Wheatstone Project

Supporting Document for a Licence to Operate LNG Trains 1 and 2 and Common Facilities

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Contents

Tables

Figures

1 Introduction

1.1 Proponent

Chevron Australia Pty Ltd (CAPL) is operator of the Wheatstone Project on behalf the Wheatstone joint venture participants— the Australian subsidiaries of Chevron Corporation, Woodside Petroleum, Kuwait Foreign Petroleum Exploration Company, Kyushu Electric Power Company, and PE Wheatstone, a company part-owned by JERA.

1.2 Project Overview

The Wheatstone Project is one of Australia's largest resource projects, comprising offshore facilities and onshore domestic gas (Domgas) and liquefied natural gas (LNG) processing plants (Figure 1-1).

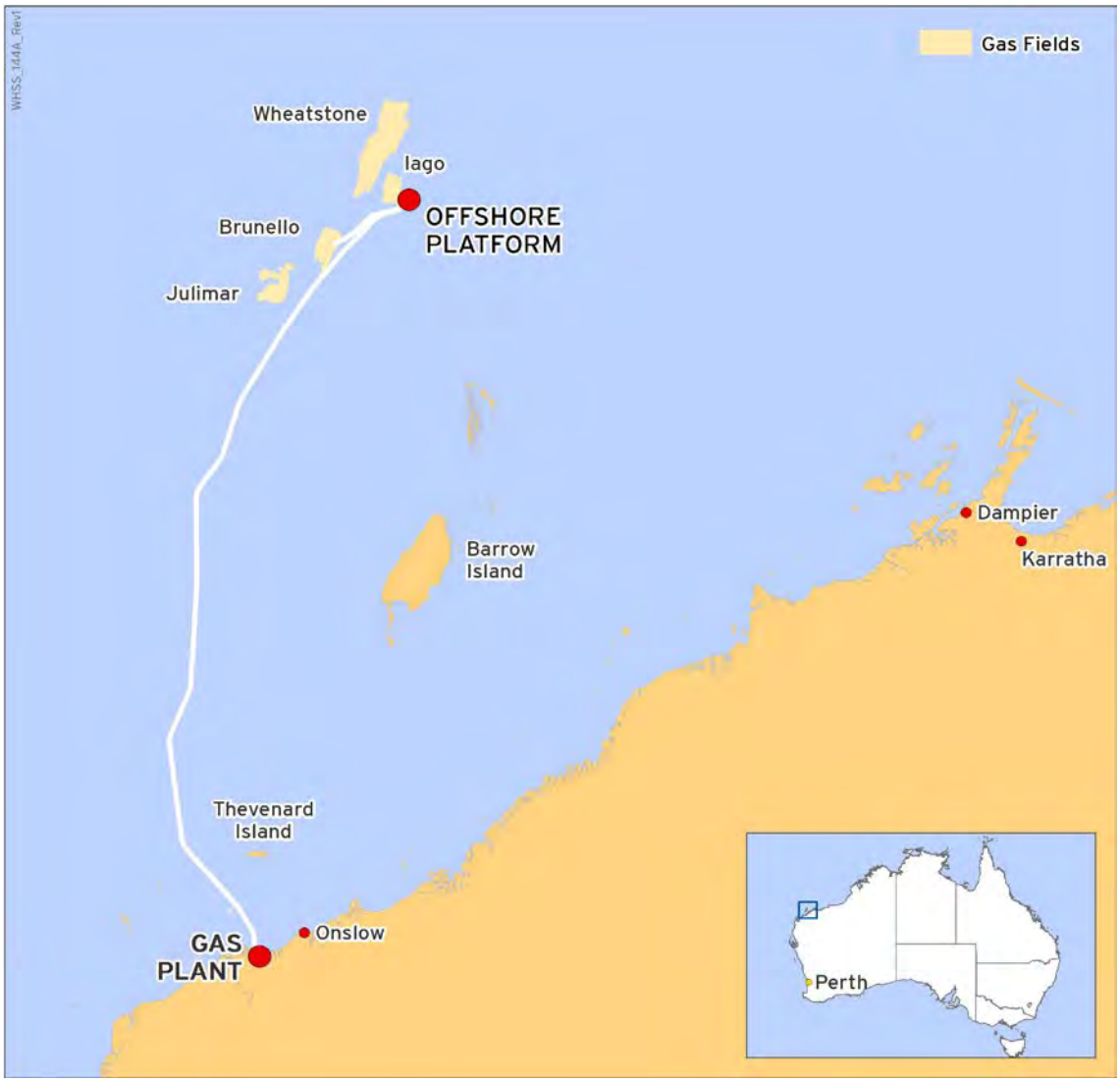

Figure 1-1: Wheatstone Project Offshore and Onshore Facilities

Offshore facilities for the Wheatstone Project will be used for gas gathering and processing. An offshore platform will initially treat gas and condensate (a low-density mixture of hydrocarbon [HC] liquids), which will then be transported via a subsea pipeline to the onshore LNG processing facility.

The onshore LNG processing facility is located on the north-west coast of Western Australia (WA) ~12 km south-west of Onslow (Figure 1-1). The foundation project comprises two LNG trains, a Domgas Plant, and common facilities, and is collectively referred to as the LNG Plant in this application unless otherwise stated. As outlined in Works Approval W5584/2014/1 (Ref. 1), the LNG Plant will be constructed, commissioned, and started in a staged approach.

The scope of this licence application is set out below.

1.3 Document Scope

This supporting document, together with the Application Form, constitutes the licence application for the operation of LNG Trains 1 and 2 and their common facilities, as defined in Section 3, using feed gas delivered from offshore gas fields (see Figure 1-1).

Not in Scope

Facilities not in scope for this document include:

- Domgas Plant
- solid and liquid wastes, which are administered under these licences:
  - LNG Plant Waste Storage Facility (L8976/2016/1) (Ref. 2)
  - Waste Management Site (L8759/2013/1) (Ref. 3)
  - Concrete Storage Area (L9082/2017/1) (Ref. 4)
- sanitary treatment system, waste discharge from the reverse osmosis (RO) plant; combined effluent sump; and permanent ocean outfall pipeline and diffuser (covered by W5671/2014/1) (Ref. 5)
- Construction Village STPs, which are administered under the Wheatstone Village and LNG Plant Temporary Utilities licence (L8650/2012/1) (Ref. 6).
- discharge of non-contaminated stormwater and potentially contaminated wastewaters (related to LNG Trains 1 and 2, common facilities, and areas located within proposed prescribed premises), which are administered under W5584/2014/1 (Ref. 1) and W5671/2014/1 (Ref. 5), respectively.

Application Form Requirements

In accordance with the Department of Water and Environmental Regulation (DWER) Application Form, Table 1-1 summarises the supporting information provided in this document.

Table 1-1: Supporting Information Requirements

Application Form Information and Attachment Requirement	Section of Document
Part 1 – Application type	Section 1
Part 2 – Applicant details	Section 1
Attachment 1A – Proof of occupier status	Section 2, Appendix A
Attachment 1B – Company extract	Appendix A
Part 3 – Premises details	Section 3
Attachment 2 – Premises maps, prescribed premise boundary, layout of key infrastructure, emission/discharge points, and sensitive receptors	Appendix B

Application Form Information and Attachment Requirement	Section of Document
Part 3.3 – Proposed prescribed premise coordinates	Appendix B
Part 4 – Proposed activities	Sections 4 and 5, Figure 4-1
Part 6 – Other DWER approvals	Section 6
Part 7 – Other approvals and consultation	Sections 6 and 8
Attachment 5 – details of other approvals	Not applicable
Part 8 – Fit and competent operator	See Application Form
Part 9 – Emissions, discharges, and waste	Section 9
Part 10 – Siting and location	Section 5.3
Attachment 7 – Siting and location	Section 5.3
Part 11 – Submission of any other relevant information	This supporting report and appendices
Attachment 8 – Other relevant information	This supporting report and appendices
Part 12 – Proposed fee calculation Attachment 9	Section 10 Appendix E
Part 13 – Submission of application	See Application Form
Part 14 – Declaration and signature	See Application Form
Attachment 10 – Request for exemption from publication	Not required

1.4 Licensing Strategy

Permanent facilities at the LNG Plant that are being constructed, commissioned, and started up in accordance with Part V of the Western Australian *Environmental Protection Act 1986* (EP Act) include:

- LNG and Domgas Plants (Stages 1, 2, and 3)
- LNG and condensate storage facilities
- LNG Plant waste storage facility.

CAPL's ultimate intention is to hold a single Licence to Operate for the permanent facilities as described in Works Approvals W5584/2014/1, W5480/2013/1, and W5671/2014/1 (Ref. 1; Ref. 7; Ref. 5) pursuant to Part V of the EP Act. CAPL is applying for Licences to Operate the LNG Plant in stages, reflecting the staged approach for construction, commissioning, and start-up of these permanent facilities.

The prescribed premises boundary proposed for this licence application, as shown in Appendix B, encompasses LNG Trains 1 and 2, the common facilities, and the LNG and condensate storage facilities.

A licence application to incorporate the Domgas facility will be submitted when that facility is commissioned. When additional permanent facilities become the subject of a Part V Licence to Operate, the prescribed premises boundary will be extended to include these facilities in the licence.

Facilities subject to existing Part V licences, such as the Wheatstone Village and LNG Plant Temporary Utilities (L8650/2012/1) (Ref. 6), continue to operate in accordance with those licences.

This approach is not predicted to result in any cumulative or additive environmental issues that cannot be assessed during the relevant licensing stage.

2 Project Location and Tenure

2.1 Project Location

The Wheatstone Project LNG Plant site is situated in the Shire of Ashburton, in the Pilbara region of WA, ~12 km south-west of Onslow. Land uses in the Shire of Ashburton—an area of ~106 000 km^2—include mining and grazing, with fishing occurring in waters off the Pilbara coast.

The LNG Plant is connected to the Wheatstone Village by a new road network and Onslow township is accessible from these areas via Onslow Road.

The Onslow Solar Salt Project, operated by Onslow Salt Pty Ltd, holds a lease ~5 km east of the LNG Plant site and 6 km north-east of the Wheatstone Village.

2.2 Tenure

Table 2-1 lists the LNG Plant's Lot and Plan details.

Table 2-1: Gazetted Lot and Plan Details

Part Lot Number	Plan Number
238	195206
567	71345
569	

3 Proposal Description

This application proposes to licence LNG Trains 1 and 2 and common facilities (including LNG and condensate storage facilities) under Part V of the EP Act. The specific infrastructure components included in this licence application are listed in Table 3-1.

Table 3-1: Application Infrastructure Details

Core Components	Included Infrastructure
LNG Trains 1 and 2	LNG processing trains 1 and 2, including for each train: • Acid gas removal, including an acid gas thermal oxidiser (AGTO) for each train • Dehydration and mercury removal • Liquefaction and refrigerant compression, including nitrogen rejection and heavy HC removal / condensate recovery.
LNG and Condensate Storage Facilities	Storage facilities including: • Two LNG tanks ~150 000 cubic metres (m^3) net each • Boil-off gas (BOG) compressors • Two Condensate tanks ~120 000 m^3 gross each • Condensate wet surface air cooler.
Common Utilities	Utilities include: • Inlet gas conditioning and condensate stabilisation • Fuel gas and recycle gas systems • Power generation • Heating media system, including a hot oil storage tank • Two amine surge tanks and an amine storage tank • Flares and vents • Diesel storage and distribution • Refrigerant storage • Wastewater and stormwater drainage generated from within the prescribed premises area • Primary treatment system (treats non-sanitary wastewater) • Fire and gas protection • Air and water systems (Note: Brine discharge from the RO Plant is managed under W5671/2014/1; Ref. 5) • Turbine inlet air humidification (TIAH) • Nitrogen generation system • Plant and instrument air.

Pursuant to Sections 56 and 57 of the EP Act, and Parts 1 and 2 of Schedule 1 of the associated EP Regulations, this application is for these prescribed premises categories:

- 10 (oil or gas production from wells)
- 34 (oil or gas refining)
- 52 (electric power generation).

Table 3-2 lists the throughput criteria for each prescribed premises category.

Table 3-2: Applicable Schedule 1 Prescribed Premises Category Criteria

Category No.	Category Description	Production / Design Capacity		Premises Fee Component
		Category	Premises	
10	Oil and gas production from wells: premises, whether on land or offshore, on which crude oil, natural gas, or condensate is extracted from below the surface of the land or the seabed, as the case requires, and is treated or separated to produce stabilised crude oil, purified natural gas, or liquefied hydrogen gases.	≥5000 tonnes per annum (tpa)	12 million tpa 1.1 million m^3 per annum of condensate	>2 million tpa
34	Oil or gas refining: premises on which crude oil, condensate, or gas is refined or processed.	Not applicable	12 million tpa	>2 million tpa
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.	≥20 MW in aggregate (using natural gas). ≥10 MW in aggregate (using fuel other than natural gas)	151.2 MW	>100 MW. (includes 14 MW of backup power, which uses diesel fuel)

Works Approval W5480/2013/1 (Ref. 7) included prescribed premises Category 73, Bulk Storage of Chemicals. However, most chemicals, acids, and alkalis stored within the proposed prescribed premises boundary are process chemicals for, or products from, prescribed premises Categories 10 and 34. The exception is diesel. However, diesel is not stored in quantities >1000 m^3 in the proposed prescribed premises boundary; therefore, prescribed premises Category 73 does not apply to this licence application.

3.1 Prescribed Premises Boundary

The proposed prescribed premises boundary is shown on an aerial photograph and is included in Appendix B.

The boundary details are also provided electronically in the Geographic Information System (GIS) Coordinate file in Appendix B, as required by Section 2.3 of the Application Form.

3.2 Existing Licenced Facilities

The LNG Train 1 Licence application currently being processed by DWER is to be included into the Wheatstone LNG Trains 1 and 2 licence. Construction of LNG Train 1 and its common facilities were completed in June 2017 under W5584/2014/1 (Ref. 1) and W5480/2013/1 (Ref. 7). The Stage 1 Compliance report for LNG Train 1 was submitted on 9 June 2017 allowing commissioning to commence on 2 July 2017. Commissioning of LNG Train 1 was completed in late 2018 with the LNG W5584/2014/1 (Ref. 1) Stage 1 Commissioning Report submitted to DWER on 1 February 2019.

4 Facility Description and Plant Process

This Section describes the facilities subject to this licence application. Figure 4-1 shows a diagram of the basic plant processes.

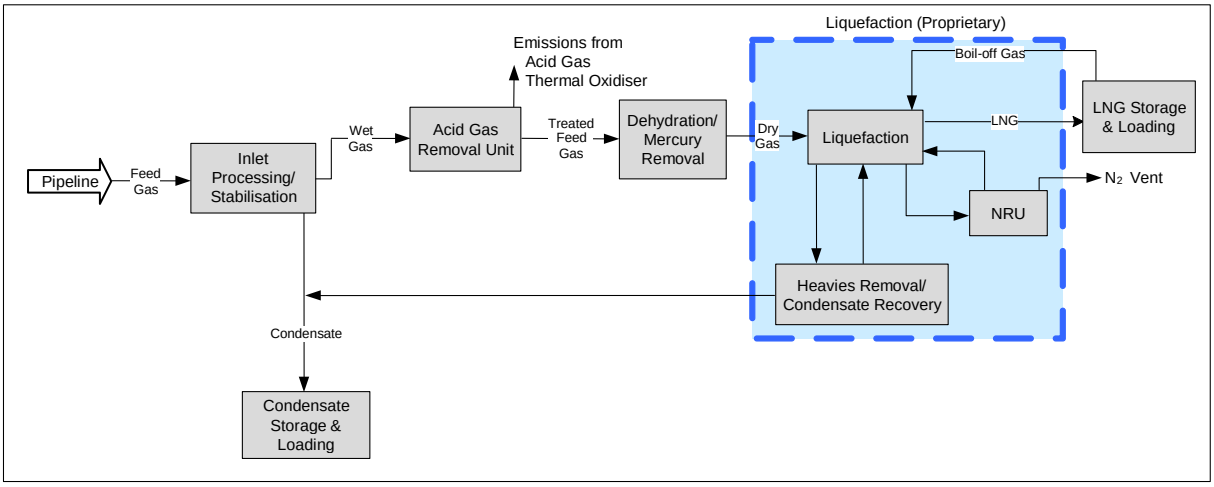

Figure 4-1: LNG Train Process Diagram

4.1 Pre-treatment and LNG Production

4.1.1 Acid Gas Removal Unit, Dehydration and Mercury Removal

Process gas is routed to the AGRU to remove carbon dioxide (CO_2) and hydrogen sulfide (H_2S) (collectively known as 'acid gas') using conventional activated methyldiethanolamine (aMDEA) technology. Some volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene, and xylene (BTEX), in the process gas will also be absorbed by the aMDEA solvent. Heat is applied to the saturated aMDEA solution to regenerate aMDEA, which is returned to the absorber via a closed-loop system. The stripped gas (which contains ~93% CO_2, water, and trace amounts of BTEX and H_2S) is disposed of through an AGTO, which oxidises HCs or sulfur compounds to CO_2, sulfur oxides (SO_x), and water.

A dehydration unit is located downstream of the AGRU and upstream of the mercury removal unit. The dehydration unit removes water from feed gas to the LNG train to prevent water freezing in the cryogenic units.

The mercury removal unit is located downstream of the dehydration unit and upstream of the liquefaction system.

4.1.2 Liquefaction and Refrigerant Compression, including Nitrogen Rejection Unit

The conditioned gas then passes into the liquefaction system, which progressively cools it to −160 °C, at which point the gas liquefies into LNG. This process uses a 'cascade' of successive refrigeration steps to progressively cool and liquefy the feed gas into LNG. Three refrigerant services are used: propane, ethylene, and methane, each in their own circulation loops. Six gas turbine compressors (GTCs) are used for each LNG train to provide power to the refrigerant compressors. This application is for LNG Trains 1 and 2; therefore, 12 GTCs are subject to this licence application.

As the conditioned gas passes through a series of heat exchangers, it cools as it gives up heat to the successive refrigerants. The cooled gas is then flashed

(allowed to expand into a separator or drum) to atmospheric pressure, cooling it further. 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 Nitrogen Rejection Unit (NRU) is used in the LNG trains to remove excess nitrogen (N_2). A series of fractionation columns cryogenically separates N_2 and concentrates it in the NRU. The concentrated N_2 with trace amounts of methane (CH_4) is vented to the atmosphere.

4.1.3 Heavy Hydrocarbon Removal and Fractionation (Licensor Proprietary Section)

Condensed HC liquid from cooling off the conditioned gas is separated and fractionated to remove the heavier HC components. This prevents heavier HC compounds from freezing in the low-temperature liquefaction section, and satisfies the heating value and composition specifications of the LNG product. These heavy components are recovered as natural gas liquids or condensate stream and are blended with the stabilised condensate from the inlet facilities to produce the final condensate product.

4.2 Common Facilities

4.2.1 Inlet Gas Conditioning and Condensate Stabilisation System

The Wheatstone Project's onshore inlet facilities condition the dehydrated feed gas from the Wheatstone offshore platform and provide a stable process gas stream to the LNG trains. Feed gas entering through the slug catcher is separated into process gas, HC condensate, and wastewater streams. Condensate is stabilised in the condensate stabiliser system, which strips off light-ends to meet condensate vapour pressure specifications, before sending the product to the condensate tanks. The stripped gas is compressed and transferred to the main feed gas line to the LNG trains for processing, and wastewater is routed to the non- sanitary wastewater treatment system.

4.2.2 Fuel Gas and Recycle Gas Systems

Fuel gas and recycle gas systems reliably provide fuel gas to users throughout the LNG facility. The fuel gas system comprises a high-pressure (HP) fuel gas section, which supplies fuel gas at about 45 barg (gauge pressure) to the GTCs and gas turbine generators (GTGs), and a low-pressure (LP) fuel gas section, which supplies fuel gas to the flare pilots and purges, the AGTOs, the Domgas Plant regeneration gas heater, and other miscellaneous users. The fuel gas is normally supplied by the methane compressor loop. Backup fuel gas can be supplied from the outlet of the dehydration unit and the inlet facilities.

4.2.3 Power Generation System

The power generation system supplies power to the two LNG trains, the Domgas Plant train, 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. Four GTGs with TIAH supply sufficient power to meet the maximum power requirements over the entire site and are subject to this licence application.

Five diesel-engine–driven generators (each nominal 2 MW capacity) supply the essential power for the LNG Plant when the main power supply system is tripped offline or is not available. The diesel generators are sized in an N+1 configuration

so that all essential power is provided by four units and the fifth is available as a spare. An additional dedicated diesel generator is installed in the operations centre to provide essential backup power to the central control room and administration offices.

4.2.4 Heating Medium System

Waste heat recovery units (WHRUs) are installed in the exhaust ducts of each refrigeration compressor gas turbine. This system essentially supplies all the LNG Plant's process heating requirements. A closed-loop, hot oil heating medium is used to transport heat from the WHRUs to supply major users, such as the condensate stabilisation facilities, AGRU regeneration, and fractionation reboiler. A small gas-fired hot oil start-up heater, common to both LNG trains, is used during start-up operations when the refrigerant gas turbine drivers are not operating.

4.2.5 Pressure Relief / Liquids Disposal and Flare Systems

A pressure relief and liquids disposal system, with both wet and dry service flare systems, supports the start-up, shutdown, emergency, and maintenance depressurisation requirements of the process facilities. The LNG Plant flare system comprises a group of HP and LP flare structures, each containing a wet, dry, and common flare. A separate marine flare handles the vapour from the LNG storage tanks and excess boil-off vapour generated during LNG ship loading.

4.2.6 Diesel Storage and Distribution

Diesel storage and above-ground distribution facilities, including the diesel lines from the materials offloading facility to the LNG Plant, provide diesel to many users, such as essential power backup systems discussed in Section 4.2.3.

4.2.7 LNG and Condensate Product Storage and Export Facilities

LNG will be stored at atmospheric pressure in two full containment tanks, each with a net capacity of ~150 000 m^3, and pumped to the loading berth to be transferred to tankers via the LNG loading arms. Condensate will be stored at atmospheric pressure in two tanks (~120 000 m^3 capacity each), and pumped to the loading berth to be transferred to tankers via the condensate loading arms.

4.2.8 Refrigerant Storage Unit

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

4.2.9 Fire and Gas Protection Systems

Fire and gas protection systems use process design controls to prevent an incident from occurring. These systems comprise various measures that prevent, control, and mitigate fire and explosion hazards associated with handling natural gas, LNG, condensate, liquefied petroleum gas, and other hazardous materials.

4.2.10 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 (refer to Section 4.2.13).

4.2.11 Wastewater and Stormwater Drainage

Wastewater from the LNG Plant's permanent facilities is categorised as non-sanitary and sanitary wastewater.

Non-sanitary Wastewater

Non-sanitary wastewater is water that is contaminated (or potentially contaminated based in its flow path) with oil, HCs, or other process chemicals. A network of wastewater lift stations located in and around the LNG Plant and various buildings (e.g. laboratory, maintenance workshop) collect wastewater and, depending on the nature of contamination, send it to either the primary treatment system for treatment and subsequent discharge via the permanent ocean outfall, or to wastewater storage tanks for subsequent off-site disposal. The primary treatment system is within the scope of this licence application. The discharge of treated wastewater via the permanent ocean outfall, covered by W5671/2014/1 (Ref. 5), is not in the scope of this licence application.

Sanitary Wastewater

Sanitary wastewater from various buildings in and around the LNG Plant is collected in sanitary lift stations and pumped to the STP. The sanitary lift stations, STP, and associated discharge of treated wastewater via the permanent ocean outfall is covered by Works Approval W5671/2014/1 (Ref. 5) and is not in the scope of this licence application.

Stormwater Drainage

The design philosophy for the stormwater and surface run-off system is to:

- prevent contamination of the surrounding environment from stormwater collected at the LNG Plant site
- collect and segregate stormwater for suitable treatment and/or disposal, as appropriate
- prevent and control erosion and sedimentation.

The stormwater drainage system, approved under W5584/2014/1 (Ref. 1), includes these features:

- A network of sedimentation ponds and sumps collect stormwater from process areas and non-process areas.
- The first 25 mm of stormwater run-off from process areas is regarded as potentially contaminated and is collected in first-flush sumps.
- Run-off exceeding the first 25 mm from process areas is considered uncontaminated and diverted by an overflow weir to the sedimentation ponds.
- Stormwater generated from non-process areas is considered uncontaminated and is captured by the stormwater system and routed to the sedimentation ponds.
- The sumps and sedimentation ponds are fitted with diversion weirs after the first-flush volume; therefore, no freeboard needs to be maintained.
- All first-flush sumps have integrated high- and low-level alarms. Low-level alarms prevent pump damage while high-level alarms are used to ensure

sufficient time to respond before a sump reaches maximum capacity in the event of a spill.

The components of the stormwater drainage system located within the proposed prescribed premises (Appendix B) for LNG Trains 1 and 2 and the common facilities are within the scope of this licence application. However, the discharge of stormwater from sedimentation ponds, administered by W5584/2014/1 (Ref. 1), is not in scope. Water not meeting the discharge criteria in W5584/2014/1 (Ref. 1) is considered contaminated and is directed to the primary treatment system or collected for off-site disposal at a CAPL-approved third-party waste facility.

Components of the stormwater drainage system associated with the Domgas Plant are not in the scope of this licence application. Stormwater from the Domgas Plant will continue to be administered in accordance with the construction and commissioning phase controls defined in W5584/2014/1 (Ref. 1).

4.2.12 Water System

The water system uses reverse osmosis to produce fresh water to meet the water needs of the LNG Plant. The RO Plant is located within the proposed prescribed premise and is within scope of this licence application; however, it is not a prescribed activity under the EP Regulations. The Permanent RO Plant waste stream discharge is administered under Works Approval W5671/2014/1 (Ref. 5) and is not in the scope of this licence application.

4.2.13 Nitrogen System

Nitrogen is supplied via a nitrogen generation system, which is backed up with a liquid nitrogen system. Nitrogen is required by the LNG Plant for:

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

4.2.14 Hydrocarbon and Chemical Storage

In addition to LNG and condensate, various chemicals are used and stored throughout the prescribed premises boundary to support the operation of LNG Trains 1 and 2 and common facilities. Chemicals are stored in areas designed to prevent loss of containment to the environment.

5 Inputs, Outputs, and Proposed Monitoring

The following subsections describe each input to and expected outputs from the prescribed premises. Where relevant, the potential impacts of any proposed discharges to the environment are discussed in more detail in Section 9. Monitoring of outputs, environmental factors, and relevant targets are also discussed.

5.1 Inputs

5.1.1 Production Stream

Feed gas, condensate, and water (process fluids) are routine inputs to the prescribed premises. For the operation of LNG Trains 1 and 2 and common facilities that are the subject of this licence application, feed gas and condensate are from the Wheatstone–Iago and Julimar–Brunello gas fields.

5.1.2 Desalinated Water

Desalinated (fresh) water is produced at the RO Plant, which is located within the proposed prescribed premise and is within scope of this licence application. However, desalination is not a prescribed activity under the EP Regulations.

5.1.3 Process Chemicals

Various process chemicals are used in the prescribed premise throughout the gas treatment process.

Process chemicals are normally delivered to the LNG Plant via road transport (in tankers or in appropriate containers such as Intermediate Bulk Containers and isotainers). The LNG Plant also has facilities for diesel to be delivered by ship.

5.1.4 Boil-off Gas

BOG generated during ship loading will be directed back into the LNG tanks, or to a marine flare if the BOG compressors are not available (e.g. because of an emergency or maintenance). BOG from ships arriving from dry dock is directed to the marine flare.

5.2 Outputs

The operation of LNG Trains 1 and 2 and common facilities results in various outputs, both as products to be exported and as wastes to be discharged and/or disposed of appropriately. The following subsections describe each proposed output. Where the output is discharged to the environment, proposed monitoring is described in Section 5.4; any potential environmental impacts are described in Section 9.

5.2.1 Products

The primary output from the operation of LNG Trains 1 and 2 and common facilities are LNG and condensate, which will be exported directly from the PLF via ships.

5.2.2 Wastewater and Stormwater Drainage

Various wastewaters are expected to be generated from the operation of LNG Trains 1 and 2 and common facilities. These include, but are not limited to:

- non-sanitary wastewater, including that intermittently produced during maintenance, shutdown, and turnaround operations
- sanitary wastewater
- uncontaminated and contaminated stormwater.

See Section 4.2.11 for further details on the stormwater drainage system and discharge of treated wastewater.

5.2.3 Solid and Liquid Wastes

Various solid and liquid wastes are generated throughout the operation of LNG Trains 1 and 2 and common facilities.

Solid wastes generated during operations can be broadly categorised as general waste, putrescible waste, recyclable waste, and hazardous waste.

Liquid wastes generated during operations include but are not limited to sludges (sanitary and non-sanitary), chemicals, oils, oil and water mixtures, laboratory wastes, and acidic/caustic solutions.

5.2.4 Atmospheric Emissions

The primary sources of identified atmospheric pollutants and air toxics associated with the operation of LNG Train 1 and 2 and common facilities are listed in Table 5-1. Appendix B shows the locations of the point source emissions listed in Table 5-1.

Table 5-1: Key Air Emission Point Sources and Associated Major Emissions

Project Key Emission Sources	Associated Air Emissions
12 GTCs within LNG Trains 1 and 2	NO_x, SO_2, VOCs[1, 3], CO
Four power station GTGs	NO_x, SO_2, VOCs,[1, 3], CO
Elevated flares: three LP, three HP (wet, dry gas + spare)	NO_x, SO_2, VOCs[1, 3], CO
One marine flare	NO_x, SO_2, CO
Two AGTOs	NO_x, SO_2, VOCs[1,2,3], CO
Fugitives	VOCs

Notes

1 *VOCs related to natural gas combustion streams typically contain unburnt aliphatic HCs.*

2 *VOCs related to AGTO vents may contain aromatic compounds.*

3 *BTEX are a subset of VOCs and are accounted for under VOC emissions.*

In addition to the key air emission sources listed in Table 5-1, note that:

- The hot oil start-up heater has a small gas-fired burner and is expected to be used infrequently and for short periods because it only operates during a black start of the LNG plant. The hot oil is normally heated by the WHRUs installed on the exhaust of the compressor gas turbines.
- Emergency diesel generators are expected to be used infrequently and for short periods when the GTGs are unavailable, e.g. during shutdowns and maintenance; hence, they are not considered major emission sources because of their limited frequency of use and limited overall volume of associated emissions.

- Fugitive emissions are considered minor; these emissions may occur from condensate storage tanks, diesel storage tanks, and other equipment such as valves, flanges, connectors, pump seals, and compressor seals in hydrocarbon service, flow lines, and connections.
- Methane venting from the NRU is considered minor.
- CO_2, which occurs naturally in the feed gas, is removed via the AGRU (as described in Section 4) and emitted to the atmosphere.

5.3 Key Receptors

The Western Australian Environmental Protection Authority's (EPA) Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses (Ref. 8) details the recommended minimum separation distances between industrial activities, including oil and gas production, and sensitive land uses. Sensitive land uses are defined as those that are potentially sensitive to industrial emissions and include residential developments, schools, hospitals, shopping centres, and other public areas and buildings.

The recommended minimum separation distance between Sensitive Land Uses and the Wheatstone LNG Plant site is 2000 metres (2 km).Table 5-2 lists the key sensitive land use receptors and their distances from the LNG Plant. Those closest to the LNG Plant are Four Mile Creek (public access), located 4 km north east, the Old Onslow Town Site, located 4 km west, and the Onslow Salt Ponds (industrial premises) located 4 km east - all significantly more than the recommended separation distance of 2,000 metres. A map of the sensitive land uses is included in Appendix B.

Table 5-2 Location of Key Sensitive Land Use Receptors

Sensitive Land Uses	Distance from the Wheatstone LNG Plant Site
Old Onslow Town Site	4 km west
Four Mile Creek (Public access area)	4 km north east
Industrial premises – Onslow Salt Ponds	4 km east
Ashburton River Camp Site – Site 1	7.8 km south
Ashburton River Camp Site - Site 2	7.9 km south
Wheatstone Village	8 km south east
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	11.8 km south east
Residential – Onslow Town Site	12 km north east
Beadon Creek	13 km north east
Urala Homestead	18.4 km south east
Mindaroo Homestead	27 km south

The Western Australian Department of Environment Regulation Guidance Statement - Environmental Siting (Ref. 9) details the areas of high conservation

value and special significance (Specified Ecosystems) that could potentially be impacted by industrial emissions and discharges from prescribed premises.

The Specified Ecosystems in the vicinity of the LNG Plant site include *Threatened / Priority Fauna, Acid Sulfate Soils Risk Map Pilbara Coastline, and Hydrography WA 250k – Surface Water Polygons (GA 2015)*. Threatened / Priority Fauna and Acid Sulfate Soils have been previously assessed and approved under the Wheatstone Project Part IV and EPBC assessments, and therefore, have not been included in this application.

The stormwater drainage system has been designed to prevent contamination of the surrounding environment and prevent/control erosion and sedimentation from stormwater collected at the LNG Plant site and thereby reduce the risk of discharges to waterways. A map of the Specified Ecosystems is included in Appendix B

5.4 Proposed Monitoring

Inputs Monitoring: CAPL does not propose any monitoring of inputs into the LNG Trains 1 and 2 and common facilities prescribed premises.

Process Monitoring: CAPL does not propose any process monitoring for the LNG Trains 1 and 2 and common facilities prescribed premises.

Outputs Monitoring: CAPL proposes to monitor atmospheric emissions from the prescribed premises via stack emission monitoring programs, as described in Section 5.4.1.1. The ambient air quality monitoring program will continue to be implemented in accordance with the LNG and Domgas Plant – Regulatory Commissioning Plan) (Ref. 10) required by W5584/2014/1 (Ref. 1). Therefore, it is proposed to address ambient air quality monitoring during the licence application for Stage 3 (refer to Section 5.4.2).

Stormwater and treated wastewater discharge monitoring is administered under W5584/2014/1 (Ref. 1) and W5671/2014/1 (Ref. 5) respectively; therefore, no additional monitoring is proposed

Groundwater will be monitored under the Mangrove, Algal Mat and Tidal Creek Protection Management Plan (Ref. 11) to meet Condition 14-2 of Ministerial Statement No. 873 (MS 873). No additional monitoring is proposed.

Waste (solid and liquid) is monitored under LNG Plant Waste Storage Facility licence (L8976/2016/1; Ref. 2), Waste Management Site (L8759/2013/1; Ref. 3), and the Concrete Storage Area (L9082/2017/1; Ref. 4). No additional monitoring is proposed in this licence application.

5.4.1 Atmospheric Emissions

CAPL proposes to monitor atmospheric emissions from the prescribed premises via stack emission monitoring programs, as described in Sections 5.4 and 5.4.1.1.

5.4.1.1 Stack Emission Monitoring Program

The stack emission monitoring program is outlined in Table 5-3. Appendix B shows the location of each monitoring site.

Table 5-3: Emissions Monitoring Program

Atmospheric Emission Point Source	Parameters	Monitoring Method	Frequency
Emergency Diesel Generators	Diesel consumption	Fuel totaliser	Continuous[1]
HP/LP Flares	Volume of process HC gas burnt	HP/LP Flare flow meter	Continuous[1]
Marine Flares	Volume of process HC gas burnt	Marine Flare flow meter	Continuous[1]
GTGs	Fuel gas consumption and composition	Fuel gas flow meter and online compositional analyser	Continuous[1]
	Exhaust flow rate	United States Environmental Protection Agency (USEPA) Method 2 or 2F	Quarterly[2,3,4]
	NO_x, SO_2, CO, NMVOCs	NO_x: USEPA Method 7D or 7E	
		SO_2: USEPA Method 6C, 8, or ISO 11632:1998(E)	
		CO: USEPA Method 10	
		NMVOCs: USEPA Method 18	
GTCs	Fuel gas consumption and composition	Fuel gas flow meter and online compositional analyser	Continuous[1]
	Exhaust flow rate	USEPA Method 2 or 2F	Quarterly[2,3,4]
	NO_x, SO_2, CO, NMVOCs	NO_x: USEPA Method 7D or 7E	
		SO_2: USEPA Method 6C, 8, or ISO 11632:1998(E)	
		CO: USEPA Method 10	
		NMVOCs: USEPA Method 18	
AGTOs	Acid gas consumption and composition	Flow meter and online compositional analyser	Continuous[1]
	Exhaust flow rate	USEPA Method 2 or 2F	Quarterly[2,3,4]
	NO_x, SO_2, CO, NMVOCs	NO_x: USEPA Method 7D or 7E	
		SO_2: USEPA Method 6C, 8, or ISO 11632:1998(E)	
		CO: USEPA Method 10	
		VOCs: USEPA Method 18	

Notes:

1 *The monitoring requirements pertaining to fuel composition include the heating values.*

2 *This monitoring activity will be undertaken by a third-party specialist contractor.*

3 *If more than one monitoring method is stated for a parameter, only one method will be used for each sample, depending on factors such as available equipment or supplies, stack conditions, accessibility, and accreditations. Methods may be modified for safety or technical reasons.*

4 *Continuous data collection may include intermittent periods of downtime for maintenance or unplanned events (e.g. extreme weather events).*

Particulate matter (PM; PM_{10} and $PM_{2.5}$) is not included in the scope of the stack emission monitoring program as it is considered a pollutant of low significance given the:

- major emission sources within the LNG Plant run on fuel gas, which is clean burning
- very low levels of PM_{10} are expected to be generated in the exhaust emission streams due to the high combustion efficiency of the equipment
- insignificant contribution of PM from the operation of the LNG Plant as demonstrated by the ambient air quality modelling results summarised in W5584/2014/1 (Ref. 1). Ambient levels are <5% of the relevant PM_{10} National Environment Protection Measure (NEPM; Ref. 12) criteria.

5.4.2 Ambient Air Quality Monitoring

The ambient air quality monitoring program defined in the Commissioning Phase Air Monitoring Program (Ref. 14) (Attachment 4 of the LNG and Domgas Plant – Regulatory Commissioning Plan [Ref. 10]) will continue to be implemented until the end of the W5584/2014/1 commissioning period (i.e. related to Stage 3). As such, it is proposed to address ambient air quality monitoring during the licence application for Stage 3.

5.4.3 Stormwater Monitoring

The monitoring and discharge of stormwater is not in scope of this licence application. For further details refer to Section 4.2.11.

6 Existing Regulatory Controls

The subsections below summarise the key legislation and guidelines under which the LNG Plant will operate.

6.1 National Greenhouse and Energy Reporting Act 2007

The Commonwealth *National Greenhouse and Energy Reporting Act 2007* includes a legal requirement for reporting and distributing information about greenhouse gas (GHG) emissions, GHG projects, and the energy use and production of corporations. CAPL is required to report GHG emissions annually. The Safeguard Mechanism also applies to the Wheatstone facility, which requires that facilities with direct CO_2 emissions >100 000 tonnes a year keep net emissions at or below baseline emission levels.

6.2 Planning and Development Act 2005

The prescribed premises are located within the Ashburton North Strategic Industrial Area (ANSIA), which was created by the WA government under the *Planning and Development Act 2005* to cater for heavy industry for multiple proponents and related downstream opportunities (Ref. 15). The ANSIA estate will include a multi-user port facility, land areas for proponents, and infrastructure to accommodate LNG and other HC and natural gas processing for Domgas supply (Ref. 15).

In October 2011, the Shire of Ashburton adopted the ANSIA Structure Plan and submitted it to the WA Planning Commission for endorsement. After endorsement, Town Planning Scheme No. 7 was amended under the *Planning and Development Act 2005* (WA) to include the ANSIA Structure Plan.

The Pilbara Joint Development Approval Panel granted Planning Approval for the LNG and Domgas Plants on 10 July 2013.

6.3 Environmental Protection Act 1986 and Environment Protection and Biodiversity Conservation Act 1999

The environmental impact assessment (EIA) process for the proposed Wheatstone Project commenced in September 2008 when the proposal was formally referred to the WA Department of Environment and Conservation (now DWER) and the Commonwealth Department of Environment, Water, Heritage and the Arts (now Department of the Environment and Energy [DotEE]). The EIA process is administrated by DWER (under the WA EP Act) and DotEE (under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act]).

Both agencies agreed to a coordinated environmental assessment process, under which a single draft Environmental Impact Statement/Environmental Review and Management Program (EIS/ERMP) document (Ref. 16) was developed to satisfy the requirements of each agency. The Wheatstone Project was given final environmental approval under the EP Act via MS 873, which was published on 30 August 2011 (and subsequently amended by MS 903, 922, and 931), and EPBC Act via Referral Approval EPBC 2008/4469, published on 22 September 2011.

6.4 Environmental Protection Act 1986 Part V

Clearing of flora and vegetation within the terrestrial assessment area (TAA) was addressed and approved under Part IV of the EP Act via MS 873; therefore, a clearing permit is not required under Part V of the EP Act.

6.4.1 Works Approval W5584 and W5480

The construction and commissioning of LNG Trains 1 and 2 and common facilities, and LNG Plant and condensate storage facilities were approved by Works Approvals W5584/2014/1 (Ref. 1) and W5480/2013/1 (Ref. 7), respectively.

The design of LNG Trains 1 and 2 and common facilities includes various features specific to reducing the emissions from the premises. Where these design features are sufficient to reduce potential emissions without further operational controls, this licence application makes no further commitments. Pursuant to Condition 5.1.1 of W5584/2014/1 and W5480/2013/1 (Ref. 1; Ref. 7), compliance reports are submitted to assess the constructed facility against the design approved by the Works Approvals.

Conditions 5.1.5 and 5.1.3 of W5584/2014/1 and W5480/2013/1 (Ref. 1; Ref. 7) both require CAPL to submit to the Director of DWER for approval a commissioning report for each stage of the works, within one month of completing commissioning of each stage.

6.5 Rights in Water and Irrigation Act 1914

The *Rights in Water and Irrigation Act 1914* (WA) prescribes the extraction of ground and surface water. No ground and surface water use is expected from the proposed prescribed premises during construction or operation of the LNG and Domgas Plants.

6.6 Dangerous Goods Safety Act 2004

The storage of dangerous goods is governed by the *Dangerous Goods Safety Act 2004* (WA) and subsidiary regulations (Dangerous Goods Safety [Storage and Handling of Non-explosives] Regulations 2007; Dangerous Goods Safety [Major Hazard Facilities] Regulations 2007), which are administered by the WA Department of Mines, Industry Regulation and Safety (DMIRS).

In November 2016 the Wheatstone LNG Plant Major Hazard Facility Safety Report (Ref. 17) was accepted by DMIRS (then the Department of Mines and Petroleum) and a dangerous goods licence was issued to CAPL for the Schedule 1 substances associated with its operations.

7 Existing Environment

The following sections summarise the environment surrounding the proposed premises.

7.1 Climate

The Pilbara region experiences 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 (Ref. 18). Mean annual rainfall in the Onslow area is 317 mm, with most falling in the first half of the year and a pronounced dry period occurring between September and December (Ref. 19).

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 7-1) (Ref. 23). The average yearly evaporation (about 3100 mm) consistently exceeds average yearly rainfall (Ref. 19).

The Onslow area is situated on the most cyclone-prone part of the WA coast. On average a cyclone with wind gusts greater than 90 km/h occurs every two years, with an estimated eight severe cyclone events since 1910 (Ref. 20).

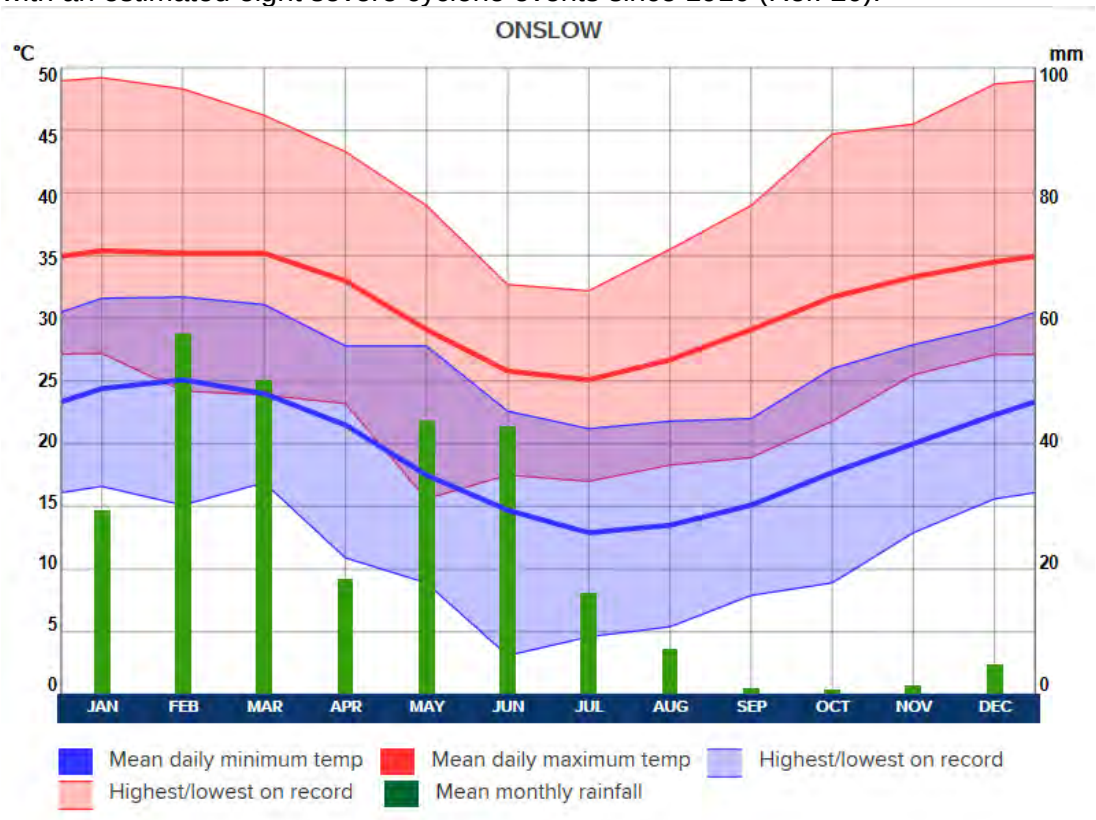

Figure 7-1: Climate Averages for Onslow Airport

Source: Ref. ***Error! Reference source not found.***

7.2 Landforms

The topography of the area surrounding the Wheatstone Project site is dominated by undulating dunal systems, alluvial / colluvial plains, and low-lying coastal

systems (Ref. **Error! Reference source not found.**). As such, spot heights in the Wheatstone Project region range between 5 m Australian Height Datum (AHD) and 21 m AHD (Ref. 21), and are associated with longitudinal dune networks and fringing and coastal dunes. Similarly, areas of low relief (generally <5 m AHD) are associated with samphire and supra-tidal salt flats, claypans, tidal creeks, and mangroves.

7.3 Surface and Ground Waters

The surface water environment of the premises is influenced by variable seasonal climatic conditions (Ref. **Error! Reference source not found.**). Surface water is predominantly the result of run-off from local subcatchments during periods of high precipitation.

The prescribed premises are located in the Ashburton River Delta, which is characterised as a coastal flood plain. When the Ashburton River floods, its flood waters spill onto the flood plain and may significantly add to the stream flow in the drainage lines of the Wheatstone Project area (Ref. 21.).

Evaporation rates in the region are also highly variable between seasons—the average evaporation rate in June is 135 mm and 370 mm in December (Ref. 19).

A groundwater study of the TAA was undertaken by URS (Ref. 2223) to understand the depth to groundwater at various sites within the TAA. URS concluded that local groundwater is brackish to hypersaline, near neutral to slightly alkaline, and a sodium–chloride type. Dissolved metal concentrations in the groundwater exceeded the Australian and New Zealand guidelines (Ref. 24) in many of the monitoring bores, which is commensurate with local groundwater salt concentrations and high groundwater salinity. The proposed prescribed premises are not located within any public drinking water source areas (Ref. 24).

7.4 Flora and Vegetation

The Wheatstone Project area is located within the Carnarvon bioregion (Ref. 25), which has a low and gently undulating landscape with open drainage. Vegetation is mainly acacia and saltbush/bluebush shrubland, with areas of tussock grassland in the north. Major land tenure is pastoral leasehold, with some conservation reserves, such as the Cape Range National Park.

The Wheatstone Project area lies within the Carnarvon Botanical District of the Eremaean Botanical Province, as defined by Beard (Ref. 26). The vegetation of this province is typically open and frequently dominated by spinifex, acacia, and occasional eucalypts.

No occurrences of threatened flora nor threatened or priority ecological communities (i.e. communities at risk of becoming a threatened ecological community), were recorded in the Wheatstone Project area during the field surveys done by Biota Environmental Sciences (Ref. 27).

Eleven non-native species were identified within the LNG Plant study area. Three of these—*Prosopis pallid, Prosopis glandulosa*, and *Parkinsonia aculeata*—are classified as declared weeds under the *Agriculture and Related Resources Protection Act 1976* (WA). *Prosopis pallid* and *Prosopis glandulosa* are widespread within the Wheatstone study area (Ref. 27).

7.5 Fauna

Terrestrial fauna and habitats were surveyed within the Wheatstone Project study area (Ref. 28). Six fauna habitats were considered to be present within the entire Wheatstone Project study area:

- Primary Dune: Spinifex and Triodia grassland and Buffel tussock on primary dune
- Sand / Loam Plains: *Acacia* sp. over *Triodia epactia* hummock grassland on sand / loam plain
- Samphire: Samphire on claypan
- Inland Dune: *Triodia epactia* dominated hummock grassland on inland dune system
- Tussock on Clay: Tussock grassland on claypan
- Drainage: *Eucalyptus* sp. and Buffel tussock dominated drainage line.

The habitat types within the Wheatstone Project study area are well represented both locally and in the wider region.

7.6 Ambient Air Quality

Ambient air quality around Onslow (the nearest sensitive receptor identified in the assessment) is likely to be influenced by ocean sources, biogenic emissions, PM_{10}, and regional smoke (Ref. 29).

Information regarding the local ambient air quality experienced in the Onslow region indicates that the main sources of VOC and NO_x emissions come from biogenic and bushfire sources (Ref. 30).

Existing dust at the LNG Plant is predominantly windblown with some minor anthropogenic sources such as dust produced by vehicles on unsealed roads in the area. Dust levels are seasonally variable due to a distinct wet season directly associated with tropical cyclones at the beginning of the year, and a marked end of year dry period. Data collected at monitoring stations in the TAA between May 2009 and April 2010 indicate that average dust levels over the year were 13.8 µg/m^3 of PM_{10}, with a maximum monthly PM_{10} average of 28.1 µg/m^3 in January (Ref. 16). These figures indicate that dust levels are within the criterion specified by the NEPM (Ambient Air Quality) for PM_{10} maximum 24-hour average concentration of 50 µg/m^3 (Ref. 12).

8 Stakeholder and Community Consultation

An extensive consultation program was undertaken for the Wheatstone Project as a whole, to support the environmental assessment of the Project under Part IV of the EP Act. This consultation program included, but was not limited to:

- stakeholder workshops
- presentations
- meetings
- public review of scoping and approval documentation.

The stakeholder consultation program identified community concerns, strategies to address potential impacts, and incorporated issues raised by the community into the planning and project design. More detail relating to this stakeholder consultation program, including stakeholders engaged and consultation methods/approaches, can be found in Section 5 of the EIS/ERMP (Ref. 16).

In addition to the above consultation methods, this application will be advertised by DWER in *The West Australian* newspaper and open for public comment for 21 days as required by the EP Act.

9 Environmental Impacts and Management

This Section of the licence application assesses the potential environmental impacts associated with discharges and emissions to the environment during the operation of LNG Trains 1 and 2 and common facilities. Appropriate management measures are proposed to mitigate any identified potential impacts.

Key management measures identified in this Section include pollution control and monitoring equipment. In the context of this licence application, pollution control and monitoring equipment is defined as:

- Pollution control equipment has the primary function to eliminate or mitigate the risk of discharge into the environment of environmentally hazardous material. A list of pollution control equipment is listed in Appendix C.
- Monitoring equipment is installed or used primarily for recording any parameter or quantity to be monitored and reported in accordance with the licence granted pursuant to this application. Monitoring equipment in this licence application is listed in Appendix D.

Note: Any reference to a Plan, Program, Report, or Procedure approved pursuant to Part IV of the EP Act in this licence application means the current version of that Plan, Program, Report, or Procedure as approved from time to time, including any amendments or replacements to that Plan, Program, Report, or Procedure made during the term of the licence. If commitments made in any Plan, Program, Report, or Procedure change from time to time, the commitments in those Plans, Programs, Reports, or Procedures take priority over commitments made in this licence application.

9.1 Emissions to Air

Atmospheric emissions have the potential to impact on the environment, which includes impacts on human health and wellbeing, odour, amenity, vegetation, and fauna.

The Works Approval application for W5584/2014/1 (Ref. 1) detailed the associated base emission rates and design emission targets for the two LNG trains and the Domgas Train applicable to the major emission sources detailed in Table 5-1. The base emission rates were used as inputs into several air quality modelling studies to assess potential impacts from the fully commissioned LNG Plant.

Ambient modelled emissions were compared to the NEPM (Ambient Air Quality) criteria (Ref. 12) and air toxins were compared to the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (Ref.31). These were modelled for selective sensitive receptors, including the town of Onslow, and for maximum values on the model grid.

The results of the air quality modelling studies at both local and regional scales indicate that, for all modelling scenarios, ground-level concentrations of airborne pollutants are below relevant assessment criteria and are as stated in W5584/2014/1 (Ref. 1).

Management Measures:

Works Approval W5584/2014/1 (Ref. 1) approved the design of the LNG Plant including LNG Trains 1 and 2 and common facilities (Stage 1), including the construction and installation of equipment with the potential to cause atmospheric emissions.

The Wheatstone Air Emission Design Report (AEDR; Ref. 32) (described and appended to the works approval application [Ref. 1]) specifically describes the emission reduction measures in design selected to minimise the major sources of atmospheric emissions to As Low As Reasonably Practicable (ALARP) levels. These measures are specifically described in Chapters 7 and 8 of the AEDR.

9.2 Odour Emissions

Odour emissions have the potential to adversely affect the welfare, health, convenience, comfort, and enjoyment of public amenity. The EP Act protects against 'unreasonable emissions' of odour.

Minor odour emissions may occur occasionally during commissioning and operation of the LNG and Domgas Plants. As no camp accommodation or residential areas occur near the LNG Plant, minor odour emissions from the LNG and Domgas Plants are not predicted to result in unreasonable odour at nearby sensitive receptors.

Management Measures:

- Comply with Works Approval W5584/2014/1 (Ref. 1), which approved the design of the LNG Plant including LNG Trains 1 and 2 and common facilities (Stage 1). This included measures to reduce fugitive emissions.
- Implement preventive maintenance programs where appropriate (i.e. Flange Management Program [Ref. 33], Leak Detection and Repair Program [Ref. 34]).

An odour monitoring program specific for LNG Trains 1 and 2 and common facilities is not proposed as these facilities are not generally associated with odour emissions.

9.3 Light Emissions

Light emissions have the potential to impact fauna, particularly marine turtles and their hatchlings.

Artificial light is generated during the operation of LNG Trains 1 and 2 and common facilities from temporary and permanent lighting and flaring. Modelling of light emissions for the combined operation of LNG Trains 1 and 2 and the Domgas Plant was conducted in 2010 in support of the Project's Draft EIS/ERMP (Ref. 16); this resulted in various management measures being implemented in the design and construction of the LNG Plant. The Project lighting design considered several of the criteria outlined in the EPA's Environmental Assessment Guideline No. 5 (Ref. 35) to avoid and, where required, mitigate impacts to conservation-significant marine fauna. Project lighting design includes:

- 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.

Management Measures:

- Comply with Works Approval W5584/2014/1 (Ref. 1), which approved the design of the lighting around LNG Trains 1 and 2 and the common facilities (Stage 1 and 2), and the flare design.

- Manage and monitor lighting impacts in accordance with the Wheatstone Conservation Significant Marine Fauna Interaction Management Plan (Ref. 36), which includes monitoring ambient night-time light emissions during operation of LNG Trains 1 and 2 and the common facilities at specific locations, such as turtle hatcheries in the greater Onslow area.

No specific light management measures or light emissions monitoring are proposed during operations.

9.4 Noise Emissions

Onshore noise emissions have the potential to affect fauna, particularly birds, mammals, and marine turtles. Noise expected from the Wheatstone LNG Plant Onshore facilities during operations was modelled as part of the Draft EIS/ERMP (Ref. 16).

Predicted noise levels for two operating scenarios (normal operations and emergency flaring) showed compliance with the most stringent night-time assigned noise levels imposed under the Environmental Protection (Noise) Regulations 1997. The modelling found that the LNG Plant is unlikely to be audible above background noise at Onslow town site and the Wheatstone Village even under worst-case meteorological conditions for sound propagation.

Significant noise impacts from the operation of the LNG Plant are not expected.

Management Measures:

- Comply with Works Approval W5584/2014/1 (Ref. 1), which approved the design of LNG Trains 1 and 2 and common facilities, including the construction and installation of equipment with the potential to cause noise emissions and any design features that reduce those noise emissions.
- As per the LNG and Domgas Plant – Regulatory Commissioning Plan (Ref. 10), undertake noise monitoring to validate noise modelling predictions during the Domgas regulatory commissioning phase once the facility is complete and the LNG Plant is operating at design capacity.

9.5 Stormwater Management

Stormwater drainage is not a prescribed activity under the EP Regulations. However, stormwater management is described at a high level to show the separation of contaminated and uncontaminated flows and provide reassurance that contaminated flows are not directed to the environment. The discharge of stormwater from within the prescribed premises for the LNG Trains 1 and 2 and common facilities has the potential to cause pollution (if contaminated stormwater is released to the environment) and soil erosion (if clean stormwater is not discharged to the environment appropriately). Where stormwater is collected, contaminated and uncontaminated stormwater flows are separated.

Management Measures:

- The stormwater drainage system and the primary treatment system, which allow contaminated stormwater to be treated, are within scope of this licence application.

- Use a stormwater system to segregate stormwater run-off that has different risks of contamination, including:
  - *Contaminated run-off* – run-off occurring in areas with a high risk of contamination, including process areas and other areas involved in handling HCs
  - *Potentially contaminated run-off* – run-off from areas with a moderate or low risk of contamination (e.g. storage tank areas, car parks)
  - *On-site clean (uncontaminated) run-off* – run-off from low-risk areas where contaminants are unlikely (e.g. unpaved areas, roadways, rooftops)
  - *Intercepted off-plant site clean run-off which prevents stormwater from entering the LNG Plant*.

9.6 Solid and Liquid Waste Management

Solid and liquid waste may contaminate soil, surface waters, and groundwater; create fire hazards; and degrade visual amenity.

Wastes (solid and liquid) are administered under these licences:

- LNG Plant Waste Storage Facility licence (L8976/2016/1) (Ref. 2)
- Waste Management Site (L8759/2013/1) (Ref. 3)
- Concrete Storage Area (L9082/2017/1) (Ref. 4).

9.7 Management of Environmentally Hazardous Materials

Environmentally hazardous materials, including dangerous goods, have the potential to affect the health of humans, fauna, and flora.

The operation of LNG Trains 1 and 2 and common facilities requires numerous environmentally hazardous materials to be stored and used within the prescribed premises boundary. The storage and use of these materials are carefully monitored to minimise the potential for loss of containment. Design features installed throughout LNG Trains 1 and 2and common facilities to monitor the loss of containment of environmentally hazardous materials were approved under Works Approvals W5584/2014/1 and W5480/2013/1 (Ref. 1; Ref. 7).

All hydrocarbon and chemical storage areas meet the requirements of the *Dangerous Goods Safety Regulations 2007* (WA) as applicable.

These tanks are contained within concrete bunds, except for the condensate bund, which has a geosynthetic clay liner.

- condensate (bund with geosynthetic clay liner has hydraulic conductivity of 1×10^{-7} cm/s)
- amine (activated aMDEA)
- heating oil
- waste oil and methanol/triethylene glycol (TEG) storage
- diesel.

All these bunds are sized for holding 110% of the capacity of the largest tank or 25% of the total capacity of all tanks within the bund.

Storage tanks for LNG and refrigerants (propane and ethylene) do not have bunding and are built to these standards:

- LNG:
  - Spill containment:
    - NFPA 59A Storage and Handling of Liquefied Natural Gas
    - AS 3961
    - AS 1940
    - NFPA 30 Flammable and Combustible Liquids Code.
  - Tanks:
    - API STD 620 Design and Construction of Large, Welded, Low – pressure Storage Tanks
    - API STD 625 Tank Systems for Refrigerated Liquefied Gas Storage.
    - Tanks also have a double-containment design, with a carbon inner.
- Refrigerants (propane and ethylene):
  - Ethylene is stored in three pressurised, double-walled, vacuum-jacketed horizontal drums. Ethylene storage was assessed by a Dangerous Goods (DG) consultant and endorsed against AS 1596 with reference made to AS 3961.
  - Propane is stored in three pressurised storage drums. Propane storage was assessed by a DG consultant and endorsed against AS 1596.
  - The drums for both ethylene and propane are designed and fabricated to ASME section VIII Division 1.

Various operational management measures are in place during the operation of LNG Trains 1 and 2 and common facilities. A combination of preventive and reactive controls are used, where the focus is on preventing any loss of containment. In the unlikely event that a loss of containment occurs, the environment is remediated as soon as practicable.

Management Measures:

- Comply with the Major Hazard Facility Safety Report (Ref. 17), which manages risk to ALARP through a hierarchy of controls that focus on:
  - inventory minimisation
  - leak minimisation
  - ignition prevention
- Undertake regular facility / equipment inspections, monitoring, and maintenance in accordance with operating procedures and safety management system under the Major Hazard Facility licence for the LNG Plant
- Use and maintain pollution control equipment (listed in Appendix C)

11 Acronyms and Abbreviations

Table 11-1 defines the acronyms and abbreviations used in this document.

Table 11-1: Acronyms, Abbreviations, and Definitions

Acronym/ Abbreviation	Definition
~	Approximately
<	Fewer/less than
>	Greater/more than
≥	Greater than or equal to
°C	Degrees Celsius
°K	Degrees Kelvin
µg	Microgram
AEDR	Wheatstone Project Air Emissions Design Report–Foundation Project
AGRU	Acid Gas Removal Unit
AGTO	Acid Gas Thermal Oxidiser
AHD	Australian Height Datum
ALARP	As Low as Reasonably Practicable
Ambient Air	As described in the National Environment Protection (Ambient Air Quality) Measure is considered the external air environment, and does not include the air environment inside buildings or structures
aMDEA	Activated Methyldiethanolamine
ANSIA	Ashburton North Strategic Industrial Area
API	American Petroleum Institute
AS	Australian Standard
ASME	American Society of Mechanical Engineers
Atmospheric Emissions	Any emission to air, for any period of time, of solid, liquid, or gaseous matter. Examples include, but are not limited to, dust and greenhouse gases.
Atmospheric Pollutants	As described in the National Environment Protection (Ambient Air Quality) Measure includes carbon monoxide (CO), nitrogen dioxide (NO_2), photochemical oxidants (such as ozone [O_3]), sulfur dioxide (SO_2), lead, and particles (such as PM_{10}). In principle, this includes gaseous, aerosol, or particulate pollutants that are present in the air in low concentrations with characteristics such as toxicity or persistence so as to be a hazard to human, plant, or animal life.
barg	Gauge pressure (pressure [in bar units] above ambient or atmospheric pressure)
Base Emission Rate	The rate at which atmospheric pollutants are emitted from a source with pollution control in place
BOG	Boil-off gas
BTEX	Benzene, toluene, ethylbenzene, and xylene compounds
CAPL	Chevron Australia Pty Ltd
CH_4	Methane
cm/s	Centimetres per second
CO	Carbon monoxide
CO_2	Carbon dioxide

Acronym/ Abbreviation	Definition
Common facilities	Significant utilities and general facilities used to support the operation of the Wheatstone Gas Facility
Continuous	In the context of monitoring frequency, means monitored continuously in stream and recorded as a spot sample at intervals not more than 36 hours after the last preceding record, where possible
DG	Dangerous Goods
DMIRS	Western Australia Department of Mines, Industry Regulation and Safety
Domgas	Domestic Gas
DotEE	Commonwealth Department of the Environment and Energy
DWER	Western Australian Department of Water and Environment Regulation
EIA	Environment Impact Assessment
EIS/ERMP	Environmental Impact Statement/Environmental Review and Management Programme
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
g/s	Grams per second
GHG	*See* Greenhouse Gases
GIS	Geographic Information System
Greenhouse Gases	Components of the atmosphere that contribute to the greenhouse effect; including carbon dioxide (CO_2), methane (CH_4), sulfur hexafluoride (SF_6), and nitrous oxide (N_2O)
GTC	Gas Turbine Compressor
GTG	Gas Turbine Generator
H_2S	Hydrogen sulfide
HC	Hydrocarbon
HP	High pressure
ISO	International Organization for Standardization
km	Kilometre
km/h	Kilometres per hour
km^2	Square kilometres
kPa	Kilopascal
LNG	Liquefied Natural Gas
LNG Plant	Wheatstone Gas Facility as constructed under Works Approvals W5584/2014/1 and W5480/2013/1
LP	Low pressure
m	Metre
m^3	Cubic metre
mg	Milligram
mm	Millimetre
MS	Ministerial Statement

Acronym/ Abbreviation	Definition
MW	Megawatt
N_2	Nitrogen
N_2O	Nitrous oxide
NEPM	National Environment Protection Council. 2018. *Variation to the National Environment Protection (Ambient Air Quality) Measure (NEPM)*. National Environment Protection Council, Canberra, Australian Capital Territory.
NFPA	National Fire Protection Association (US)
N-m	Newton metre
NMVOC	Non-methane Volatile Organic Compounds
NO	Nitric oxide
NO_2	Nitrogen dioxide
Normal Operations	Operation of the two constructed LNG Trains and Domgas Plant described in Works Approvals W5584/2014/1 and W54802013/1, excluding commissioning, start-up, shutdown, and upset conditions
NO_x	Nitrogen oxides (NO and NO_2)
NRU	Nitrogen Rejection Unit
NSW	New South Wales
NZS	New Zealand Standard
O_2	Oxygen
O_3	Ozone
PLF	Product Loading Facility
PM	Particulate Matter
PM_{10}	Suspended particulate matter comprising particles having an equivalent aerodynamic diameter of less than 10 µm, as defined in AS 3580.9.8:2013
$PM_{2.5}$	Suspended particulate matter comprising particles having an equivalent aerodynamic diameter of less than 2.5 µm, as defined in AS/NZS 3580.9.13:2013
Practicable	Defined in Section 3 of the EP Act as 'means reasonably practicable having regard to, amongst other things, local conditions and circumstances (including cost) and to the current state of technical knowledge'
Project	Wheatstone Project
RO	Reverse Osmosis
Sensitive receptor	Individuals/communities/components of the environment that could be adversely affected by atmospheric pollutants; examples include dwellings, schools, hospitals, offices, protected wetlands, or public recreation areas that exist now or in the future
SF_6	Sulfur hexafluoride
SO_2	Sulfur dioxide
SO_x	Sulfur oxides
Stage 1	LNG Train 1 and its common facilities
Stage 1 & 2	LNG Train 1 & 2 and common facilities
STP	Sewage Treatment Plant
TAA	Terrestrial Assessment Area
TEG	Triethylene glycol

Acronym/ Abbreviation	Definition
TIAH	Turbine Inlet Air Humidification
tpa	Tonnes per annum
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WA	Western Australia
WHRU	Waste Heat Recovery Unit

12 References

Table 12-1: References

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