Decision Report

Application for Licence

Division 3, Part V *Environmental Protection Act 1986*

Licence Number	L9225/2019/1
Applicant	Chevron Australia Pty Ltd
ACN	086 197 757
File Number	DER2019/000441
Premises	Wheatstone LNG Project (Stage 2) Legal description - Part Lot 238 on Deposited Plan 195206 and Part Lots 567 and 569 on Deposited Plan 71345 Certificates of Title Volume LR3118 Folio 396, Volume 2779 Folio 361 and Volume LR3161 Folio 383 As defined by the coordinates in Schedule 1 of the Licence
Date of Report	31 July 2020
Status of Report	Final

Table of Contents

Definitions of terms and acronyms

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

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
AGRU	Acid Gas Removal Unit
AGTO	Acid Gas Thermal Oxidiser
AHD	Australian Height Datum
ALARP	As Low As Reasonably Practicable
aMDEA	means activated methyl diethanolamine
ANSIA	Ashburton North Strategic Industrial Area
ANZECC	Australian and New Zealand Environment and Conservation Council
API 620	American Petroleum Institute Standard API 620: Design and construction of large, welded, low pressure storage tanks
API 625	American Petroleum Institute Standard API 625: Tank systems for refrigerated liquified gas storage
API 650	American Petroleum Institute Standard API 650: Welded steel tanks for oil storage
AQMS	Air Quality Monitoring Station
AS 1596	Australian Standard AS 1596 – 2014: The storage and handling of LP gas
AS 1692	Australian Standard AS 1692 – 2006: Steel tanks for flammable and combustible liquids
AS 1940	Australian Standard AS 1940 – 2004: The storage of flammable and combustible liquids
AS 3961	Australian Standard AS 3961 – 2005: The storage and handling of liquified natural gas
AS 4323.1	Australian Standard AS 4323.1 – 1995: Stationary source emissions selection of sampling positions
ASME	American Society of Mechanical Engineers
BOG	means boil off gas
BTEX	means benzene, toluene, ethyl benzene and xylene
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations

Term	Definition
CGMP	Construction Groundwater Monitoring Procedure
CO_2	Carbon dioxide
Commissioning	means the process of operation and testing that verifies the works and all relevant systems, plant, machinery and equipment have been installed and are performing in accordance with the design specification
CS Act	*Contaminated Sites Act 2003* (WA)
DG Regulations	*Dangerous Goods Safety Regulations 2007*
DG Act	*Dangerous Goods Safety Act 2004*
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.
DMIRS	Department of Mines, Industry Regulation and Safety
Domgas	Domestic gas
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
GLC	ground level concentration
GT	Gas Turbine (driving the LNG train refrigeration compressors)
GTG	Gas Turbine Generator
GTP	Gas Treatment Plant
HOSH	Hot oil start-up heater
HP	High Pressure
H_2S	Hydrogen sulphide
Licence	Licence L9225/2019/1, contained in Attachment 1
Licence Holder	Chevron Australia Pty Ltd
LNG	Liquified Natural Gas
LP	Low Pressure

Term	Definition
m^3	cubic metres
mbgl	meters below ground level
Minister	the Minister responsible for the EP Act and associated regulations
MS	Ministerial Statement
mtpa	million tonnes per annum
MW	Megawatts
MRU	mercury removal unit
N_2	Nitrogen
NEPM	National Environmental Protection Measure
NFPA 59A	National Fire Protection Association NFPA 59A: Standard for the production, storage and handling of liquified natural gas
NPI	National Pollutant Inventory
NMVOCs	Non-methane Volatile Organic Compounds
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
NO_2	Nitrogen dioxide
NOx	Oxides of nitrogen
NRU	Nitrogen Rejection Unit
O_3	Ozone
Occupier	has the same meaning given to that term under the EP Act.
PM	Particulate Matter
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
Ringelmann	Ringelmann miniature smoke charts provided by the United Kingdom Solid Fuel Technology Institute
Risk Event	As described in *Guidance Statement: Risk Assessment*
SO_2	Sulfur dioxide
SOx	Oxides of sulfur

Term	Definition
TEG	Triethylene glycol
UDR	*Environmental Protection (Unauthorised Discharges) Regulations 2004* (WA)
USEPA	United States (of America) Environmental Protection Agency
µg/m^3	micrograms per cubic metre
µg/L	micrograms per litre
VOCs	Volatile Organic Compounds
WC Act	*Wildlife Conservation Act 1950*
WHO	World Health Organisation
WHRU	Waste Heat Recovery Units

1. Purpose and scope of assessment

Chevron Australia Pty Ltd (Chevron, the applicant) submitted an application on 21 August 2019 (the application) to DWER for a licence under Part V, Division 3 of the *Environmental Protection Act 1986* (EP Act).

The application is for the Wheatstone Foundation Project for prescribed premises categories 10, 34 and 52, and is the second licence application for operation of LNG processing and support infrastructure. The application is for operation of stage 1 and 2 infrastructure including:

- LNG train 1 and train 2;
- LNG and condensate storage facilities;
- four gas turbine generators (GTGs) for power generation;
- stormwater drainage system;
- primary water treatment system (PWTS); and
- other miscellaneous utilities and support infrastructure required to support operation of stage 1 and 2.

Licence L9199/2019/1 was granted on 29 January 2019 for stage 1 of the Wheatstone Foundation Project. In submitting the application for L9225/2019/1 for stage 1 and 2 infrastructure, Chevron also submitted a surrender application for L9199/2019/1 as it would be superceeded by L9225/2019/1 when granted.

Commissioning of remaining infrastructure at the Wheatstone Foundation Project (including the Domgas processing train and permanent marine outfall) is still ongoing therefore infrastructure not within the stage 1 and 2 scope described above is excluded from this assessment. Chevron intends to submit a future application when commissioning of remaining infrastructure is complete, with the intent to hold a single licence for all permanent facilities and infrastructure at the Wheatstone Foundation Project.

This Decision Report documents the Delegated Officer's risk assessment of emissions and discharges and determination of the application consistent with the DWER's *Guidance Statement: Risks Assessment* (DER, 2017a) and *Guideline: Decision Making* (DWER, 2019) respectively. The purpose of this assessment is for the issue of a licence for the operation of stages 1 and 2 of the Wheatstone Foundation Project.

This assessment has resulted in the Department issuing Licence L9225/2019/1 which is contained in Attachment 1.

1.1 Application details

The applicant has applied for a licence. 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: *Submission: Wheatstone LNG Plant – LNG trains 1 & 2 and Common Facilities Licence to Operate application* including attachments. • Cover Letter Wheatstone Trains 1-2 Licence Application • Wheatstone Trains 1-2 Application Form • Wheatstone Trains 1-2 Supporting Document	21 August 2019 (DWERDT196206)
Email titled: *Wheatstone RFI response submission* including attachments. • Wheatstone Train 1 and 2 – RFI Response • Attachment 1 – Wheatstone emission data • Attachment 2 – Part 9 – Revised air emission table	23 October 2019 (DWERDT2156862)
Email titled: *Wheatstone LNG Plant – Stage 2 EVR Information Request* including attachments. • SoI 150116 to 190501 • NOX data 2015 to 2019 • EVR stack summary DWER • Stack summary 2018 and 2019	3 March 2020 (A1902234)
Email titled: *Response to queries regarding stack emission results provided for Wheatstone* including attachments. • EVR stack summary DWER 280520	28 May 2020 (A1900667)

Email titled: *L9225/2019/1 Wheatstone Gas Facility – Licence application, draft instrument and decision report - Applicant comments* including attachments.
• L9225 2019 1_Chevron Wheatstone Project_Decision Draft-applicant comments
• L9225 2019 1_Chevron Wheatstone Project_Licence Draft-applicant comments
• Supporting Information (including)
  ○ Ambient monitoring data
  ○ Sector of interest analysis data
  ○ Summary graphs and pollution roses
  ○ Updated groundwater monitoring data
  ○ Updated stack summary tables
	20 July 2020 (DWERT310106)

2. Background

The Wheatstone Project, located 12 km south-west of Onslow, is being developed for the production of LNG and Domgas. Development and operation of the premises is being undertaken by the applicant on behalf of its joint venture participants which presently include Australian subsidiaries of Chevron Corporation, Kuwait Foreign Petroleum Exploration Company (KUFPEC), Woodside Petroleum, and Kyushu Electric Power Company, together with PE Wheatstone Pty Ltd, part owned by JERA.

Ministerial approval for the full Wheatstone Project was granted in 2011 under Part IV of the EP Act. The approval, Ministerial Statement 873 (MS 873), authorises development of up to six LNG trains with a throughput of up to 25 mtpa and up to four Domgas plants. The application relates to the operation of stages 1 and 2 of the Wheatstone Foundation Project, for which construction commenced in 2011. When the foundation project is complete it will produce up to 12 mtpa of LNG with the onshore processing facilities comprising two LNG trains and associated utilities, one Domgas Plant, LNG and condensate storage, and support facilities including accommodation, power supply and wastewater infrastructure and waste management.

Construction of support facilities commenced in late 2011 and construction of the GTP commenced in 2014. Due to the size and complexity of the Project, multiple works approvals and licenses under Part V of the EP Act have been granted to facilitate staged construction, commissioning and operation of the LNG processing facilities and supporting infrastructure. Two separate works approvals were issued relating to the GTP. W5480/2013/1 was granted for the construction and commissioning of the LNG and condensate storage facilities and W5584/2014/1 for construction and commissioning of the LNG trains, Domgas facilty, power generation and other supporting infrastructure. Further details are provided in section 4.4.2

Commissioning of works constructed under the works approvals has occurred in stages as described in pre-commissioning and commissioning plans which were submitted to DWER in accordance with the requirements of works approval conditions. The applicant submitted a commissioning report to DWER in accordance with the requirements of W5480/2013/1 in January 2019, and commissioning reports for stages 1 and 2 of W5584/2014/1 in February and June 2019. Licence L9199/2019/1 was granted in January 2020 for operation of stage 1 only.

During commissioning, the applicant was required to undertake ambient air quality monitoring and point source air emission monitoring to verify air emissions. The applicant submitted Emissions Verification Reports with the commissioning reports.

The application relates to the prescribed premises categories listed in Table 3.

Table 3: Prescribed premises categories in the licence

Classification of Premises	**Description**	***Premises production or design capacity or throughput***
Category 10	Oil or gas production from wells: premises, whether on land or offshore, on which crude oil, natural gas or condensate is extracted from below the surface of the land or the seabed, as the case requires, and is treated or separated to produce stabilized crude oil, purified natural gas or liquefied hydrocarbon gases.	12 million tonnes of LNG and 1.1 million m^3 of condensate per annual period
Category 34	Oil or gas refining: premises on which crude oil, condensate or gas is refined or processed.	
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.	151.2 MW (including 14MW emergency diesel generators)

3. Overview of Premises

3.1 Operational aspects

The premises is located in the Shire of Ashburton, approximately 12 km south-west of Onslow within the ANSIA.

Natural gas is extracted from the Wheatstone-Iago and Julimar–Brunello gas fields and is collected and partially processed at an offshore processing platform approximately 225 km from the WA coast. The partially processed gas and condensate is transported to the onshore GTP via a subsea pipeline. The GTP has been designed to include two LNG processing trains, a separate Domgas plant and support utilities and facilities. Natural gas is processed through the processing trains to produce LNG and condensate.

The application relates only to stage 1 and 2 infrastructure which includes LNG Train 1 and 2, the LNG and condensate storage, and other common infrastructure.

LNG production involves the following treatment stages:

- inlet gas conditioning and condensate stabilisation;
- acid gas removal;
- dehydration and mercury removal;
- liquefaction and refrigerant compression, including nitrogen rejection;
- heavy hydrocarbon removal / condensate recovery and fractionation; and
- LNG and condensate storage and loading.

The treatment process is illustrated in Figure 1 and a description of each stage is included in the following sections (from Chevron 2019a).

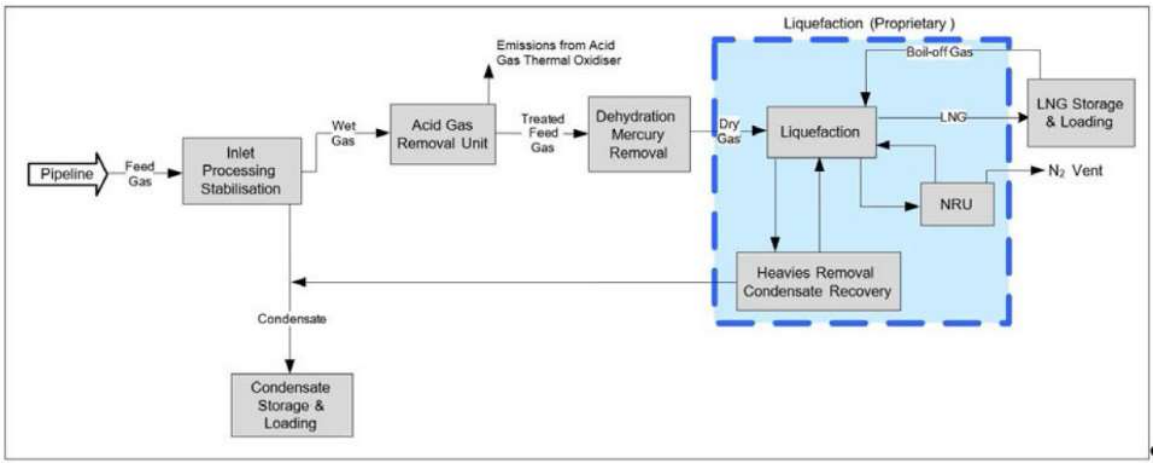


Figure 1 Wheatstone LNG treatment process

3.1.1 Inlet Gas Conditioning and Condensate Stabilisation

Conditioning of inlet gas is undertaken through a common inlet gas conditioning and condensate stabilisation system to provide a stable process gas stream to the processing trains. Dehydrated feed gas from the Wheatstone offshore platform arrives at the inlet processing facility slug catcher, which separates incoming fluids into three phases (process gas, condensate and wastewater). The condensate phase is directed to a condensate stabiliser unit where light hydrocarbons are stripped out so the condensate meets condensate vapour pressure specifications prior to being directed to the condensate tanks to await shipment.

The process gas phase is compressed and sent to the main feed gas line for the LNG trains for processing. The recovered wastewater phase is directed to the PWTS.

3.1.2 Acid gas removal

Separated process gas is routed from the slug catcher to an AGRU to remove CO_2 and H_2S (collectively termed acid gas) using conventional aMDEA technology. Acid gas is removed from the feed gas to prevent it from freezing at low temperatures in the cryogenic units of the GTP.

The AGRU is made up of two systems:

- absorber system - designed to remove CO_2 and H_2S from the gas by absorption into an aMDEA solvent. Some VOCs, including BTEX, in the process gas will also be absorbed by the aMDEA solvent; and
- regenerator system - designed to regenerate the aMDEA solvent for reuse by applying heat to the saturated aMDEA solution to separate the adsorbed acid gases. The stripped gas (comprising approximately 93% CO_2, water and trace amounts of BTEX and H_2S) is disposed via an AGTO which oxides hydrocarbons and sulfur compounds to CO_2, SOx and water and discharges them to air.

3.1.3 Dehydration and mercury removal

A dehydration unit is located downstream of the AGRU which removes water from the feed gas using a molecular sieve to prevent the water from freezing at low temperatures in the cryogenic units of the GTP.
Mercury occurs naturally in the Wheatstone-Iago and Julimar–Brunello gas reservoirs. The MRU located downstream of the dehydration unit removes mercury from the gas prior to it entering the LNG train to prevent corrosion of brazed aluminium exchangers in the liquefaction system. Mercury is absorbed by a catalyst within the MRU which will periodically require replacement. The spent catalyst will be disposed offsite to a suitably authorised facility.

3.1.4 Liquefaction and Refrigerant Compression Systems (including Nitrogen Rejection Unit)

Conditioned gas passes from the MRU into the liquefaction system. Liquefaction is the main component of the LNG train. The liquefaction system uses a ‘cascade’ of successive refrigeration steps to progressively cool the natural gas to the temperature at which point it liquefies into LNG (-160 °C). Three refrigerant services are used: propane, ethylene, and methane, each in their own circulation loops. Six GTs are used within each LNG train (12 in total) to provide power to the refrigerant compressors.

The conditioned gas passes through a series of cryogenic heat exchangers, giving up heat to the successive refrigerants and progressively cooling. The cooled gas is then flashed (allowed to expand into a separator or drum) to atmospheric pressure which further cools it. The resulting LNG is then pumped to the insulated LNG storage tanks and stored at atmospheric pressure and −160 °C.

To meet LNG and fuel gas specifications, a cryogenic NRU is used in the LNG trains to remove excess N_2. Nitrogen is cryogenically separated and concentrated in the NRU via a series of fractionation columns. The concentrated N_2 (with trace amounts of methane (CH_4)) is vented to the atmosphere via the NRU. Pure N_2 is a colourless, odourless, inert gas and makes up 78% of normal atmospheric air composition. It is also lighter than air so readily disperses when released at an elevated location and is therefore not considered an atmospheric pollutant.

3.1.5 Heavy Hydrocarbon Removal and Fractionation

Condensed hydrocarbon liquid from cooling the conditioned gas undergoes separation and

fractionation to remove the heavier hydrocarbons to prevent them from freezing in the low-temperature liquefaction section. The heavy hydrocarbon compounds are recovered as natural gas liquids or condensate and are blended with the stabilised condensate from the inlet facilities to produce the final condensate product.

3.1.6 LNG product storage and export

The LNG product will be stored within two fully contained, double-walled LNG tanks, each with a net capacity of 150,000 m^3. Periodic loading of LNG carriers will occur via a load out line that runs from the LNG tanks along the jetty and terminates at two LNG loading arms at the Product Loading Facility (PLF). Boil off gas generated during LNG carrier loading will be collected and compressed by BOG compressors then returned to the LNG tanks. If the BOG compressors are not available due to emergency or maintenance, BOG will be directed to the marine flare.

3.1.7 Condensate product storage and export

The condensate product will be stored in two 120,000 m^3 condensate tanks located within separate geo-synthetic clay lined bunds within the Premises. The tanks receive condensate from the condensate stabiliser unit and the fractionation units in the LNG trains.

Periodic loading of condensate tankers will occur via a load-out line that runs along the jetty and terminates at two condensate loading arms at the PLF.

3.1.8 Support utilities

Pressure relief / liquids disposal and flare systems

A pressure relief and liquids disposal system, consisting of both wet and dry flare systems, supports the start-up, shutdown, emergency, and maintenance depressurisation requirements of the GTP. The system is designed to collect and dispose of waste hydrocarbon vapour and recovered liquids produced during these events. The flare system comprises:

- a LP flare structure containing wet, dry, and common (spare) flare risers; and
- a HP flare structure containing wet, dry, and common (spare) flare risers.

Additional to the above, the GTP also has a separate marine flare system which only handles vapours from the LNG storage and loading system. The marine flare receives vapour from the LNG storage tanks if the BOG compressor is not operational, as well as excess BOG that is unable to be redirected back to the LNG storage tanks during LNG ship loading activities, and BOG from ships arriving from dry dock.

The wet gas relief and flare system handles gases that contain hydrocarbons with water or water vapour, and typically handles gases from ‘warm’ plant systems (i.e. prior to cryogenic cooling). The dry gas relief and flare system handles cold gas free of water vapour. Both systems operate independently of each other and consist of a large collection header and liquid knockout drum to separate any liquids from the gas prior to it being routed to the flare risers. A spare knockout drum and flare riser are provided to serve as a common backup system to both the wet and dry flare systems.

The design of the plant is such that flaring should not occur during routine operations other than flare pilots and purged gas. Hydrocarbon emissions will instead be captured and redirected back into the process. Boil of gas from the LNG tanks is compressed and sent back to the LNG trains. Flaring should only occur during unusual situations such as emergencies, process upsets, plant start-up and shutdowns as a safety measure to allow the controlled release of pressure from the gas collection and processing system. Released gases and liquids are routed to the flare risers where the released gases are burned as they exit the flare stacks. Combustion, rather than venting, of the released gases is undertaken to combust the majority of the contained VOCs (including BTEX) to minimise potential environmental and

health impacts.

Fuel gas system

The fuel gas system is designed to provide fuel gas throughout the GTP.

The fuel gas system comprises:

- a HP fuel gas section which supplies fuel gas to the GTs and GTGs; and
- a LP fuel gas section which supplies fuel gas to the flare pilots and purges, AGTO, Domgas plant, regeneration heaters and other miscellaneous users.

Fuel gas is normally supplied by the methane compressor, however, back up fuel gas can be supplied from the outlet of the dehydration unit and from the inlet facilities.

Power Generation System

Four GTGs with turbine inlet air humidification (TIAH) will supply sufficient power to meet the power requirements of the two LNG trains, the Domgas plant, utilities and offsite areas including the storage tanks, marine PLF administration and maintenance areas.

When the main power supply system is tripped, offline or unavailable, backup power supply for the GTP will be provided by five diesel engine driven generators (2MW capacity each). The diesel generators are sized in an N+1 configuration so that all essential power is provided by four units and the fifth unit is available as a spare. A sixth diesel generator is installed at the operations centre to provide backup power to the central control room and administration.

Heating medium system

Waste heat recovery units are installed in the exhaust ducts of each refrigeration compressor GT to recover waste heat. This system largely supplies all the GTP's process heating requirements. Heat is supplied to major users such as the condensate stabilisation facilities, AGRU regeneration, and fractionation reboiler, via a closed-loop, hot oil heating medium. A small gas-fired HOSH, is used during start-up operations when there is insufficient waste heat due to the refrigerant gas turbine drivers not operating.

Fire and gas protection systems

The GTP has been constructed with fire and gas protection systems. The primary objective of the systems is to use process design controls to prevent an incident from occurring. The systems comprise a series of measures designed to prevent, control, and mitigate fire and explosion hazards associated with handling natural gas, LNG, condensate, liquefied petroleum gas, and other hazardous materials.

Plant and instrument air system

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. The instrument air system also supplies the purging air for control system devices and feeds into the nitrogen generation system.

Refrigerant storage unit

A refrigerant storage unit stores refrigerant-grade ethylene and propane for make-up (as required) to the ethylene and propane refrigeration systems in both LNG trains.

Nitrogen system

Nitrogen is required on the Premises for:

- compressor / pump seals and cable seals for cryogenic pumps;
- tank blanketing, purging of equipment and piping; and
- back-up purge gas to the flare headers.

Nitrogen is supplied via a nitrogen generation system, which is backed up with a liquid nitrogen system.

3.1.9 Water management

The wastewater, stormwater, water supply and treatment systems are described in the sections below.

Wastewater

Two categories of wastewater are generated from the GTP:

- non-sanitary (process) wastewater; and
- sanitary wastewater.

Non-sanitary wastewater comprises process wastewater (i.e. from the laboratory, maintenance workshops, drains, wash-down water, knock-out drums) and produced water separated from the feed gas during processing. It is contaminated or potentially contaminated with oil, hydrocarbons or other process chemicals. Non-sanitary wastewater is collected in oily wastewater lift stations and directed to the PWTS.

Sanitary wastewater (sewage) flows from various buildings into sanitary lift stations from where it is pumped to a sewage treatment plant. The sanitary wastewater system, sewage treatment plant and discharge via the Permanent Marine Outfall (PMO) is not within the scope of the application and is currently covered by W5671/2014/1 pending completion of commissioning of the PMO.

Stormwater

Stormwater drainage at the GTP is designed to collect and segregate contaminated, potentially contaminated and uncontaminated stormwater for treatment (where required) and disposal. The stormwater drainage system comprises a network of drains, sedimentation ponds and sumps which collect stormwater from process and non-process areas. Clean uncontaminated runoff is diverted away from process areas to minimise the volume of potentially contaminated stormwater requiring management.

The stormwater drainage system is designed to segregate stormwater into contaminated/potentially contaminated and clean/uncontaminated according to the design features described below.

- The first 25 mm of stormwater runoff (first flush) from process areas is considered potentially contaminated and is collected in a series of first flush sumps. The sumps have an overflow/underflow baffle arrangement which separates surface oily water from the stormwater. Separated oily water is directed to the PWTS. Remaining sump water is sampled and if it meets criteria to be considered uncontaminated it will be directed to the sedimentation ponds. If the uncontaminated criteria is not met the water will be directed to the PWTS.
- Runoff in excess of the first 25 mm from the process area is considered uncontaminated and is diverted by an overflow weir away from the first flush sumps, toward the sedimentation ponds.
- First flush sumps have both high and low level alarms. High level alarms provide time to respond before sumps reach capacity. Low level alarms prevent pump damage.
- Stormwater from non-process areas is considered uncontaminated and is directed toward the sedimentation ponds.
- The sedimentation ponds have been designed and constructed as infiltration basins which capture and temporarily store stormwater prior to evaporation and infiltration into the soil profile.

Primary Water Treatment System

The PWTS comprises corrugated plate interceptor (CPI) system, Dissolved Air Flotation (DAF) system, and DAF Effluent Filters. Liquid hydrocarbons and oily waste separated from the wastewater within each stage of the PWTS are directed to a Waste Oil or Oily sludge holding tank pending offsite disposal to an authorised facility.

Output from the PWTS is sampled and monitored via continuous composite sampling. Treated water is discharged to a Combined Effluent Sump outside the Premises. The Combined Effluent Sump receives wastewater from a number of sources and discharges the water to the marine environment via the PMO. Discharge to the marine environment via the Combined Effluent Sump and PMO is authorised under the requirements of W5671/2014/1 and is not within the scope of the application (refer to section 0 for further details).

Water supply

The fresh water needs of the GTP are supplied via a Reverse Osmosis (RO) Plant. Waste water (brine) from the RO plant is directed to the Combined Effluent Sump outside the premises for discharge via the PMO. Discharge from the Combined Effluent Sump to the PMO is currently authorised under the commissioning requirements of W5671/2014/1 therefore discharges from the RO plant are not within the scope of the application and have not been assessed (refer to section 3.3 for further details).

3.2 Infrastructure

The premises infrastructure, as it relates to Category 10, 34 and 52 activities, is detailed in Table 4 and with reference to the site plan (Figure 2).

Table 4: Wheatstone LNG Project infrastructure

	Infrastructure	**Site Plan Reference**
	Prescribed Activity Category 10 and 34	
Gas from the Wheatstone and Iago gas fields is transported via a subsea pipeline from an offshore platform to the onshore LNG processing facility at Ashburton North to produce LNG and condensate via a single LNG train. The produced LNG and condensate is exported via ship.		
1	2 x LNG train (includes 12 GE LM6000PF+ refrigeration compressor GTs)	1A, 1B
2	2 x AGRU	2A, 2B
	2x AGTO	3A, 3B
3	1 x Inlet gas conditioning and condensate stabilization system	4
	1x Slug catcher	5
4	2 x Dehydration unit	6A, 6B
5	2x MRU	7A, 7B
6	2 x 150,000m^3 LNG storage tanks	8A, 8B
7	2 x 120,000m^3 condensate storage tanks	9A, 9B
8	1 x LNG and condensate piperack	10
9	1 x Low pressure flare system (contains wet, dry and common)	11
10	1x High pressure flare system (contains wet, dry and common)	12
11	1 x Marine flare system	13
12	1x Heating medium system (including a HOSH)	14

	Infrastructure	Site Plan Reference
13	3 x 287 m^3 ethylene refrigerant storage drums	15
14	3 x 567 m^3 propane refrigerant storage drums	16
15	1 x 166 m^3 amine storage tank (concentrated aMDEA solution)	173
16	1 x 1,053 m^3 amine surge tank (diluted aMDEA solution)	18A, 18B
17	1x 1,805 m^3 hot oil storage tank	19
18	1 x 243 m^3 methanol / TEG storage tank (containing Methanol, TEG, Benzene and light hydrocarbons)	20
	Prescribed Activity Category 52	
Electrical power is provided by four GTGs, which provide 137 MW of power for the GTP as well as the common utility and off-site areas, including the LNG and condensate storage tanks, marine product loading facility (PLF), and the administration and maintenance areas as well as other ancillary demands. When the main power supply is not available, emergency power is provided by six diesel engine generators.		
19	4 x GE LM6000PF GTGs (with TIAH)	21A, 21B, 21C, 21D
20	6 x 2MW diesel generators (emergency supply)	22A, 22B, 22C, 22D, 22E, 22F
21	1 x 563 m^3 emergency generators diesel storage tank	23
	Directly related activities	
Contaminated wastewater from various waste streams, including process wastewater and contaminated stormwater, is directed to the Primary Treatment System.		
22	Diesel line	24
23	1 x 115 m^3 operations diesel storage tank	25
24	1 x 112 m^3 waste oil storage tank	26
25	1x 112 m^3 wastewater tank	27
26	Non-sanitary wastewater Primary Treatment System (comprising a diversion tank, two treatment trains each including a corrugated plate interceptor, dissolved air flotation system and dissolved air flotation effluent filter, and two oily sludge storage tanks)	28
27	17 x Non-sanitary process wastewater lift stations	29A, 29B, 29C, 29D, 129E, 29F, 29G, 29H, 29I, 29J, 29K, 29L, 29M, 29N, 29O, 29P, 29Q
28	11 x Concrete first flush sumps (contaminated and potentially contaminated stormwater)	30A, 30B, 30C, 30D, 30E, 30F, 30G, 30H, 30I, 30J, 30K
29	6 x Unlined clean stormwater sedimentation ponds	31A, 31B, 31C, 31D, 31E, 31F
30	2.6 GL/annum Reverse Osmosis Plant	32

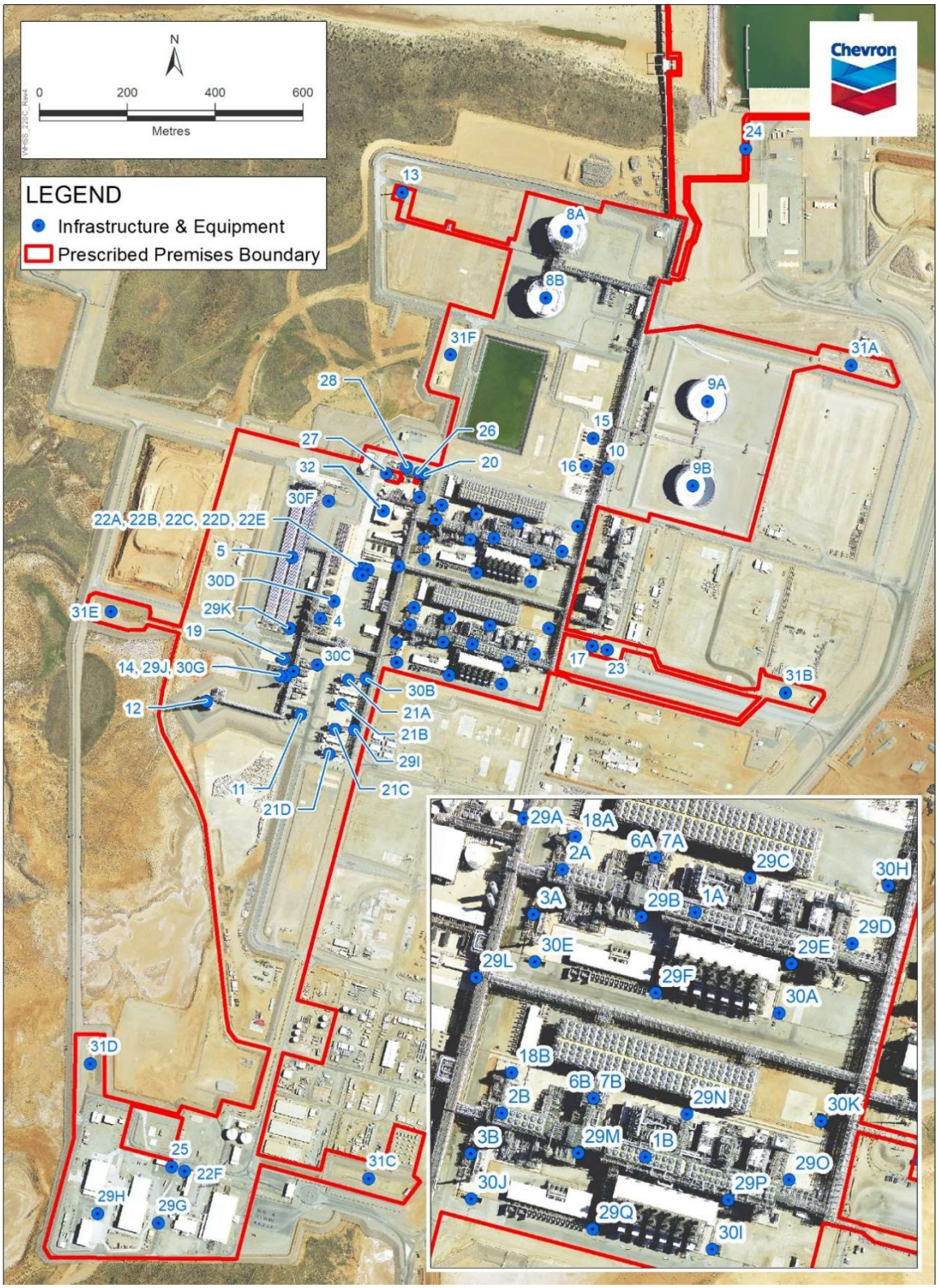


Figure 2 Wheatstone LNG Project site layout plan

3.3 Exclusions to the Assessment

The application pertains only to stage 1 and 2 of the Wheatstone Foundation Project which includes infrastructure for which commissioning has been completed, and is not within the scope of any existing licenses, or applications.

Excluded from the scope of this assessment is infrastructure which is still undergoing commissioning in accordance with works approvals granted for the development of the Wheatstone Foundation Project, and supporting facilities which are already subject to a licence under Part V, Division 3 of the EP Act. Infrastructure and facilities which are excluded include the following:

- Domgas facility (W5584/2013/1);
- sanitary treatment system, Combined Effluent Sump and PMO pipeline and diffuser which are located outside the premises boundary (covered by W5671/2014/1). The Combined Effluent Sump receives treated water from the PWTS and brine from the RO plant, which are within the premises, and discharges to the PMO pipeline. Discharges from the PWTS and RO plant to the marine environment via the Combined Effluent Sump and PMO will be considered under a future licence application to be submitted following satisfactory completion of the validation commissioning in accordance with the requirements of W5671/2014/1 ;
- supporting facilities including the Wheatstone LNG Plant Waste Storage Facility (L8976/2016/1), Wheatstone Waste Management Site (L8759/2013/1), Wheatstone Concrete Storage Area (L9082/2017/1); and
- Construction Village sewage treatment plants (STPs) and the discharge of treated effluent and brine via the temporary marine outfall (subject to L8650/2012/1).

Potential environmental impacts associated with GHG emissions have been assessed under Part IV of the EP Act (EPA Report 1404) and reporting of GHG emissions from the LNG and Domgas plants is required on an annual basis in accordance with revised condition 19-1 of MS 873 (as amended via MS 922, EPA Report 1462). Condition 19-1 is currently subject to an inquiry by the EPA under section 46(1) of the EPA Act to determine the adequacy of the condition. As the inquiry is still in progress, regulatory requirements relating to GHG emissions may be subject to change when the inquiry is completed.

The Delegated Officer has therefore determined not to duplicate assessment of GHG emissions or include regulatory controls relating to GHG emissions in accordance with the *Guidance Statement: Setting Conditions*.

Ship loading activities have not been considered in the assessment as they occur outside the premises boundary and are not a prescribed activity under the EP Act.

4. Legislative context

Table 5 summarises approvals relevant to the assessment.

Table 5: Relevant approvals and tenure

Legislation	Approval reference	Holder	Approval details
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	EPBC 2008/4469	Chevron Australia Pty Ltd	Conditional approval for the Wheatstone Project was granted on 22 September 2011. See section 4.3.3 for further details.

Legislation	Approval reference	Holder	Approval details
Land Administration Act 1997	Wheatstone Project Plant Site Lease		The Wheatstone Project Plant Site Lease was signed on 8 September 2011 by the landowner (the Western Australian Land Authority) and Chevron Australia Pty Ltd. The lease permits use of part of the Premises for construction and operation of gas processing facilities and ancillary infrastructure. The lease has been granted for a period of 30 years with options for two further terms of 10 years.
Port Authorities Act 1999	CUCA Lease Product Loading Facility Lease		The CUCA Lease and Product Loading Facilities Lease were signed on 21 September 2011 by the Dampier Port Authority and Chevron Australia Pty Ltd. The leases permit use of part of the Premises for LNG storage tanks and associated facilities and for the Product Loading facility and associated infrastructure and facilities. The leases are for a period of 30 years with options for two further terms of 10 years.
1967 Petroleum Pipelines Act 1999 (WA)	Petroleum production pipeline licence PL99		Approval granted for petroleum trunkline through the Wheatstone Start up and Operations Environment Plan (WS2-COP-00001), accepted 14 January 2016.
Dangerous Goods Safety Act 2004	Dangerous Goods licence DGS022240		A Dangerous Goods licence was issued on 15 December 2016. The licence expires on 15 December 2021.
Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007	Approved Safety Report		In November 2016 the Wheatstone LNG Plant Major Hazard Facility Safety Report was accepted by DMIRS (then the Department of Mines and Petroleum).
Part IV of the EP Act (WA)	Ministerial Statement Number 873 (MS 873) EPA Report 1404 (Ministerial statement amendments 903 (EPA Report 1440), 922 (EPA Report 1462), 931 (EPA Report 1464) and 1130 (EPA Report 1464)		Conditional approval for the Wheatstone Project was granted on 30 August 2011 and has subsequently been subject to a number of amendments. See section 4.1 for further details

Legislation	Approval reference	Holder	Approval details
Planning and Development Act 2005	Ref : 20120415		The Pilbara Joint Development Approval Panel granted Planning Approval for the Wheatstone Foundation Project on 10 July 2013.

Key Findings: The Delegated Officer has determined that the applicant holds relevant access to the premises for more than 30 years as per the lease agreements with the Western Australian Land Authority and Dampier Ports Authority, and that, in consideration of the risk assessment, the Licence duration can be set for 20 years in accordance with *Guidance Statement: Licence Duration*.

4.1 Part IV of the EP Act

4.1.1 Background

The proposal to construct and operate the Wheatstone Project was referred to the WA EPA under Part IV of the EP Act in September 2008 and the Proposal was assessed through an Environmental Impact Statement / Environmental Review and Management Program (EIS/ERMP) assessment process. A bilateral assessment was undertaken under the EP Act and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In June 2011, the EPA released its report and recommendations on the project (Report 1404), and Ministerial Approval was granted on 30 August 2011 subject to the conditions outlined in MS 873. The approval authorises the construction and operation of a 25 million tpa LNG facility and associated Domgas facility in the ANSIA. The key components of the Proposal are summarised below:

- subsea gas trunkline to bring produced gas onshore to the LNG and Domgas plants;
- PLF;
- materials offloading facility (MOF);
- LNG plant comprising up to six LNG trains, up to four LNG storage tanks, up to four condensate storage tanks, and up to eight elevated flares;
- Domgas plants (up to four);
- support infrastructure including power generation, waste disposal facility, wastewater treatment and an offshore marine outfall;
- accommodation facilities; and
- Domgas pipelines (up to two) to transport natural gas to the Dampier to Bunbury Natural Gas Pipeline (DBNGP).

The applicant has applied for a number of changes to MS 873 under section 45C of the EP Act to account for minor project changes and remove project elements which are not environmentally significant or can be regulated under Part V of the EP Act.

Changes have also been made to MS 873 (conditions 19-1 to 19-9 relating to implementation of GHG emissions abatement) following an inquiry under section 46(1) of the EP Act. The conditions were removed from MS 873 via MS 922, and were replaced with condition 19-1. The condition requires annual reporting of GHG emissions from the LNG and Domgas plants. The changes to condition 19 were made on the basis of ensuring conditions in MS 873 relating to GHG emissions were complementary to the Commonwealth Government's greenhouse gas

reduction legislation. The Commonwealth's greenhouse gas reduction legislation was repealed subsequent to the changes to condition 19.

In the absence of Commonwealth greenhouse gas reduction legislation the Minister requested a second inquiry under s 46(1) of the EP Act on 2 January 2018 to investigate the adequacy of the amended condition 19 in MS 922. The inquiry had not been completed at the time of this report.

4.1.2 Ministerial Statement 873

MS 873 contains conditions that need to be considered in the assessment of emissions and discharges from the Premises and the imposition of regulatory controls. These are summarised in Table 6.

Table 6: Consideration of MS 873 conditions relevant to this application

Condition	Overview	Delegated Officer considerations
10-11 to 10-16	The condition requires the development of a Conservation Significant Marine Fauna Interaction Management Plan for the purpose of detecting, avoiding and mitigating impacts on conservation significant marine fauna (includes marine mammals, marine turtles, whale sharks and sawfish) during construction and operation of the nearshore and offshore marine facilities, trunkline and Offshore facility. This includes actions for managing impacts on marine turtles from light. 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.	The primary instrument for regulating the impact on marine turtles from light and noise emissions is MS 873 and the Significant Marine Fauna Interaction Management Plan. The plan includes noise and light management strategies and planning for flaring events during daytime. Monitoring specified in the plan includes a marine turtle monitoring program to detect changes to the turtle population.
13-11, 13-12, 13-15	Prior to submitting any works approval application relating to discharge of waste water from onshore facilities, the Proponent was required to submit the documents described below. • A report which mapped areas where environmental quality objectives and levels of ecological protection were to be achieved, identifies environmental quality criteria for discharge to maintain the environmental quality objectives and levels of ecological protection, and the number of dilutions necessary, to achieve them. • An Effluent Quality Validation and Reporting Plan that outlines a program of Whole Effluent Toxicity Testing, and reconsiders environmental quality criteria and	EPA Report 1404 recommends that regulation and on-going management of waste water discharges be under Part V of the EP Act and that instruments include conditions that ensure the environmental quality objectives and levels of protection in Schedule 2 of MS 873 are met. Condition 13 sets the environmental quality management framework to use for establishing management objectives for any waste water discharges associated with the Wheatstone Project. The Delegated Officer notes the Proponent developed and submitted a Permanent Onshore Facilities Waste Water Discharge Plan in accordance with the requirements of condition 13 prior to application for W5671/2014/1. The Delegated Officer notes that waste water discharge to the marine environment is not within the scope of the application as commissioning and validation testing of the

Condition	Overview	Delegated Officer considerations
	dilutions required to achieve environmental quality objectives and levels of ecological protection if there are any significant changes in effluent composition. If monitoring indicates environmental quality objectives and levels of ecological protection are not being met or not likely to be met reporting is required.	discharge infrastructure is still ongoing under the requirements of W5671/2014/1.
14-2 to 14-4	Prior to ground disturbing activities that could impact on mangroves and algal mat habitats the Proponent was required to develop and submit a Mangrove, Algal Mat and Tidal Creek Protection Management Plan for the purpose of minimising impacts on mangroves, algal mats, juvenile turtle habitat and sawfish nursery habitat between and including the Ashburton River and Four Mile Creek. This includes management actions relating to contaminated surface runoff, and chemical and hydrocarbon spills and leaks. Commitments relevant to the Premises include: • chemical / fuel storage will include secondary containment measures; • chemical / hydrocarbon wastes will be disposed of appropriately; and • stormwater runoff will be directed through open drains/ditches via sedimentation basins prior to discharge to the environment. The Plan also details monitoring programs for detecting impacts on mangroves, algal mats and tidal creek systems. The Proponent is required to implement the approved plan as well as make it publicly available.	The Delegated Officer has reviewed the Mangrove, Algal Mat and Tidal Creek Protection Management Plan and considers some management measures are applicable to activities within the Premises however monitoring is limited to within the Mangrove, Algal Mat and Tidal Creek habitats (external to the Premises). Commitments made in the plan will be considered as part of this Decision Report EPA Report 1404 recommends that to prevent soil, surface, marine and groundwater pollution instruments under Part V of the EP Act include: • annual groundwater monitoring around the facility pad and potentially contaminating infrastructure; • spill reporting; • segregation of uncontaminated and contaminated stormwater; • routing of uncontaminated stormwater through detention basins to allow monitoring of quality and flow; • contaminant limits for uncontaminated stormwater including <1ppm total petroleum hydrocarbons (TPH) for discharges to creek systems or the marine environment; and • contaminated water should be treated prior to discharge to the marine environment. The Delegated Officer notes the EPA's recommendations and will consider them in accordance with the risk assessment outcomes.
18-1 to 18-4	The conditions require the Proponent to install and operate the LNG and Domgas plants to achieve best practice in respect of minimizing emissions of VOCs and NOx, optimising the smokeless capacity	The Delegated Officer notes the applicant submitted an Air Emission Design Report and peer review with the application for W5584/2014/1.

Condition	Overview	Delegated Officer considerations
	of flares to minimise visible smoke and minimise non-emergency flaring. To achieve this the Proponent was required to submit with its Works Approval Application an Air Emission Design Report (and peer review) to demonstrate the design features included in the plant to minimise and monitor emissions to air and compare these features with other similar international and Australian operations. Where practicable the Proponent is also required to replace plant and equipment with that which meets best practice standards at the time of replacement and the replacement equipment shall not result in an increase in emissions or reduction in air quality.	EPA Report 1404 recommends that regulation and on-going management of air emissions be under Part V of the EP Act and recommends Part V instruments include: • requirements for ambient air monitoring to verify modeling predictions; • monitoring of the volume of gas flared per year and the occurrence of black smoke emissions; • targets for BTEX and mercury based on assumptions in the ERMP; and • requirement for a Biennial Leak Detection and Repair program using a Flame Ionization Detector or Photo Ionization Detector. The Delegated Officer notes the EPA's recommendations and will consider them in accordance with the risk assessment outcomes. It is also noted that the Wheatstone Project Leak Detection and Repair Plan was submitted together with the commissioning plan for the GTP under requirements of W5480/2013/1 and W5584/2014/1.
19-1	The condition requires the proponent to report GHG emissions from the GTP and Domgas plant on an annual basis in a manner prescribed by the CEO.	As described in section 4.1.1, subsequent to the issue of MS 873, a s46 inquiry into condition 19 was conducted resulting in changes to the condition through MS 922. The condition is likely to be subject to further changes as a result of a second s46 inquiry currently in progress relating to the adequacy of the condition. The Delegated Officer notes that GHG emissions from the Wheatstone Project were considered by the EPA in section 3.5 of EPA Report 1404. The report also included a recommendation that Part V instruments include flow metering and gas sampling for significant sources of GHG to allow accurate estimation of emissions. The Delegated Officer notes however that the condition requires reporting of emissions on an annual basis, therefore the applicant must ensure they have suitable monitoring in place in order to be able to meet reporting requirements. As per section 3.3, the Delegated Officer determined not to assess or regulate GHG emissions as it has already been assessed and is regulated via conditions of MS 873.

Key Findings:

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 873 conditions, and commitments made in Management Plans and Programs required by MS 873, and will avoid duplication in Licence conditions.

Where emissions and discharges have been assessed in this Decision Report, the scope of the Management Plans and Programs required by MS 873 has been reviewed in order to avoid duplication and inconsistency in the conditions of the licence. Where the Delegated Officer has identified that environmental risk is not adequately regulated through other approvals, it may be regulated under Part V of the EP Act.

In consideration of the requirements of the Part IV approval relating to the premises the Delegated Officer has determined that the following environmental aspects are managed through MS 873, under Part IV of the EP Act:

1) management and monitoring of impacts of noise and light on turtle populations;
2) greenhouse gas emissions; and
3) monitoring of impacts to Mangrove, Algal Mat and Tidal Creek habitats.

Based on the EPA's recommendations pertaining to environmental regulation and management under Part V of the EP Act, the Delegated Officer has determined that, where the risk assessment outcomes determine regulatory controls are required, the following requirements will be included within the licence:

1) groundwater monitoring;
2) contaminant limits for discharge to surface water environments;
3) ambient air monitoring and reporting requirements; and
4) point source emission to air monitoring and reporting requirements.

The Delegated Officer has determined that some of the EPA recommendations were addressed in the design of the GTP and the associated works approval or are already requirements under the EP Act and/or associated regulations (i.e. spill reporting).

4.2 Contaminated sites

There are currently no sites registered under the *Contaminated Sites Act 2003* (CS Act) within the premises or in close proximity.

4.3 Other relevant approvals

4.3.1 Planning approvals

The premises is located within the ANSIA, which was created by the WA government under the *Planning and Development Act 2005* for the purpose of LNG and Domgas processing as well as related downstream processing industries. The ANSIA estate is intended to include a multi-user port facility, land areas for proponents, and infrastructure to accommodate LNG and other hydrocarbon and natural gas processing for Domgas supply.

Planning approval for the ANSIA is administered by the WA Planning Commission under the ASNIA Improvement Scheme No. 1 which was gazetted on 30 September 2016. The scheme replaces the Shire of Ashburton's Town Planning Scheme No. 7 as the land use planning instrument for the ANSIA. Planning Approval for the Wheatstone Project was granted by the Pilbara Joint Development Approval Panel on 10 July 2013.

4.3.2 Department of Mines, Industry Regulation and Safety

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

Dangerous goods licenses for the storage of dangerous goods have been obtained (DGS022240) under the *Dangerous Goods Safety Act 2004.*

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

DMIRS has approved the Wheatstone Start up and Operations Environment Plan (WS2-COP-00001) which is implemented by the applicant in accordance with the above mentioned legislation.

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

The Wheatstone Project was referred to the then Commonwealth Department of Environment, Water, Heritage and the Arts (now the Department of the Environment and Energy) in September 2008 at the same time as the Project's referral to the EPA. A coordinated assessment of the Project through an Environmental Impact Statement was conducted. The Wheatstone Project was subsequently approved by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities on 22 September 2011 (EPBC 2008/4469)

Conditions imposed under the EPBC Act approval complement those imposed under Part IV of the EP Act relating to:

- impacts associated with dredging, and with marine drilling and blasting;
- impacts on conservation significant marine fauna (including turtles) associated with offshore and onshore activities;
- impacts to coastal habitats of conservation significant fauna from changes to coastal processes;
- wastewater discharges to the marine environment;
- greenhouse gas management and abatement;
- management of decommissioning activities; and
- biodiversity offsets.

4.4 Part V of the EP Act

4.4.1 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.

4.4.2 Works approval and licence history

Works approvals authorising construction of the premises were originally issued to Bechtel

(Western Australia) Pty Ltd (Bechtel) who was engaged by Chevron as the engineering, procurement and construction contractor to deliver the GTP and associated facilities of the Wheatstone Foundation Project. Instruments were later transferred to Chevron when they assumed operational control of the premises.

Works Approval W5480/2013/1 was granted to Bechtel to authorise construction of the LNG and condensate storage facilities. A construction compliance document and a commissioning report, as per the requirements of conditions 5.1.1 to 5.1.3 of the works approval, were submitted to the DWER in February 2017 and January 2019 respectively.

Works Approval W5584/2014/1 was granted to Bechtel to authorise construction of the Wheatstone Project LNG trains, Domgas Plant and associated supporting utilities. Conditions 3.1.1 to 3.1.6 of the works approval required submission of a construction compliance document, a pre-commissioning and hydrostatic testing report, and commissioning reports for the three stage of the project. The required documents for stages 1 and 2 of the project were submitted to DWER and have been considered in this assessment.

Table 7 summarises the works approval and licence history for the premises as it relates to infrastructure which is the subject of this application and assessment.

Table 7: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
W5480/2013/1	10/10/2013	New works approval for the construction of the Wheatstone Project LNG and Condensate storage facilities and associated infrastructure.
	29/09/2017	Works approval amendment to extend the duration of the works approval by 6 months to allow additional time for commissioning to be completed due to construction delays.
	27/03/2018	Works approval amendment to revise the Premises boundary to include condensate storage tank containment bunding, and to extend the duration of the works approval by 12 months to allow additional time for commissioning to be completed due to construction delays.
	30/10/2018	Works approval transferred from Bechtel (Western Australia) Pty Ltd to Chevron Australia Pty Ltd.
	10/01/2019	Works approval amendment to extend the duration of the works approval by 12 months to allow sufficient time for completion of commissioning and assessment of a licence application for the Premises.
	24/04/2019	Reissue of Amendment Notice 3 to correct a clerical error (date of amendment).
W5584/2014/1	23/04/2014	New works approval for the construction of the Wheatstone Project LNG trains (Trains 1 and 2), Domgas processing train, stormwater drainage and supporting utilities including power generation, flares and vents, dangerous goods storage, heating media systems, and fuel and gas recycle system
	20/12/2018	Works approval transferred from Bechtel (Western Australia) Pty Ltd to Chevron Australia Pty Ltd.
	21/12/2018	Works approval amendment to extend the duration of the works approval by 12 months to allow sufficient time for completion of commissioning and assessment of a licence application for the Premises. Commissioning periods for the works approval were also extended by 6 months.

Instrument	Issued	Nature and extent of works approval, licence or amendment
L9199/2019/1	29/1/2020	Licence issued for operation of stage 1 LNG processing and support infrastructure at the Wheatstone Foundation Project. The licence was issued for operation of : • LNG train 1; • LNG and condensate storage facilities; • two gas turbine generators (GTGs) for power generation; • stormwater drainage system; • primary water treatment system (PWTS); and • other miscellaneous utilities and support infrastructure required to support operation of stage 1
L9199/2019/1	31/07/2020	Licence surrendered for operation of Wheatstone LNG Project (stage 1)
L9225/2019/1	31/07/2020	This application – licence issued for operation of stage 1 and 2 LNG processing and support infrastructure at the Wheatstone Foundation Project.

4.4.3 Compliance history

There have been no statutory notices or prosecutions in relation to the premises.

A number of complaints have been received by DWER's Pollution Watch hotline in relation to dark smoke emissions from the premises throughout the pre-commissioning and commissioning period from late 2017 to early 2019. Each complaint was investigated and all were considered to be in accordance with expected emissions detailed in the Commissioning Plan for the premises and no further action was undertaken by DWER. Black smoke emissions during commissioning are typically associated with non-routine flaring due to process upsets and start-ups/shutdowns requiring feed gas to be diverted to the flare which can cause varying degrees of dark smoke emissions. The occurrence of dark smoke emission events has decreased as the GTP has reached steady state operations, less process upsets occur and correspondingly less start-up/shutdowns are required.

Further details relating to the dark smoke emission incidents are included in Appendix 2.

Chevron has also reported several recent incidents of waste discharge to the environment under section 72 of the EP Act. Impacted areas were remediated and validation sampling is planned to confirm contamination is not present. Chevron has also reported incidences of non-compliance with licence conditions for L9199/2019/1. Further details of the incidents are included in Appendix 2.

5. Modelling and monitoring data

5.1 Air quality modelling

The applicant undertook the following air quality modelling studies to assess the potential impact of the Wheatstone Project on air quality as a result of emissions to air:

- 2010 - *Chevron Australia (Pty) Ltd Wheatstone Project. Air Quality Impact Assessment (SKM)*. The assessment was undertaken for the full 25 Mtpa Wheatstone Project (comprising five LNG trains, four Domgas facilities and nine power generation turbines). Modelling was conducted using TAPM with preliminary design emissions for the Wheatstone Project emission sources to predict local region (<20 km) air quality impacts for NO_2, SO_2, PM_{10}, BTEX, and O_3 for normal operating conditions and upset scenarios. The assessment predicted maximum GLCs at receptors were all below relevant NEPM

criteria and that GLC of O_3 and NO_2 were predicted to have the most significant increase as a result of the Wheatstone Project. The 2010 assessment has not been further considered in this assessment as the modelling was conducted for the full five LNG train 25Mtpa Wheatstone Project (rather than the 12Mtpa Foundation Project) and was based on preliminary emission estimates for emission sources therefore the results are not directly comparable to measured results for the premises. There were also a number of limitations to the study including the exclusion of the effect of regional fires on the background air quality, under prediction of regional ozone levels, and exclusion of a scenario including condensate ship loading, which while undertaken infrequently is a significant source of VOC emissions.

- 2013 - *Wheatstone LNG Foundation Project - Air Quality Assessment (Air Assessments)*. Updated modelling was undertaken to estimate emissions associated with operation of the 8.9 Mtpa Wheatstone Foundation Project (two LNG trains) and address the identified limitations of the 2010 study. The modelling assessment utilised three models. AERMOD was selected for predicting local impacts (up to 13 km from the premises) based on its ability to model the relevant dispersion processes. For the ship loading scenario described below, TAPM was selected to model local VOC emission impacts based on its ability to model heavier than air releases. TAPM-CTM was selected for predicting regional scale (up to 100 km) O_3 and NO_2 impacts with the inclusion of emissions from fires within the background. The 2013 assessment used emission rates based on detailed design and considered six operational scenarios including:
    - normal/routine operations (Scenario 1);
    - recuperative thermal oxidiser trip for one of the LNG trains where the AGRU vent gas is directed to the LP flare (Scenario 2);
    - blocked NRU outlet vent resulting in gas vented directly to atmosphere consisting of concentrated N_2, with trace amounts of methane (Scenario 3);
    - loss of BOG compressors where the BOG from the LNG tankers is routed to the marine flare (Scenario 4);
    - loading a condensate ship, where VOC rich vapours are displaced from the ship's hold (Scenario 5); and
    - start-up of an LNG train with the use of a start-up oil heater and non-routine flaring to the LP flare (Scenario 6).

The following sources were included in the 2013 assessment:

- 12 GTs;
- four GTGs;
- three AGTO's (one for each LNG train, and one for the Domgas plant);
- the Domgas regeneration gas process heater and hot oil start up process heater;
- flare system;
- VOC emissions from condensate shiploading; and
- ship combustion sources from the LNG and condensate carriers and tugs.

Minor emission sources were excluded from the assessment including vehicles, small, infrequent emission sources such as diesel generators and VOCs from fugitive releases as the plant design and maintenance was considered to ensure fugitive emissions are low.

DWER's air quality experts reviewed the 2013 air quality assessment as part of the assessment of the works approval application W5584/2014/1 for the Wheatstone GTP. At the time of the review it was determined that appropriate model selection, input data and

assumptions were used to produce reliable conclusions. The modelling predicted the maximum concentration of emissions outside the premises boundary and at various sensitive receptor locations, including the town of Onslow. Predictions were made for the project in isolation as well as inclusive of estimated background pollutant concentrations. Modelling results indicated operation of the Wheatstone Foundation Project will result in only minor impact on regional air quality. The results of the maximum (local scale) modelled GLCs outside the premises boundary compared to air quality criteria are presented in Table 8 and the maximum (local scale) modelled GLCs at select sensitive receptors compared to air quality criteria are presented in Table 9. With the exception of PM_{10} and $PM_{2.5}$, background pollutant concentrations are generally low. PM_{10} and $PM_{2.5}$ background levels are a large proportion of the 24-hour criteria (54 and 24% respectively) however the predicted contribution from the Wheatstone Foundation Project emissions is low (<5% of the criteria).

For all the operating scenarios assessed, there is little variation in predicted concentrations, apart from BTEX emissions during the ship loading scenario. The local scale predicted GLCs demonstrate that the contribution of the Wheatstone Foundation Project to ambient air quality is typically low (<5% of the criteria) with the exception of NO_2 emissions which are predicted to be a maximum of 21.5% of the 1-hour criteria (excluding background) or 23.2% of the criteria including background outside the premises boundary.

Regional modelling was undertaken using TAPM-CTM to predict concentrations of O_3 and NO_2 as the model allows for all sources including bushfires to be modelled. The modelling results determined that due to the influence of fires in the background year background O_3 and NO_2 concentrations are relatively high. The modelling results also showed that the proximity of fires to receptors in the background year influences background concentrations with maximum NO_2 concentrations occurring inland near where bushfires occurred in the background year, and to a lesser extent close to industrial sources such as at Barrow Island and on the Burrup Peninsular. Summarised results of the regional modelling maximum predicted GLCs for the model grid are illustrated in Table 10. The second highest results are also shown in the table as they are considered more appropriate due to the inclusion of natural sources such as fire in the model. The 2013 air quality assessment report did not provide data for regional modelling predictions at Onslow. However, the contour plots in the report indicate that the maximum predicted 1 hour NO_2 GLC due to background and existing sources at Onslow is between 30-40 ppb, and the second highest is approximately 10 ppb. There was negligible change to the maximum predicted concentrations resulting from the inclusion of Wheatstone and future industry illustrating the Wheatstone Foundation Project is expected to have only minor impact on regional air quality.

The regional modelling demonstrates that predicted O_3 concentrations at Onslow (inclusive of Wheatstone Foundation Project and background data) are moderately high at 46% of the NEPM 1-hour criteria and 55% of the NEPM 4-hour criteria. Figure 3 illustrates the predicted 1-hour O_3 concentration at Onslow associated with the modelled scenarios, and comparison with natural and other background sources. The figure shows that the predicted contribution of the Wheatstone Foundation Project to O_3 levels at Onslow for the modelled scenarios is ≤5% (or 5 ppm) of the criteria supporting the findings of the NO_2 regional modelling that the Wheatstone Foundation Project is expected to have only minor impact on regional air quality.

Table 8 Predicted maximum concentration outside the premises for the Wheatstone Foundation Project (8.9 mtpa) background levels included (AERMOD local scale modelling)

Pollutant	Ave. Period	Conc. Statistic	Assessment Criteria	Background		Routine		Non Routine									
						1		2		3		4		5		6	
				GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria
CO	8-hour	Max	9,000 ppb	100	1.1	144	1.6	144	1.6	144	1.6	144	1.6	144	1.6	135	1.5
NO_2	1-hour	Max	120 ppb	2	1.7	27.8	23.2	27.8	23.2	27.8	23.2	27.8	23.2	27.8	23.2	19.1	15.9
	Annual	Ave	30 ppb	1	3.3	2.4	8	2.4	8	2.4	8	2.4	8	2.4	8	2.46	8.2
SO_2	1-hour	Max	200 ppb	0	0	0.9	0.5	0.6	0.3	0.9	0.5	0.9	0.5	0.9	0.5	0.5	0.3
	24-hr	Max	80 ppb	0	0	0.28	0.4	0.23	0.2	0.28	0.4	0.28	0.4	0.28	0.4	0.17	0.2
	Annual	Ave	20 ppb	0	0	0.046	0.2	0.035	0.2	0.046	0.2	0.046	0.2	0.046	0.2	0.028	0.1
PM_{10}	24-hr	Max	50 µg/m^3	27	54	28.2	56	28.2	56	28.2	56	28.45	57	28.2	56	27.83	56
$PM_{2.5}$	24-hr	Max	25 µg/m^3	6	24	7.2	29	7.2	29	7.2	29	7.45	29	7.2	29	6.83	27
	Annual	Ave	8 µg/m^3	5	62.5	5.24	66	5.24	66	5.25	66	5.25	66	5.24	66	5.18	65
Benzene	Annual	Ave	9.6 µg/m^3	0.06	0.6	0.105	1.1	0.095	1.0	0.100	1.0	0.105	1.1	0.245	2.6	0.090	0.9
Toluene	24-hr	Max	1,000 ppb	0.05	0.005	0.3	0.03	0.2	0.02	0.3	0.03	0.3	0.03	4	0.4	0.2	0.02
	Annual	Ave	100 ppb	0.05	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.21	0.21	0.07	0.07
Xylenes	24-hr	Max	250 ppb	0.05	0.02	0.15	0.06	0.15	0.06	0.15	0.06	0.15	0.06	1.68	0.67	0.13	0.05
	Annual	Ave	200 ppb	0.015	0.015	0.04	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.1	0.05	0.02	0.01
Formaldehyde	24-hr	Max	40 ppb	0.55	1.38	0.64	1.6	0.64	1.6	0.64	1.6	0.64	1.6	0.64	1.6	0.6	1.5
H_2S	1-hour	99.9th	1.11 µg/m^3	0	0	0.012	1	0.007	0.6	0.012	1	0.012	1	0.012	1	0.008	0.7

Note 1: Scenarios 1 and 6 are considered to be the closest representative scenario to the application as they relate to emissions associated with normal operation of the Wheatstone Foundation Project and to emissions associated with start up of a LNG train (inclusive of support infrastructure) respectively.
Note 2: GLCs have been calculated based on the % criteria values provided in Air Assessments 2013.

Table 9 Predicted maximum concentration at select sensitive receptors for the Wheatstone Foundation Project (8.9 mtpa) background levels included (AERMOD local scale modelling)

Pollutant	Average Period	Conc. Statistic	NEPM Assessment Criteria	Max on Grid		Max outside Wheatstone lease		Onslow Town		Onslow Salt		Macedon Village		Ashburton River Camp Site – Site 1		Ashburton River Camp Site – Site 2	
				GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria
NO_2	1-hour	Max	120 ppb	40.1	33.4	27.8	23.2	**11.5**	**9.6**	28	23.3	13	10.8	8	6.7	11	9.2
	Annual	Ave	30 ppb	9.2	30.7	3.9	13	**1.5**	**4.8**	3.5	11.7	1.6	5.3	1.1	3.5	1.1	3.5
SO_2	1-hour	Max	200	1.4	0.7	0.9	0.5	**0.3**	**0.15**	NA							
	24-hr	Max	80	0.7	0.9	0.28	0.4	**0.04**	**0.05**								
	Annual	Ave	20	0.095	0.5	0.046	0.2	**0.007**	**0.04**								
PM_{10}	24-hr	Max	50 µg/m^3	29.1	58	28.2	56	**27.1**	**54**	27.1	54	27.6	55	27.1	54	27.2	54
$PM_{2.5}$	24-hr	Max	25 µg/m^3	8.1	32	7.2	29	**6.1**	**25**	6.1	25	6.6	26	6.1	24	6.2	25
	Annual	Ave	8 µg/m^3	5.32	67	5.24	66	**5.03**	**63**	5.03	63	5.12	64	5.01	63	5.01	63
Benzene	Annual	Ave	9.6 µg/m^3	0.13	1.4	0.1	1.0	**0.065**	**0.7**	0.065	0.7	0.062	0.6	0.061	0.6	0..061	0.6
H_2S	1-hour	Max	1.11 µg/m^3	0.02	1.8	0.012	1.1	**0.0028**	**0.3**	0.0028	0.3	0.004	0.4	0.002	0.2	0.002	0.2

Note 1: The Macedon Village has been removed since the modelling study and is no longer in use. The Village was located approximately 800 m from the Macedon Plant.

Table 10 Regional modelling predicted maximum concentration of O_3 and NO_2 anywhere on the model grid for the Wheatstone Foundation Project (8.9 mtpa) background levels included (TAPM regional scale modelling)

Pollutant	Average Period	Conc. Statistic	NEPM Assessment Criteria	Back-ground		Routine Scenario		Non-Routine Scenarios									
						1		2		3		4		5		6	
				GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria	GLC	% Criteria
NO_2	1-hour	Max	120 ppb	75.1	63	75.6	63	75.6	63	75.6	63	75.7	63	75.6	63	75.1	63
	1-hour	2nd	120 ppb	45	38	45	38	45	38	45	38	45	38	45	38	45	38
	Annual	Ave	30 ppb	9.2	31	9.3	31	9.3	31	9.3	31	9.3	31	9.3	31	9.3	31
O_3	1-hour	Max	100 ppb	87	87	86	86	86	86	86	86	86	86	86	86	86	86
	1-hour	2nd	100 ppb	74	74	67	67	67	67	67	67	67	67	68	68	67	67
	4-hour	Max	80 ppb	76	95	75	94	75	94	75	94	75	94	75	94	75	94
	4-hour	2nd	80 ppb	69	86	63.5	79	63.5	79	63.5	79	63.5	79	64.2	80	63.5	79

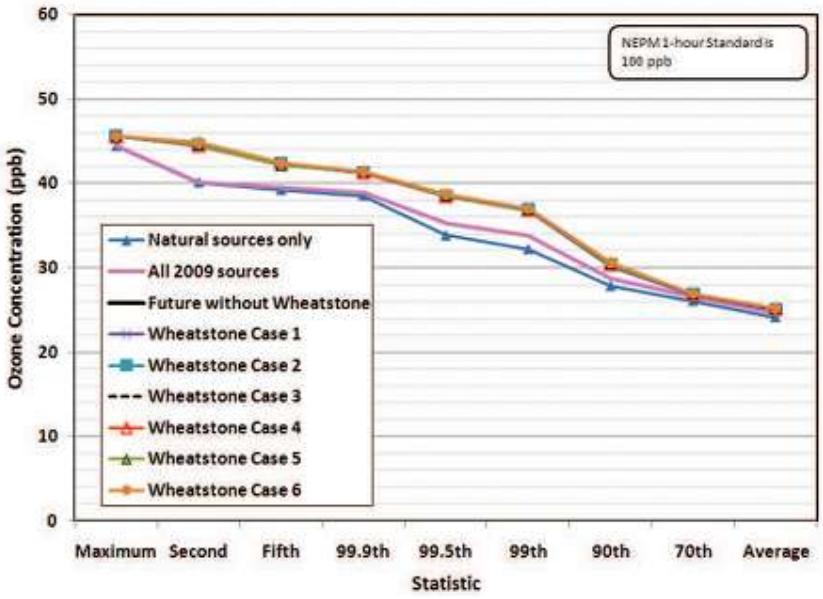


Figure 3 Predicted 1-hour ozone concentration at Onslow (TAPM regional scale modelling)

For the assessment of the application, DWER's air quality experts considered the outcomes of the 2013 air quality assessment together with monitoring results presented in the premises Stage 1 and 2 commissioning Air Emission Verification Monitoring reports as well as additional monitoring results provided by the applicant during the assessment period for 2019/2020.

The review identified that measured emissions at Onslow are in some cases higher than model predicted GLCs (local scale) (further details are in section 5.2.1) although it is recognised that Wheatstone is only a minor contributor to ambient air quality. The review also identified that modelled emission rates for NO_2, CO and SO_2 are in some cases lower than actual emission rates measured during and after commissioning (further details are in section 5.2.2). These factors give rise to the possibility that the modelling may have underestimated predicted pollutant concentrations as emission rates on which the model was based may not have been sufficiently conservative to account for higher emissions during the commissioning stage.

The purpose of air quality models is to generate conservative estimates of the impact of a proposal on ambient air quality. Given the uncertainties in estimation of ambient air quality concentrations by air quality dispersion models, it should not be assumed that a modelled prediction indicates a real-world pollution condition. The Department expects that conservative emission rate values are used for modelling to cover the various operational stages, processes and unpredictable intermittent emissions.

5.2 Air emissions verification monitoring (commissioning)

In accordance with the requirements of W5584/2014/1 the applicant developed and submitted to DWER a commissioning plan, inclusive of an air monitoring program for each stage of commissioning of the Wheatstone Foundation Project. The applicant submitted the results of the commissioning phase air monitoring program in Air Emission Verification Reports following the completion of commissioning of each stage of works in accordance with the requirements of W5584/2014/1.

The monitoring program and results of the program relevant to the application are described in the following sections. The submitted Air Emission Verification Reports were reviewed by DWER's air quality experts who verified that the data provided was valid.

5.2.1 Ambient air quality

The scope of the ambient air monitoring program undertaken throughout commissioning of the premises is described in Table 11. The ambient air monitoring program is intended to continue until commissioning of all three stages of the Wheatstone Foundation Project are complete (commissioning of the Domgas plant is the final stage of commissioning for the project). Monitoring of particulate matter was not included in the ambient air monitoring program as it was considered a pollutant of low significance given the very low levels expected to be generated from the GTP due the high combustion efficiency of the equipment, and the majority of emission sources running on fuel gas. The 2013 modelling supports this predicting the GTP will contribute <5% of the relevant criteria for PM_{10} and $PM_{2.5}$. Monitoring of H_2S was also not included in the ambient monitoring program as the 2013 modelling indicated the Wheatstone Foundation Project will contribute <1% of the relevant criteria at Onslow. Given the separation between the premises and receptors, and there being other potential sources of H_2S in proximity to Onslow, such as wastewater treatment plants, the level of risk associated with this pollutant is considered to be low

Table 11 Wheatstone Foundation Project ambient air monitoring program (commissioning phase)

Monitoring location	Monitoring equipment	Parameters	Frequency
Onslow Town Site AQMS	UV Absorption Analyser	O_3	Continuous
	Chemiluminescence Analyser	NO, NO_2, NOx	Continuous
	UV Fluorescence Analyser	SO_2	Continuous
	Carbon Monoxide Analyser	CO	Continuous
	Passive Diffuse Sampler	NMVOC, NO_2, SO_2	Monthly (sample collected over 7-14 days)
	Weather Station	Wind Speed and Direction, Ambient Temperature, Relative Humidity, Rainfall	Continuous
CWDDG1 Eastern Fence line	Passive Diffuse Sampler	NMVOC, NO_2, SO_2	Monthly (sample collected over 7-14 days)
	Weather Station	Wind Speed and Direction, Ambient Temperature, Relative Humidity, Rainfall	Continuous
CWDDG10 Western Fence line	Passive Diffuse Sampler	NMVOC, NO_2, SO_2	Monthly (sample collected over 7-14 days)
CV PDS Construction Village northern boundary	Passive Diffuse Sampler	NMVOC, NO_2, SO_2	Monthly (sample collected over 7-14 days)

Note 1: Continuous data collection may include intermittent periods of downtime for maintenance or unplanned events (e.g. extreme weather events).
Note 2: Nitrogen dioxide determined by chemiluminescence is a calculated parameter.
Note 3: The sampling period does not allow PDS monitoring data to be compared directly against short term guideline values. However a conservative calculation approach, i.e. using the nominal 7 to 14 day monitoring period data to calculate an equivalent one-hour PDS value will be undertaken to enable comparison against the guideline value

The ambient monitoring data, which consisted of measured results from July 2017 to June 2020

(where available), indicated that the relevant assessment criteria for ambient air quality had been met at the Onslow AQMS. A summary of the maximum recorded results compared with the assessment criteria, as well as the 2013 local model predicted GLC (routine operation) for Onslow, has been included in Table 12. The maximum hourly measured GLC each month for NO_2, SO_2 and O_3 st the Onlsow AQMS compared with relevant NEPM criteria are illustrated in Figure 4 for the ime period since commissioning commenced.

Table 12 Summary of ambient air quality monitoring maximum results at Onslow compared with modelled results

Pollutant	Average Period	Conc. Statistic	Assessment Criteria	Max. GLC modelled at Onslow	Max. GLC Onslow AQMS (Jul 2017-June 2020)	% Assessment Criteria	% Max. GLC modelled at Onslow
CO	8-hour	Max	9000 ppb	NA	1780	19.8	NA
NO_2	1-hour	Max	120 ppb	11.5	25.2	21	219
	Annual	Ave	30 ppb	1.5	1.3[4]	4.33	86.7
SO_2	1-hour	Max	200 ppb	0.3	5.3	2.65	1767
	24-hr	Max	80 ppb	0.04	1[4]	1.25	2500
	Annual	Ave	20 ppb	0.007	0.3[4]	1.5	4286
O_3	1-hour	Max	100 ppb	46	57.4	57.4	125
	4-hr	Max	80 ppb	44	54.8	68.5	125
Benzene[1,]	1-hour	Ave	29 µg/m^3[2]	NA	0.28[4]	1.0	NA
	Annual	Ave	9.6 µg/m^3[3]	0.065	0.12[4]	1.25	NA
Toluene[1]	24-hr	Max	3780 µg/m^3[3]	0.07	2[4]	0.05	NA
	Annual	Ave	380 µg/m^3[3]	0.055	0.44[4]	0.12	NA
Xylenes[1]	24-hr	Max	1085 µg/m^3[3]	0.07	0.71[4]	0.065	NA
	Annual	Ave	870 µg/m^3[3]	0.017	0.37[4]	0.04	NA

Note 1: Monitoring of NMVOCs was conducted over a 5-7 day period via passive sampling and is not directly comparable with the criteria or modelled results. A conservative approach has been applied by considering the concentration from the 5-7 day sampling period to have all been collected within a single 24 hour period (or 1 hour period in the case of Benzene) for comparison with the assessment criteria. The average concentration from 12 sample events has also been used to as representative of the annual average for comparison with the assessment criteria. A conservative approach of applying detection limits as concentrations where none was recorded has also been applied to the results.

Note 2: Criteria is not available in the NEPM and is therefore taken from the *NSW EPA Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 201*6.

Note 3: Assessment criteria assume standard temperature and pressure of 25ºC and 101.3kPa.

Note 4: Maximum measured GLC based on results from July 2017 to April 2019 as results only provided for this timeframe.

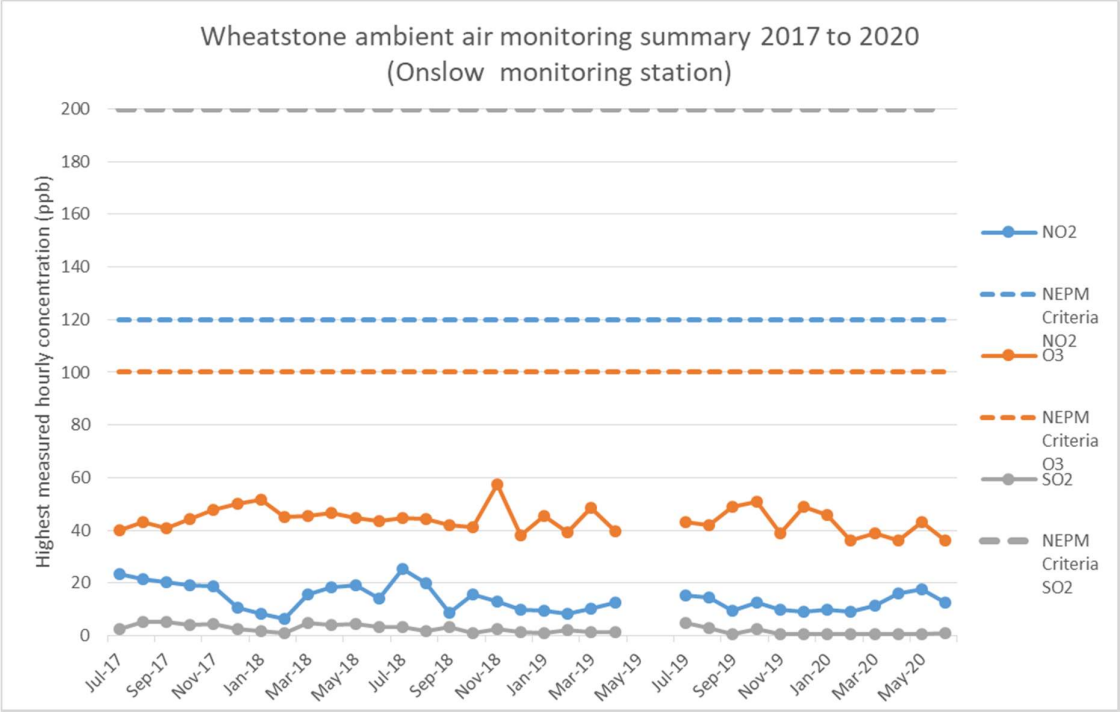


Figure 4 Onslow townsite ambient air quality monitoring summary (monthly maximum hourly measured concentrations vs NEPM criteria)

The monitoring results show that ambient concentrations of NMVOCs (BTEX) measured by passive samplers are very low. Direct comparison to the NEPM criterion is not possible given the nature of the passive diffuse sampling method (non-continuous). However, taking the conservative approach and assuming all of the measured concentration was collected in a single hour, the maximum result of 0.28 µg/m^3 is 1% of the NSW EPA one-hour criterion for Benzene. The average of 12 months of the monitoring data was 0.12 µg/m^3 which is approximately 1.25% of the NEPM annual criterion.

The maximum ambient concentration of SO_2 at the Onslow AQMS was also low being 2.65% of the 1-hour SO_2 criteria. The maximum ambient concentrations of NO_2 and O_3 measured at the Onslow AQMS were moderately high measuring 21% and 57.4% of the NEPM 1-hour criteria respectively. The maximum ambient concentration of CO was also moderately high measuring 19.8% of the NEPM 8-hour criteria although

Comparison of the maximum measured pollutant concentrations with the maximum local modelled GLC for Onslow shows that, for NO_2 and SO_2 in particular maximum measured results significantly exceed the maximum modelled GLC at Onslow. As discussed in section 5.1, DWER air quality experts consider that the results indicate the modelling may not have been sufficiently conservative and modelling underestimation is possible.

5.2.2 Point source emissions to air

Point source air emission monitoring during commissioning of the Wheatstone Foundation Project stage 1 and 2 included stack testing and process monitoring of key emissions sources (GTGs, GTs, AGTO and HOSH). The scope of the point source air emission monitoring program undertaken is described in Table 13.

Table 13 Wheatstone Foundation Project point source air emission monitoring program (commissioning phase)

Emission Point[1]	Parameter	Method[2]	Frequency
GTs, GTGs and AGTO	NOx	USEPA Method 7D or 7E	Quarterly
	SO_2	USEPA Method 6C, 8, or ISO11632:1998(E)	
	CO	USEPA Method 10	
	NMVOC	USEPA Method 18	
HOSH	NOx	USEPA Method 7D or 7E	Once-off
	SO_2	USEPA Method 6C, 8, or ISO11632:1998(E)	
	CO	USEPA Method 10	
	NMVOC	USEPA Method 18	

Note 1: Sampling locations were assessed for compliance with AS 4323.1 and all found to be compliance for non-ideal locations with the exception of GTG1 and GTG2 due to the flow angle at one or more points in the sampling traverse exceeding 15 degrees however this did not appear to have a material impact on monitoring results. Stratification testing of the sampling locations was undertaken with the results showing that the gas emissions are considered homogeneous and non-stratified.

Note 2: Where more than one monitoring method is stated for a parameter, only one of the methods listed was used, depending upon factors such as available equipment or supplies, stack conditions, accessibility and accreditations.

A summary of the monitoring program results compared with design criteria for the key infrastructure is presented in Table 14. Results for NMVOCs are not included as all measured results were below the limit of detection (LOD) with the exception of one record of 4.9 mg/m^3 for AGTO1 in August 2018. Measured emission rates for NOx and CO for the GTs, GTGs and AGTOs (also includes SO_2) are also illustrated in Figure 5

to Figure 8 with discussion in the following paragraphs.

Table 14 Point source air emission monitoring results for stage 1 and 2 commissioning compared with design criteria

Source	No. samples	Parameter	Design emission target (mg/m^3)	Design emission concentration (mg/m^3)	Measured concentration range (mg/m^3)	No. design emission target exceedances	No. design emission concentration exceedances	Design emission rate (g/s)	Measured emission rate range (g/s)	No. design emission rate exceedances
LNG Train 1 GTs (6)	78	NO_X	70	49	8.1-57	0	**2**	3.17	0.39-2.93	**0**
		CO	125	83	11-140	2	**4**	5.42	0.38-8.41	**5**
LNG Train 2 GTs (6)	60	NO_X	70	49	13-79	5	**21**	3.17	0.57-7.32	**8**
		CO	125	83	4-141	1	**6**	5.42	0.24-5.7	**1**
GTGs (4)	53	NO_X	70	49	48-119	34	**56**	3.575	1.81-4.98	**18**
		CO	125	83	30-250	2	**14**	6.075	0.83-12.72	**1**
AGTOs (2)	20	NO_X	350	113	92-171	0	**14**	1.4	0.7-1.6	**2**
		CO	125	171	2-2812	8	**8**	2.15	0-23.3	**7**
		SO_2	NA	61	5-93	NA	**8**	0.75	0.1-1	**1**
HOSH (1)	1	NO_X	350	102	110	0	**1**	0.9	1	**1**
		CO	125	52	<2.5	0	**0**	0.4	<0.1	**0**

Note 1: Design criteria are taken from the *Wheatstone Project: Air Emission Design Report – Foundation Project (2013)* which was submitted with the application for W5584/2014/1 as per the requirements of MS 873. The design emission rates provided in the report are for total emissions for the 12 GTs, the four GTGs and the two AGTOs. The values provided were therefore converted to emission rates for each individual source by dividing the provided rate (g/s) by the number of emission sources for each type.

Note 2: It has been assumed the design concentrations (mg/m^3) provided in the *Wheatstone Project: Air Emission Design Report – Foundation Project (2013)* are for individual units. The report does not clearly state this however it would not be possible to determine an emission concentration from combined sources unless they are released from a single discharge point.

Note 3: SO_2 emissions measured for the GTs, GTGs and HOSH were below the LOD, and the LOD exceeds the design criteria, therefore meaningful comparison of measured results to design criteria was not possible and is not included in the table.

Note 4: All measured results for NMVOcs were below the LOD with the exception of one record of 4.9 mg/m^3 for AGTO1 in August 2018. NMVOC results are therefore not included in the table.

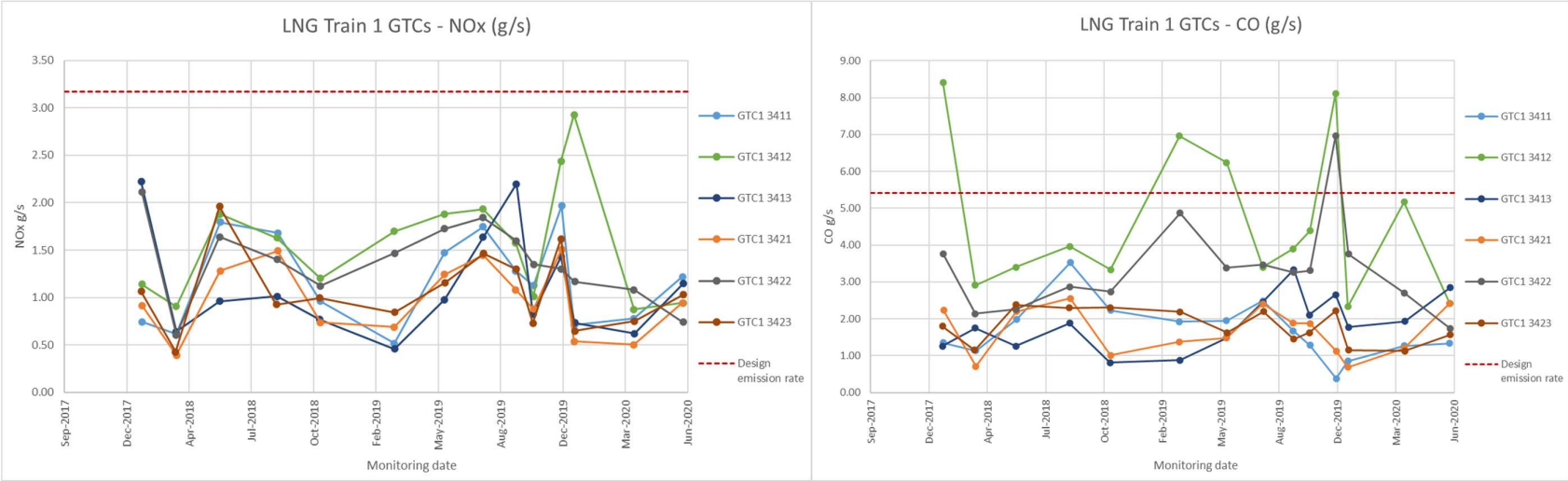


Figure 5 Measured NOx and CO emission rates for LNG train 1 GTs

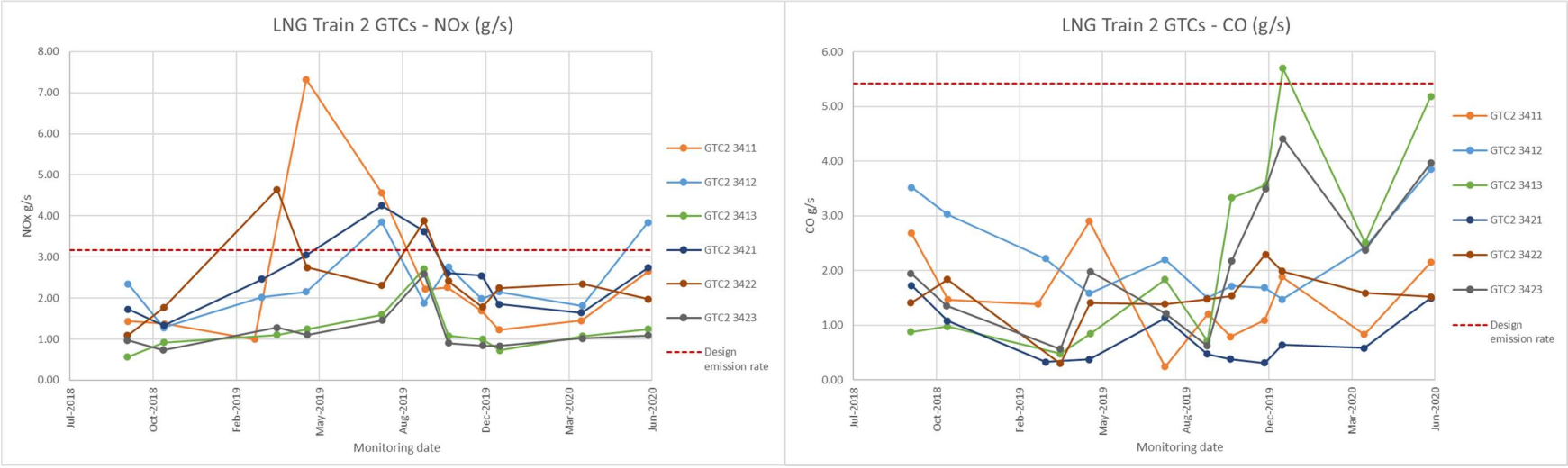


Figure 6 Measured NOx and CO emission rates for LNG train 2 GTs

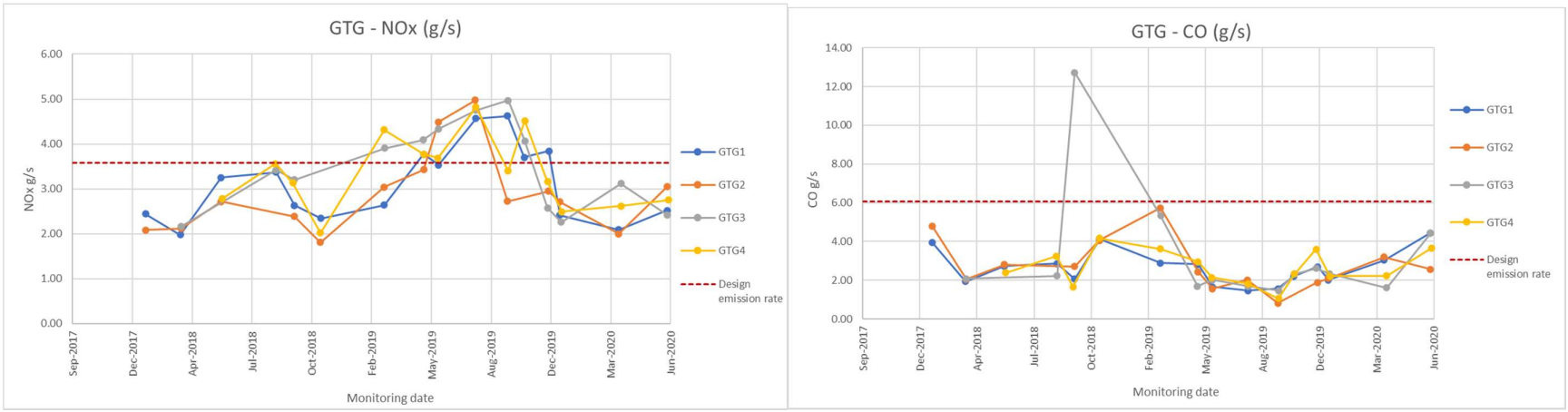
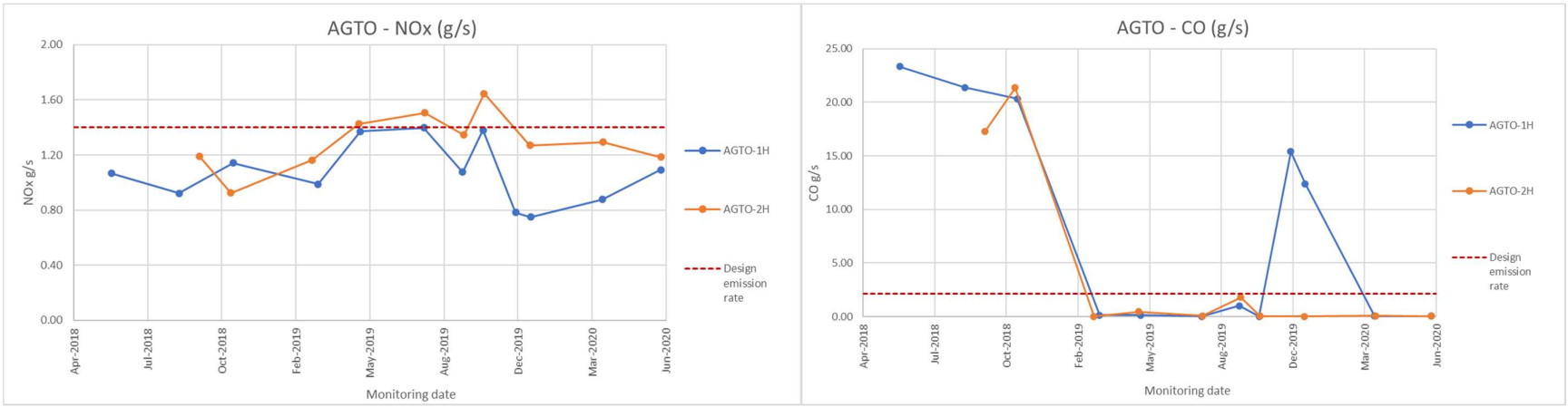


Figure 7 Measured NOx and CO emission rates for GTGs



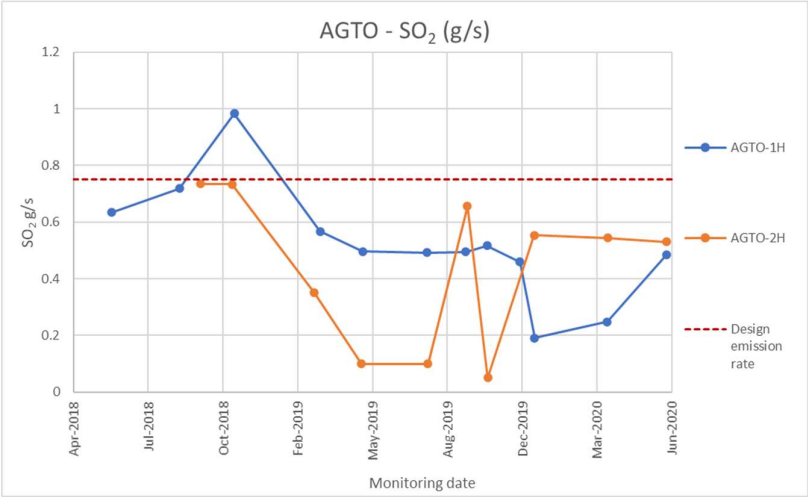


Figure 8 Measured NOx, CO and SO_2 emission rates for AGTOs

Design emission rates and concentrations as well as targets for the GTs, GTGs, AGTOs and HOSH were included in the *Wheatstone Project: Air Emission Design Report – Foundation Project (2013).* The design emission rates provided in the report were largely aligned with the emission rates used for modelling the routine operating scenario (2013). Emission rates provided in the report were for the sum of emissions from each type of source therefore, to allow for comparison to measured emissions rates, the provided emission rates were divided by the number of sources to determine an emission rate per source.

Measured NOx and CO emissions from the train 1 GTs were predominantly below the relevant design criteria (Table 14). Exceedance of the CO design criteria were predominantly for a single source indicating the majority of train 1 GTs are performing in line with design criteria. Measured CO emissions from the train 2 GTs were predominantly below the relevant design criteria however numerous exceedances of the NOx design criteria occurred (Table 14 and Figure 6). Exceedance of design criteria during commissioning of infrastructure can occur when the infrastructure is not operating at sufficiently high load as the effectiveness of emission controls can be reduced resulting in higher emissions. It is therefore expected that emission rates will reduce and stabilise as the GTP reaches steady state. The most recent train 2 GT monitoring results for NOx are predominantly below the design criteria.

Measured NOx for the GTGs often exceeded the relevant design criteria and occasional exceedance of CO design criteria also occurred (Table 14 and Figure 7). The GTGs were operating at relatively low load during the commissioning period typically at loads of 7 to 12 MW (approximately 16-33% of capacity). As referred to above, at low loads, turbines do not operate as efficiently typically resulting in higher emissions (in particular CO and NOx) due to incomplete combustion, and emission control, in particular dry low emissions (DLE) equipment, operating sub-optimally. Reduction in emission rates is therefore anticipated as the GTGs are operated at higher loads. The most recent GTG monitoring results indicate emission rates have reduced to below design.

One of the key emissions from the AGTOs is SO_2 which is formed through the destruction of VOCs and H_2S. Measured results were predominantly within the design criteria. Measured CO for the AGTOs exceeded the design criteria significantly during early monitoring events (Table 14 and Figure 8). Investigation of the cause of the higher than anticipated emissions found that the combustion air flow measurement was incorrect, resulting in lower than required conversion of acid gases, and higher than design combustion air cooling in the combustion chamber. Correction of the error in air flow rate measurement resulted in the combustion chamber temperature increasing and CO emissions reducing to within expected levels although AGTO1 has experienced another exceedance since the correction. Measured NOx emissions have also exceeded the design criteria however have reduced in the most recent monitoring events.

Key Findings: Air quality modelling and monitoring

The Delegated Officer has determined that the measured point source air emissions have, during some monitoring events, exceeded the design criteria/modelled emission rates for the premises infrastructure. The Delegated Officer noted that emissions can be expected to be higher during commissioning of the plant than during steady state operation due to lower loads on the equipment reducing efficiency resulting in emission controls operating sub-optimally, and ongoing performance optimisation occurring throughout commissioning and early stage operation of the GTP. It is anticipated that emissions will reduce and stabilise as the operating strategy for the GTP matures. The most recent monitoring results indicate emissions have predominantly reduced from higher levels recorded during commissioning to within the design criteria.

The Delegated Officer has also determined that monitoring results for the Onslow AQMS met the ambient air quality assessment criteria, however the measured pollutant levels exceeded the local model predicted maximum GLCs at Onslow for some of the

measured parameters, in particular the 1-hour criteria for NO_2 and SO_2. It is expected that air quality modelling should be sufficiently conservative to cover various operational scenarios and unpredictable intermittent emissions, including throughout commissioning.

Based on comparison of the emission verification monitoring results for the Wheatstone Foundation Project (ambient and point source), to the modelled GLCs and design emission rates which were used for the Wheatstone Foundation Project Ambient Air Quality Modelling (2013), the Delegated Officer has determined that the emission rates used for modelling were not sufficiently conservative to account for higher emissions during the commissioning period therefore the modelling potentially underestimated GLCs. The modelling therefore potentially underestimates GLCs and there is some uncertainty in the maximum local predictions of the model as these have already been exceeded. It is however acknowledged that the modelling demonstrates that emissions from the Wheatstone Project have minimal impact on regional ambient air quality, and there are other more significant contributory sources to air quality at Onslow which could have impacted the monitoring results.

The Delegated Officer's expectation is that the applicant will review all emission verification monitoring results and modelling predictions following the completion of the final stage 3 commissioning of the Wheatstone Foundation Project and include discussion of these in any future applications for licence or amendment. The review should assess whether to the modelling is sufficiently conservative, to cover the various operational scenarios, inclusive of start-up and commissioning, and unpredictable intermittent emissions.

5.3 Noise modelling

The applicant undertook a noise modelling study to predict noise levels associated with the operation of the Wheatstone Project at nearby sensitive receptors. The noise modelling study was undertaken for operation of five LNG trains and five Domgas plants at the Wheatstone Project. The study predicted noise levels associated with normal operation as well as emergency flaring at receptors in the vicinity of the Wheatstone Project. The results of the noise modelling are shown in Table 15. As the application only relates to operation of two LNG trains (and associated infrastructure), but modelling was undertaken for a significantly larger project, the modelling results are expected to be higher than actual noise levels associated with the operation of the premises.

Table 15 Predicted noise levels (LA_{10} dB(A)) during operation of the Wheatstone Project (URS 2009)

Sensitive receptors	Assigned night-time levels	Background night-time (L_{A90})	Predicted noise at worst wind conditions[1]	
			Normal operations	Emergency flaring
Onslow	35	34	27	30
4 Mile Creek	N/A	36	37	41
5 Mile Pool[2]	N/A	25	28	32
Old Onslow Heritage Site	N/A	25	36	41
Onslow Salt (industrial site)	65	-	35	41
Macedon Gas Plant[3]	65	-	~40	~45

Note 1: Noise modelling results are for operation of the full Wheatstone Project assessed under Part IV of the EP Act inclusive of five LNG trains, five Domgas plants, power supply and associated emergency flaring.
Note 2: Noise modelling results for the Ashburton River Camp Sites and the Ashburton North Village Noise were not specifically identified within URS 2009 however based on noise contours presented in the report are approximately equivalent to results for the 5 Mile Pool.
Note 3: Noise modelling results for the Macedon Gas Plant were not specifically identified within URS 2009 however based on noise contours presented in the report are approximately equal to the values presented in the table.

The noise modelling was reviewed by DWER's noise experts as part of the assessment of the works approval application for the GTP (W5584/2014/1) and it was determined that noise levels associated with operation of the two train Wheatstone Foundation Project would be able to be managed to comply with the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations).

Four Mile Creek, the Old Onslow Heritage Site and Five Mile Pool are public access/recreation areas and are not considered premises in accordance with the Noise Regulations, therefore the assigned night-time levels do not apply. Predicted noise levels are higher than background noise levels therefore noise from the GTP may be audible at these locations under worst-case meteorological conditions.

As part of the commissioning requirements for W5584/2014/1, the applicant will assess sound levels when stage 3 commissioning (Domgas plant) is complete, and will validate the noise model results.

Key Findings:

The Delegated Officer has determined that while assigned night-time levels are predicted to be exceeded under worst case meteorological conditions at some surrounding public access areas (4 Mile Creek and Old Onslow Heritage Site), assigned levels within the Noise Regulations do not apply to these areas. Therefore the premises can be managed to comply with the Noise Regulations. It is however noted that noise from the GTP may be audible at these locations under worst-case meteorological conditions.

The Delegated Officer has also determined that the noise modelling was undertaken for five LNG trains and five Domgas plants operating at the Wheatstone Project, and that the application relates to operation of only two LNG trains and associated infrastructure. Noise levels are therefore expected to be lower than the predicted levels presented in Table 15.

The Delegated Officer has also noted that the applicant has committed in the W5584/2014/1 LNG and Domgas Commissioning Plan (Bechtel 2018) to assess equipment sound levels and validate the results of the noise model when Train 1, Train 2 and the Domgas plant are operational. The Delegated Officer has therefore determined to review the assessment of noise levels as part of the assessment of the application for operation of all three stages of the Wheatstone Foundation Project.

5.4 Groundwater monitoring

A baseline assessment of groundwater was undertaken through drilling, testing and sampling of 69 groundwater bores and 28 drive point piezometers. The assessment determined the water table elevation to be closely linked to topography. The premises was interpreted to be underlain by a shallow water table and largely a groundwater discharge zone with groundwater flow direction predominantly to the north and north-east (URS 2010a) toward the ocean and Hooley Creek.

Subsequent to the baseline assessment, ongoing groundwater monitoring has been undertaken biannually at 14 groundwater monitoring wells within or in close proximity to the Premises during the construction and commissioning phase in accordance with a Construction Groundwater Monitoring Procedure (CGMP).

In November 2018 an additional 20 groundwater monitoring wells were established at 12 locations within or in close proximity to the premises. The new monitoring wells were installed to:

- improve the layout of the monitoring network relative to hydrocarbon and chemical storage areas;
- improve the construction of the monitoring wells and ensure they are established to appropriate depths;
- improve understanding and resolve knowledge gaps in relation to understanding of groundwater movement; and
- ensure monitoring wells are located within Chevron's tenure boundary to prevent future access issues.

Nested monitoring wells were installed at nine of the monitoring locations targeting shallow and intermediate depths. The use of nested wells is intended to collect further data on groundwater depths and flow direction as groundwater level monitoring results collected to date indicate a perched water table has developed within the GTP pad (which has been constructed up to 5.5 m thick in parts). Two of the shallow monitoring wells have subsequently been decommissioned due to access issues. Figure 9 illustrates the location of the currently installed monitoring network within proximity to the premises. Monitoring wells E014G-S and E031G-S were both decommissioned in 2018.

Figure 9 Wheatstone Foundation Project existing monitoring well network (Chevron)

5.4.1 Water levels

Standing water levels measured throughout the premises construction and commissioning period typically ranged from approximately 1 mbgl to 6 mbgl (Figure 10). As the monitoring wells were constructed post establishment of the pad for the GTP, a review of the bore construction well data was undertaken. The review indicated that the measured standing water levels are typically <1 m from the original ground surface (i.e. those with deeper standing water levels, such as LNG 1, tended to be located in areas where the pad depth was greatest) and in some cases the measured standing water level was above the original ground surface indicating a perched water table has formed within the GTP pad.

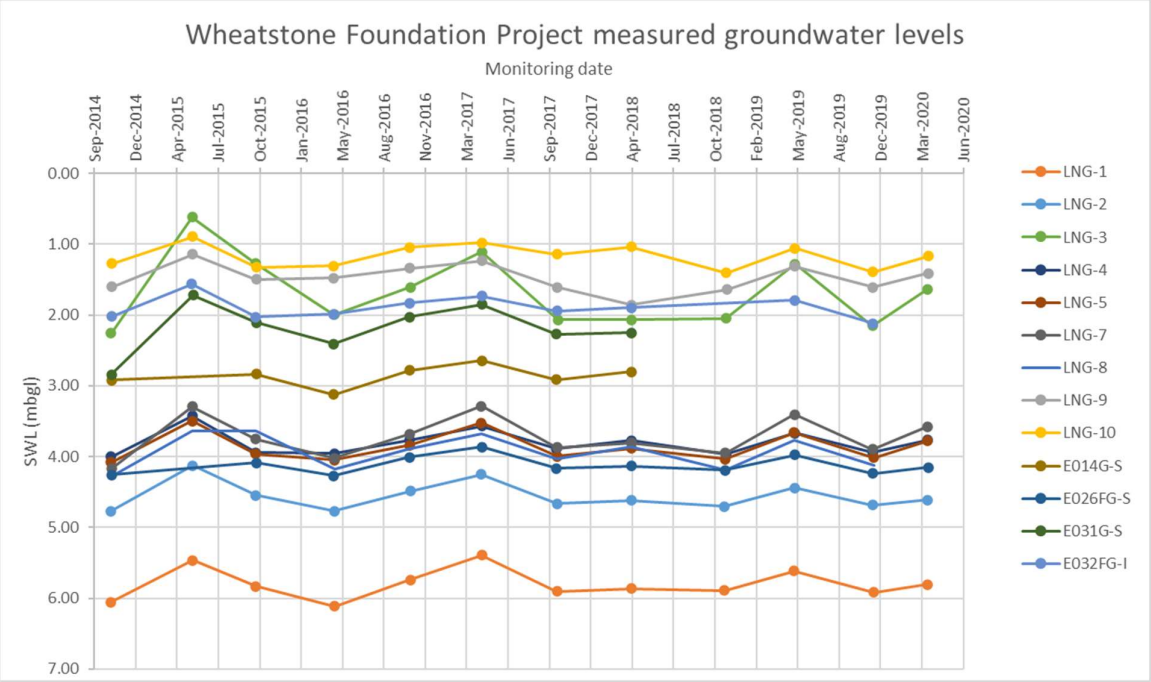


Figure 10 Measured SWLs for the Wheatstone Project (2014-2020)

5.4.2 Groundwater chemistry

The applicant provided groundwater quality information for the groundwater monitoring wells sampled from 2014 to 2020. The monitoring data indicates groundwater below the premises is typically saline to hypersaline with TDS values ranging from approximately 26,000 mg/L to 130,000 mg/L. There were some lower observed TDS measurements (up to approximately 10,000 mg/L TDS), however, these primarily occurred in monitoring wells when the standing water level was indicative of a perched water table within the GTP pad and are therefore likely primarily the result of infiltrated stormwater. Measured pH values ranged between pH 5.8 and pH 8.4 but were predominantly near neutral to slightly acidic.

Dissolved metal concentrations in groundwater exceed some of the ANZECC 2000 Guidelines for Fresh and Marine Water Quality 95% ecosystem protection trigger values. Elevated Aluminium, Cadmium, Copper, Lead, Nickel, Zinc and Chromium have been recorded in some monitoring wells. The comparatively high dissolved metal concentrations are commensurate with the high groundwater salinity (Chevron 2019a). Monitoring to date indicates hydrocarbon and VOCs have not been recorded within the monitoring wells, with the exception of a single monitoring event in 2018 at well LNG-6 which subsequently has not had measurable hydrocarbons recorded.

6. Consultation

The Application for a licence was made available on DWER's website for public comment from 20th November to 11th December 2019. Two letters were also sent to direct interest stakeholders (Shire of Ashburton and Pilbara Ports Authority) inviting submissions. No submissions relating to the application were received from the stakeholders.

The draft Decision Report and Licence were provided to the Applicant for review and comment on 11 June 2020. Chevron responded on 20 July 2020.

Comments received from Chevron are detailed in Appendix 3 and have been considered in the final Decision Report and Licence.

7. Location and siting

7.1 Siting context

The premises is located on part Lot 238 on Deposited Plan 195206, and part Lots 567 and 569 on Deposited Plan 71345, Talandji, within the Shire of Ashburton. The premises is approximately 12 km south-west of the Onslow townsite within the ANSIA. The ANSIA has a 3 km wide statutory buffer between development and relevant sensitive areas.

Other industrial projects in the local area include the BHP Macedon Gas Project (approximately 2.5 km south-west, within the ANSIA) and the Onslow Solar Salt Project (the closest salt pond is approximately 4 km east). Adjacent land to the south and east of the ANSIA is zoned "Rural", while the area to the west, including the Ashburton River mouth and old Onslow townsite, are zoned "Conservation, Recreational and Nature Landscape".

The closest receptor occupied by people is the Wheatstone Ashburton North Village located 8 km south-east of the premises. The village is operated by the applicant. The closest public use areas are the Old Onslow Townsite and the Four Mile Creek recreational area. The closest public residences are within the town of Onslow approximately 12 km north-east of the premises.

The premises is located in the Ashburton River Delta, which is characterised as a coastal flood plain.

7.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 16 and illustrated in Figure 11. Measurements are taken from the closest premises boundary.

Table 16: Residential and sensitive receptors distance from activity boundary

Sensitive Land Uses	Distance from activity boundary
Macedon Gas Project (industrial site)	2.5 km south west
Old Onslow Town Site (heritage site, zoned Conservation, Recreational and Nature Landscape)	4 km west
Four Mile Creek (Public access/recreation area)	4 km north east
Onslow salt ponds (industrial site)	4 km east (measured to the nearest salt pond)
Ashburton River Camp Site – Site 1	7.8 km south
Ashburton River Camp Site - Site 2	7.9 km south
Wheatstone Ashburton North Village (Chevron operated worker	8 km south east

Sensitive Land Uses	Distance from activity boundary
accommodation camp)	
Onslow Salt Offices	10.1 km north east
Onslow Airport	11.1 km north east
Onslow Power Station and Proposed Site for the Onslow Water Desalination Plant (industrial site)	11.8 km south east
Onslow Town Site (residential area and sensitive public receptors)	12 km north east
Beadon Creek	13 km north east
Urala Homestead	18.4 km south east
Mindaroo Homestead	27 km south

Key finding: In accordance with the *Guidance Statement: Risk Assessments*, the Delegated Officer has determined that this assessment will not consider the risk of potential impacts to people in accommodation camps occupied by the applicant. Potential impacts to people at these locations are subject to requirements under occupational health and safety regulations and obligations.

The Wheatstone Ashburton North Village is operated by the applicant (on behalf of different joint venture partners); therefore, the Delegated Officer considers that people at the camp are excluded as potential receptors.

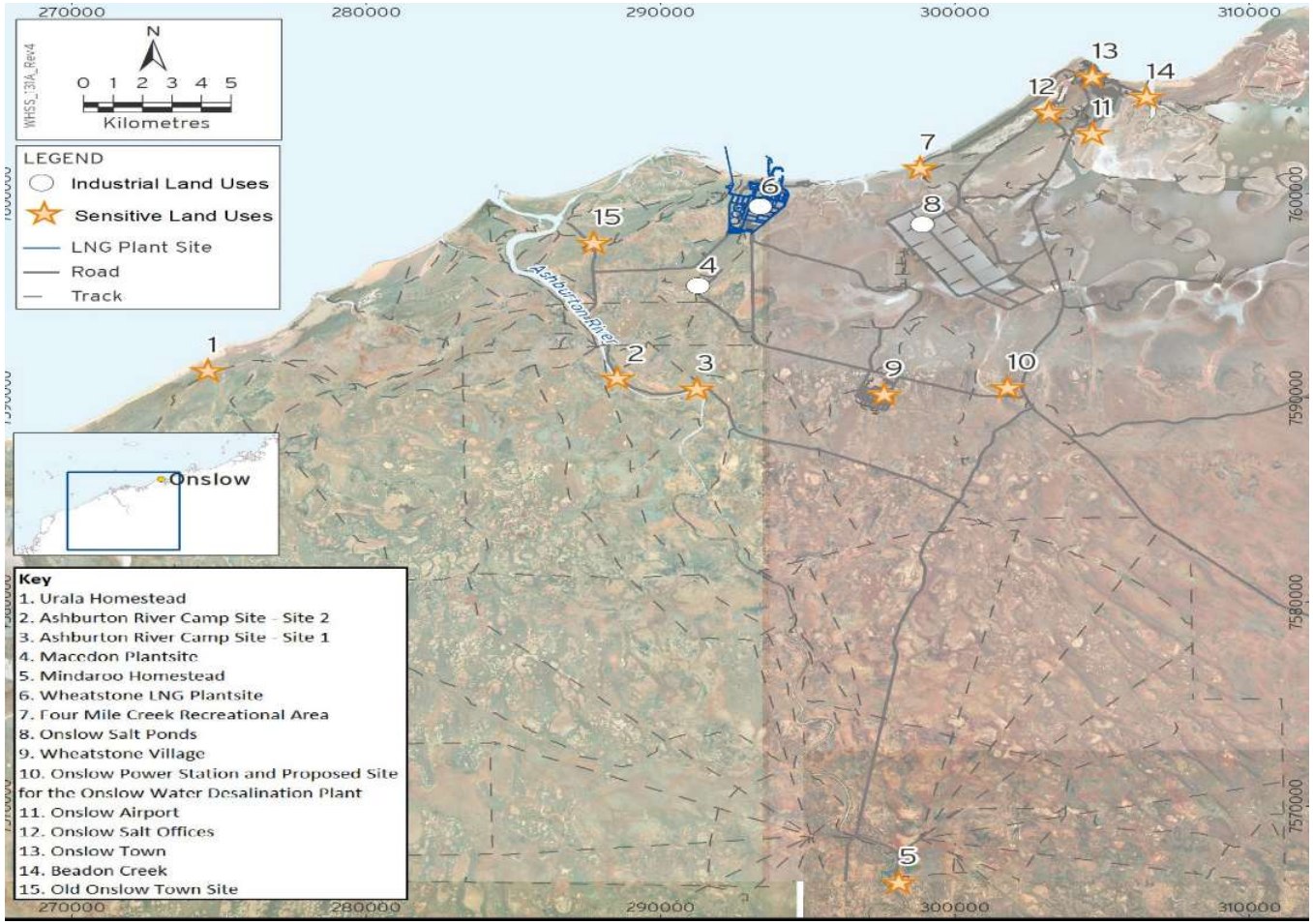


Figure 11 Sensitive receptor locations in proximity to the Wheatstone Project (Chevron 2019a)

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 17. Table 17 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 17: Environmental values

Specified ecosystems	**Distance from the premises**
Pilbara Surface Water Area	Located within the surface water area proclaimed under the RIWI Act.
Pilbara Groundwater Area	Located within the groundwater area proclaimed under the RIWI Act.
Biological component	**Distance from the premises**
Threatened Fauna (Marine turtle rookery))	Nesting and foraging ranges for Flatback, Green and Hawksbill turtles overlap the Wheatstone Project area. Only flatback turtles nest on beaches in proximity to the premises (Chevron 2016). The nearest flatback turtle nesting beach (Ashburton River delta beach) is located approximately 4.5 km west of the ANSIA. Flatback turtle nesting has also been observed at Sunset Beach (more than 8 km east), and between Beadon Creek and Coolgra Point (more than 10 km east), of the ANSIA (URS 2010c).
Threatened/Priority Fauna (other)	Six species (mammals and birds) listed as Threatened/Priority Fauna under the EPBC Act and WC Act were recorded in the vicinity of the premises during baseline surveys. An additional nine listed species may also occur in the area. The baseline assessment of the marine environment found that 14 threatened marine fauna species including birds, mammals, reptiles and sharks are known to occur nearshore and offshore to the premises.
Other relevant ecosystem values	**Distance from the premises**
Ashburton River Delta	The premises is located within part of the Ashburton River Delta which is recognized as an important, high conservation value and regionally significant ecosystem. The delta supports an extensive area of mangroves and diversity of mangrove assemblages. The Delta is known to provide habitat for species listed under the EPBC Act and WC Act (juvenile sawfish and turtle nesting).

7.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 18.

Table 18: Groundwater and water sources

Groundwater and water sources	**Distance from Premises**	**Environmental value**
Minor creek – Hooley Creek	Fluvial overflow channel and tidal creek (3 distinct tidal channels with a single ocean inlet), approximately 1.4 km east	Mangrove and tidal habitats and expansive areas of algal mats that support a variety of marine fauna, including species listed under the

Groundwater and water sources	Distance from Premises	Environmental value
	of the premises boundary. The premises is located within the Hooley Creek surface water sub-catchment. The Hooley Creek tidal flats receive water from rainfall events, spring tides and storm surges.	EPBC Act and WC Act such as sawfish and juvenile turtles.
Major river – Ashburton River / Estuary	Major watercourse, approximately 5.5 km west of the premises boundary. The watercourse is typically ephemeral and flows in response to significant rainfall events. Flows therefore typically occur during cyclone season and are of short duration. Flood waters from the Ashburton River spill onto the flood plain and may significantly add to the stream flow in the drainage lines within and in proximity to the premises.	Surface water drainage system (estuarine, with upper limits fresh) within fringing mangrove and algal mat communities.
Groundwater	A baseline assessment of groundwater was undertaken through drilling, testing and sampling of 69 groundwater bores and 28 drive point piezometers. The assessment determined the water table elevation is closely linked to topography. The premises was interpreted to be underlain by a shallow water table and is largely a groundwater discharge zone with groundwater flow direction predominantly to the north and north-east (URS 2010a) toward the ocean and Hooley Creek. Monitoring bores were constructed and monitored throughout the premises construction period with measured water levels ranging from typically ~1 mbgl to up to ~6 mbgl. Monitoring wells were constructed post establishment of the pad for the GTP and review of the data indicates water levels are typically <1 m from the original ground surface and in some cases are present as a perched water table above the original ground surface	Groundwater is not used for potable or industrial use. Groundwater is brackish to hypersaline near neutral to slightly alkaline, and a sodium–chloride type. Dissolved metal concentrations in groundwater exceed some of the ANZECC 2000 Guidelines for Fresh and Marine Water Quality. The comparatively high dissolved metal concentrations are commensurate with the high groundwater salinity (Chevron 2019a). The groundwater flow direction and the area being a groundwater discharge zone indicate the groundwater system is potentially linked to the marine ecosystem and tidal creeks and can therefore impact on the environmental value of these ecosystems. The baseline subterranean fauna study results indicate that while subterranean fauna (stygofauna) have been found within aquifers beneath the premises, the community is not diverse or significant and that based on the subterranean habitats present there is a low risk that species

Groundwater and water sources	Distance from Premises	Environmental value
	within the GTP pad.	would be restricted to the premises area (Chevron 2010).
Cane River Water Reserve	Approximately 34km east of the Premises.	Public Drinking Water Source Area (PDWSA). Due to the groundwater flow direction and distance to the PDWSA the Delegated Officer considers that there is no source-parthway-receptor link.

7.5 Soil type

Topography within the premises and surrounds is dominated by undulating dunal systems, alluvial / colluvial plains and low-lying coastal systems with spot heights ranging from 5 to 21 m AHD. High points are associated with the longitudinal dune network and fringing and coastal dunes. Areas of low relief (generally <5 m AHD) are associated with samphire and supra-tidal salt flats, claypans, tidal creeks, and mangroves (Chevron 2010).

A baseline soil assessment of the surface and shallow subsurface soil profiles identified three soil groups within the shallow soil profile as described below (Chevron 2010).

- Red earths - characterised as fine to coarse grained red to red-brown sand/silty sand with minor clay content, quartz and minor feldspar, as well as low to medium plasticity, fine to medium grained, red to red-brown clayey sand/sandy clay with variable shell content.
- Marine/organic deposits - characterised as low to high plasticity clay to clayey sand/sand, brown to dark grey, fine to medium grained, mottling may range from yellow to orange, firm to very soft.
- Calcareous sands/rock - characterised as moderately to very well cemented fine to coarse grained sands to well cemented rock, pale brown to cream/white and high shell content calcareous sand/sandstone.

Potential Acid Sulfate Soil (PASS) is present at shallow depths between 0.5 mbgl and 4.5 mbgl within parts of the premises. The PASS material is considered to be of marine/organic origin and is generally located within landform units associated with intertidal flats, tidal creek and mangrove swamp and the samphire flats (Chevron 2010).

7.6 Meteorology

7.6.1 Regional climatic aspects

The premises is located within the Pilbara region characterized by an arid to tropical climate and is influenced by two air masses—the Indian Ocean tropical maritime air moving in from the west or north-west during summer, and the tropical continental air from inland during winter.

The Onslow area is located on a cyclone-prone part of the WA coast. Cyclone activity typically occurs from November to April and can generate significant rainfall and winds. An estimated eight severe cyclone events have been recorded within the Onslow area since 1910. On average the Pilbara region experiences significant winds of greater than 90 km/h approximately once every two years (Chevron 2019a).

7.6.2 Rainfall and temperature

Mean annual rainfall in the Onslow area is 317 mm, with most of the rain falling in the first half of the year and a pronounced dry period occurring between September and December.

Onslow experiences mean maximum and minimum summer temperatures of 36 °C and 24 °C respectively. Mean maximum and minimum winter temperatures are 26 °C and 14 °C respectively (Figure 12). The average yearly evaporation (approximately 3,100 mm) exceeds average yearly rainfall consistently throughout the year (Chevron 2019a).

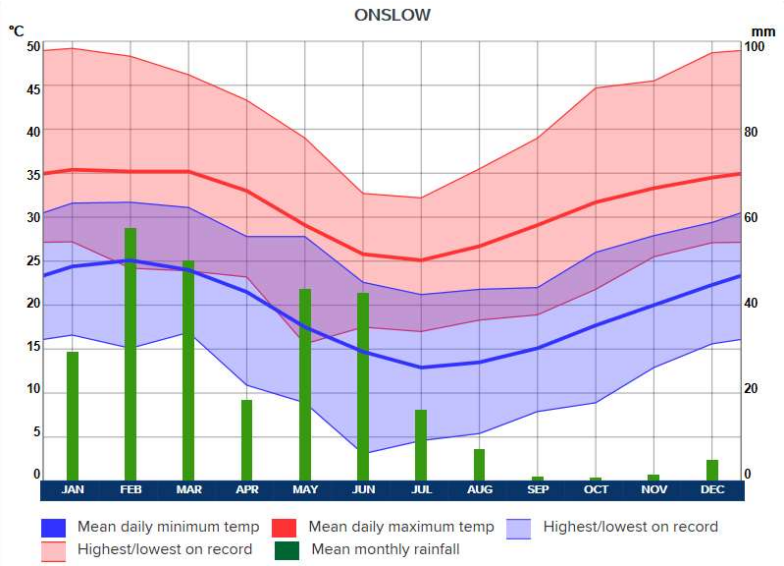


Figure 12 Climate averages for Onslow Airport (Chevron 2019a)

7.6.3 Wind direction and strength

Baseline meteorological monitoring was undertaken at the site of the GTP from 2009 to 2012. Wind measurements collected at the site were considered most representative of the available meteorological measurements to generate a meteorological file for ambient air quality modelling. Annual and seasonal wind roses were generated from the meteorological file and are presented in Figure 13 and Figure 14 below. The wind roses illustrate winds are seasonal and are predominantly from the west-north-west, west or south-west of the Premises through Summer, Autumn and Spring. Wind speeds tend to reduce in Winter and predominantly come from the south-east to south-west.

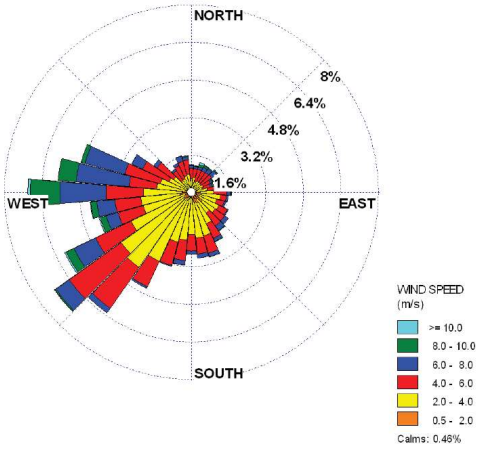


Figure 13 Annual wind rose for the Wheatstone Foundation Project site (2010) (Air Assessments 2013)

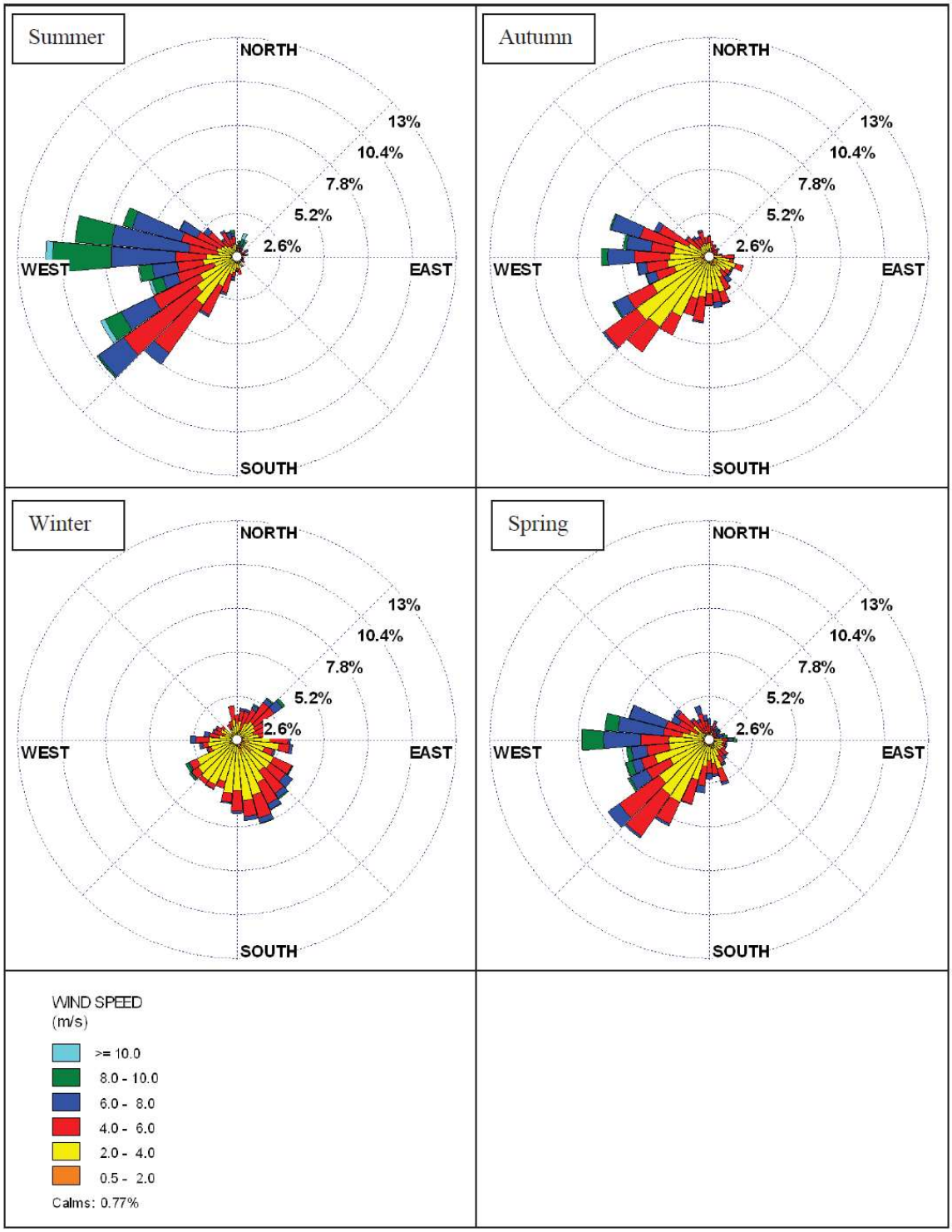


Figure 14 Seasonal wind roses for the Wheatstone Foundation Project site (2010) (Air Assessments 2013)

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

8. Risk assessment

8.1 Determination of emission, pathway and receptor

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

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 19 and Table 20.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 19 and Table 20 below.

Table 19: Identification of emissions, pathway and receptors during operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Category 10 and 34 ***GTP and LNG and condensate storage facilities***	LNG and condensate processing and storage	Point source discharges to air. Fuel combustion gases from the GTs, HOSH & flare pilot (NOx, SOx, CO, VOCs (including BTEX), PM) Combustion gases from the AGTO (primarily SOx, with residual NOx, CO, VOCs (including BTEX), PM) O_3 (secondary pollutant)	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east	Air / wind dispersion	Public health impacts	Yes	In accordance with the *Guidance Statement: Risk Assessments*, worker accommodation camps are not considered a potential receptor and therefore have been excluded from the risk assessment. See detailed risk assessment in section 8.4 (combustion gases) and 8.5 (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.

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 areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east			Yes	In accordance with the Guidance Statement: Risk Assessments, worker accommodation camps are not considered a potential receptor and therefore have been excluded from the risk assessment. See detailed risk assessment in section 8.6.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Environmentally hazardous materials due to loss of containment (spill, leak, discharge) Environmentally hazardous materials include condensate, LNG, diesel, oil, waste oil, aMDEA, refrigerants (propane, ethylene, and methane) and miscellaneous process chemicals	Groundwater – perched groundwater within the GTP pad varies in depth from ~1-5mbgl Marine environment – approximately 600 m from the closest storage tanks (LNG tanks) Hooley creek mangrove, algal mat and tidal habitats – approximately 1.4 km east of the premises boundary The premises is within the Ashburton River Delta, an important, high conservation value and regionally significant ecosystem.	Direct discharge to land Infiltration through soil to groundwater Groundwater flow to ecologically sensitive ecosystems (marine, mangrove etc) Discharge to the marine environment via overland flow	Soil and groundwater contamination. Groundwater contamination affecting the health of sensitive ecosystems (the Ashburton Delta and its mangroves, algal mats and tidal creek systems). Contamination of the marine environment potentially impacting the health of marine fauna.	Yes	See detailed risk assessment in section 8.7.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Noise emissions associated with operation of the GTP	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east	Air / wind dispersion	Amenity impacts	No	The ANSIA includes a 3 km statutory buffer to ensure separation of industry and sensitive land uses. Noise modelling was conducted in support of the Draft EIS/ERMP and reviewed by DWERs noise experts during the assessment of the W5584/2014/1 application (refer to section 5.3). The noise modelling predictions indicate that operation of a five LNG train and five Domgas train operation at Wheatstone can comply with assigned levels at sensitive receptors under worst case conditions. The modelling also predicted that plant noise may be audible at nearby recreation areas under worst-case meteorological conditions however as the application relates to operation of two LNG trains and associated infrastructure only, noise emissions are expected to be significantly less than predicted levels at sensitive receptors. Based on the outcome of the noise modelling and scope of the application, the Delegated Officer considers that there is sufficient separation distance to sensitive receptors for there to be low risk of amenity impact associated with noise emissions. The Delegated Officer considers that the provisions of the Noise Regulations are sufficient to regulate noise.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
			Turtle nesting beaches - approximately 4.5 km west and more than 8 km and 10 km east		Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that potential noise impacts on conservation significant marine fauna (including turtles) are regulated under MS 873 (conditions 10-11 to 10-16) Managing and monitoring of noise impacts on turtle hatcheries in the greater Onslow area will be undertaken in accordance with the Wheatstone Conservation Significant Marine Fauna Interaction Management Plan.

		Light emissions associated with operation of the GTP	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east	Air dispersion	Amenity impacts	No	Modelling of light emissions relating to the operation of the Wheatstone Foundation Project was conducted in support of the Draft EIS/ERMP for the Project. Based on the modelling outcomes, various management measures were included in the design and construction of the GTP to minimise light emissions. The primary purpose of minimising light emissions was to minimise potential lighting impacts on conservation significant marine fauna (particularly turtle populations) as per the requirements of conditions 10-11 to 10-16 of MS 873. The lighting design and management measures implemented to avoid and mitigate lighting impacts included the following: • no decorative lighting; • no use of metal halides, mercury vapour fixtures, white or ultra-violet lights; • focus on downward lighting design to reduce overhead glow on cloudy nights; • focus jetty lighting onto work surfaces and reduce illuminating lights; and • lighting (with the exception of emergency lighting) is controlled by photovoltaic cells that automatically switch on or off depending on ambient light conditions. Subsequent modelling undertaken indicates that illumination from lighting at the premises (inclusive of emergency lighting) will not be above that of any natural phenomena (such as a clear moonlit night).

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
							The Delegated Officer has determined that, given the distance to the nearest sensitive receptors (public), the requirements of MS 873 to mitigate impacts of environmental stressors (including light spill) to conservation significant marine fauna will adequately minimise light emissions to prevent public amenity impacts. The Delegated Officer considers no further regulation in relation to light emissions is required under Part V of the EP Act.
			Turtle nesting beaches - approximately 4.5 km west and more than 8 km and 10 km east		Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that potential lighting impacts on conservation significant marine fauna (including turtles) are regulated under MS 873 (conditions 10-11 to 10-16) Managing and monitoring of lighting impacts on turtle hatcheries in the greater Onslow area will be undertaken in accordance with the Wheatstone Conservation Significant Marine Fauna Interaction Management Plan.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Potentially contaminated non-sanitary (process) wastewater and potentially contaminated stormwater from the GTP.	Groundwater – perched groundwater within the GTP pad varies in depth from ~1-5 mbgl Marine environment – approximately 600 m from the closest storage tanks (LNG tanks) Hooley creek mangrove, algal mat and tidal habitats – approximately 1.4 km east of the premises boundary The premises is within the Ashburton River Delta, an important, high conservation value and regionally significant ecosystem.	Direct discharge to land Infiltration through soil to groundwater Direct discharge to ecologically sensitive ecosystems (marine, mangrove etc) Discharge to the marine environment via overland flow	Soil and groundwater contamination Contamination of surface waters affecting the health of linked sensitive ecosystems (mangroves, algal mats and tidal creek systems) Contamination of the marine environment	Yes	See detailed risk assessment in section 8.8.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Fugitive dust from open areas of the premises	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east The premises is within the Ashburton River Delta, an important, high conservation value and regionally significant ecosystem.	Air / wind dispersion	Public health and amenity impacts Smothering of vegetation within sensitive ecosystems (such as the mangroves, algal mats and tidal creek systems) causing a reduction in photosynthesis and subsequent impact on plant health.	No	Fugitive dust may be generated from open areas within the premises boundary. The majority of the premises is paved, gravel surfaced or has established infrastructure consequently there are limited areas susceptible to fugitive dust generation and emissions are therefore not expected to be significant The Delegated Officer considers that based on the distance to the nearest sensitive receptors, and limited areas susceptible to dust generation, there is a very low likelihood of adverse impacts occurring associated with fugitive dust emissions from the premises. The Delegated Officer considers that the provisions of section 49 of the EP Act are sufficient to regulate fugitive dust from the premises.
Category 52 Power generation	Power generation through operation of gas turbine generators or back up diesel generators	Point source emissions to air Combustion gases from the GTG's and back up diesel generators (NOx, SOx, CO, VOCs (including BTEX), PM) O_3 (secondary pollutant)	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east	Air / wind dispersion	Public health impacts	Yes	In accordance with the Guidance Statement: Risk Assessments, worker accommodation camps are not considered a potential receptor and therefore have been excluded from the risk assessment. See detailed risk assessment in section 8.4 (combustion gases) and 8.5 (ozone).

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Loss of diesel containment (leaks and/or spills) from the backup generators or storage tanks	Groundwater – perched groundwater within the GTP pad varies in depth from ~1-5 mbgl Marine environment – approximately 600 m from the closest storage tanks (LNG tanks) Hooley creek mangrove, algal mat and tidal habitats – approximately 1.4 km east of the premises boundary The premises is within the Ashburton River Delta, an important, high conservation value and regionally significant ecosystem.	Direct discharge to land Infiltration through soil to groundwater Groundwater flow to ecologically sensitive ecosystems (marine, mangrove etc) Discharge to the marine environment via overland flow	Soil and groundwater contamination. Groundwater contamination affecting the health of sensitive ecosystems (the Ashburton Delta and its mangroves, algal mats and tidal creek systems). Contamination of the marine environment potentially impacting the health of marine fauna.	Yes	See detailed risk assessment in section 8.7

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Noise emissions associated with operation of the GTGs	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east	Air / wind dispersion	Amenity impacts	No	The ANSIA includes a 3 km statutory buffer to ensure separation of industry and sensitive land uses. Noise modelling was conducted in support of the Draft EIS/ERMP and reviewed by DWERs noise experts during the assessment of the W5584/2014/1 application (refer to section 5.3). The noise modelling predictions indicate that operation of a five LNG train and five Domgas train operation (inclusive of associated power generation activities) at Wheatstone can comply with assigned levels at sensitive receptors under worst case conditions. The modelling also predicted that plant noise may be audible at nearby recreation areas under worst-case meteorological conditions however as the application relates to operation of two LNG trains and associated infrastructure only (including power generation for operation of the trains), noise emissions are expected to be significantly less than predicted levels at sensitive receptors. Based on the outcome of the noise modelling and scope of the application, the Delegated Officer considers that there is sufficient separation distance to sensitive receptors for there to be low risk of amenity impact associated with noise emissions. The Delegated Officer considers that the provisions of the Noise Regulations are sufficient to regulate noise.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
			Turtle nesting beaches - approximately 4.5 km west and more than 8 km and 10 km east		Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that potential noise impacts on conservation significant marine fauna (including turtles) are regulated under MS 873 (conditions 10-11 to 10-16) Managing and monitoring of noise impacts on turtle hatcheries in the greater Onslow area will be undertaken in accordance with the Wheatstone Conservation Significant Marine Fauna Interaction Management Plan.

		Light emissions associated with operation of the GTGs	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east	Air dispersion	Amenity impacts	No	Modelling of light emissions relating to the operation of the Wheatstone Foundation Project was conducted in support of the Draft EIS/ERMP for the Project. Based on the modelling outcomes, various management measures were included in the design and construction of the GTP to minimise light emissions. The primary purpose of minimising light emissions was to minimise potential lighting impacts on conservation significant marine fauna (particularly turtle populations) as per the requirements of conditions 10-11 to 10-16 of MS 873. The lighting design and management measures implemented to avoid and mitigate lighting impacts included the following: • no decorative lighting; • no use of metal halides, mercury vapour fixtures, white or ultra-violet lights; • focus on downward lighting design to reduce overhead glow on cloudy nights; and • lighting (with the exception of emergency lighting) is controlled by photovoltaic cells that automatically switch on or off depending on ambient light conditions. The Delegated Officer has determined that, given the distance to the nearest sensitive receptors (public), the requirements of MS 873 to mitigate impacts of environmental stressors (including light spill) to conservation significant marine fauna will adequately minimise light emissions to prevent public amenity impacts. The Delegated Officer considers no further regulation in

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
							relation to light emissions is required under Part V.
			Turtle nesting beaches - approximately 4.5 km west and more than 8 km and 10 km east		Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that potential lighting impacts on conservation significant marine fauna (including turtles) are regulated under MS 873 (conditions 10-11 to 10-16) Managing and monitoring of lighting impacts on turtle hatcheries in the greater Onslow area will be undertaken in accordance with the Wheatstone Conservation Significant Marine Fauna Interaction Management Plan.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Potentially contaminated washdown water or stormwater from the GTGs	Groundwater – perched groundwater within the GTP pad varies in depth from ~1-5 mbgl Marine environment – approximately 1,600 m from the GTGs Hooley creek mangrove, algal mat and tidal habitats – approximately 1.4 km east of the premises boundary The premises is within the Ashburton River Delta, an important, high conservation value and regionally significant ecosystem.	Direct discharge to land Infiltration through soil to groundwater Direct discharge to ecologically sensitive ecosystems (marine, mangrove etc) Discharge to the marine environment via overland flow	Soil and groundwater contamination Contamination of surface waters affecting the health of linked sensitive ecosystems (mangroves, algal mats and tidal creek systems) Contamination of the marine environment	Yes	See detailed risk assessment in section 8.8.

Table 20: Identification of emissions, pathway and receptors during upset conditions

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Category 10 and 34 ***Operation of the GTP***	Flaring of hydrocarbon gases due to upset conditions or maintenance of the GTP	Point source emissions to air. Fuel combustion gases (NOx, SOx, CO, VOCs (including BTEX), PM) O_3 (secondary pollutant) Dark smoke associated with incomplete combustion during flaring	Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east	Air / wind dispersion	Public health impacts	Yes	In accordance with the *Guidance Statement: Risk Assessments*, worker accommodation camps are not considered a potential receptor. See detailed risk assessment in section 8.4 (combustion gases and dark smoke) and 8.5 (ozone).

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Noise emissions			Amenity impacts	No	The ANSIA includes a 3 km statutory buffer to ensure separation of industry and sensitive land uses. Noise modelling was conducted in support of the Draft EIS/ERMP and reviewed by DWERs noise experts during the assessment of the W5584/2014/1 application (refer to section 5.3). The modelling included an emergency flaring scenario. The noise modelling predictions indicate that operation of a five LNG train and five Domgas train operation at Wheatstone can comply with assigned levels at sensitive receptors under worst case conditions. The modelling also predicted that plant noise may be audible at nearby recreation areas under worst-case meteorological conditions however as the application relates to operation of two LNG trains and associated infrastructure only, noise emissions are expected to be significantly less than predicted levels at sensitive receptors. Based on the outcome of the noise modelling and scope of the application, the Delegated Officer considers that there is sufficient separation distance to sensitive receptors for there to be low risk of amenity impact associated with noise emissions resulting from flaring. The Delegated Officer considers that the provisions of the Noise Regulations 1997 are sufficient to regulate noise.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
			Turtle nesting beaches - approximately 4.5 km west and more than 8 km and 10 km east		Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that potential noise impacts on conservation significant marine fauna (including turtles) are regulated under MS 873 (conditions 10-11 to 10-16) Managing and monitoring of noise impacts on turtle hatcheries in the greater Onslow area will be undertaken in accordance with the Wheatstone Conservation Significant Marine Fauna Interaction Management Plan.
		Light emissions		Air dispersion			The Delegated Officer has determined that potential lighting impacts on conservation significant marine fauna (including turtles) are regulated under MS 873 (conditions 10-11 to 10-16) Managing and monitoring of lighting impacts on turtle hatcheries in the greater Onslow area will be undertaken in accordance with the Wheatstone Conservation Significant Marine Fauna Interaction Management Plan.

			Public access areas – 4 km west and 4 km north-east Industrial premises – Macedon Project 2.5 km south-west and Onslow Salt 4 km east. Onslow townsite – 12 km north east		Amenity impacts		Modelling of light emissions relating to the operation of the Wheatstone Foundation Project was conducted in support of the Draft EIS/ERMP for the Project. Based on the modelling outcomes, various management measures were included in the design and construction of the GTP to minimise light emissions. The primary purpose of minimising light emissions was to minimise potential lighting impacts on conservation significant marine fauna (particularly turtle populations) as per the requirements of conditions 10-11 to 10-16 of MS 873. The lighting design and management measures implemented to avoid and mitigate lighting impacts included the following: • no decorative lighting; • no use of metal halides, mercury vapour fixtures, white or ultra-violet lights; • focus on downward lighting design to reduce overhead glow on cloudy nights; and • focus jetty lighting onto work surfaces and reduce illuminating lights. The Wheatstone Conservation Significant Marine Fauna Interaction Management Plan also includes specific requirements for planning for flaring events during daytime to reduce the impact of light emission from flaring events. The Delegated Officer has determined that, given the distance to the nearest sensitive receptors (public), requirements of MS 873 to mitigate impacts of environmental stressors

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
							(including light spill) to conservation significant marine fauna will adequately minimise light emissions to prevent public amenity impacts. The Delegated Officer considers no further regulation in relation to light emissions is required under Part V.

8.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 21 below.

Table 21: 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 22 below.

Table 22: 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.

8.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 23 below:

Table 23: 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.

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

8.4.1 Description of risk event

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 GTP. The combustion gases are released to air through emission stacks and are transported through the atmosphere via dispersion. The released gases can impact on the air quality potentially causing adverse health impact to sensitive receptors.

8.4.2 Identification and general characterisation of emission

Combustion gases (NOx, SO_2, CO, VOCs) and PM are common pollutants produced by industrial processes and motor vehicles as a result of fuel combustion. The ratio and rate of pollutants produced are dependent on fuel type and combustion efficiency. The Wheatstone GTP produces point source emissions of combustion gases and PM as a result of the combustion of natural gas, diesel and recovered acid gases.

Natural gas is combusted as the fuel source within GTGs, GTs and the HOSH. Operation of the HOSH will be infrequent as it will only be used during start-up operations when there is insufficient waste heat due to the refrigerant GTs not operating. Reservoir characterisation of Wheatstone area gas fields which will supply the feed gas indicates there will be low levels of H_2S in the reservoir fluids. Additionally, the fuel gas for the GTGs, GTs and the HOSH will be primarily obtained from process gas which has been treated via the AGRU to remove the majority of H_2S. The fuel gas is therefore expected to have minimal H_2S or SOx therefore estimates for SO_2 emissions have been based on the design value of 1ppmv H_2S (normal operations).

Low volumes of natural gas are also continuously combusted within the flare pilot and on an infrequent basis, large volumes are combusted via the flares (flaring) when excess gas is purged

for safety and operational purposes. Combustion of the purged gas minimises the emission of VOCs from the flares. The GTP has been designed so that sources of hydrocarbon emissions are recycled into the process, or recovered for use as fuel or product, to exclude the need for routine flaring of gas. As a result of this design, flaring is only expected to occur during emergencies, process upsets, plant start-up and shut-downs.

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 (GTGs) has tripped, is offline or otherwise unavailable.

Acid gases (approximately 93%) 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 AGTO. The AGTO oxidises hydrocarbons (including VOCs) and sulfur compounds within the gas to CO_2, SO_2 and water which are emitted from the AGTO stack. When the AGTO is shutdown for maintenance, repair or a process trip, the gases are diverted to the LP wet flare stack where they are combusted.

The point source emission design criteria for the key combustion emission sources are summarised in Table 14 and Table 24 (taken from the *Wheatstone Foundation Project Air Emissions Design Report 2013*). The design criteria were based on vendor performance guarantees for the installed infrastructure and emission control systems where available as these are typically more conservative than actual emissions. In the absence of vendor performance guarantees design criteria were estimated using USEPA Compilation of Air Pollutant Emissions Factors (AP-42) or NPI emission factors. 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*.

As discussed in section 5.2.2, exceedances of the design criteria occurred throughout the commissioning period. This is considered to likely be the result of the infrastructure running at lower than optimal loads in the case of the GTs and GTGs, and emission control equipment not operating as efficiently as at higher optimal loads. As the GTP is optimised it is expected that emissions will reduce and stabilise. Incorrect combustion air flow measurement in the AGTOs also resulted in emissions exceeding the CO design criteria. Correction of the error appears to have reduced emissions to within expected levels. As the GTP continues to operate at a steady state, emissions are anticipated to remain within the design critera.

The primary point source of PM emissions from the GTP is from incomplete combustion during flaring generating dark smoke (soot). No routine flaring will occur at the premises, with the GTP design such that flaring should only occur during emergencies, process upsets and plant start-up and shutdown. Particulate emissions from the GTGs and GTs are not considered significant as they are predicted to be below 5 mg/m^3 (Table 24). Volatile organic compound emissions from the GTGs and GTs are also expected to be low due to their high combustion efficiency.

Table 24: Point source emission design criteria (Wheatstone Foundation Project Air Emissions Design Report, Chevron 2013)

Emission source	Pollutant	Design emission concentration (mg/m^3) [1]	Design emission rate (g/s) [1,2]	Design emission target (mg/m^3)[1,3]
GTGs[5]	NOx [4]	49	14.3	70
	PM_{10}	2.5	0.7	50
	SO_2	0.08	0.02	-
	CO	83	24.3	125

Emission source	Pollutant	Design emission concentration (mg/m^3) [1]	Design emission rate (g/s) [1,2]	Design emission target (mg/m^3)[1,3]
	NMVOC	0.9	0.25	40
GTs[5]	NOx [4]	49	38	70
	PM_{10}	3	3.2	50
	SO_2	0.1	0.1	-
	CO	83	65	125
	NMVOC	1.0	1	40
HOSH[6]	NOx [4]	102	0.9	350
	PM_{10}	50	0.4	50
	SO_2	0.2	0.002	-
	CO	52	0.4	125
	NMVOC	7	0.06	40
	BTEX		0.1	-
AGTO[6]	NOx [4]	113	2.8	350
	PM_{10}	2.2	0.06	50
	SO_2	61	1.5	-
	CO	171	4.3	125
	NMVOC	20	0.06	20
	BTEX[7]		2.33	-
	H_2S[7]		0.008	-

Note 1: The *Wheatstone Project: Air Emission Design Report – Foundation Project (2013)* states that emissions shown are for the total number of units. While this is appropriate for emission rates (g/s), as rates from multiple sources can be added together to determine an overall rate, it is not applicable to concentrations. It is not be possible to determine an emission concentration from combined sources unless they are connected and released from a single discharge point, therefore the concentrations specified in the table are taken to apply to individual sources.
Note 2: As per the *Wheatstone Project: Air Emission Design Report – Foundation Project (2013)* and discussion in Note 1, the design emission rates provided in the report are for a total of 4 GTGs, 12 GTs, 2 AGTOs and 1 HOSH.
Note 3: Emission targets apply at the point of discharge to the environment.
Note 4: Calculated as NO_2.
Note 5: Reference conditions are at 15% oxygen reference level, dry, at 0 °C and 101.3 kPa.
Note 6: Reference conditions are at 3% oxygen reference level, dry, at 0 °C and 101.3 kPa
Note 7: BTEX and H_2S emissions use a vendor guaranteed destruction efficiency of 99%.

Table 25 Design emission rates for flares

Emission source	Pollutant	Design emission rate (routine scenario)[1] (g/s)	Design emission rate (upset scenario) (g/s)
Dry Flare[2]	NO_x	0.43	9.1
	PM_{10}	0.09	1.8
	SO_2	0.001	0.08
	VOC	0.02	1.14
	CO	3.7	78.1
	BTEX	0.12	1.1

Wet Flare[3]	NO_x	0.44	4.7
	PM_{10}	0.09	1
	SO_2	0.001	1.4
	VOC	0.02	0.25
	CO	3.8	40.5
	BTEX	0.06	4.3
Marine Flare[4]	NO_x	0.03	32.4
	PM_{10}	0.01	6.6
	SO_2	0.0001	0.0003
	VOC	0.002	0.4
	CO	0.3	278

Note 1: Estimated from flares during routine operations (pilot and purge).
Note 2: Upset scenario based on a blocked NRU vent outlet.
Note 3: Upset scenario based on a thermal oxidiser trip.
Note 4: Upset scenario based on a loss of a BOG compressor.

Modelling of flaring events during upset conditions (modelling scenarios 3, 4 and 6 described in section 5.1) had minimal impact on predicted ambient concentrations in comparison with the routine operation scenario. The minimal change associated with flaring events is considered to be due to the large heat release which occurs during flaring. This results in plume rise increasing the apparent release height of pollutants resulting in lower GLCs (Air Assessments 2013).

Flaring and associated dark smoke emissions have occurred periodically throughout the commissioning period (section 4.4.3). This was expected as process upset conditions occur in the process of bringing the GTP up to a steady and reliable state, and subsequent shutdown of the trains. The flares are not designed for smokeless operation during emergency relief scenarios therefore occasional dark smoke emissions associated with flaring events are expected to occur, and will continue to occur periodically during operation of the GTP.

During commissioning of the LP flare system performance issues with the LP to HP flare staging system occurred, which is likely to have contributed to the frequency and duration of dark smoke events during the commissioning period. As a result of issues with the LP flare system, under certain conditions the HP flare receives gas at a pressure lower than the optimal range for minimising dark smoke.

A flare improvement project was implemented to minimise routing of low-pressure gas to the HP flare system thereby reducing the potential for dark smoke emissions. Additionally the LP flare tips will be replaced with an enhanced design flare tip to improve equipment integrity and reliable smokeless operation under normal operating. This is anticipate to be completed in 2021.

8.4.3 Description of potential adverse impact from the emission

Combustion emissions and PM can potentially have adverse impact on human-health, dependant 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. 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.

Additional to the contribution of VOCs to the formation of O_3, 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.

Particulate matter 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 fugitive dust 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 organise 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.

As per section 7.2 the key receptor in proximity to the premises is the Onslow townsite approximately 12 km north east.

8.4.4 Criteria for assessment

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 26. 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 27. 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 8.4.2 (Table 24 and Table 25).

Table 26: NEPM (Ambient Air) assessment criteria

Pollutant	Averaging period	Maximum concentration		Goal (maximum allowable exceedances)
		ppb	µg/m³	
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

Pollutant	Averaging period	Maximum concentration		Goal (maximum allowable exceedances)
		ppb	µg/m^3	
	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 27: NEPM (Air Toxics) monitoring investigation levels

Pollutant	Averaging period	Maximum concentration	
		ppb	µg/m^3
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 2016*.

8.4.5 Applicant controls

The GTP has been designed and constructed to incorporate contemporary emission controls, which are detailed in the *Wheatstone Project Air Emission Design Report (Chevron 2013)* developed under MS 873. Infrastructure and operational controls are summarised in Table 28

As per section 5.2.1, ambient air quality monitoring has been undertaken by the applicant at the Onslow AQMS, and point source emission monitoring at discharge points within the premises throughout commissioning. The ambient monitoring is currently continuing in accordance with the requirements of L9199/2019/1 and point source emission monitoring is continuing on a quarterly bases for GTs, GTGs and the AGTO which the applicant proposed to continue.

Table 28: Applicant's proposed controls for point source combustion emissions

Site infrastructure	Description
GTGs	• GE LM6000PF turbines have been installed due to having one of the higher thermal efficiencies compared to other drivers typically used. • Each GTG is fitted with DLE combustor systems. The DLE combustor systems have the ability to control NOx emissions to 25 ppm down to 50% load. • Each GTG is equipped with TIAH which uses cooling to improve the overall thermal efficiency and power output during high ambient temperature conditions. • Fuel gas will contain low concentrations of H_2S due to treatment in the AGRUs resulting in negligible H_2S and SOx emissions. • Continuous monitoring of fuel gas composition (online analyser) and consumption (flow meter).
GTs	• GE LM6000PF+ turbines were installed due to having one of the higher thermal efficiencies compared to other drivers typically used at GTPs and they also have greater reliability in the high ambient air temperatures experienced in the Pilbara region. Improved reliability is expected to reduce the risk of unplanned outages and subsequent potential for unplanned flaring. • The refrigeration compressor GTs are fitted with DLE combustor systems and TIAH to improve the overall energy efficiency of the LNG trains and minimise associated combustion emissions. The DLE have the ability to control NOx emissions to 25 ppm down to 50% load. • The exhaust duct of each refrigeration compressor GT has been installed with WHRUs. This system of waste heat recovery largely supplies all the GTP's process heating requirements minimising the requirement for routine use of the HOSH and associated combustion emissions. • GTP has been established with two 50% parallel compressor systems in the refrigeration circuits to allow continued operation at reduced rate during gas turbine and compressor maintenance periods. This design reduces the number of maintenance related start-ups and shutdowns and flaring associated with these events. • The GTs are controlled via a load balancing program which allows for them to be started, shutdown or placed on recycle without significant upset to the system. Reduced likelihood of upset conditions, reduces the need for associated flaring. • Compressors are provided with the ability to restart from a pressurised condition following a non-emergency trip, avoiding depressurising to the flare for start-up • Fuel gas will contain low concentrations of H_2S due to treatment in the AGRUs resulting in negligible H_2S and SOx emissions. • Continuous monitoring of fuel gas composition (online analyser) and consumption (flow meter).
Ethylene and propane refrigerant storage drums	• Propane and ethylene storage drums have been included in the GTP which have sufficient capacity to store the entire refrigerant inventory of one LNG train plus additional capacity for refrigerant makeup instead of needing to flare the refrigerants during a shut-down of the compressors or an LNG train.
AGRU	• aMDEA is used as the solvent in the AGRU. aMDEA has one of the lowest affinities for VOCs, reducing the amount of dissolved or entrained VOCs within the circulating solvent requiring disposal via the AGTO. • Low pressure flashing removes most of the entrained hydrocarbons from the solvent prior to regeneration reducing the amount in the acid gas stream requiring disposal via the AGTO. The recovered hydrocarbons are used as fuel gas.

Site infrastructure	Description
	• When the AGTO is not available, acid gases recovered by the AGRU will be directed to the wet flare for combustion (rather than venting via the AGRU) to minimise emissions of VOCs (BTEX). The flare is expected to have a destruction efficiency of 98%.
AGTO	• The AGTO has a stack height of 35 m above ground level to assist the dispersion of formed SO_2 and any remaining VOCs or H_2S discharged from the stack. • The AGTO will be operated at a firing temperature of >760ºC and more than one second residence time to achieve a destruction efficiency of >99% for VOCs (BTEX) and H_2S. • The destruction efficiency will be maintained by continuous monitoring of the combustion chamber temperature, oxygen in the flue gas and by maintaining the design residence times. • Continuous monitoring of fuel gas composition (online analyser) and consumption (flow meter).
HOSH	• The HOSH will only be used for short periods of time during initial start-up, or other periods when LNG train GTs are not operational (no WHRU for heating medium system). • The HOSH has low NOx burner technology installed. • Fuel gas will contain low concentrations of H_2S due to treatment in the AGRUs resulting in negligible H_2S and SOx emissions. • Continuous monitoring of fuel gas consumption (flow meter).
Flares	• Flaring is only expected to occur during emergencies, process upsets, plant start-up and shutdowns. • The flares are designed to operate smokeless during most flaring operations (with the exception of unusual emergency relief scenarios such as a plant power failure) with visible emissions of Ringelmann 1 or lower (i.e. 20% opacity or lower). • The LP and marine flares have air assist provided to improve burn efficiency and minimise dark smoke emissions. • The HP flare uses a sonic multi-jet tip for increased mixing to improve burn efficiency and minimise dark smoke emissions. • Dark smoke is also minimised through the specially designed flare tip, which allows high pressure gas flow and efficient combustion to occur in a smokeless manner reducing emissions of CO, VOCs and partially combusted hydrocarbons. • Flare design allows for staging to handle a large range of relief flowrates and provide sufficient mixing at the flare tips to minimise dark smoke. • To prevent burning of entrained liquids which can damage the flare tips and cause dark smoke, the wet and dry gas flare knockout drums are appropriately sized to remove liquids from the flare gas and prevent carry over. • The flares are elevated to allow for better dispersion of unburnt VOCs and H_2S. • The flare stack heights are HP 95 m and LP and marine 45 m, above ground level to aid in dispersion of emissions. • Continuous monitoring of the volume of hydrocarbon gas burnt via a flow meter. • Annual monitoring of the flare gas composition at the LP and HP fuel gas headers.
LNG train 1 and train 2	• The GTP has been designed so that sources of hydrocarbon emissions are recycled into the process, or recovered for use as fuel or product, to exclude the need for routine flaring of gas other than flare pilots and purged gas.

Site infrastructure	Description
	• The LNG trains have been designed so that maintenance of parts of the system can be undertaken without shutting down the entire LNG train minimising the need for flaring due to maintenance. • The LNG train configuration and compressor design allows for process refrigerants to remain contained in the refrigeration system during shutdown and restart rather than needing to be flared. • Shutdown procedures include reducing operating pressures and routing of hydrocarbons in the system to the recycle or fuel gas system to the maximum extent possible. • The GTP process and equipment has been designed to operate for four years between major maintenance shutdowns to minimise start-up and shutdown requirements. • The GTP control system monitors equipment to detect possible failures and initiate maintenance. • MRUs are located downstream of the dehydration units to remove mercury from the gas prior to it entering the LNG trains.
Diesel generators	• Only operated when the GTGs have tripped, are offline or otherwise unavailable • Continuous monitoring of fuel consumption (fuel totaliser).

8.4.6 Key findings

The Delegated Officer has reviewed the information regarding emission of combustion gases and has found:

1. Point source emission monitoring indicates design criteria for point source emissions to air for NOx, CO and SO_2 have been exceeded during the commissioning period.
2. Emissions to air are expected to be higher during commissioning as equipment has not yet reached a steady operational state and performance of the plant is being optimised. Emissions are expected to reduce and stabilise as a steady operational state is reached. The most recent monitoring results indicate emissions appear to be reducing to within design criteria.
3. No exceedances of ambient monitoring criteria occurred during commissioning of the premises however measured the maximum measured ambient air quality concentrations were higher than model predictions, in particular for NO_2 and SO_2. There is some uncertainty in the model predictions as the maximum predictions of the local model have already been exceeded therefore ambient air quality monitoring should continue.
4. The GTP is designed to maximise recycling of hydrocarbon emissions into the process, or recovery for use as fuel or product, therefore flaring events are expected to be infrequent.
5. The flares are designed to operate smokeless (Ringelmann 1 or lower) during most flaring operations (with the exception of unusual emergency relief scenarios) however dark smoke events occurred on occasions throughout the commissioning period. While some dark smoke events are expected in association with commissioning, an issue with the LP to HP flare staging system resulted in a greater frequency and duration of events than was anticipated. Corrective actions have been undertaken to address this issue and prevent ongoing occurrence of the dark smoke events which have an amenity impact for residents of the town of Onslow.

8.4.7 Consequence

Emissions modelling conducted for the Wheatstone Foundation Project demonstrated that all relevant ambient air quality assessment criteria for combustion gases and PM are expected to be met during routine and non-routine operation (section 5.1). The predicted GLCs demonstrate that the contribution of the Wheatstone Foundation Project to ambient air quality is typically low (<5% of the criteria) with the exception of NO_2 which is predicted to contribute up to 21.5% of the NEPM criteria outside the premises. The maximum measured GLC at the Onslow AQMS was for NO_2 (21% of the 1-hour NEPM criteria) which is the most significant emission from the premises as modelling predicts it has the greatest contribution to GLCs.

Ambient air quality monitoring shows all assessment criteria were met throughout the commissioning period for combustion gases even though the GTGs were operating at low load, and the AGTO experienced issues with incomplete combustion, resulting in higher than predicted combustion emissions.

The maximum modelled and measured GLCs for SO_2 and VOCs are <3% of the relevant NEPM standards at Onslow therefore the Delegated Officer has determined that air quality assessment criteria are likely to be met and that there will be minimal off-site impact at a local scale. The maximum measured GLC for CO is 19.8% of the relevant NEPM criteria however Wheatstone is only predicted to contribute 0.5% of the NEPM criteria outside the premises boundary (refer to Table 8) therefore the Delegated Officer has determined that air quality assessment criteria are likely to be met and that there will be minimal off-site impact at a local scale. Correspondingly the Delegated Officer considers the consequence of SO_2, VOC and CO emissions to be **Minor**.

The maximum measured GLC for NO_2 at Onslow is 21% of the relevant NEPM criteria and local scale modelling predicts the Wheatstone Project will contribute up to 21.5% of the NO_2 NEPM criteria outside the premises boundary therefore the Delegated Officer has determined that air quality assessment criteria are likely to be met and that there will be low level off-site impact at a local scale. Therefore, the Delegated Officer considers the consequence of NO_2 emissions to be **Moderate**.

Ambient air quality monitoring of PM has not been undertaken as modelling indicates the Wheatstone Foundation Project will contribute <5% of the GLC for PM_{10} and $PM_{2.5}$. Modelling predicts for the worst case, GLCs will be up to 54% of the daily PM_{10} NEPM criteria and up to 66% of the annual PM_{10} NEPM criteria. Given the predicted low contribution of the premises to PM_{10} and $PM_{2.5}$ the Delegated Officer has determined that air quality assessment criteria are likely to be met and that there will be minimal off-site impact at a local scale. Therefore, the Delegated Officer considers the consequence of PM emissions to be **Minor**.

8.4.8 Likelihood of Risk Event

Based upon the proximity of the premises to sensitive receptors, ambient modelling and monitoring data collected from the Onslow AQMS, and point source emission monitoring results relating to the application, the Delegated Officer has determined that the likelihood of the emission of combustion gases or PM causing adverse health impact to sensitive receptors will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Unlikely**.

8.4.9 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 21) and determined that the overall rating for the risk of combustion emissions and PM impacting on the health of sensitive receptors is **Medium**.

8.5 Risk Assessment – ozone

8.5.1 Description of ozone emissions

Ozone is a secondary pollutant produced by the reaction of NOx, VOCs and sunlight. Emissions of NO_X and VOCs from various sources within the GTP including the GTGs, GTs, flares and AGTO contribute to the creation of ground level O_3 within the surrounding area. Ozone is also a naturally occurring pollutant. Contribution to increased GLCs of ozone can potentially cause adverse health impacts to sensitive receptors.

8.5.2 Description of potential adverse impact from the emission

Ozone is a powerful oxidant which can irritate airways. Ozone 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 ozone exposure which includes visible foliage injury, growth retardation, and increased sensitivity to stress (WHO 2000).

8.5.3 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 29.

Table 29 NEPM standards for ozone

Pollutant	Averaging period	Monitoring investigation level		Goal (Maximum allowable exceedance)
		ppm	µg/m³	
O_3	1 hour	0.10	214	1 day a year
	4 hours	0.08	171	1 day a year

8.5.4 Applicant controls

The size, overall stack height and anticipated flow rates of exit gas from the various sources all promote the dispersion of pollutants (NOx and VOC) which contribute to the formation of ground level O_3. A summary of controls for reducing NOx and VOC emissions (combustion emissions) has been provided in sections 8.4.5 and 8.6.5. Reducing emissions of pollutants which contribute to the formation of O_3 will minimise the contribution of the premises to O_3 concentrations within the surrounding area.

As per section 5.2.1, ambient air quality monitoring has been undertaken at the Onslow AQMS by the applicant throughout the commissioning. The ambient monitoring is currently continuing in accordance with cCommissioning requirements.

8.5.5 Key findings

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

1. Ozone is not a direct emission but is created by the reaction of NOx and VOC emissions.
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.

8.5.6 Consequence

The 2013 Wheatstone Foundation Project modelling study found that existing background O_3 concentrations are relatively high. The modelling indicated that GLCs of O_3 could reach 86% of the 1-hour, and 94% of the 4-hour assessment criteria (Table 10). This is based on regional modelling which included the impact of bushfires in the background data year. The modelling predicted that these maximum concentrations would occur inland near where the bushfires occurred indicating the fires are the primary contributor to GLCs of O_3. There was negligible change to the maximum GLCs predicted anywhere on the model grid between the background data and the modelling scenarios, indicating that the impact of emissions from the premises on regional O_3 levels is minimal. Higher GLCs were also predicted close to existing industrial sources on the Burrup Peninsula and Barrow Island.

The regional modelling predicted moderate O_3 concentrations at the Onslow townsite (closest sensitive receptors) of 46% of the 1-hour, and 55% of the 4-hour assessment criteria (Figure 3 and Table 12). However, ambient air quality monitoring data collected to date at the Onslow AQMS indicates that the maximum recorded O_3 concentration is 69% of the assessment criteria. While this is higher than predicted O_3 GLCs modelled for worst case scenario conditions at Onslow, it cannot be determined whether this is due to background contributions or associated with emissions from the premises.

The Delegated Officer has determined that public health criteria for ozone are likely to be met due to measured and modelled O_3 levels being within the assessment criteria at Onslow. Modelling indicates the Wheatstone Foundation Project has minimal contribution to predicted regional GLCs of O_3 therefore there is expected to be minimal offsite impact of O_3 emissions relating to the operation of the premises. Therefore, the Delegated Officer considers the consequence of O_3 emissions to be **Minor**.

8.5.7 Likelihood of Risk Event

Considering the maximum measured and modelled O_3 concentration at Onslow, the Delegated Officer has determined that the likelihood of health impacts to sensitive receptors occurring will be **Unlikely**.

8.5.8 Overall rating of ozone

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 21) and determined that the overall rating for the risk of ozone emissions causing adverse health impacts is **Medium.**

8.6 Risk Assessment – fugitive gaseous emissions

8.6.1 Description of risk event

Fugitive gaseous emissions, such as NOx, SO_2, CO, VOCs (including BTEX) and H_2S, escaping from valves, flanges, pump seals, compressor seals, connectors and product storage (LNG and condensate) can have adverse impacts on local air quality potentially leading to health impact for sensitive receptors.

8.6.2 Identification and general characterisation of emission

Fugitive gaseous emissions can occur within the premises due to leaks from valves, flanges, pump seals, compressor seals and connectors within the LNG trains and supporting infrastructure. Fugitive gaseous emissions also occur from the LNG and condensate storage facilities and pipework.

Gradual heating (or pressure change) of LNG and condensate (within storage infrastructure or pipework) cause it to evaporate and produce BOG. Boil-off gas needs to be released to

prevent over pressurising of the holding infrastructure. Storage infrastructure on the premises has been designed to minimise the generation of BOG and a BOG recovery system has been installed to recover as much of the BOG as possible minimising fugitive emissions associated with this source.

An estimation of plant fugitive emissions for the Wheatstone Foundation Project was made at the time of developing the Wheatstone Project Air Emission Design Report. The estimate was made using NPI method 2 and was based on the number of piping systems components (valves, flanges, pump seals etc.). The estimation only considered hydrocarbon emissions as outlined in Table 30.

Table 30 Predicted fugitive emission rates for the Wheatstone Foundation Project

Emission source	Pollutant	Design emission rate (g/s)
Fugitives	VOCs	7.6
	BTEX	0.03

Ambient air quality modelling did not consider the contribution of fugitive gaseous emissions as the GTP design was considered to ensure fugitive emissions are low, and would therefore have negligible contribution to GLCs outside the premises.

8.6.3 Description of potential adverse impact from the emission

Fugitive gaseous emissions can lead to increased GLCs of pollutants potentially resulting in health impact for sensitive receptors. The health impacts of the majority of the pollutants are described in section 8.4.3.

Hydrogen sulfide has a pungent odour at low concentrations; however, there are few detectable toxicological health hazards at concentrations less than 1 ppm (1.5 mg/m^3) even with exposure for long periods. Eye irritation can occur between 10 to 20 ppm. Respiratory difficulties can be experienced above 320 ppm (WHO, 2000).

8.6.4 Criteria for assessment

The NEPM ambient air quality standards described in section 8.4.4 are applicable.

8.6.5 Applicant controls

The Wheatstone Foundation Project has been designed to incorporate contemporary emission controls, which are detailed in the Wheatstone Foundation Project Air Emission Design Report developed to meet requirements of MS 873. Infrastructure and operational controls intended to prevent and/or minimise the release of fugitive gaseous emissions are summarised in Table 31.

The applicant also developed a Leak Detection and Repair Plan (LDAR Plan) which was submitted with the commissioning plans in accordance with the conditions of W5584/2014/1 and W5480/2013/1. The LDAR Plan outlines the leak detection methodologies and frequency which will be implemented on the premises to detect hydrocarbon leaks, mitigation of leaks and record keeping in relation to implementation of the LDAR Plan. The leak detection methodologies outlined include:

- optical gas imaging (six-monthly);
- organic vapour analysers/toxic vapour analysers consistent with USEPA Method 21 Protocol: Determination of Volatile Organic Compound Leaks (USEPA Method 21) (as required);
- N_2/Helium leak detection (as required); and
- visual inspections (ongoing).

Table 31: Applicant's proposed controls for fugitive gaseous emissions

Site infrastructure	Description
BOG vapour recovery system	• The GTP includes a full capacity BOG vapour recovery system consisting of three electric motor driven BOG compressors to recover and compress vapour generated from the LNG storage and loading facilities. • The BOG from the LNG storage tanks is returned to the Liquefaction Methane Compression and NRU for reliquification. The BOG from ship loading is routed back to the LNG storage tanks. • The system has been sized to handle 110% of the predicted maximum BOG flow rate to avoid the need to flare BOG (except during the initial phase of de-inerting of LNG carriers). • In the event of a BOG compressor failure, the BOG recycle compressor can act as backup to the main BOG compressor so that BOG vapour can be routed to the recycle compressor, rather than being flared. • Boil-off gas only needs to be flared (marine flare) in the event the compressed gas cannot be routed to the LNG train for processing due to maintenance or an emergency.
LNG storage tanks	• The storage tanks have been designed and constructed in accordance with relevant standards including AS 1940, AS 3961, NFPA 59A, API 620 (Appendix Q and other applicable sections) and API 625. • The storage tanks are double walled with the outer tank constructed of concrete with a carbon inner steel liner and a secondary 9% nickel steel bottom and corner protection. The inner tank is constructed of 9% nickel steel. The containment is designed to be capable of containing the refrigerated liquid and vapour in the event of leakage from the inner tank. • The storage tanks have a comprehensive insulation system designed to minimise heat gain and limit the generation of BOG, to <0.05% of the gross volume per day. • Nitrogen leak testing was undertaken on the tanks prior to introducing LNG to identify and repair leaks.
Condensate storage tanks	• The storage tanks have been designed and constructed in accordance with relevant standards including AS 1940, AS 1692 and API 650. • The storage tanks have an overflow pipe work system that directs overflow to the bunded area (to grade) to minimise vaporisation during freefall from the overflow point to ground level. • The tanks have a pontoon type double deck floating roof to minimise the available space for vapourisation. The roof has primary and secondary seals to minimise fugitive emissions. • The tanks have been coated in heat reflective paint to reduce warming and associated vapourisation of the contained condensate. • Condensate fed into the tanks is cooled using a Wet Surface Air Cooler to lower the vapour pressure under high ambient temperature conditions. • The vapour pressure of condensate is monitored so that the Wet Surface Air Cooler only operates when required. • Nitrogen leak testing was undertaken on the tanks prior to introducing condensate to identify and repair leaks.
GTs	• The main refrigerant compressors have dry gas seals and seal gas recovery systems.
LNG train 1 (general)	• Welded joints have been used inside the Cold Boxes to limit fugitive emissions. • The Cold Boxes are purged with N_2 to enable detection of small hydrocarbon leaks. • All hydrocarbon service valves are specified as low emission valves, which meet a leakage requirement of less than 100 ppm methane. • Pumps are specified with mechanical seals to arrest leakage to the environment, with dual seals for more volatile services such as Ethane, Propane, Butane and Ethylene.

Site infrastructure	Description
	• 'Can' pumps with no fugitive emissions are used for LNG service. • All fixed roof atmospheric storage tanks containing hydrocarbons (including the heating oil, diesel, aMDEA, waste oil and methanol/TEG tanks) have domed roofs and N_2 blanketing to prevent formation of flammable atmospheres and oxidation of the hydrocarbons. The tanks also have vacuum relief and an emergency vent. • Open ended lines are designed with caps, plugs or a second valve at the open end. • Sample connections are designed to be closed loop, if possible, and return the flushed fluid to the process or to the flare system, where necessary. • Condensate vapour pressure and temperature is controlled via stabilisation and fractionation systems. • Vapours from the condensate stabilisation unit are routed to the AGRU for recovery and processing. • After major turnarounds, the N_2/Helium leak detection will be used to ensure system tightness.

8.6.6 Key findings

The Delegated Officer has reviewed the information regarding fugitive gaseous emissions and has found:

1. The GTP includes infrastructure features and specifications to minimise the volume of fugitive gaseous emissions from the premises. Where possible vapours are collected and returned to the process or, if unable to be, are flared rather than vented as the GTP has been designed to exclude the need to vent process gas.
2. At the time of conducting the ambient air modelling for the Wheatstone Foundation Project the assessment considered that fugitive gaseous emissions were sufficiently low that they would have negligible contribution to pollutant GLCs outside the premises
3. The EPA Report 1404 recommended the Part V instrument include a Biennial Leak Detection and Repair (LDAR) Program using a Flame Ionization Detector or Photo Ionization Detector and covering all potential leak points consistent with USEPA Method 21 protocol. The applicant was required to develop and submit a LDAR Plan with the commissioning plan for the GTP under requirements of W5480/2013/1 and W5584/2014/1. The submitted plan includes four primary methods of leak detection including biannual Optical Gas Imaging and use of Organic Vapour Analysers/Toxic Vapour Analysers consistent with USEPA Method 21 protocol as required.

8.6.7 Consequence

If fugitive gaseous emissions occur, the Delegated Officer has determined that public health criteria are likely to be met and there will be minimal impact at a local scale. Therefore, the Delegated Officer considers the consequence of fugitive gaseous emissions to be **Minor**.

8.6.8 Likelihood of Risk Event

Considering the applicant's controls relating to fugitive emissions and the distance to sensitive receptors the Delegated Officer has determined that the likelihood of health impact to sensitive receptors from fugitive gaseous emissions occurring will be **Rare**.

8.6.9 Overall rating of fugitive gaseous emission

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 21) and determined that the overall rating for the risk of fugitive gaseous emissions is **Low**.

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

8.7.1 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.

8.7.2 Identification and general characterisation of emission

Various types and quantities of hazardous materials are stored onsite including hydrocarbons and other process chemicals. Large quantities of hazardous materials stored within the premises are described in Table 32. Releases of hazardous materials from storage infrastructure, transfer lines, connections or fill points can gain access to, and impact upon, the surrounding environment. Aromatic hydrocarbons such as BTEX are likely to be the most toxic component of the hazardous materials stored on the premises.

The closest storage infrastructure to the marine environment is the LNG storage tanks which are approximately 500 m south. However, released LNG is likely to largely evaporate therefore a release is not expected to travel a large distance. Condensate storage is approximately 700 m and the closest diesel storage tank is approximately 1,400 m from the marine environment. Diesel delivery to the premises occurs via the MOF.

There are no significant water courses within the premises boundary and the premises has an established stormwater system which will aid in confining releases to within the premises.

Table 32: Types and quantities of significant volumes of environmentally hazardous materials stored within the premises

Material description	Quantity
Condensate	2 x 120,000 m^3
LNG	2 x 150,000 m^3
Concentrated amine (aMDEA) solution	166 m^3
Dilute amine (aMDEA) solution	1,053 m^3
Ethylene	3 x 287 m^3
Propane	3 x 567 m^3
Methanol/TEG	243 m^3
Diesel	1 x 563 m^3 and 1 x 115 m^3
Heating oil	1,805 m^3
Waste oil	112 m^3

In addition to the bulk storage tanks described in Table 32, there is also a bunded bulk chemical storage area and oil/hydrocarbon storage area at the southern portion of the premises close to the warehouse and vehicle maintenance workshop.

The premises is underlain by a brackish to hypersaline shallow water table and is largely a groundwater discharge zone with groundwater flow direction predominantly to the north and north-east toward the ocean and Hooley Creek. The GTP has been constructed on a pad creating separation between the water table and premises infrastructure. Groundwater monitoring indicates the standing water depth varies from 1 to 6 mbgl.

8.7.3 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, surface water and the marine environment. The premises' stormwater system captures all runoff from areas at risk of contamination, therefore releases of hazardous materials are likely to impact the affected soil and potentially migrate into groundwater. Runoff of hazardous materials outside the premises is considered unlikely to occur as the materials will report to the stormwater system. The most likely pathway for offsite contamination to occur is therefore via groundwater flow and discharge.

Groundwater at the premises has no beneficial use due to salinity levels, but as described in section 7.4, potentially discharges to the marine environment and also flows toward the Hooley Creek areas. Altered groundwater quality could potentially lead to a decline in health of the conservation significant mangrove, tidal mudflat and algal mat ecological communities associated with the Hooley Creek. These communities are known to support a variety of marine fauna, including species listed under the EPBC Act and WC Act such as sawfish and juvenile turtles which would be impacted by a decline in ecological community health. Mangroves are known to be sensitive to hydrocarbon impact which can cause defoliation and mortality due to smothering of the roots (Chevron 2010).

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.

8.7.4 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 UDR specifies hazardous materials, including acids, alkalis and hydrocarbons that must not be discharged to the environment.

8.7.5 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 33. These controls have been reviewed as part of this assessment.

Table 33: Applicant's proposed controls for storage of hazardous materials

Site infrastructure	Design details/ Description
General	• Regular infrastructure inspections, monitoring and maintenance will be 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 reporting to collection sumps on the premises will be removed through sump vacuum truck extraction points and will be investigated and reported per site operational procedures. • Corrosion-resistant materials were used in the construction of the premises to minimise the risk of corrosion related integrity issues. • Clean up of spillage in accordance with the facility Spill Response Procedure. • Training for employees in appropriate spill response.
LNG storage tanks	• The storage tanks have been designed and constructed in accordance with relevant standards including AS 1940, AS 3961, NFPA 59A, API 620 (Appendix Q and other applicable sections) and API 625. • The tanks are double walled with the outer tank constructed of concrete with a carbon inner steel liner and a secondary 9% nickel steel bottom and corner protection. The inner tank is constructed of 9% nickel steel. The containment is designed to be capable of containing all the refrigerated liquid and vapour in the event of leakage from the inner tank. • Accumulation of LNG in the outer/inner tank annulus will cool the tank walls/based. Leak detection has been installed in the outer tank bottom annulus to continuously monitor the temperature. Sensor elements will trigger an alarm in the control room when low temperatures are detected indicating a leak in the inner tank. Another alarm will be triggered if the monitoring system malfunctions. • A heating system has been established at the base of the outer tank to keep the slab at 3°C to avoid ice formation and subsequent heaving/uprising. • Two level liquid tank gauges have been installed with stilling wells and a field indicator. • The tanks have a high and high-high level alarm. An interlock shuts down incoming LNG flow when the high-high level is reached. • There is no piping penetrating the shell of the primary of secondary tank. All piping has been routed through the suspended deck of the primary tank and/or the roof of the secondary tank to reduce the risk of leaks at tank wall penetrations. • Nitrogen leak testing was undertaken on the tanks prior to introducing LNG to identify and repair leaks.
Condensate storage	• The storage tanks have been designed and constructed to comply

Site infrastructure	Design details/ Description
tanks	with the requirements of AS 1940, AS 1692 and API 650. • Each tank is located in its own bunded area capable of storing 110% of the tank volume. The bunded area is lined with a geosynthetic clay liner with a hydraulic conductivity of $1x10^{-7}$ cm/s. • The tanks have a filling control system and overflow pipework system. • The tanks have a radar level indicator with stilling well, a differential pressure indicator and a visual local floating type gauge to monitor tank levels. • The tanks have a high and high-high level alarm. An interlock shuts down incoming condensate flow when the high-high level is reached. • Radial grooves in the concrete tank foundation allow for visual leak detection. The area will be monitored during routine inspections. • Nitrogen leak testing was undertaken on the tanks prior to introducing condensate to identify and repair leaks.
Propane and ethylene storage drums	• Storage drums are designed and constructed in accordance with section VIII Division 1 of the ASME Boiler and Pressure Vessel Code. • Ethylene is stored within three pressurised, double walled, vacuum jacketed horizontal drums which have been assessed by a Dangerous Goods consultant as complying with AS 1596. The drums are connected to each other to maintain the same level in all three. • Propane is stored within three pressurised storage drums which have been assessed by a Dangerous Goods consultant as complying with AS 1596. The drums are connected to each other to maintain the same level in all three. • The storage drums have a leak detection system. • Each storage drum is connected to a high and high-high level alarm. An interlock stops pumping when the high-high liquid level is reached. • The storage drums are located within a curbed area sloped to direct runoff to a collection sump.
Amine (aMDEA) storage and surge tanks Hot oil storage tank Methanol/TEG storage tank Waste oil storage tank Diesel storage tanks	• Storage complies with the applicable requirements of the DG Regulations, AS 1940 and with API 650 (except the diesel storage tanks) • 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. • The Methanol/TEG storage tank has been epoxy lined internally to prevent corrosion. • Tanks have a monitored high level alarm.
First flush sumps	• The first flush sumps which are part of the premises stormwater system are sized to contain a 10 minute spill from the GTP process area. • The first flush sumps have a high level alarm to ensure there is time for a response in the event of a spill reporting to the sumps before

Site infrastructure	Design details/ Description
	reaching maximum capacity.
Diesel line	• The unloading point for diesel delivery from the materials offloading facility must have a dry break coupling.
LNG/Condensate pipe rack	• The LNG and condensate lines have pressure monitoring with an unexpected drop in pressure indicating a potential leak.
General	• Daily visual inspections of the plant infrastructure are undertaken to check for leaks.

The applicant has undertaken groundwater monitoring throughout the construction and commissioning of the premises (refer to section 5.4) in order to confirm baseline water quality, detect any potential impact to groundwater resulting from the project and develop further understanding of the hydrogeological regime in proximity to the premises. As per the discussion in section 5.4, the monitoring indicates a perched water table may have developed with the constructed pad. Further monitoring bores have been established to detect potential contamination within the perched water table as well as the existing water table, as well as to develop understanding of flow between the two.

8.7.6 Key findings

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

1. Infrastructure controls implemented in the design and construction of the premises in accordance with W5584/2014/1 and W5480/2013/1 significantly reduce the likelihood of environmentally hazardous materials being released and associated impacts occurring.
2. The Mangrove, Algal Mat and Tidal Creek Protection Management Plan includes monitoring to detect impacts to these ecosystems in proximity to the Premises (Hooley Creek and Ashburton River Delta) but does not include monitoring of groundwater within the premises to detect impacts at the source. The EPA Report 1404 recommended inclusion of annual groundwater monitoring on the premises. The applicant has established a series of groundwater monitoring bores within or in close proximity to the premises. New bores installed in 2019 target a potential perched aquifer which has developed within the GTP pad and the pre-existing water table.
3. 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.
4. 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.

8.7.7 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, groundwater and mangrove, tidal mudflat and algal mat ecological communities at the Hooley Creek area.

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 mid to long-term or permanent 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 or Hooley Creek area. Therefore, the Delegated Officer considers the consequence of such an event to be **Severe.**

8.7.8 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 are most likely to occur from transfer points or leaking welds/joins and 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**.

8.7.9 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 21) 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 **High** for large volume releases.

8.8 Risk Assessment – discharge of contaminated water

8.8.1 Description of discharge of contaminated water

Stormwater and process wastewater 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, where necessary treated, and discharged, 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.

8.8.2 Identification and general characterisation of emission

Stormwater

The premises has been established on a pad to provide protection from stormwater inflow and potential flooding. It has been constructed with an established stormwater system which separates stormwater into three streams based on their risk of contamination;

- contaminated - runoff from areas where there is a high risk of contamination including the LNG train areas and other areas involved in handling hydrocarbons and process chemicals, including bunded areas;
- potentially contaminated - runoff from areas where there is a moderate or low risk of contamination such as the storage tank areas and car parks; and

- clean (uncontaminated) - runoff from areas where there is unlikely to be contaminants present such as unpaved areas, roadways and rooftops.

In order to minimise the volume of potentially contaminated stormwater requiring management, uncontaminated runoff is diverted away from process areas. As described in section 3.1.9, the first 25 mm of runoff from process areas is directed to concrete first flush sumps via a drainage network. Hydrocarbons are separated from the water by an underflow/overflow baffle and are directed to the PWTS. The remaining sump water is then sampled and analysed and if criteria are met to be considered uncontaminated, the water is directed to one to the sedimentation ponds on the premises. If the contaminant levels exceed the uncontaminated criteria the water is pumped to the PWTS to undergo further treatment. There are 11 first flush sumps within the premises with a total storage capacity of 3,733 m^3.

Runoff in excess of the first 25 mm from the process area is considered uncontaminated and is diverted by an overflow weir and drainage to the sedimentation ponds. Stormwater from non-process areas is also directed to these ponds via a drainage network, as is runoff from car parks (after being directed through an oil and sediment trap). The sedimentation ponds are unlined, allowing contained water to infiltrate into the ground as well as evaporate. There are six sedimentation ponds on the premises which have been designed and constructed to accommodate a 1 in 30 year Annual Recurrence Interval (ARI) rainfall event. The ponds include overflow culverts for release of rainfall in excess of the design volume.

The premises is predominantly paved therefore stormwater is not likely to contain high sediment loads. Due to the handling of hydrocarbons on the premises the stormwater may contain hydrocarbons including BTEX which is a known toxicant. Due to the premises location within a region in close proximity to the marine environment, which is subject to marine tidal influence, surface water runoff can have elevated salinity.

Process wastewater

Non-sanitary process wastewater has the potential to be contaminated with process chemicals and/or hydrocarbons. Sources of process wastewater within the premises include:

- drains from machinery base plates;
- water draw-offs and blowdowns for vessels containing hydrocarbons;
- maintenance drains;
- effluent from wet gas knock-out drums and the AGTO knock-out drum;
- combustion turbine detergent washings and drains from compressor area collection tanks;
- combustion turbine detergent washings and drains from power generation area;
- wash down from the GTG area;
- discharges from the stabiliser system;
- discharges from the dehydration unit and AGRU systems; and
- blowdown of wastewaster contaminated with soluble aMDEA from the AGRU.

Wastewater from the various sources is directed into wastewater lift stations from where it is pumped to the PWTS for removal of hydrocarbons and solids prior to discharge to a Combined Effluent Sump located outside the premises. Discharge of the treated wastewater from the Combined Effluent Sump is not assessed in this Decision Report as commissioning of the discharge infrastructure (PMO) is currently continuing in accordance with W5671/2014/1. The assessment therefore only considers the potential for release of process water via overflows, leaks or spills from the PWTS.

The PWTS includes three stages of treatment which include a CPI system, a DAF system and a DAF effluent filter. Recovered oil and contaminated sludges from the system are stored in a Waste Oil Tank and a Sludge Holding Tank awaiting offsite disposal to a licensed facility.

8.8.3 Description of potential adverse impact from the emission

Discharge of stormwater or process wastewater to the environment, which is potentially contaminated with hydrocarbons, process chemicals and/or sediment, 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 has no beneficial use due to salinity levels, but as described in section 7.4, potentially discharges to the marine environment and also flows toward the Hooley Creek area. Altered groundwater quality, or runoff of contaminated or sediment laden stormwater could potentially lead to a decline in health of the conservation significant mangrove, tidal mudflat and algal mat ecological communities associated with the Hooley Creek. These communities are known to support a variety of marine fauna, including species listed under the EPBC Act and WC Act such as sawfish and juvenile turtles which would be impacted by a decline in ecological community health and associated loss of habitat. Fauna in the area could also experience toxic effects from contaminants within stormwater or process water. Mangroves are known to be sensitive to hydrocarbons as well as sedimentation causing smothering of the aerial root systems.

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.

8.8.4 Criteria for assessment

Relevant land and water 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.

The applicant developed and has implemented water quality criteria for discharge of stormwater during the construction and commissioning of the premises. The criteria have been compared with the ANZECC 2000 Guidelines for Fresh and Marine Water Quality. The selected turbidity criteria is higher than default trigger values for estuarine ecosystems however turbidity for the Ashburton River is highly variable given its ephemeral nature. Measured values range between 10 NTU at lower flows to up to 3,300 NTU at flows of up to 250 m/s (Chevron 2017). Weighted values range between 10 to 587 NTU. Based on the receiving environment, the adopted turbidity criteria is considered appropriate.

The applicant has suggested a total recoverable hydrocarbon limit of 15 mg/L which has been adopted from the *Water quality protection note 68, Mechanical equipment washdown* (Department of Water 2013) and was applied throughout the construction and commissioning of the infrastructure. The Delegated Officer considers this limit is appropriate given it is for water discharged via infiltration and direct discharge to surface drainage does not occur. The adopted criteria for uncontaminated stormwater discharge are detailed in Table 34.

Table 34: Criteria for uncontaminated stormwater discharge from the premises

Water quality parameter	Discharge criteria
Total recoverable hydrocarbons	15 mg/L
pH	6 – 9
Turbidity	370 NTU

8.8.5 Applicant controls

This assessment has reviewed the controls set out in Table 35 for stormwater and process wastewater.

Table 35: Applicant's proposed controls for discharge of contaminated water

Site infrastructure	Description
Controls for management of stormwater	
Stormwater drainage First flush sumps Sedimentation ponds	• The stormwater drainage system is designed to collect and segregate contaminated, potentially contaminated and clean/uncontaminated stormwater for treatment (where required) and disposal. • Clean uncontaminated runoff is diverted away from process areas to minimise the volume of potentially contaminated stormwater requiring management. • Water from paved process areas is considered potentially contaminated and the first 25 mm of runoff (first flush) from these area is directed to concrete first flush sumps, which have been designed to contain this volume of runoff. • The first flush sumps have a high level alarm. • The first flush sumps have an overflow/underflow baffle to recover oily water which is directed to the PWTS. Contained sump water is sampled and analysed. If uncontaminated criteria are met the water is routed to the sedimentation ponds or if not is piped to the PWTS. • Runoff in excess of the first 25 mm is considered uncontaminated and is diverted by an overflow weir away from the first flush sumps, to the sedimentation ponds. Stormwater runoff from non-process areas is considered uncontaminated and is routed via drains to these ponds. • Water collected within the sedimentation ponds evaporates or infiltrates through the soil profile. • Stormwater from parking lots is diverted through an oil and sediment trap and is discharged into the uncontaminated stormwater drains and routed to the sedimentation ponds. • As per Table 33, environmentally hazardous substances are in the majority located within bunded areas. Stormwater captured within bunded areas is directed to the PWTS to avoid contaminant loading in the stormwater system.
Controls for management of process wastewater	
Wastewater lift stations PWTS	• All process wastewaters are directed to and collected within concrete wastewater lift stations from where they are pumped to a PWTS. • Wastewater lift stations have high level alarms. • A diversion tank capable of holding 17 hours of process wastewater has been installed upstream of the PWTS to store water in the event the system is out of service for maintenance or a fault.

Site infrastructure	Description
	• Wastewater is treated via a three stage PWTS which is comprised of two treatment trains, each including a CPI, a DAF system and a DAF effluent filter to remove oil and solids from the wastewater. • Recovered waste oil and oily sludge is stored in separate tanks pending offsite disposal. • The PWTS is located within a concrete bunded area and also includes the diversion tank and oily sludge storage tanks.

8.8.6 Key findings

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

1. 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.
2. All stormwater will be routed to a collection point within the premises (either first flush sumps and/or sedimentation ponds). All collected stormwater will be sampled and analysed before being released from first flush sumps to the sedimentation ponds. Water not meeting uncontaminated criteria will be sent to the PWTS for treatment.
3. Uncontaminated stormwater will be discharged to the terrestrial environment via infiltration from unlined sedimentation ponds.
4. 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.
5. All process wastewater will be collected in contained infrastructure (wastewater lift stations) and pumped to the PWTS. Treated water will be discharged from the PWTS to infrastructure (Combined Effluent Sump) external to the premises, and will not be directly discharged to the environment. Discharge from the Combined Effluent Sump to the environment via the PMO is authorised through another EP Act Part V Regulatory Instrument (W5671/2014/1). Impacts and risk associated with discharge from the PMO are therefore not included in this assessment.
6. The Mangrove, Algal Mat and Tidal Creek Protection Management Plan required under MS 873 includes monitoring to detect impacts to these ecosystems in proximity to the premises (Hooley Creek and Ashburton River Delta). If impacts occur to these ecosystems associated with discharge of contaminated water, they are expected to be detected through the ongoing implementation of the Plan.

8.8.7 Consequence

If discharge of contaminated stormwater or process wastewater occurs, then the Delegated Officer has determined that short-term impact to an area of high conservation value or special significance, being the mangrove, tidal mudflat and algal mat ecological communities of the Hooley Creek and Ashburton River Delta areas, could occur. Therefore, the Delegated Officer considers the consequence of discharge of contaminated stormwater or process water to be **Major**.

8.8.8 Likelihood of Risk Event

Based on the applicant's proposed controls, the distance to sensitive ecosystems (Hooley Creek, marine, Ashburton River Delta) and the nature of stormwater and process water from the premises, the Delegated Officer has determined that the likelihood of short –term impact upon the surrounding sensitive ecosystems as a result of stormwater or process water discharge may only occur in exceptional circumstances. Therefore, the likelihood has been determined as **Rare**.

8.8.9 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 21) and determined that the overall rating for the risk of discharge of potentially contaminated water is **Medium.**

8.9 Summary of acceptability and treatment of Risk Events

A summary of the risk assessment and the acceptability or unacceptability of the risk events set out above, with the appropriate treatment and control, are set out in Table 36 below. Controls are described further in section 9.

Table 36: 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	GTGs, GTs, flares, HOSH, AGTO	Air/wind to sensitive receptor causing public health impacts	Infrastructure and management controls	Moderate consequence (NOx) Minor consequence (CO, SOx, VOCs) 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.	Fugitive gaseous emissions	LNG and condensate storage tanks, GTP valves, flanges, pump seals, compressor seals, connectors	Air/wind to sensitive receptor causing public health impacts	Infrastructure and management controls	Minor consequence Rare **Low 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)**			
4.	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	Infrastructure and management controls	Minor consequence Possible **Medium risk**	Acceptable subject to regulatory controls
5.	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	Infrastructure and management controls	Severe consequence Rare **High risk**	Acceptable subject to regulatory controls
6.	Discharge of potentially contaminated water	Stormwater system Process wastewater system	Direct discharge to natural drainage or terrestrial environment causing contamination and possible infiltration to groundwater	Infrastructure and management controls.	Major consequence Rare **Medium risk**	Acceptable subject to Applicant controls

9. Regulatory controls

A summary of regulatory controls determined to be appropriate for the Risk Event is set out in Table 37. The risks are set out in the assessment in section 8 and the controls are detailed in this section. DWER will determine controls having regard to the adequacy of controls proposed by the Applicant. The conditions of the licence will be set to give effect to the determined regulatory controls.

Table 37: Summary of regulatory controls to be applied

		Controls (references are to sections below, setting out details of controls)							
		General	Infrastructure and equipment	Emissions and limits	Emission monitoring	Ambient monitoring	Process monitoring	Specified actions	Record keeping and Reporting
Risk Items (see risk analysis in section 8)	Combustion gases	●	●	●	●	●	●		●
	Ozone					●			●
	Fugitive gaseous emissions		●					●	●
	Release of environmentally hazardous materials		●			●			●
	Discharge of contaminated water	●	●	●	●				●

9.1 Licence controls – discharges to air and ozone

9.1.1 Infrastructure and equipment

Predicted emissions and impact on air quality considers the inclusion of emission control technology in the design of the premises therefore the emission control technology, operational conditions and monitoring specified in the premises design and construction (through the Wheatstone Project Air Emission Design Report) have been specified as operational requirements through Condition 1 for the GTs, GTGs, AGRU, AGTO and HOSH.

The premises has been designed to minimise the impact of discharges to air, in particular through design to minimise requirements for flaring except in certain scenarios where flaring must occur, primarily for safety reasons. Condition 1 therefore also specifies the scenarios when flaring can occur in accordance with the GTP design.

9.1.2 Specified emissions and limits

Condition 2 has been included in the licence to specify the emission points and types of pollutants which have been assessed in this Decision Report and are authorised to be discharged from point sources within the premises. 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 licence.

Combustion emissions from the premises have been assessed as medium risk during routine and non-routine operations based on the ambient air modelling and monitoring undertaken during commissioning of the premises. As combustion emissions are expected to be highest during the premises commissioning stage, and the highest recorded pollutant concentration at Onslow during the commissioning stage was <25% of the NEPM criteria (NO_2), and the remaining pollutants were <6% of the NEPM criteria (CO, SO_2, VOCs) the Delegated Officer has determined that limits for combustion emissions discharged from the premises are not required in the licence.

A limit on dark smoke emissions from the flares has been included through condition 3. In accordance with the Wheatstone Project Air Emission Design Report, the premises has been designed to minimise the amount of flaring required and the flares are designed to operate smokeless during most flaring operations with visible emissions of Ringelmann 1 or lower (i.e. 20% opacity or lower). The Delegated Officer therefore expects that the infrastructure will be able to achieve this and has set a limit on dark smoke emissions in accordance with this. An exemption to the limit has been applied in the licence through condition 4 for start -up, shut down or upset conditions where operational combustion efficiency is not able to be achieved, and the flares are therefore not able to operate smokeless at this time. The applicant is expected to undertake management actions to minimise the dark smoke during such events however therefore this requirement has been included in the condition in order for the limit exemption to apply.

9.1.3 Monitoring

Monitoring requirements for discharges to air have been imposed through condition 11 to verify that emissions from the GTP infrastructure are achieving the design criteria for the premises. Stack testing for the HOSH has not been included due to the low frequency of operation of the infrastructure (during start up of the LNG train). Stack testing has also not been included for the flares due to the safety risk associated with such an activity.

The applicant provided emission verification monitoring data collected during the commissioning of the premises infrastructure which indicates that design emission criteria for NOx, CO and SO_2 have been exceeded during the commissioning period for some sources.

Continued monitoring of the primary emission sources is therefore required to confirm the design emissions rates that can be achieved as the operation of the GTP continues to be optimised. Quarterly monitoring of NOx, CO and SO_2 has therefore been included as a requirement for the GTGs, GTs and AGTO.

Power demand, maintenance requirements and equipment trips will dictate the number of GTGs and GTs operational at any one time. All infrastructure may therefore not be operational at the time of scheduled testing. To accommodate this the licence requires that sampling is carried out on a quarterly basis if the GTGs and GTs are operational.

Commissioning monitoring data has demonstrated that VOC emissions from the GTGs and GTs are negligible therefore monitoring of VOCs from these emission sources has not been included in the licence. Point source monitoring of VOC emissions has been included for the AGTO however to confirm it is effectively oxidising VOCs.

It is expected that emissions of PM_{10} and $PM_{2.5}$ will be low, given the combustion efficiency of the infrastructure and fuel source (gas). Particulate monitoring was therefore not required as part of the commissioning of the GTP infrastructure. Sample port sizes were based on monitoring methods for NOx, CO and SO_2 and are of insufficient diameter for NATA accredited particulate monitoring to be undertaken. Particulate monitoring is therefore not included in the monitoring condition.

The methods for monitoring are consistent with those previously used by the applicant and are considered appropriate. Conditions 12 and 13 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.

Due to the size and proximity of the population of Onslow, together with the scale and nature of emissions from the premises, the Delegated Officer considers continued ambient air monitoring at the town of Onslow AQMS is necessary to ensure the premises does not impact the air quality or health of residents. Conditions 14 to 16 have been included in the licence to specify the ambient air quality and meteorological monitoring requirements to be implemented at the Onslow AQMS. The Onslow AQMS ambient air quality monitoring program specified replicates that undertaken throughout commissioning of the premises and the first stage of operation of the premises under L9199/2019/1. 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, SO_2, CO and O_3 are to be continuously monitored with averaging periods for each pollutant aligning with the NEPM criteria. Monthly passive sampling for VOCs for seven days has been specified with analysis by a NATA accredited laboratory to ensure the monitoring data is reliable and accurate. 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 Onslow AQMS.

Condition 14 includes Reportable Event triggers which align with the NEPM criteria for NO_2, SO_2, CO and O_3. Condition 15 specifies that a report of the Reportable Event must be provided to the CEO in the event any of the triggers are exceeded. Reporting and investigation of NEPM exceedances is considered necessary to assess whether the discharges from the premises may be impacting on the Onslow community. The content of the report is described in schedule 3 of the licence. It includes the monitoring data in relation to the event and investigation outcomes on determination of the source of the exceedance and any mitigation measures undertaken in response to the event.

9.1.4 Process monitoring

As per the previous section, condition 11 requires the applicant to undertake quarterly stack testing when GTGs and GTs are operational. Continuous monitoring of the fuel consumption of the GTGs and GTs has therefore been included in condition 11 to verify the operating frequency of the equipment with the units in operation at the time of monitoring. Should the data show that the operation of the GTGs and GTs does not correlate with the units being monitored, the licence conditions may be reviewed. Stack testing also requires the flow rates to be monitored.

Continuous monitoring of fuel consumption has also been included for the HOSH to provide verification that the infrastructure is operating on an infrequent basis, as specified in the operational requirements in condition 1. Should data indicate that the equipment is operating on a more frequent basis, the risk assessment, and air quality modelling may need to be reviewed.

As the AGTO is a key emission control for emissions from the AGRU, it should have limited downtime. Monitoring of fuel consumption for the AGTO has therefore also been included to verify operating frequency.

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. The GTP is also designed to minimise the amount of flaring undertaken. Condition 11 therefore includes continuous monitoring of the volume of gas flared in order to verify emissions from the flares, and confirm flaring continues to be minimised.

9.2 Licence controls – Fugitive emissions

9.2.1 Infrastructure and equipment

The premises has been designed to minimise fugitive emissions. The majority of fugitive emissions controls were included in the design and construction of the premises. Infrastructure and operational requirements and controls described in the Wheatstone Foundation Project Air Emission Design Report which are intended to minimise or prevent fugitive emissions have therefore been specified in Condition 1.

These include requirements which prevent the need for venting such as directing AGRU emisisons to the flare for combustion when the AGTO is offline, recovery of BOG to the LNG train or direction to the marine flare if the BOG compressors are unavailable. They also include requirements which prevent or minimise the generation of fugitive emissions such as nitrogen blanketing of storage tanks.

9.2.2 Specified actions

The EPA identified fugitive emissions as a potential risk associated with the operation of the premises and recommended in EPA Report 1404 that the Part V licence include a requirement for a Biennial Leak Detection and Repair program for the Wheatstone Project. A LDAR Plan was provided to the DWER with the commissioning plan for the premises. This Plan includes use of a variety of leak detection methods and control and repair strategies, including biannual Optical Gas Imaging and as needed use of organic and toxic vapour analaysers. Condition 6 has been included in the licence to require the applicant to undertake a six-monthly Optical Gas Imaging survey of the premises to address the EPA recommendation. The monitoring requirement and timing has been taken from the LDAR Plan. The outcomes of surveys are required to be reported in the Annual Environmental Report required by condition 24 of the licence.

9.3 Licence controls – discharges to land

9.3.1 Infrastructure and equipment

The risk assessment determined there is a high risk associated with the release of environmentally hazardous substances to the environment. The applicant's controls in relation to the storage and handling of environmentally hazardous materials have been specified as operational requirements in condition 1. The controls, infrastructure and equipment must be maintained and operated on site to minimise the risk of environmentally hazardous substances being discharged to the environment.

The requirements specified in condition 1 are summarised in Table 38.

Table 38 Infrastructure and equipment operational requirements for environmentally hazardous substances

Site Infrastructure	Requirements
LNG storage tanks	Storage tanks must have: • continuous temperature based leak detection linked to an alarm; • a monitored high and a high-high level alarm; and • an interlock which shuts down incoming flow when the high-high level alarm is triggered.
Condensate storage tanks located within a geosynthetic clay lined bunded containment area with a with a hydraulic conductivity of $1x10^{-7}$ cm/s.	The bunded containment area shall be capable of storing 110% of the tank volume. Storage bunding must be emptied prior to an impending cyclone unless unsafe to do so. Storage tanks must have: • a monitored high and a high-high level alarm; and

Site Infrastructure	Requirements
	• an interlock which shuts down incoming flow when the high-high level alarm is triggered.
Propane and ethylene storage drums	Storage drums must: • be maintained with sufficient capacity to store the refrigerant inventory of LNG train 1 and 2 during normal operating conditions; • have a continuous leak detection system linked to an alarm; • have a monitored high and a high-high level alarm; and • have an interlock which shuts down incoming flow when the high-high level alarm is triggered.
Operations diesel storage tank	Tanks are located within a concrete bunded containment area which is capable of storing 110% of the tank volume of the largest storage tank, or 25% of the total storage volume if multiple tanks occur within the bund. Tank bunding must be emptied prior to an impending cyclone unless unsafe to do so. Tanks must have: • nitrogen blanketing; and • a monitored high level alarm.
Emergency diesel generators storage tank	
Methanol / TEG storage tank	
Waste oil storage tank	
Wastewater tank	
Amine storage tank (concentrated aMDEA solution)	
Amine surge tank (diluted aMDEA solution)	
Hot oil storage tank	
Diesel line	A dry break coupling must be in use when unloading diesel from the materials offloading facility to the diesel line.

Condition 1 also includes controls relating to the management of stormwater and process wastewater to prevent release of contaminated water to the environment. The controls, infrastructure and equipment must be maintained and operated on site to minimise the risk of contaminated water being discharged to the environment. The specified requirements have been derived from those proposed by the applicant.

The requirements specified in condition 1 are summarised in Table 38. Additionally, as per Table 38, tank bunds are required to be emptied prior to a cyclone where it is safe to do so to prevent release of potentially contaminated water from within the bund to the environment.

Table 39 Infrastructure and equipment operational requirements for stormwater and process wastewater

Site Infrastructure	Requirements
Wastewater lift stations	Must be operated and maintained for the collection of process wastewater. Must have a monitored high level alarm.
PWTS	Contaminated stormwater and process wastewater from wastewater lift stations, process unit sumps and

Site Infrastructure	Requirements
Comprises a diversion tank, influent splitter box, two treatment trains and two oily sludge holding tanks located within a concrete bunded containment area draining to a collection sump. Each treatment train comprises: -a corrugated plate interceptor; -a dissolved air flotation system; and -a dissolved air flotation effluent filter	first flush sumps must be treated through the PWTS prior to discharge from the Premises or otherwise collected for offsite disposal. Composite sampling of treated wastewater must be undertaken. Sludges and waste oil collected from the PWTS must be directed to the waste oil storage tank, oily sludge holding tank or collected for offsite disposal.
Stormwater infrastructure Drainage First flush sumps Sedimentation ponds	The first 25 mm of stormwater runoff from process areas must be directed to a first flush sump. The drainage network must direct uncontaminated water to sedimentation ponds. Stormwater from car parks must be directed through an oil and sediment trap. First flush sumps must have a monitored high level alarm and an oil skimmer. If stormwater within the first slush sumps does not meet the water quality criteria in condition 5 when monitored, it must be diverted to the Primary Water Treatment System for treatment. First flush sumps must be inspected prior to an impending cyclone and contained water removed to ensure the sumps have >90% capacity, unless unsafe to do so.

9.3.2 Specified emissions and limits

Condition 2 has been included in the licence to specify the emission points and types of emission (clean stormwater) which have been assessed in this Decision Report and are authorised to be discharged to land from the premises.

Limits have been specified in condition 5 on the basis that stormwater being discharged from the premises should be uncontaminated to minimise the likelihood of stormwater discharge impacting on the sensitive ecosystems (such as mangroves) in the surrounding region. The applicant proposed water quality limits for stormwater which the Delegated Officer determined are acceptable.

Emissions and limits have not been specified for treated process wastewater discharged from the PWTS as the wastewater will discharge to a Combined Effluent Sump outside the premises (not the environment). Discharge of co-mingled wastewater streams from the Combined Effluent Sump is currently authorised under W5671/2014/1.

9.3.3 Monitoring

Monitoring requirements for discharges to land have been imposed through condition 17 to confirm that the quality of stormwater which is directed to the sedimentation ponds is suitable for discharge to land, and will not exceed the limits specified in condition 5.

Monitoring and analysis methods have been specified in the condition to ensure that monitoring data is reliable and accurate. Non-NATA accredited analysis is permitted for some parameters due to the remote nature of the site, and short holding times which make it not possible to meet the specified holding times for these parameters.

Condition 18 has been included in the licence to specify ambient groundwater monitoring requirements for the premises. Ambient groundwater monitoring has been included as a

requirement due to:

- the risk assessment determining there is a high risk associated with the release of environmentally hazardous substances to the environment; and
- EPA Report 1404 recommending groundwater monitoring around the GTP pad and potentially contaminating infrastructure be included in the Part V Licence.

Ambient groundwater monitoring will enable detection of changes in groundwater quality which could result from discharges of environmentally hazardous materials or contaminated stormwater or process water to land.

The applicant provided a series of groundwater monitoring bores proposed for the premises ambient groundwater monitoring network. The monitoring locations were selected based on the location of potentially contaminating infrastructure and activities, potential groundwater flow paths and continuing to develop understanding of the hydrogeological regime at the pemises. The majority of the monitoring bores selected are nested (shallow and intermediate) and were newly installed in 2019 to replace monitoring bores that were monitored throughout the construction and commissioning period. Many of the bores monitored through the construction and commissioning period are either no longer accessible, or were not suitably installed to provide reliable monitoring data. A perched water table has also developed in the GTP pad and the existing monitoring bores do not adequately target this.

The Delegated Officer has considered the applicant's proposed ambient groundwater monitoring network and determined that it sufficiently covers the extent of the premises and potentially contaminating activities. Only shallow monitoring bores have been included as specified monitoring locations in condition 18 as the first signs of contamination will occur in the perched water table. Recognising that the perched water table may subside, condition 18 allows for samples to be collected from the corresponding intermediate bore in the event sampling can't be undertaken from a shallow monitoring bore.

The monitoring frequency has been specified as six-monthly to align with the monitoring frequency undertaken by the applicant during the construction, commissioning and operation of stage 1. The monitoring suite includes standard water quality parameters such as standing water levels, pH, electrical conductivity, and hydrocarbons including total recoverable hydrocarbons and BTEX.

9.4 General monitoring requirements

Multiple monitoring requirements, requiring use of various monitoring equipment and to a range of frequencies are required by the conditions of the licence. General monitoring requirements which may be applicable to one or more of the licence monitoring requirements have therefore been included in conditions 7 to 10.

- To ensure monitoring results are recorded this requirement has been specified in condition 7.
- To ensure that monitoring events are sufficiently far apart in accordance, with the intent of the monitoring frequencies described in the licence, condition 8 has been included to specify the time between monitoring events for each frequency of monitoring required by the licence.
- To ensure monitoring data is reliable, accurate and relevant conditions 9 and 10 have been included to specify availability of continuous monitoring equipment and calibration requirements for other monitoring equipment.

9.5 Record keeping and reporting

Notification requirements have been included in condition 21 of the Licence to provide a framework and requirements for reporting of limit exceedances as well as any non-compliance

with the conditions of the licence. Reporting of limit exceedances and non-compliances informs the Department of activities on the premises which may impact on the risk assessment for the premises.

The premises is in close proximity to a township (Onslow) and the activities undertaken may impact on the health or amenity of residents. Condition 22 has therefore been included in the licence requiring the applicant to record the details of complaints and actions taken in response to complaints. Recording, reporting and investigating of complaints aids in determining if the community is being impacted by the operation of the premises.

The licence conditions require that stack testing, process monitoring, ambient air, groundwater, meteorological, and stormwater discharge monitoring must be undertaken in association with the licence. The results of the monitoring are required to be submitted to DWER in the form of an Annual Environmental Report. Submission of an Annual Environmental Report allows for the Department to review the contained information to inform future review and risk assessments, and assess if the activities on the premises are impacting on the environment. Condition 24 has been included in the licence to specify the timeframe for submission of the Annual Environmental Report and the information which must be included in the report. Information to be reported is primarily the results of all monitoring of discharges to air, discharges to land, ambient air, meteorological data, and groundwater. Results and outcomes from the biannual Optical Gas Imaging Surveys are also required to be reported.

The applicant will also be required to submit an Annual Audit Compliance Report each year to demonstrate whether the Licence conditions have been complied with in the preceding year. Condition 23 has been included to specify this requirement.

10. Determination of licence conditions

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

The *Guidance Statement: Licence Duration* has been applied and the issued licence expires in 20 years from date of issue.

Table 40 provides a summary of the conditions to be applied to this licence.

Table 40: Summary of conditions to be applied

Condition Ref	Grounds
Infrastructure and equipment 1	These conditions are valid, risk-based and contain appropriate controls.
Emissions and discharges 2, 3, 4, 5 and 6	These conditions are valid, risk-based and consistent with the EP Act
Monitoring (general) 7, 8, 9, and 10	
Monitoring (discharges to air and ambient) 11, 12, 13, 14, 15 and 16	
Monitoring (discharges to land including ambient groundwater) 17 and 18	
Record keeping 19, 20, 21, 22, 23 and 24	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

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

11. Conclusion

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

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

Caron Goodbourn
Manager, Process Industries
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1 Key documents

	Document title	In text ref	Availability
1.	Works Approval W5480/2013/1– Wheatstone Project LNG and Condensate Storage Facilities	W5480/2013/1	accessed at www.dwer.wa.gov.au
2.	Works Approval W5584/2014/1– Wheatstone Project LNG and Domgas Plant	W5584/2014/1	
3.	Works Approval W5671/2014/1 – Wheatstone Project LNG Plant Permanent Sewage Treatment Plant	W5671/2014/1	
4.	Licence and Decision Report for L9199/2019/1 Wheatstone Project Onslow	L9199/2019/1	
5.	Application for Licence – Wheatstone LNG Plant – LNG trains 1 & 2 and Common Facilities including application form and supporting document	Chevron 2019a	DWER records (DWERDT196206)
6.	Chevron Wheatstone Air Quality Data (Stage 2 Commissioning)	Chevron 2019b	DWER records (DWERDT2115545)
7.	Wheatstone Stage 2 Emissions Verification Report	Chevron 2019c	DWER records (DWERDT168711)
8.	Wheatstone Stage 2 Emissions Verification Report – Additional supporting information in response to request	Chevron 2019d	DWER records (DWERDT211120)
9.	Wheatstone Stage 2 Commissioning Report	Chevron 2019e	DWER records (DWERDT168709)
10.	Wheatstone Project LNG Plant Works Approval Application LNG and Domgas Plants	Chevron 2013	DWER records (A705369)
11.	Draft Environmental Impact Statement/ Environmental Review and Management Programme for the Proposed Wheatstone Project	Chevron 2010	Accessed at www.epa.wa.gov.au/
12.	Wheatstone Foundation Project Air Quality Assessment	Air Assessments 2013	DWER records (A705369)
13.	Environmental Noise Impact Assessment – Chevron Wheatstone LNG Plant	URS 2009	DWER records (A705369, Appendix D)
14.	W5584/2014/1 LNG and Domgas Commissioning Plan	Bechtel 2018	DWER records (A1602097)
15.	Wheatstone Conservation Significant Marine Fauna Interaction Management	Chevron 2016	Accessed at http://chevronaustralia.com.au

	Document title	In text ref	Availability
	Plan		
16.	Mangrove, Algal Mat and Tidal Creek Protection Management Plan	Chevron 2017	Accessed at http://chevronaustralia.com.au
17.	Wheatstone Project Groundwater Studies	URS 2010a	
18.	Wheatstone Project Surface Water Studies	URS 2010b	
19.	Wheatstone Project Appendix O1 – An assessment of Light Emissions in Relation to Sea Turtle Nesting Beaches in the Wheatstone Project Area	URS 2010c	
20.	Ministerial Statement 873 (Wheatstone Development - Gas Processing, Export Facilities and Infrastructure)	MS 873	Accessed at www.epa.wa.gov.au/
21.	EPA Report 1404 Wheatstone Development - Gas Processing, Export Facilities and Infrastructure	EPA 1404	
22.	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	DER 2015a	Accessed at www.dwer.wa.gov.au
23.	DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	DER 2015b	
24.	DER, August 2016. *Guidance Statement: Licence duration.* Department of Environment Regulation, Perth.	DER 2016a	
25.	DER, February 2017. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	DER 2017	
26.	DWER, June 2019. *Guideline: Decision Making*. Department of Water and Environmental Regulation, Perth.	DWER 2019a	
27.	DWER, June 2019. *Guideline: Industry Regulation Guide to Licensing*. Department of Water and Environmental Regulation, Perth.	DWER 2019b	
28.	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 incidents and complaints

DWER reference	Incident description	Incident/Complaint date
37330	Bechtel reported that approximately 500 litres of alkaline water associated with concrete activities for W5480/2013/1 was released from collection ponds/tanks located within the prescribed premises boundary. Additionally to prevent further release from the collection ponds, approximately 36,000L of the wastewater was trucked and discharged to a disused project borrow pit located outside of the prescribed premises. A Letter of Warning was issued to Bechtel in relation to the incident and the investigation closed.	10/07/2015
46516, 46585, 46597, 47345, 50679, 50750, 50802, 50939, 51456, 52272, 52781, 52787, 53073, 55165, 55248	Multiple reports of dark smoke emissions coming from the Wheatstone GTP were received during the pre-commissioning and commissioning period (2017 to 2019) for the Wheatstone GTP. Commissioning activities at the Premises have been conducted in accordance with the approved W5584/2014/1 Commissioning Plan (and amendments to the plan). The plan was first submitted to the DWER on the 8th December 2016. The commissioning process involves progressively bringing components of the LNG plant into operation, running for a period and then shutting down. The process of bringing various GTP components into operation can require flaring of feed gas, purged gas and refrigerants (propane and ethylene) and also inherently involves process upsets and start-ups/shutdowns requiring feed gas to be diverted to the flare for flaring. Flaring is also required during commissioning until gas meets the specifications required by downstream processing units. Flaring can cause varying degrees of dark smoke emissions depending on the combustion efficiency of the flare event. Chevron provided details of commissioning activities occurring at the time of the complaints which resulted in dark smoke emissions due to flaring. There were no exceedances of ambient air quality targets (defined in the Commissioning Plan) recorded at the Onslow Town Air Quality Monitoring Station on the dates the dark smoke emissions occurred.	07/09/2017, 14/09/2017, 15/09/2017, 22/11/2017, 26/07/2018, 03/08/2018, 10/08/2018, 27/08/2018, 20/10/2018, 18/12/2018, 03/02/2019, 04/02/2019, 23/02/2019, 12/10/2019, 18/10/2019
54768	Chevron reported that a discharge of condensate occurred on the site when pressure in a line carrying LNG to the ships increased leading to the failure of a safety valve causing a small leak. Discharge of approximately 216 L of condensate to ground occurred as a result. Accessible impacted soil was removed, tested and disposed.	27/12/2018
56068	Release of firefighting foam containing PFAS to ground causing localised soil impact. Testing of a PFAS free firefighting foam to blanket condensate fires was being undertaken on a concrete pad. The PFAS free firefighting foam was insufficient to blanket the fire and foam (containing PFAS) from the	27/8/2019

DWER reference	Incident description	Incident/Complaint date
	standby fire truck was required to bring the fire under control. This resulted in release of foam water containing PFAS over the edges of the concrete pad and beneath the concrete through cracks/expansion joints. Only 6 L of foam was used to blanket the fire therefore the release was less than this amount. Impacted soils were excavated to 10-15cm depth and disposed to a licensed facility. Removal of the concrete pad and further soil is planned, and validation sampling will be undertaken to confirm all contaminated material has been removed.	
56813/56782	Approximately 8,000L of contaminated stormwater containing therminol (polyethylbenzene) was incorrectly directed from a containment bund to the stormwater drainage system instead of the oily water lift station due to the incorrect valve on the bund being opened (valves were incorrectly labelled and have since been rectified) to release contained water after a rain event. Hydrocarbon spill pads were applied to the impacted drainage line as first response and the drainage system was flushed with fire water with hydrocarbon booms used to contain and remove the hydrocarbons from the drainage line. Validation sampling will be undertaken to confirm completion of remediation.	14/3/2020

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

Condition/DR section	Summary of Applicant's comment	DWER response
Condition 1	Requested operational requirements make reference to 'during normal operating conditions' for emission control system requirements to align with existing premises licence L9199/2019/1. Requested inclusion of ship loading and de-inerting as activities when flaring via the marine flare can occur to align with previous premises licence L9199/2019/1. Provided updated references to infrastructure locations and an updated infrastructure location map.	The Delegated Officer considered all requested changes and determined that: • references to normal operating conditions had been left out in error therefore were included where required in Table 1; • the extended pH limit was considered for the assessment of the existing Licence L9199/2019/1 and was left out in error therefore was corrected; • the Air Emission Design Report refers to 3% O_2 reference conditions for the AGTOs therefore the reference conditions in Table 6 have been corrected to align with the report; • ambient air concentration sampling methods for NO/NO_2/NOx, CO and O_3 were excluded from Table 7 in error and the relevant AS sampling methods have been included in the table; and • plans and infrastructure/discharge point /monitoring locations were updated to align with the updated references and plans provided.
Condition 2	Provided updated references to discharge point locations and maps and clarification of emissions for the HOSH and the AGTOs.	
Condition 5	Requested the range for the pH limit be changed from 6-8 to 6-9 to align with existing premises licence L9199/2019/1.	
Condition 11	Provided updated references to monitoring locations and maps. Requested the AGTO concentration unit for gases be changed from referenced to 15% O_2 to 3% O_2 to align with the Air Emission Design Report specifications. Provided comment that notes 3 and 4 were not referenced in the table.	
Condition 14	Noted that the AS3580.4.1 specified for sampling was only relevant to SO_2 monitoring and correct Australian Standard should be included for O3, NO/NO_2/NOx and CO.	

Condition/DR section	Summary of Applicant's comment	DWER response
Section 5.1 and 5.3	The applicant suggested that a similar/consistent approach to discussion and assessment of noise and air quality should have been applied in the decision report as the report considers the five train noise modelling study in its discussion and assessment of noise emissions, whereas the 2010 five train air quality assessment/modelling findings were not used for comparison with measured GLCs and stack monitoring results. Rather, the 2013 air quality assessment for the two train Wheatstone Foundation Project was used for comparison.	The Department considers available information in its assessment of applications and will use information considered to be most relevant to the application. As stated in section 5.1 of this decision report, the 2010 air quality study was for a project twice the size of the application, there were limitations with the study and emission rates used for the modelling were different to those in the AEDR for the two train Wheatstone Foundation Project. Therefore, the Delegated Officer considered the outcomes of the 2013 air quality study were most appropriate for comparison with monitoring results for this assessment. The applicant did not provide any additional noise modelling or monitoring information for the Department to base its decision making on, therefore discussion and assessment of noise emissions was based on the only available information, which was the noise modelling for the full five train Wheatstone Project.
Section 5.1 and 5.2	The applicant provided comments and suggested rewording of sections of the summary assessment of air quality modelling and monitoring results in sections 5.1 and 5.2 of the decision report. The applicant also submitted further information to support the comments and changes recommended including sector of interest analysis and pollution roses (for the Wheatstone Project and Onslow Power Station), as well as time series GLCs before and after commissioning the GTP for measured NO_2, SO_2 and O_3 at the Onslow AQMS. The applicant submitted that the provided additional monitoring data demonstrates that GLCs were higher prior to commissioning than the period after commissioning commenced, that other localised sources contribute to ambient air quality at the Onslow AQMS and that GLCs at Onslow are insensitive to emissions rates from the GTP. Suggested changes, commentary and additional information provided by the applicant are summarised	The Department considered available information for its assessment of air emissions including information submitted for works approval applications for the Wheatstone Foundation Project, publicly available information relating to the Wheatstone Project (such as submissions and management plans relating to the EPA assessment of the project), information submitted as part of compliance requirements for the works approvals, the application and additional information submitted for the Stage 1 Wheatstone licence L9199/2019/1, and the application and additional information submitted for this licence L9225/2019/1. The Delegated Officer considers that monitoring data and discussion of any relevant factors which influence the data should be provided as part of an application or earlier during the assessment process to be a key consideration of the Department's assessment of the application, not after the assessment has been drafted. The Delegated Officers consideration of the applicant's suggested changes, commentary and additional information submitted in response to the draft documents are summarised below.

Condition/DR section	Summary of Applicant's comment	DWER response
	below. 1) Provided further detail as to why air emissions are higher during commissioning than steady state operation for the GTP. This includes ongoing optimisation of performance. 2) Clarified that the 2010 air quality assessment considered design emission rates specific to the 5-train project (not generic rates as stated) 3) Clarified that the 2010 and 2013 air quality assessments considered routine and non-routine/upset operating scenarios 4) Additional reasoning why the 2010 modelling results can be considered in the assessment. 5) Statement that measured emissions rates (overall on a mass per unit time basis, from any point source type) are lower than modelled emissions rates, and have also trended lower throughout the commissioning period providing confidence that model input data and assumptions remain valid and conservative. The applicant provided revised wording of DWER's discussion relating to measured versus modelled emission rates based on this and suggested that as DWER deemed modelling was appropriate at works approval stage and emission rates are now less than modelled rates there is confidence that input data was sufficiently conservative. Stated that the accuracy of modelling as per EPA Guidance 40CFRPart51_appw_05 should be within a factor of 2 and that the completed modelling meets this. 6) Further discussion of regional modelling results for O_3 and NO_2 including that due to the distance of Onslow from the premises, the background	1) Text was amended to clarify the reasoning for higher air emissions during commissioning than steady state operation. 2) Text was amended to clarify that emission rates used for the 2010 air quality assessment were based on preliminary design rates. 3) Added text to clarify the 2010 assessment considered routine and non-routine operating scenarios. Not considered to be required for the 2013 assessment as the specific modelling scenarios are described. 4) The Delegated Officer did not consider it necessary to include further detail on the relevance of the 2010 modelling to this study. The modelling is not suitable for direct comparison with monitoring results and, as described for the previous item, the 2013 assessment is considered by the Delegated Officer to be most appropriate for comparison with monitoring data. 5) Emission rates are demonstrated in Figures 5 to 8 and show that there has been fluctuation in emission rates and there have been exceedances of modelled/design emission rates for some sources and pollutants. Exceedance of emission design criteria are also highlighted in Table 14. Emission rates have been considered per emission source not per emission source type as the monitoring is not continuous, therefore results can only be considered on an individual source basis. While the Delegated Officer considers that emission rates in general appear to have reduced from the highest rates recorded during commissioning, not all emission sources demonstrate clear trends at this point in time. The most recent emission monitoring results include one exceedance of a design emission rate and the results in general appear to be approximately in line with, or higher than, the initial monitoring event for each source. Continued monitoring will allow for trends to become more evident. The Delegated Officer considers the discussion relating to emission rates and modelling is appropriate based on the

Condition/DR section	Summary of Applicant's comment	DWER response
	modelled year has a proportionally larger influence on the modelled maximum GLCs particularly given the influence of the Wheatstone project on GLCs is predicted to be low. Comparison of predicted versus measured NO_2 at receptors isn't the only factor to evaluate model conservatism. 7) Comment that DWER's statement that modelled emission rates for Wheatstone appear to be lower than those of other GTPs is not appropriate given the difference in plant design between plants and that the statement also contradicts DWER's earlier assessment of modelling undertaken for the works approval for the Wheatstone GTP which considered that the emission rates used for modelling were appropriate. 8) Requested that tables showing measured emission rates verses modelled emission rates are used in the decision report rather than the summary table showing exceedances in Table 14 as this provides more context on progression of rates vs model with time. 9) Requested terminology in reference to design specifications in Table 14 and the following figures be amended to align with terminology in the Air Emission Design Report. 10) Provided discussion of NO_2 GLCs and sector of interest analysis data for GLCs for NO_2 to demonstrate that measured GLCs for NO_2 were higher pre commissioning than during, suggesting that emissions from the GTP are having minimal impact on air quality as measured at the Onslow AQMS. Also included comment that there are other contributory sources influencing air quality at Onslow. Suggested use of ambient air monitoring	information made available during the assessment period by the applicant. 6) The Delegated Officer agrees that for the regional modelling the proximity of fires to a receptor in the 'background data year' has a proportionally larger influence on the regional modelled maximum GLCs and that the influence of the Wheatstone Project on GLCs at Onslow is low. The Decision Report already included a statement that the Wheatstone Project is predicted to have minor impact on regional air quality and this has been restated to clarify this and is referred to in the key findings. The Delegated Officer considered that the local scale, rather than regional scale, modelling results were most appropriate for comparison with the ambient data collected at the Onslow AQMS as the majority of the time monitoring results are unlikely to be influenced by fires. Clarification has been included in the report when local modelling is referred to and additional discussion on regional modelling results for Onslow. It is acknowledged that there are many factors that influence model conservatism, however the Department has identified that the measured emission rates were in some cases higher than the modelled emission rates (design emission rate) therefore modelling may underestimate GLCs for relevant pollutants, particularly for the commissioning period. It is important that this potential limitation is identified so it can be a consideration in the risk assessment. 7) The statement referring to other modelling assessments was removed. 8) The amount of data in the stack monitoring result tables make them difficult to present in the report. The Delegated Officer considers that Figures 5 to 8 adequately illustrate the progression of monitoring results over time and these were included, rather than the tables, as information presented in this manner is considered easier for a reader to understand than large tables of data and is also relevant to making an

Condition/DR section	Summary of Applicant's comment	DWER response
	summary from 2015 to 2020 (provided additional data to support this) to illustrate pre and post commissioning measured GLCs and also suggested removal of the column % Max GLC modelled at Onslow from Table 12 as it is not a valid approach to evaluate model accuracy (reference was made to regional modelling predictions for NO_2 and O_3). 11) Provided additional key findings the applicant considers are relevant to the assessment including that GLCs at Onslow post start up of the GTP are similar to or less than prior to start up and that point source emissions have trended lower over time throughout the commissioning period and have been lower than predicted emissions rates in the most recent monitoring events. 12) Removed the key finding that the Delegated Officer considered that modelling was not sufficiently conservative to account for higher emissions during the commissioning period therefore there is some uncertainty regarding the predicted risk of exceeding the criteria when the Wheatstone Foundation project is in full production. The basis for removal was that the Project is currently in full production and operating at steady state, stack emissions are reducing, there has been no exceedances and GLCs were higher pre-start up than post therefore the applicant considers the risk of exceeding ambient air quality criteria to be very low.	assessment of trends. The summary in Table 14 is intended to support the discussion relating to exceedances. 9) Terminology was amended. 10) Monitoring data relevant to the application and supporting commentary regarding influences on the data should be provided with an application or early in the assessment phase in order to be considered as part of an assessment. The Delegated Officer notes that some of the additional data had previously been provided, the additional sector of interest analysis data and pollution roses provided do not demonstrate anything that will have a material effect on the assessment and these have not been considered further. It is stated in the Decision Report that the Wheatstone Project is predicted to have minor impact on regional air quality. There are other factors which may have influenced air quality at Onslow (including the decommissioning of the old Onslow Power station and commissioning of a new station which includes battery storage and solar generation) which could have impacted GLCs over the time period pre and post commissioning so clear conclusions cannot be drawn from the data provided. 11) The Delegated Officer did not make these findings in the assessment therefore the suggested changes were not made. 12) The Delegated Officer retained the key finding relating to model conservatism relating to commissioning however the wording has been altered to align with earlier statements in the Decision Report that modelling may not be have been sufficiently conservative and comment has been included to clarify that there are other contributing sources to the regional air quality. The Delegated Officer made a similar finding regarding model conservatism in the Decision Report for the previous licence L9199/2019/1 and does not consider that the applicant provided sufficient detail during the assessment phase to address this uncertainty. It is important that the Department identifies the potential limitations of the modelling as this influences the risk

Condition/DR section	Summary of Applicant's comment	DWER response
		assessment and highlights to the applicant that review may be required in the future if changes are planned or the modelling is required for other purposes such as future amendments or changes on the premises. In summary, minor alternations were made to the air quality modelling and monitoring discussion based on the applicant's comments however the Delegated Officer considers the discussion and key findings to be appropriate based on the information that was available for the assessment.
General	The applicant provided clarifications in response to queries noted in the draft decision report, updated infrastructure maps and provided corrections to minor errors in various sections of the document.	The Decision Report was updated where required based on the additional information and maps provided.

Attachment 1: Issued Licence L9225/2019/1