
Cobalt	µg/L	61
Copper	µg/L	11
Lead	µg/L	134
Mercury	µg/L	1.4
Nickel	µg/L	427
Selenium	µg/L	183
Silver	µg/L	49
Vanadium	µg/L	3050
Zinc	µg/L	419

Relevant land, surface water and groundwater quality assessment criteria for uncontrolled discharges of process wastewaters and stormwater include:

- ANZECC 2000 Guidelines for Fresh and Marine Water Quality (99% level of protection);
- NEPM Assessment of Site Contamination 1999 as amended (2013) Schedule B1 – Guideline on Investigation Levels for Soil and Groundwater; and
- Assessment and Management of Contaminated Sites (DER, 2014) provides ecological and human health assessment levels for soil, groundwater, surface water and sediment.

9.6.5 Applicant controls

The Applicant has existing process wastewater, collection and drainage systems for Pluto LNG Project that will be integrated with Pluto Train 2. No new wastewater treatment and discharge infrastructure is required to be constructed for Pluto Train 2.

Table 40: Applicant controls for for management of process wastewaters and stormwater

Site infrastructure	Description
Stormwater collection and treatment system	Drainage systems will be provided to ensure the segregation and direction to appropriate treatment and/or disposal facilities of effluent from the process, utilities and contaminated surface water streams. These effluent streams and collection systems include: • Entirely Oil-Free (EOF) - open surface water drainage system designed to collect and direct clean water from outside of kerbed areas around process facilities and bunded areas around the storage tanks. EOF water is channelled via a network of open channels, sumps and pipes where it can be disposed of to natural drainage lines around the site, without treatment. In the event of a spill within EOF areas, implementation of spill response procedures will ensure immediate cleanup of spills from EOF surfaces and maintain clean EOF areas. • Accidentally Oil-Contaminated (AOC) - collection of surface water run-off by means of bunded areas. AOC drainage areas are those areas where there is the possibility of accidental contamination with oil or other contaminants, i.e. accidental spills. Accidental spillages shall be contained by kerbs or floor slopes in the process areas and bunds for storage tank areas. AOC areas are designed to limit ingress of rain and prevent overflow to the surrounding paved areas. Implementing spill response procedures will also ensure immediate clean-up of spillages from AOC surfaces and maintain clean kerbed and bunded areas. AOC water collected in the bunded areas will be inspected and analysed and either transferred to the Controlled Discharge Facility (CDF) for treatment if contaminated (ie. first flush) or released to EOF if uncontaminated. AOC bunding will be sized to capture that of a 1 in 10 year storm event for a 24 hr duration, each area will be graded to a sump or low point with a drain valve and vacuum truck connection. AOC areas will be provided for process units containing liquid hydrocarbons and areas that surround Continuously Oil Contaminated (COC) areas. It is estimated there will be approximately 23 AOC sumps. For process areas containing large liquid inventories (Acid Gas and Hot oil), the bunded area will be designed to contain the greater of the following volumes with 150 mm freeboard and conform to the requirements of AS 1940: - The sum of 100% of the tank volume and the runoff from a 25-year, 24-hour rainfall. - 110% of a single tank volume. - 25% of tanks in aggregate when bunded together. • Continuously Oil-Contaminated (COC) - drainage system collects any oily leakages from equipment by localised kerbs, sumps, drip trays, drain trays, funnels, etc. COC effluent will be collected via vacuum tanker and disposed offsite. COC sources include equipment or packages with a high potential for lubrication oil leakage (e.g. pumps, gearbox and compressor skids). • Process Closed Drainage (CD) – includes closed process drainage systems within the acid gas removal area containing amine compounds (a-MDEA). CD systems are considered part of the unit, whereby drainage is recovered into the process, and fluids are not discharged to the oily water drainage systems or Effluent Treatment Plant (ETP). All sumps, AOC areas and EOF trenches will be constructed of concrete. A short LNG containment trench adjacent to the liquefaction process units will be capable of capturing spills from normal or abnormal operations. This trench will enable capture and boil off of any LNG spills.
Pluto Sewage Treatment Plant (STP)	The existing STP is an activated sludge and extended aeration Membrane Bio-Reactor (MBR) sewage treatment system which incorporates pre-treatment and chemical dosing for disinfection. The STP has a maximum design rate of 150m^3/day of domestic wastewater and is authorised under Existing Licence L8752/2013/1, which requires quarterly monitoring of treated wastewater quality. The Applicant has calculated the STP can handle the additional flow associated with the expanded workforce during construction and operation

Site infrastructure	Description
	of Pluto Train 2. Treated wastewater from the STP is either discharged to greenspace irrigation areas onsite or discharged to the MUBRL.
Controlled Discharge Facility (CDF)	Allows inspection and testing of effluent quality before a decision is taken to discharge to the EOF surface water system if not contaminated, or to the ETP for further treatment if contaminated. The basins are constructed from reinforced concrete and incorporate a first flush compartment and a peak overflow compartment.
Effluent Treatment Plant (ETP)	For treatment of contaminated AOC and process wastewater. The Pluto ETP provides primary, secondary and tertiary treatment of contaminated water prior to reuse or marine discharge. Discharge criteria for the ETP are specified in the Pluto LNG Project TWWMDMP developed under Ministerial Statement 757. The TWWMDMP also details contingency measures to be enacted in the event that the discharge criteria are exceeded. This ensures that the Pluto LNG Plant can continue to operate should the ETP experience upset conditions or the treated effluent is above the required specifications. Concentrated wastewater solids produced by the treatment processes are disposed off-site in appropriately licensed and approved facilities
Controlled discharge to MUBRL	Discharge of effluent via the Water Corporation's MUBRL will continue to be managed via the approved Pluto LNG Project TWWMDMP, which provides management framework to be implemented and reported against through annual licence reporting specified under Existing Licence L8752/2013/1. Management controls for discharge of treated wastewaters from the Premises are specified under MS 757 (Condition 7) and includes the following: - Whole Effluent Toxicity (WET) testing on actual treated wastewater is undertaken periodically; - Monitoring of wastewater to occur at source prior to commingling and at the discharge point. Wastewater to be monitored in accordance with regulatory requirements and to include monitoring of discharge rates; - Monitoring to confirm: • discharged wastewater meets specified criteria; • the prediction of no significant impact to nearshore communities and to ensure contaminants are not bioaccumulated by marine organisms. This shall include agreed 'trigger values' for initiation of further studies and remedial actions as necessary; • that an appropriate level of ecological protection is being achieved at the edge of the agreed mixing zone. The concentration of total hydrocarbon in wastewater discharged to Mermaid Sound to be measured daily; • treated wastewater meets the social use values at end of pipe or within a distance, from point of discharge, agreed with the relevant authorities; and • the ETP performance is in line with the objectives of the TWWMDMP.

9.6.6 Key findings

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

- The Premises has comprehensive stormwater and process wastewater systems designed to contain, and where necessary treat, contaminated water minimising the likelihood of its discharge to the environment.
- Due to the Premises location being subject to cyclonic activity, maintenance of stormwater infrastructure (including discharge, treatment or offsite disposal of any contained water) should be undertaken if cyclones or heavy rainfall are predicted to impact the Premises.

- Treated water will be discharged from the ETP to Water Corporations MUBRL which discharges to King Bay. Discharges from the MUBRL are authorised and regulated under MS 594, and include additional external industry sources in addition to Pluto LNG Project. The Applicant has calculated the pre-authorised discharge volume of 146,000m^3 is sufficient for Pluto LNG and Pluto Train 2 operations.
- The discharge of treated wastewater from the Premises is also regulated under MS 757 and managed by the TWWMDMP. MS 757 requires the Applicant to implement the TWWMDMP, which sets out environmental values, environmental quality objectives and levels of ecological protection to be achieved around the outfall, sets "trigger" levels for the implementation of remedial, management and/or preventative actions to protect the water quality and the marine environment, requires WET testing of wastewater, consistent with ANZECC requirements, and requires a monitoring program to enable determination of whether the water quality objectives are being met.
- Existing Licence L8752/2013/1 has conditions requiring monitoring and reporting of the volumes and quality of discharged water. Licence conditions relating to the discharge will be reviewed to assess duplication with commitments made in the TWWMP and Part IV requirements.

9.6.7 Consequence

The Delegated Officer has determined that environmental quality criteria for wastewater discharges from the ETP and STP are likely to be met and that there will be minimal off-site impact associated with these discharges. Therefore, the Delegated Officer considers the consequence of discharge of contaminated stormwater or process water to be **Minor**.

If discharge of untreated contaminated stormwater or process wastewater occurs from process areas outside of the controlled discharges to the MUBRL, then the Delegated Officer has determined that short-term impact to an area of high conservation value or special significance, being Mermaid Sound which supports conservation significant fauna, could occur. Therefore, the Delegated Officer considers the consequence of discharge of contaminated stormwater or process water to be **Major**.

9.6.8 Likelihood of Risk Event

Based on the Applicant's proposed controls, the distance to sensitive ecosystems (marine) and the nature of stormwater and process water from the Premises, the Delegated Officer has determined that impact upon the surrounding sensitive ecosystems as a resulting from discharge of untreated stormwater or process water and discharges to the MUBRL will probably not occur in most circumstances. Therefore, the likelihood has been determined as **Unlikely**.

9.6.9 Overall rating of discharge of potentially contaminated water

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of discharge of potentially contaminated water is **Medium.**

9.7 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 41 below. Controls are described further in section 11.

Table 41: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
1.	Combustion gases (NOx, CO, SOx, VOCs)	GTCs, GTG, flares, RcTOs	Air/wind to sensitive receptor causing public health impacts	Infrastructure and management controls	Minor consequence Unlikely **Medium risk**	Acceptable subject to regulatory controls
2.	Ozone (O_3)	Secondary pollutant (not a direct emission)	Air/wind to sensitive receptor causing public health impacts	Infrastructure and management controls	Minor consequence Unlikely **Medium risk**	Acceptable subject to regulatory controls
3.	Release of environmentally hazardous materials (minor)	LNG, Condensate and other hydrocarbon and chemical storage	Direct discharge to terrestrial environment causing contamination and possible infiltration to groundwater / marine environment	Infrastructure and management controls	Minor consequence Possible **Medium risk**	Acceptable subject to regulatory controls
4.	Release of environmentally hazardous materials (major)	LNG, Condensate and other hydrocarbon and chemical storage	Direct discharge to terrestrial environment causing contamination and possible infiltration to groundwater/ marine environment	Infrastructure and management controls	Major consequence Rare **Medium risk**	Acceptable subject to regulatory controls
5.	Discharge of potentially contaminated water (from process areas)	Stormwater system Process wastewater system	Direct discharge to natural drainage or terrestrial environment causing contamination and possible infiltration to groundwater/ marine environment	Infrastructure and management controls.	Major consequence Unlikely **Medium risk**	Acceptable subject to Applicant controls

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor** **(Impact)**			
6.	Discharge of potentially contaminated water (MUBRL)	Stormwater system Process wastewater system	Direct discharge to natural drainage or terrestrial environment causing contamination and possible infiltration to groundwater/ marine environment	Infrastructure and management controls.	Minor consequence Unlikely **Medium risk**	Acceptable subject to Applicant controls

10. Regulatory controls

10.1 Works Approval controls

In accordance with the *Guidance Statement: Risk Assessments* (DER 2017b) the Applicant's controls in relation to management of discharges to air, land and surface water will be conditioned as they lower the assessed likelihood of the risk event.

In accordance with DWER's *Guide to Licensing* (June 2019), additional conditions have been added to allow commissioning of the infrastructure and time-limited operations. The works are required to be constructed in accordance with the engineering designs and specifications submitted with the Application. Evidence of the completed works will be required to be submitted to the CEO in a construction compliance report, prior to the commencement of commissioning works.

Environmental commissioning reports will be required to be submitted to the CEO following the completion of commissioning of infrastructure, which includes a summary of commissioning activities and the environmental performance of the as constructed infrastructure and equipment.

Environmental Commissioning has been authorised under the works approval which includes both "commissioning" (24 months including initial GTG start-up 6 months prior to commissioning of the LNG train following introduction of feed gas) and "environmental commissioning" (12 months) as described in section 3.6. Validation of environmental performance will occur during the final stage of environmental commissioning with conditions requiring regular monitoring of air emissions; both point source and ambient monitoring (refer to section 10.1.2). The Applicant is required to notify the CEO of the completion of key milestones that trigger the various phases of environmental commissioning in order for the Department to remain informed on the progress of commissioning activities. This includes notification of the commencement and completion of environmental commissioning as well as notification of the introduction of feed gas.

A time-limited operational phase of 9 months will also be allowed under the works approval commencing at the completion of environmental commissioning. An extended period for time-limited operations has been allowed to account for the scale of the project and volume of monitoring data that will require collation and assessment to inform a decision on the licence application. In making this determination the Delegated Officer has considered the regulatory controls in place during this time and considers them suitable for the level for risk.

Monitoring and reporting is also required during environmental commissioning and time limited operations (refer to sections 10.1.2 and 10.1.4 below)

10.1.1 Specified emission discharge points, and limits

Conditions have been included in the Works Approval to specify the emission points and types of pollutants which have been assessed in this Decision Report and authorised for construction, commissioning and time limited operations under the works approval. The height of the emission points aids in dispersion of pollutants to minimise contribution to ambient GLCs. Heights have therefore been specified for each emission point on the Works Approval. Emission limits will be reviewed through assessment of the licence and commissioning data.

10.1.2 Monitoring requirements

Monitoring requirements for discharges to air during commissioning and time limited operations have been imposed during environmental commissioning and time limited operations to verify that emission rates that formed the basis for the air quality modelling are being achieved. Stack testing of point source discharge points will be required to confirm the

accuracy of the ambient air quality impact predictions outlined in the Applicant's AQIA.

It is noted that VOC emissions from gas turbines are not predicted to be significant however monitoring is included on the works approval for verification purposes during commissioning. No monitoring is required during the time-limited operational phase, however monitoring requirements will be reviewed in the unlikely event that verification testing during commissioning suggests VOC emissions are higher than predicted and pose a more significant risk.

Due to the scale and nature of emissions from the Premises, and as a result of cumulative emission sources on the Burrup Peninsula, the Delegated Officer considers continued ambient air monitoring at the Burrup Peninsula, Dampier and Karratha monitoring stations is necessary to ensure the Premises does not impact the air quality or health of residents. Conditions have been included in the Works Approval to specify the ambient air quality and meteorological monitoring requirements to be implemented at the relevant monitoring stations.

To ensure the monitoring data is reliable and accurate, the conditions specify that ambient air quality and meteorological monitoring is to be undertaken in accordance with the relevant Australian Standard. Concentrations of NO, NO_2, NOx, CO and O_3 are to be continuously monitored with averaging periods for each pollutant aligning with the NEPM criteria. Wind speed and direction are the key meteorological parameters requiring monitoring. The meteorological data will aid in determining the source of emissions if high concentrations are recorded at the relevant monitoring stations.

Conditions have been included to require monitoring to be undertaken in accordance with AS 4323.1, and for all sampling and analysis to be undertaken by a holder of NATA accreditation for the relevant methods of sampling and analysis. These conditions are required to ensure the monitoring data is reliable and accurate.

10.1.3 Process monitoring

As per the previous section, conditions in the works approval will require the Applicant to undertake quarterly stack testing when the GTCs and GTG are being commissioned and operated. Continuous monitoring of the fuel consumption of the GTCs and GTG has therefore been included to verify the operating frequency of the equipment with the units in operation at the time of monitoring. Stack testing also requires the flow rates to be monitored.

As stack testing is not able to be undertaken for the flares, emissions from the flares need to be calculated based on the volume of gas flared from the infrastructure. Pluto Train 2 is also designed to minimise the amount of flaring undertaken. The works approval therefore includes a requirement for continuous monitoring of the volume of gas flared in order to verify emissions from the flares, and confirm flaring continues to be minimised. Dark smoke emissions will also be required to be monitoring during flaring events.

10.1.4 Monitoring reports

The Applicant is required to provide Environmental Commissioning Progress Reports on an annual basis throughout the environmental commissioning period containing a summary of commissioning activities completed during the preceding 12 months of commissioning and monitoring data recorded (point source and ambient monitoring). The report will also contain details of any discharges of wastewater from hydrostatic testing performed including results of water quality monitoring undertaken. Submission of annual progress reports will provide DWER with oversight of commissioning activities and emissions generated during the commissioning period and will aid in the assessment of the licence application.

A Final Environmental Commissioning Report will be required to be submitted at the completion of environmental commissioning containing any monitoring data collected during the remainder of the environmental commissioning period, an assessment of the environmental performance of the installed infrastructure, details of compliance against the

works approval conditions and (if required) proposed measures to meet the manufacturer's design specifications and the conditions of this works approval. The report will be also contain results of noise monitoring performed under the works approval, details on the amount of LNG product processed during environmental commissioning and the types and volumes of wastewater generated during hydrostatic testing, including the monitoring regimes and disposal methods.

A similar report will be required on completion of time-limited operations containing information relevant to that period of operation.

Operating Licence L8752/2013/2 for Pluto LNG Project requires an Annual Environmental Report (AER) to be submitted to DWER each year, which summarises the results of stack emissions testing and dark smoke monitoring and other Licence notifications and reporting. Results are required to be compared with previously completed monitoring results. It is expected that upon completion of the works and commissioning and time limited operations under the works approval, the Applicant will apply for an amendment to L8752/2013/2 to incorporate Pluto Train 2 infrastructure and operations. Reporting conditions under L8752/2013/2 will be reviewed at that time to incorporate the monitoring and reporting of Pluto Train 2 emissions and discharges.

11. Determination of Works Approval conditions

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

The Works Approval expires in 7 years from date of issue.

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. Applicant's comments

The Applicant was provided with the draft Decision Report and draft Works Approval on 3 November 2020, 3 February 2021 and XXXX 2021. The Applicant provided comments which are summarised, along with DWER's response, in Appendix 3.

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 Works Approval 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.	Works Approval Application, including DWER application form and supporting documents (as detailed in Table 2). Woodside, October 2019.	Application	DWER records (DWERDT213114)
2.	Pluto LNG Project: Air Quality Management Plan (rev 4) Woodside, December 2019	Pluto AQMP	Accessed at https://files.woodside/docs/default-source/our-business---documents-and-files/pluto---documents-and-files/pluto-lng-environmental-compliance-documents/pluto-lng-project---air-quality-management-plan-(rev-4)-2019.pdf?sfvrsn=4bf1b39d_10
3.	Pluto LNG Project: Treated Wastewater Management Plan (rev 4) Woodside, 13 March 2014	Pluto TWWMP	Accessed at https://files.woodside/docs/default-source/our-business---documents-and-files/pluto---documents-and-files/pluto-lng-environmental-compliance-documents/pluto-lng-project---treated-waste-water-marine-discharge-management-plan.pdf?sfvrsn=c7a0e38d_4
4.	Pluto LNG Project: Greenhouse Gas Abatement Program (rev 2) Woodside, June 2011	Woodside 2011	Accessed at https://files.woodside/docs/default-source/our-business---documents-and-files/pluto---documents-and-files/pluto-lng-environmental-compliance-documents/pluto_lng_project_-_greenhouse_gas_abatement_program.pdf?sfvrsn=40d81cf5_6
5.	Pluto LNG Project: Sea Turtle Management Plan Operations and Maintenance (rev 6) Woodside, August 2018	Pluto STMP	Accessed at https://files.woodside/docs/default-source/our-business---documents-and-files/pluto---documents-and-files/pluto-lng-environmental-compliance-documents/pluto-lng-project---sea-turtle-management-plan.pdf?sfvrsn=3c29ac91_4
6.	Licence L8752/2013/2 – Pluto LNG Project (Train 1)	L8752/2013/2	Accessed at www.der.wa.gov.au
7.	Pluto Gas Plant Annual Environmental Report – April 2018 to March 2019 (Woodside, 26/6/2019)	Woodside 2019	DWER records (DWERDT172526)
8.	Ministerial Statement 757 – Pluto LNG Project	MS 914	Accessed at www.epa.wa.gov.au/
9.	Ministerial Statement 594 – Water Corporation Multi User Brine Return Line	MS 594	Accessed at www.epa.wa.gov.au/
10.	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	DER 2015a	Accessed at www.dwer.wa.gov.au

11.	DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	DER 2015b	
12.	DER, August 2016. *Guidance Statement: Licence duration.* Department of Environment Regulation, Perth.	DER 2016a	
13.	DER, November 2016. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	DER 2017	
14.	DWER, June 2019. *Guideline: Decision Making*. Department of Water and Environmental Regulation, Perth.	DWER 2019a	
15.	DWER, June 2019. *Guideline: Industry Regulation Guide to Licensing*. Department of Water and Environmental Regulation, Perth.	DWER 2019b	
16.	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) (2000). Australian Water Quality Guidelines for Fresh and Marine Water Quality	ANZECC / ARMCANZ 2000	Accessed at http://www.agriculture.gov.au/SiteCollectionDocuments/water/nwqmsguideline-4-vol1.pdf
17.	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).	ANZECC ARMCANZ 1997	Accessed at https://www.waterquality.gov.au/sites/default/files/documents/effluent-management.pdf
18.	National Environment Protection Assessment of Site Contamination Measure (ASC NEPM)	ASC NEPM 1999	Accessed at http://nepc.gov.au/nepms/assessment-site-contamination
19.	*New South Wales (NSW) Protection of the Environment Operations (Clean Air) Regulation 2010*	NSW Clean Air Regulations 2010	Accessed at https://www.legislation.nsw.gov.au/#/view/regulation/2010/428
20.	IFC (International Finance Corporation). 2007. *Environmental, Health, and Safety General Guidelines*. Washington, DC: IFC.	IFC 2007	Accessed at https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines
21.	WHO, 2000. *Air Quality guidelines for Europe, 2nd Edition*, WHO Regional Publications, European Series, No. 91, WHO Regional Office of Europe, Copenhagen, Denmark	WHO 2000	Accessed at http://www.euro.who.int

Appendix 2: Summary of Direct Interest Stakeholder comments on Application

Summary of Stakeholder comment	DWER response
The City of Karratha responded on 13 March 2020, notifying DWER that an application for development approval had been submitted and was being assessed under delegation.	Noted by the Delegated Officer.
Stakeholders have submitted that the construction and operation of Pluto Train 2 will result in a dramatic increase in emissions that contribute significantly to climate change, increase the threats to human health for those living in the vicinity, and also convert to acids which are deposited on the petroglyphs of Murujuga which record unique and irreplaceable cultural heritage.	In line with the State government policy *Greenhouse Gas Emissions Policy for Major Projects*, greenhouse gas (GHG) emissions from the premises (in addition to other environmental factors) are regulated by the Western Australia Environmental Protection Authority (EPA), specifically under MS 757. Under MS 757 the Applicant is required to implement a Greenhouse Gas Emissions Management Plan, subject to review by the EPA and approval by the Minister for the Environment. The Policy supports the development of Greenhouse Gas Management plans for proponents which: 1. outline strategies to avoid, reduce, mitigate and offset the project's direct (scope 1) emissions 2. contributing towards the State's aspiration of net zero by 2050; 3. are unique to a proposal's specific circumstances; 4. allow proponents to take account of opportunities at either facility level or across national 5. operations; 6. allow proponents to propose their own timeframes and interim targets; 7. include requirements for periodic public reporting against their targets; and 8. account for and align with Commonwealth requirements. GHG emissions associated with the construction and operation of Pluto Train 2 have therefore not been considered in this assessment performed under the provisions of Part V of the EP Act. This is in line with DWER's *Guidance Statement: Setting Conditions*, which states conditions will not unnecessarily duplicate requirements imposed directly by the EP Act or another written law. In line with the precautionary principle, to ensure there is a framework in place for protection of the Murujuga rock art into the future, DWER, in conjunction with MAC, is implementing the Murujuga Rock Art strategy which establishes the regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs (further details are in section 5.2 of this Decision Report). As per the risk assessment in section 10 (Tables 19 and 20), the Delegated Officer has determined that the regulatory framework described in section 5.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries

Summary of Stakeholder comment	DWER response
	located on Murujuga and surrounds which could potentially impact rock art, and therefore a coordinated approach is required. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.
Stakeholder notes substantial changes have occurred since Pluto Train 1 was built and Train 2 was approved in concept, including: • the socio-political-environmental context has changed since MS 757 was signed; there is new knowledge and greater public awareness about the Murujuga rock art, its cultural heritage significance, and its vulnerability to corrosive industrial emissions; • Murujuga has been put forward for World Heritage Listing by State and Commonwealth governments and the Murujuga Aboriginal Corporation (MAC), with many statements made about its unique and important cultural significance. As a result, it is especially critical that the results of cumulative emissions must be measured and factored into the setting of conditions through the works approval assessment process; • there is greater acknowledgement of and concern about the health impacts of industrial emissions on workers, local residents, and visitors to Murujuga; • there is overwhelming public concern about the wide-reaching and critical impacts of climate change due to greenhouse gas (GHG) emissions; • Woodside has not yet submitted a plan for their GHG abatement and targets for emissions reduction to support the WA Government's aspiration of net-zero emissions by 2050; • the WA government has acknowledged that past monitoring of industrial emissions has been inadequate to understand the actual effect of emissions on the irreplaceable Burrup rock art; It is essential that cumulative emissions are measured and analysed to calculate potential threats to public health (including from fugitive and accidental emissions), and to calculate cumulative acidic deposition on the Murujuga rocks that contain the petroglyphs.	DWER notes the significance of the Murujuga rock art, which has immense cultural and spiritual significance to Aboriginal people and of significant state, national and international heritage value. DWER is working with MAC to implement the Murujuga Rock Art strategy as outlined above. The State Government is working with MAC to undertake the next step in the World Heritage listing process, which is to prepare the formal nomination dossier. The Murujuga Rock Art Strategy released by DWER in February 2019, establishes a transparent, risk-based and adaptive framework for managing and monitoring the rock art to protect it from the impacts of anthropogenic emissions. It uses a scientifically rigorous approach to monitoring, analysis and management that will provide an appropriate level of protection to the rock art. Sections 6.1, 10.3 and 10.4 summarise the Applicant's AQIA which includes predictive modelling of ambient air emissions in the air shed surrounding the Premises. The modelling considered plausible cumulative emission scenarios and compared them against the NEPM (Ambient Air Quality) criteria for significant pollutants expected during operation of Pluto LNG plant (Trains 1 and 2) in combination with existing and future proposed industrial sources in the area. The modelling found that for cumulative scenarios there will be no exceedance of NEPM (Ambient Air Quality) criteria. Validation testing of emissions is required under the conditions of the works approval to verify the modelling assumptions. Ambient air monitoring at Burrup, Dampier and Karratha is also required to ensure the continued protection of human health in these locations. As stated above, GHG emissions have not been considered in this report as these emissions are regulated under MS 757.
The contractor awarded the Burrup monitoring tender does not seem well-placed to develop and implement the Murujuga rock art monitoring program. Without experience in highly-specialised scientific monitoring and analyses, it is also uncertain whether the contractor would be in a position to train MAC Land and Sea Rangers "to gain new skills as the custodians of Murujuga".	This matter is outside of the scope of Part V of the EP Act. The Delegated Officer notes, however, that DWER and MAC will partner to oversee the monitoring program, evaluating and reporting on trends and changes in the condition of the rock art. MAC rangers working with DWER and alongside the Puliyapang team, will receive training to gain new skills as the custodians of Murujuga.

Summary of Stakeholder comment	DWER response
The stakeholder submitted that Woodside's Burrup Hub may not be financially viable, and that it is not financially advantageous to the citizens of WA and Australia when all environmental costs are considered. It is appropriate that DWER and EPA should delay any final decision on the works approval application for Pluto Train 2 until: • the Murujuga monitoring program is established and some results have been obtained, • Woodside has presented the greenhouse gas and air quality management plans to EPA and they are considered in light of the State's emissions targets, and • the economic viability and commitment by Woodside's partners have been determined.	Consideration of the financial viability of the Burrup Hub is outside of the scope of Part V of the EP Act.
Stakeholder urges DWER to closely examine cumulative emissions of all industries on the Burrup, their proposed controls, their impacts on air quality, public and environmental health, the rock art, and the contribution to global greenhouse gases, as required by the Precautionary Principle. DWER can and should tighten the controls to reduce emissions, set very strict conditions on emissions, and set specific numerical targets with reporting dates that are checked.	DWER's Regulatory Framework includes a risk-based approach to ensure that there is not an unacceptable risk of harm to public health or the environment. Licensing and approval decisions, including conditions imposed on works approval or licence, are proportionate to the level of risk (consequence and likelihood) that the activity poses to public health and the environment. DWER has regard for cumulative emissions when assessing potential impacts on air quality (refer Air Quality Modelling Guidance Notes, DoE March 2016 available on DWERs website). As outlined above and described in section 5.2, the Murujuga Rock Art strategy, is the most appropriate framework for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art. GHG emissions are regulated under MS 757.
Works approvals and licenses issued; while a 2016 amendment to L8752/2013/2 to remove ambient air quality monitoring might have been intended to remove a duplication between DWER and EPA, it is still of concern because there was a long period when their monitoring was either not done, or the results not made public. How can we and the public have any confidence that accurate data were/are being collected and that the data analyses are being scrutinised so that Woodside is held to account for emissions violations.	Works Approval W6332/2019/1 requires ambient air monitoring to be conducted during commissioning and time limited operations of Pluto Train 2. It is anticipated such conditions will be transferred to an operating licence post commissioning and time limited operations under W6332/2019/1. W6332/2019/1 specifies the relevant Australian Standards for monitoring methodology and requires analysis by NATA accredited
Application supporting document: Section 2.3: *Environmental Protection and Biodiversity Conservation Act 1999.* Although "Pluto LNG was assessed under the Environmental Protection and Biodiversity Conservation Act 1999, in parallel with the assessment under the EP Act" and approval for Pluto LNG was granted in October 2007, significant events have happened since that date including: • Murujuga became a national park (2013), • the significance of the rock art has been stated and accepted by both State and Commonwealth governments, • more data have been collected identifying the potential threats to the petrolgyphs, including impacts	DWER recognises Murujuga (the Dampier Archipelago, including the Burrup Peninsula and surrounds) as a unique ecological and archaeological area containing one of the largest collections of Aboriginal engraved rock art in the world. The rock art is of immense cultural and spiritual significance to Aboriginal people, and of national and international heritage value. The Murujuga Rock Art Stakeholder Reference Group was established by Environment Minister Stephen Dawson in September 2018 to facilitate engagement between the MAC and key government, industry and community representatives on the development and implementation of the strategy.

Summary of Stakeholder comment	DWER response
from acidic industrial emissions, and • early in 2020 Murujuga was put forward for inclusion on the tentative list for World Heritage status. For all these reasons and the environmentally sensitive nature of this region, Pluto Train 2 needs to be thoroughly reassessed under the EPBC and the WA EP Acts, especially in terms of management controls on emissions and discharges, during both the building construction and operation phases.	The Delegated Officer considers that the strategy establishes a transparent, risk-based and adaptive framework for managing and monitoring the rock art to protect it from the impacts of anthropogenic emissions. It uses a scientifically rigorous approach to monitoring, analysis and management that will provide an appropriate level of protection to the rock art. Several management plans required under MS 757, including the Pluto LNG Project Air Quality Management Plan and the Assessment of Best Practice for Minimising Emissions to Air from Major Plant – Pluto Train 2, have been updated to incorporate Pluto Train 2 and have been reviewed by the EPA and endorsed by the Minister for Environment in early 2020.
Application supporting document Table 5: Protected and sensitive areas: There is an important inconsistency in the reporting about the four named categories in Table 5 (p. 16) of the application. NOX and SOX emissions are listed as “threats” to Burrup Peninsula rock pool communities which are approximately 1 km from the premise boundary. However, there is no mention of any threat from NOX and SOX emissions to rock art within Murujuga National Park or the National Heritage places, even though they are much closer (0.3 and 0.5 km from the boundary, respectively). We know that NOX and SOX emissions mix with atmospheric moisture to form acids which are deposited on the rocks and degrade the petroglyphs, and that emissions can easily be transported 300-500 m downwind of Woodside's huge emissions stacks. This inconsistency should be queried and investigated further.	The regulatory framework for assessing and managing potential impacts on Murujuga’s rock art petroglyphs is described in section 5.2. The Delegated Officer considered the potential for air emissions to impact on rock art (Tables 19 and 20) and concluded that the regulatory framework described in section 5.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.
Application supporting document Section 3.6.1: Hearson Cove is heavily used for fishing and recreation by both locals and visitors to the national park. It is a sensitive premise that is only about 3 km from the Pluto Train 2 site (straight line, as airborne emissions could travel), and cumulative health impacts of emissions must be calculated. The road to Hearson Cove actually passes within several hundred metres of the Pluto Train 2 site which is a real worry given the frequent local and tourist traffic.	The risk assessment has considered the potential health risk at recreational areas as detailed in sections 10.3 and 10.4.
Application supporting document Section 3.9 Existing Air Quality Woodside states that “NO2 is typically observed well below the relevant NEPM (Ambient Air Quality) maximum hourly average standard of 120 ppb for NO2. Measured maximum hourly average and annual average NO2 concentrations (ppb) during the monitoring program run by Woodside demonstrate clearly that there have been no exceedances of any NO2 standards over the monitoring period of several years.” However, exceedances of NO2 standards for the last several years are not the only concern for these reasons: • NO2 levels as low 14-2 ppb (annual average) in a child’s first year of life might increase their chance of getting asthma; • long-term exposure to NO2 has been linked to deficits in lung function growth, which is especially	Assessment of the risk associated with air emissions, including NO_2 is detailed in sections 10.3 and 10.4 of this Decision Report. The assessment has been undertaken in accordance with DWER’s regulatory framework (*Guidance Statement: Risk Assessments*) with the level of risk associated with NO_2 emissions during commissioning and operation found to be medium. Relevant criteria for air emissions were taken from the NEPM (Ambient Air Quality) which is considered the appropriate criteria to apply for the protection of human health. A medium level of risk is acceptable and likely to be subject to some regulatory controls. Accordingly, controls including monitoring, limits and infrastructure requirements to minimise emissions (NO2 as well as other potentially significant air pollutants) have

Summary of Stakeholder comment	DWER response
important given the projected operation to 2070 (https://www.woodside.com.au/; Scarborough and Pluto Train 2 Brochure); • there may have been more exceedances, hourly or otherwise, during commissioning of Pluto LNG (prior to several years ago), which could occur again during testing and commissioning of Pluto Train 2; • there has been an annual increase in point-source NOx, and consequent increase in ambient NO2 pollution, between 2014-2018 although this has not been included in Woodside's modelling and future projections to the EPA (National Pollutant Inventory, http://www.npi.gov.au/home). The discussion of the review of SO2 monitoring results on Burrup Peninsula (p. 18) is of concern: "estimates for exhaust SO2 for most sources are at or near the limit of detection, thus a reasonable estimate for an annual average would be 0.1 ppb (the NEPM Ambient Air Quality standard for annual SO2 is 20 ppb). Maximum hourly average concentrations would not be expected to exceed 10 ppb for most locations away from the most significant sources in the region, which are engine exhausts on ships. The ships are an integral part of the Pluto Train 2 gas production process, since they are required for transport and release damaging acidic emissions, especially during loading. Despite Woodside stating that hourly average concentrations are estimated to be below the NEPM standard, this SO_2 doesn't disappear or necessarily disperse. It mixes with atmospheric moisture and is deposited on rocks and degrades the petroglyphs, which is another reason that the works approval should require that cumulative deposition rates and variations must be calculated, monitored and reported.	been included in the works approval as per regulatory controls outlined in section 11. The ships associated with Pluto LNG Project have not been considered in this assessment as they do not form part of the prescribed premises. In accordance with DWER's *Guidance Statement: Setting Conditions*, conditions enforced under Part V of the EP Act must be fairly and reasonably related to the activities within the category of the prescribed premises subject to a works approval or licence. Point source SO_2 emissions monitoring will be conducted under the works approval to validate the assumptions in the predictive modelling submitted as part of the works approval assessment.
Application supporting document Section 4.5.4: Stormwater and Surface Runoffs Woodside states that the "Pluto project can capture up to 2500 m^3 within the AOC system which caters for a 1 in 10 year storm event. The limited quantity of stormwater collected in the AOC will preferentially be treated for reuse within the Pluto facility." However, given that the number of extreme weather events has been increasing, and that this region already receives substantial rainfall in very short periods during major cyclone and tropical depression events, it is not clear that this capture capacity is sufficient, especially since it only caters for a 1 in 10 year storm event. What happens to excess stormwater within the AOC system when volume exceeds 2500m^3? Water containment and treatment facilities are often overwhelmed during cyclone events and water is diverted to prevent flooding of the site. Where does this wastewater go and how are those areas protected from major environmental impacts? The adjacent coastal region provides feeding grounds for migratory birds and shallow-marine species who are already under threat from reduced feeding and nursery habitats.	As outlined in section 10.6.5, Accidentally Oil Contaminated (AOC) bunded areas will be designed to prevent ingress of rain and overflow to surrounding (paved) areas. Immediate clean-up of spillages and maintenance of clean kerbed and bunded areas will reduce the risk of stormwater contamination within these areas. Should water in the AOC areas become contaminated it will be transferred to the Controlled Discharge Facility (CDF) for treatment and either re-used or discharged to the Water Corporation's Multi User Brine Return Line (MUBRL). Discharge to the MUBRL is managed via the approved Pluto LNG Project Treated Waste Water Marine Discharge Management Plan. The Applicant has advised the CDF and the ETP have sufficient design capacity to cater for increased stormwater expected to be generated from the Pluto Train 2 AOC areas. The risk assessment in section 10.6 found a medium risk is presented from wastewater discharges which is acceptable subject to regulatory controls. A condition of works approval W6332/2019/1 requires contaminated wastewater and stormwater from Pluto Train 2 to be directed to the ETP or be disposed of by other lawful means.
Application supporting document Section 4.8: Air emissions design Stakeholder notes that emissions discharge points L6 and L7 (Fig. 9, p. 38) are very near the south-eastern edge of the Woodside lease boundary and therefore close to the public road and moderately close to Hearson Cove and Deep Gorge, and queries if these can be moved to another location that will be	A risk assessment of air emissions on public health is detailed in sections 10.3 and 10.4. The assessment has been undertaken in accordance with DWER's regulatory framework, with the level of risk associated with NOx, CO and SO_2 emissions during commissioning and operation found to be

Summary of Stakeholder comment	DWER response
further from/have less impact on public health and the rock art.	medium. Relevant criteria for air emissions were taken from the NEPM (Ambient Air Quality) which is considered the appropriate criteria to apply for the protection of human health. A medium level of risk is acceptable and likely to be subject to some regulatory controls. Accordingly controls including monitoring, limits and infrastructure requirements to minimise emissions (NOx) have been included in the works approval as per regulatory controls outlined in section 11.
Application supporting document Section 4.8.2: Air emissions inventory Stakeholder notes the omission of CO2 and CH4 from Tables 11 and 12, showing the "main emissions to air during normal operations from listed combustion equipment (as described in MS 757)", is a major shortcoming and further evidence that what was required for Pluto 1 LNG is no longer sufficient. These are the most significant GHG and must be accounted for in Woodside's emissions inventory; CH4 is a significant gas in fugitive emissions and yet it is not included. All emissions should be totalled on the basis of annual emissions, rather than just given in g/s. Furthermore, why is NOx the only type of emission listed in Table 10 (Pluto Train 2 Performance Targets and Air Emission Limits).	As outlined above, in accordance with State government policy *Greenhouse Gas Emissions Policy for Major Projects*, greenhouse gas (GHG) emissions from the premises (in addition to other environmental factors) are regulated by the EPA, specifically for Pluto LNG Project, under MS 757. Under MS 757 the Applicant is required to implement a Greenhouse Gas Emissions Management Plan, subject to review by the EPA and approval by the Minister for the Environment. The Applicant has listed NOx as the only emission with a target and limit as this is the most significant point source emission associated with Pluto Train 2 that may impact on public health.
Application supporting document Section 4.8.3: Emission reduction measures in design Woodside states that "an assessment of best practice .... identified the gas turbines for electrical power and compression drivers, the acid gas removal units, the recuperative thermal oxidiser (RcTO), and flaring as the most significant sources of air emissions for the Project." However, for methane they only give a qualitative statement: there is a significant greenhouse gas emissions reduction by combusting this methane compared to venting it to atmosphere. The discussion of acid gas removal and the nitrogen rejection unit (Section 4.8.3.2) is somewhat ambiguous and partly misleading: "typically, [the RcTO is] able to achieve destruction efficiency more than 99% compared to the typical destruction efficiency of a regenerative type thermal oxidizer ranging from 95% to 98% (Pollution Systems, 2018)." Given the very large volume of emissions produced during LNG production, even 99% efficiency could result in substantial acidic deposition and resultant negative impacts on the rock art and human health. In past documents and during our meetings with them, Woodside has emphasised this high level of efficiency; however, they always refer to 'best practice' instead of acknowledging publicly that it is technically possible to further reduce emissions by installing additional technology.	A risk assessment of air emissions on public health is detailed in sections 10.3 and 10.4. The assessment has been undertaken in accordance with DWER's regulatory framework, with the level of risk associated with NOx, CO and SO_2 emissions during commissioning and operation found to be medium. Relevant criteria for air emissions were taken from the NEPM (Ambient Air Quality) which is considered the appropriate criteria to apply for the protection of human health. A medium level of risk is acceptable and subject to some regulatory controls. The regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs is described in section 5.2.
Application supporting document Section 4.9: Flares Woodside seem to be underplaying the true amount and frequency of flaring at Pluto LNG. While we appreciate that they may be trying to minimise emissions from flaring through both emission reduction measures and operational management, we think that much more could and should be done in order to better safeguard public health and protect the unique Aboriginal heritage preserved in the rock art.	DWER notes the stakeholder concerns regarding air emissions from flaring. DWER has undertaken a risk based assessment of emissions associated with flaring (section 10.3 of this report) and determined this presents a moderate risk to public health. The risk assessment was informed by the Applicant's AQIA that found all operating scenarios, including during upset conditions (flaring) comply with the NEPM (Ambient Air Quality) criteria. A medium level of risk is acceptable and likely to be subject to some regulatory controls. The regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs is described in section 5.2.

Summary of Stakeholder comment	DWER response
Application supporting document Section 4.10: Air Quality Monitoring The application document admits “complexities and uncertainties around potential impacts associated possible anthropogenic emissions” and that “further work is planned by the Murujuga Rock Art Stakeholder Reference Group to understand the complex system and potentially define key system inputs and dynamic characteristics which may result in accelerated weathering.” Given these uncertainties, it is appropriate that the works approval application for Pluto Train 2 is not granted until these results are known so that the true impacts of emissions on air quality for both humans and the petroglyphs can be fully assessed, as required by the Precautionary Principle.	The regulatory framework for assessing and managing potential impacts on Murujuga’s rock art petroglyphs is described in section 5.2. The Delegated Officer considered the potential for air emissions to impact on rock art (Tables 19 and 20) and concluded that the regulatory framework described in section 5.3 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate.
Application supporting document Section 4.11: Noise Management Woodside states that “during steady state operations, the most significant noise emissions will be from the existing flare system, and compressors and gas turbines ... Any noise complaints received will be investigated and documented. Noise monitoring and additional mitigation measures will also be assessed if complaints are received.” There is no discussion of the cumulative noise produced from the simultaneous operation of Pluto Trains 1 and 2, and in particular their impact on local fauna and especially sea turtles and migratory birds. Obviously, they cannot make a complaint, although that does not mean they are unaffected which is of concern given the intense industrial pressure on this ecologically important area.	The Delegated Officer notes the Applicant has committed to conducting noise monitoring and validation to ensure designed noise levels are met for major noise sources. This is an important step in validating the noise modelling predictions and also ensuring compliance with the Noise Regulations. As such, the Delegated Officer has included conditions in the works approval requiring a report detailing the results of the noise validation monitoring to be submitted to DWER within 3 months of commencing time limited operations. This will ensure actual noise emissions can be assessed and compliance with the Noise Regulations can be determined.
Application supporting document Section 6: Emissions and discharges management Stakeholder requests all air quality monitoring results, from the testing and operations phases, are made available to DWER, the EPA and the public on a quarterly basis, so that they can be independently verified and compared with observations and changes in deposition/other data that will be collected by the Murujuga rock art strategy and monitoring program.	DWER’s risk assessment found that emissions to air from Pluto Train 2 present a medium risk of impacts to public health. Conditions on the works approval require submission of an Environmental Commissioning Report detailing the result of all point source and ambient air monitoring performed during the commissioning phase. Point source air emissions will be monitored quarterly while ambient air monitoring will be continuous. Commissioning has been authorised for a period of 12 months, after which time, to continue to time limited operations, the Applicant will be required to submit the Environmental Commissioning Report. This will allow DWER to review the monitoring data and determine if steady state operations has been achieved. Conditions on the works approval outline the requirement to report on contingency actions proposed in the event of not reaching steady state operations, and ongoing operations under a licence is unlikely to be authorised until such time as the Applicant can demonstrate steady state operations. Interested parties can lodge an application for access to documents through DWER’s website (Freedom of Information (FOI) page). Whenever possible, documents will be provided outside the FOI process. DWER has obligations including, but not limited to, the workings of Government, confidentiality, and the rights of third parties in relation to personal and business/commercial information. For these reasons, certain information is only released through the direct request or FOI process. DWER does not typically require monitoring data to be made publicly available.

Summary of Stakeholder comment	DWER response
	The Delegated Officer notes that annual emission data for the Premises are submitted by the facility operator each year to the National Pollutant Inventory. Emission reports for the Premises can be found at www.npi.gov.au The Stakeholder may also consider requesting AERs direct from the Applicant.
Noise and Light emissions: We concerned about the possible impacts on migratory birds and nesting turtles, especially given the apparently contradictory statements between these two sections of the WAA document "Construction activities for Pluto Train 2 are expected to take place outside of 7 am and 7 pm Monday to Saturday, therefore a Construction Noise Management Plan will be prepared." (Section 6.5, Noise emissions) "Construction of Pluto Train 2 will predominantly be carried out during daylight hours, with some activities being carried out at night." (Section 6.6, Light emissions) Woodside needs to clarify which statement is correct and how they will mitigate against negative effects to fauna, especially nesting turtles.	As outlined in Table 20, the Delegated Officer has determined that potential impacts to marine turtles from noise emissions is regulated under MS 757 (conditions 9-1 to 9-5. Similarly, the Delegated Officer has determined that potential impacts to marine turtles from light emissions is regulated under MS 757 (conditions 9-1 to 9-5). Managing and monitoring of noise and light impacts to turtles utilising Holden Beach for nesting activities will be undertaken in accordance with the Pluto LNG Project Sea Turtle Management Plan.
The Stakeholder believes Woodside has used the presence of the existing Pluto LNG Train 1 to underestimate potential environmental impacts of Pluto Train 2. The increase in processing gas capacity may result in additional discharges and emissions that aren't sufficiently recognised. Woodside should acknowledge the potential impacts of the extension and provide estimates and management options to identify and address the cumulative impacts to the environment.	The Delegated Officer has reviewed the Applicant's supporting documents including the AQMP and AQIA and has determined the predictive air emissions modelling is plausible and sufficiently conservative to provide a reasonable foreseeable estimate of likely cumulative emissions associated with the operation of Pluto Train 2. Refer to risk assessment in sections 10.3 and 10.4
Ambient air monitoring: few historical observed values from the ambient air monitoring program for Pluto LNG Project have been included in the Application document. It is expected that Woodside make relevant data available, including material as part of the works approval application, as this represents the most likely scenario of impacts to air quality that will occur from Pluto Train 2. Stakeholder noted that O_3 is a high level pollutant and PM_{10} occurs at high levels in the area but Woodside has dismissed these levels as the result of non-industrial sources. Measured values for O_3 and PM_{10} have not been provided in the works approval application and it is therefore difficult to assess the severity of this situation. It would be of interest to compare the results of the air quality monitoring program of Pluto LNG with the proposed updated NEPM standards as these are likely to be more relevant over the life of Pluto Train 2.	As above, the Applicant has provided an AQMP that reviews historical ambient air monitoring data as well as the emissions of major industrial sources in the area. Values for O_3 and PM_{10} have been provided and discussed and found to be a reasonable assessment by the Delegated Officer.
Flaring: Woodside reports Pluto LNG has minimal flaring during normal operations but acknowledges flares are significant sources of NOx, PM_{10} and VOCs. Noting the proposal is for no new flares to be constructed, Woodside has not indicated likely changes to frequency, duration or severity of flares with the increased volume of gas through the system. Woodside should quantify current flaring regimes and provide quantitative estimates of potential flaring for Pluto Train 2.	Applicant has quantified flaring regimes during Pluto Train 2 operations (expected to be non-routine scenarios) and also has provided estimates for DWER's assessment in the AQMP.
Commissioning of Pluto Train 2: Stakeholder requests further information and some changes to wording of non-committal statements, regarding proposed air emissions testing and monitoring procedures. Statements such as "is likely to involve quarterly source testing" and "a source testing schedule is	As per section 11 of this Decision Report the Applicant controls have been conditioned on the works approval including quarterly air emissions testing

Summary of Stakeholder comment	DWER response
proposed to commence" do not hold Woodside accountable to complete these checks. Stakeholder requests specific limits be included for "point source emissions testing and monitoring" procedure, with mitigation measures implemented if exceeded. Procedure for managing potentially unacceptable levels of air emissions is vague and responses in the case of exceedance have not been addressed.	from major sources and limits for NOx emissions based on infrastructure design specifications.
Acceleration of weathering and deterioration of rock art: the application does not provide projections for NOx and SOx emissions, stakeholder unable to comment on potential impact of such emissions. Stakeholder acknowledges there is disagreement on the impacts emissions have on weathering processes and note there are no established limits of acceptable or trigger values. However, given the outstanding heritage value and significance of the rock art, stakeholder believes a precautionary approach should be taken, rather than potential impacts dismissed. Stakeholder notes that although emissions from Pluto Train 2 alone may not reach destructive levels, the cumulative effect of emissions and reductions in air quality is unknown. The proposal currently lacks adequate mitigation and management responses in relation to potential impacts on rock art. It is expected that Woodside align its air quality monitoring commitments with that of the Murujuga Rock Art Strategy (MRA) and the Ambient Air Quality Monitoring Network currently being considered for implementation in the MRA strategy.	The regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs is described in section 5.2. The Delegated Officer considered the potential for air emissions to impact on rock art (Tables 19 and 20) and concluded that the regulatory framework described in section 5.3 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate.
Stakeholder notes application does not discuss potential impacts from processing "third party gas" which may alter the composition of discharges and emissions. Modelled levels of emissions may be underestimated. Woodside should clearly state what third party gases will be processed and account for the impacts that processing these gases will have on the composition of emissions and discharges from Pluto Train 2.	The Application submitted does not make reference to the processing of gas from sources other than the Scarborough gas fields, therefore the possibility of other sources has not been considered in this assessment. The Delegated Officer notes that any changes to the emissions / discharges from the Premises as a result of changes to gas feeds being processed may trigger section 53 of the EP Act requiring further approvals that would result in a risk based assessment / review of the potential impacts to the environment / human health associated with the proposal.
Discharge of treated wastewaters from Pluto Train 2: Stakeholder concerned that the application has not addressed the increase in discharges to the Water Corporation Multi-User Brine Return Line (managed via the Treated Wastewater Marine Discharge Management Plan), whether these discharges will impact the environment and if the existing management plan accounts for increased volumes of wastewater generated from Pluto Train 2.	The Applicant has advised that the operation of Pluto Train 2 will result in increased wastewater requiring treatment and subsequent re-use or discharge. Section 10.6 of this Decision Report considers the risk of discharges of contaminated wastewater which includes a review of the premises controls for managing wastewaters and the capacity for discharge to Water Corporations MUBRL.
Regarding wastewater and stormwater, stakeholder notes the Accidentally Oil-Contaminated system caters for a 1 in 10 year storm event. Stakeholder unsure if this capacity, and its relationship to extreme weather events, is standard. Given climate change scenarios predict increases in extreme weather events, stakeholder doubts how well the system will prevent contaminated water being accidentally discharged. Spills and management: Stakeholder requests more information on management and mitigation of spills. Application mentions a spill response procedure in the event of spills in the Entirely Oil Free area, yet details of these procedures are not provided. Woodside advises that water collected in the Accidentally Oil Contaminated areas will be analysed to determine contamination, after which non-contaminants will be released. Stakeholder requests details on	As outlined in section 10.6.5, Accidentally Oil Contaminated (AOC) bunded areas will be designed to prevent ingress of rain and overflow to surrounding (paved) areas. Immediate clean-up of spillages and maintenance of clean kerbed and bunded areas will reduce the risk of stormwater contamination within these areas. Should water in the AOC areas become contaminated it will be transferred to the Controlled Discharge Facility (CDF) for treatment and either re-used or discharged to the Water Corporations' Multi User Brine Return Line (MUBRL). Discharge to the MUBRL is managed via the approved Pluto LNG Project Treated Waste Water Marine Discharge Management Plan. The Applicant has advised the CDF and the ETP have

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standards used to determine contamination. Stakeholder requests Woodside provide details on past spills at Pluto LNG, to assist in determining the adequacy of proposed procedures for Pluto Train 2.	sufficient design capacity to cater for increased stormwater expected to be generated from the Pluto Train 2 AOC areas. The risk assessment in section 10.6 found a medium risk is presented from wastewater discharges which is acceptable subject to regulatory controls. A condition of works approval W6332/2019/1 requires contaminated wastewater and stormwater from Pluto Train 2 to be directed to the ETP or be disposed of by other lawful means.

Appendix 3: Summary of Applicant's comments on draft risk assessment and draft conditions

Condition/Relevant section of report	Summary of Applicant comment	DWER response
Draft provided 20 November 2020		
Works approval conditions		
Cover page	The Applicant provided further information relating to Category 10 and Category 34 descriptions and updated the design capacity for Category 10 accordingly.	Noted and amended. Further information is included in section 2.
Condition 1 (Table 1)	Applicant provided clarification regarding infrastructure listed in Table 1	Noted.
Condition 5	The Applicant noted that two commissioning activities will occur up to six months prior to the introduction of feed gas, including; 1. filling the refrigerant storage bullets, and 2. commissioning the GTG. Subsequently, the Applicant requested that the definition for "environmental commissioning" be amended to remove reference to introduction of feed gas. The refrigerant storage bullets will be required to be filled up to 6 months prior to the start-up of the LNG train. Minor intermittent flaring will be required to dispose of tank vapours generated during the filling process. This intermittent flaring may occur for approximately two weeks. The GTG will be required to be commissioned up to 6 months prior to the introduction of feed gas to Train 2 to allow sufficient time for the GTG to be integrated into the existing power generation network prior to the start-up of train 2. An alternative fuel gas supply will be provided to the GTG to support the commissioning process prior to the introduction of feed gas. In referencing the *Guide to Licencing*, the Applicant noted that the GTG commissioning activities would preferably fall under the 'Environmental Commissioning' definition and therefore requested that environmental commissioning timeframe be amended to 36 months to include this activity	In their application, the Applicant describes commissioning in three phases: pre-commissioning, commissioning and environmental commissioning (refer to section 3.6 above). "Commissioning", as described by the Applicant, relates to the introduction of feed gas and initial start-up of the plant while "environmental commissioning" relates to the first year of steady state operation and the period during which emissions verification testing will be undertaken. In accordance with DWER's *Guideline: Industry Regulation Guide to Licensing*, environmental commissioning can be authorised under the works approval which allows and controls, "limited operation for the purposes of optimising plant and equipment to meet predicted emissions". Based on this, the Delegated Officer considers that the "commissioning" and "environmental commissioning" activities described in section 3.6 meet this description and has authorised these activities under the works approval. Emissions during the commissioning period have been assessed and conditions applied to regulate environmental risk including monitoring of point source emissions and ambient air quality. The Delegated Officer has determined that "Pre-commissioning" activities (as described in section 3.6 above) are not considered "environmental commissioning" and are not subject to conditions under the works approval. This includes minor flaring associated with filling of refrigerant storage bullets and hydrostatic testing. Environmental commissioning of the works is allowed to commence on submission of an Environmental Compliance Report. Staging of the submission of the Environmental Compliance Report(s) is at the discretion of the Applicant noting that environmental commissioning of an item of infrastructure, or component(s) thereof, cannot commence until an Environment Compliance Report for that item of infrastructure, or component(s) thereof has been submitted.

Condition/Relevant section of report	Summary of Applicant comment	DWER response
		Notification requirements have been included on the works approval to ensure the department remains updated on the progress of commissioning activities.
Condition 8 (Table 4) and 12 (Table 10)	The Applicant requested the removal of VOC and PM testing due to low level of contaminants present.	The Delegated Officer considers the risk of PM emissions from the gas turbines to be sufficiently low to warrant removal of this requirement. PM emissions are more generally associated with incomplete combustion during flaring. Testing to verify the low risk of VOC emissions will still be required with monitoring requirements reviewed through the assessment of a licence application and dependent on results of validation monitoring (refer to section 10.1.2)
	The Applicant noted that PEMS is only capable of monitoring NOx and CO.	Noted.
Conditions 12 and 27	The Applicant requested that the condition be amended to exclude dark smoke monitoring from requiring NATA accreditation.	The Delegated Officer notes that condition 10 is not applicable to dark smoke monitoring. A note has been added to Table 4 (condition 8) specifying that in-field non-NATA monitoring is permitted.
Conditions 14 and 28	The Applicant request that the condition be amended to allow 80% data availability per calendar days as 90% data availability per calendar month only allows 3 days to resolve a system malfunction which may not be sufficient for a major malfunction. The Applicant did not request a change to annual data availability requirement of 95% per calendar year.	The Delegated Officer notes that the specified data availability requirement is consistent with similar licences throughout the state and provides a level of confidence that sufficient data is being captured for quality assurance purposes. As such, the Delegated Officer considers the existing condition suitable, however, will review the condition should the Applicant experience significant, and persistent, difficulty meeting this requirement.
Condition 17	The Applicant requested 60 calendar days for the submission of the Environmental Commissioning Report noting the significant information required to be included and time required for internal report preparation.	Amended noting that data will still be available for consideration in any future licence application.
Condition 20 (Table 7)	The Applicant request specific information relating to the operation of the RcTO (i.e. residence time and firing temperature) be removed from the works approval as this is considered commercially sensitive information pending final design and procurement of the plant.	Accepted noting the level of risk and that monitoring requirements (both point source and ambient air quality monitoring) provide some certainty that pollution control equipment is operating efficiently throughout the time limited operating period. Conditions will be reviewed during the assessment of any future licence application and applied as appropriate to ensure effectiveness of the equipment in the long term.
Condition 35	The Applicant requested additional 30 days for the submission of the compliance report required to be submitted at the completion of time limited operations.	Allowed noting that DWER will review the information contained in the report and, if required, amend the licence accordingly.
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Table 3	The Applicant requested that Table 3 specifying the production or design capacity be aligned to	Refer to response above relating to the “Cover page”

Condition/Relevant section of report	Summary of Applicant comment	DWER response
	Table 2 within the works approval.	
Section 3.6	The Applicant provided further information regarding hydrostatic testing and commissioning.	Noted and decision report updated and conditions amended (refer to section 3.6 and information above relating to condition 5)
Section 9.3.2	The Applicant provide further information regarding the venting of emissions from the RcTO to atmosphere in situations where routing emissions to the flare as a contingency measure is not available. The Applicant advised this to expected be an extremely rare event. The Applicant advised that this was identified as a potential safety risk during a recent HAZOP whereby given the low pressure streams being directed to the flare, a high pressure event in the flare would impact the ability of these streams to be routed to the flare, as such they would be routed to atmosphere at the associated RcTO vent stack.	Noted and report updated.
Section 9.5.5 (Table 38)	The Applicant advised that the following controls were not proposed as part of this proposal: • flame shields on flange joints on propane and ethylene storage vessels; and • nitrogen purge blanketing on aMDEA storage tank.	Noted and report updated.
Draft provided 3 February 2021		
Works approval conditions		
Condition 8 (Table 4) and Condition 23 (Table 10)	The Applicant requested that the requirement to measure flow rate, SO_2, VOCs and particulates using PEMS be removed as it is outside the system's capability.	Noted and amended.
	The Applicant noted that particulates are not measured from the RcTOs due to low concentrations and requested that this be removed.	Accepted and removed noting that particular emissions from the gas turbines and RcTOs are not considered to be significant (refer to section 9.3.2).
	The Application requested that AS 4323.1 be included as an alternative method to USEPA Method 2 for measuring flow rate.	Accepted and updated.
	The Applicant requested that method TO-15 be allowed for measuring VOC emissions.	The department requested further clarification noting that this method is not commonly used for this purpose and is targeted at ambient air quality rather than point source emissions. On review, the Applicant elected to withdraw this request and US EPA Method 18 has been retained.
Condition 17	The Applicant requested that the timeframe for submitting the progress reports be extended from 45 days to 90 days.	Reporting date extended to 60 days to ensure information is provided to the department in a timely manner.
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Condition/Relevant section of report	Summary of Applicant comment	DWER response
Section 3.6	Applicant identified that hydrostatic test water may be disposed of via the ETP.	Condition 7 authorises the discharge of contaminated wastewater to the ETP prior to disposal via the marine outfall. The Delegated Officer considers that discharge from the ETP is adequately regulated under the existing licence conditions and TWWMDMP which include discharge criteria and monitoring requirements.