Application for Licence

Division 3, Part V *Environmental Protection Act 1986*

Licence Number	L9224/2019/1
Applicant	Yara Pilbara Fertilisers Pty Ltd
ACN	095 441 151
File Number	DER2019/000563
Premises	Yara Fertilisers Ammonia Plant Village Road BURRUP WA 6714 Legal description - Part of Lot 564 on Deposited Plan 31023 As defined by the coordinates in Schedule 2 of the Licence
Date of Report	20 April 2020
Status of Report	Final

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1. Definitions of terms and acronyms

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

Table 1: Definitions

Term	Definition
AACR	annual audit compliance report
ACN	Australian Company Number
AEP	annual exceedance probability
AER	annual environment report
ANZECC	Australian and New Zealand Environment and Conservation Council
Applicant	Yara Pilbara Fertilisers Pty Ltd
ARI	average recurrence interval
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CO_2	Carbon dioxide
CS Act	*Contaminated Sites Act 2003* (WA)
Decision Report	refers to this document.
Delegated Officer	an officer under section 20 of the EP Act.
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority (WA)
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
Existing Licence	The Licence L7997/2002/11 issued under Part V, Division 3 of the EP Act and in force prior to the commencement of, and during this assessment
GLC	ground level concentration
HDPE	high density polyethylene
KBR	Kellogg Brown and Root
Licence Holder	Yara Pilbara Fertilisers Pty Ltd
m^3	cubic metres
MDEA	methyl diethanolamine

Minister	the Minister responsible for the EP Act and associated regulations
MMDD	maximum modified dry density
MS	Ministerial Statement
mtpa	million tonnes per annum
MUBRL	Multi-User Brine Return Line
NEPM	National Environmental Protection Measure
NH_3	ammonia
NO_2	nitrogen dioxide
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Normal operating conditions	Any operation of a particular process, excluding start-up and shutdown, where the plant is operating.
NOx	oxides of nitrogen
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
Risk Event	As described in *Guidance Statement: Risk Assessment*
Start-up	means the period when plant or equipment is brought from inactivity to normal operating conditions
Shut-down	means the period when plant or equipment is brought from normal operating conditions to inactivity
SO_2	sulfur dioxide
STP	Sewage Treatment Plant
TAN	Technical Ammonium Nitrate
t/day	tonnes per day
µg/m^3	micrograms per cubic metre
µg/L	micrograms per litre
VOCs	Volatile organic compounds
YPF	Yara Pilbara Fertilisers Pty Ltd
YPN	Yara Pilbara Nitrates Pty Ltd

2. Purpose and scope of assessment

Yara Pilbara Fertilisers Pty Ltd (YPF) currently operates a liquid ammonia plant (Ammonia Plant) under Existing Licence L7997/2002/11 issued on 21 April 2015. On 29 June 2018, the Existing Licence was amended to include operation of the adjacent Yara Pilbara Nitrates Pty Ltd (YPN) Technical Ammonium Nitrate (TAN) Plant as construction and commissioning of the TAN Plant had been completed.

The Existing Licence authorises the Ammonia Plant to produce 950,000 tonnes per year of ammonia, and the TAN Plant to produce 350,000 tonnes per year of solid TAN prills. The Existing Licence also authorises treatment of 36 cubic metres per day of sewage via a sewage treatment plant (STP) at the Ammonia Plant.

On 18 October 2019 DWER received separate licence applications from YPF for the Ammonia Plant, and from YPN for the TAN Plant, to replace the Existing Licence due to expire on 20 April 2020. The new licence application for the Ammonia Plant seeks to continue operation of the plant as per current practices with no changes to the premises production capacity sought. The application also seeks to construct an evaporation pond for the disposal of treated domestic wastewater from the existing STP. The evaporation pond will replace use of infiltration basins for disposal of treated domestic wastewater. No further changes to the current operation of the Ammonia Plant were sought in the application.

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 new licence for the operation of the YPF Ammonia Plant. The new licence will replace Existing Licence L7997/2002/11 and will relate only to the operation of the Ammonia Plant.

This assessment has resulted in the Department issuing Licence L9224/2019/1 which is contained in Attachment 1.

2.1 Application details

On 18 October 2019, YPF submitted an application for a licence for its Ammonia Plant. Table 2 lists the documents submitted during the assessment process which relate to the application.

Table 2: Documents and information submitted during the assessment process

Document/information description	Date received
Application form and supporting document: Application for new licence. Yara Pilbara Fertilisers (DWERDT219727)	18 October 2019
Email correspondence: L9224/2019/1 Yara Pilbara Fertilisers Ammonia Plant Licence Application – Additional information requested (DWERDT232499)	5 December 2019
Email correspondence: Additional Information for Proposed Sewage Treatment Plant Evaporation Pond (DWERDT245787)	16 January 2020
Email correspondence: Response to wastewater queries for the assessment of the Yara licence applications L9223 and L9224 (DWERDT255236)	17 February 2020
Email correspondence: Further Information Sewage Treatment Plant Evaporation Pond (DWERDT258561)	28 February 2020
Email correspondence: Yara Pilbara Fertilisers Ammonia Plant Draft Licence and Draft Decision Report - Applicants Comments (A1882875)	7 April 2020

Table 3 lists the prescribed premises categories that have been applied for. No change has been requested to the approved premises production or design capacities for the categories specified in Schedule 2 of the Existing Licence. The application sought inclusion of additional category 61 (Liquid waste facility) on the licence due to wastewater being received on the premises from the adjacent TAN plant which will be licensed as a separate premises. Category 61 was not specified on the existing licence because the TAN and Ammonia Plants were located on a single premises.

Table 3: Prescribed Premises Categories applied for in the application for a licence

Classification of Premises	Description	Premises production or design capacity or throughput
Category 31	Chemical manufacturing: premises (other than premises within category 32) on which chemical products are manufactured by a chemical process.	950,000 tonnes per year
Category 61	Liquid waste facility: premises on which liquid waste produced on other premises (other than sewage waste) is stored, reprocessed, treated or irrigated.	3,500,000 tonnes per year
Category 85	Sewage facility: premises – (a) on which sewage is treated (excluding septic tanks); or (b) from which treated sewage is discharged onto land or into waters.	36 cubic metres per day

Key Finding: The Delegated Officer has determined that Category 61 Liquid waste facility is not applicable to the premises as wastewater received from the TAN plant is not stored, reprocessed, treated or irrigated. Wastewater from the TAN plant is received directly into a pipeline on the premises from which it is discharged to the Multi-User Brine Return Line (MUBRL) for offsite discharge to King Bay.

3. Background

YPF (formerly named Burrup Fertilisers Pty Ltd) owns the Ammonia Plant located on part of Lot 564 Village Road, Burrup, and holds a lease over the lot. The plant is located approximately 11.5 km north of the town of Karratha and 7 km northeast of the town of Dampier. Approval to construct and operate the plant was granted by the Minister for the Environment under Part IV of the EP Act in 2002, the first licence to operate the plant was granted under Part V of the EP Act in 2005, and operation of the plant commenced in 2006.

YPF is a wholly owned subsidiary of Yara Australia Pty Ltd, a wholly owned subsidiary of Yara International ASA. Yara International ASA is one of the world's largest chemical companies and the world's largest supplier of mineral fertilisers operating technical nitrate production plants in Sweden, Norway, France and Germany, and numerous mineral fertiliser plants worldwide. Yara International ASA and its predecessor companies have been in business since 1905.

A Works Approval W4701/2010/1 was granted on 25 July 2013 to YPN for the construction of a TAN Plant at Lot 3017 Village Rd, Burrup, adjacent to the Ammonia plant. The TAN Plant processes ammonia from the Ammonia Plant to produce TAN prills. YPN is a joint venture between parent companies Yara International ASA (50%) and Orica Limited (50%). In June 2018 the licence for the Ammonia Plant (L7997/2002/11) was amended to include conditions authorising operation of the TAN Plant. The amended licence was issued to YPF and YPN as joint Licence Holders.

YPN and YPF are seeking separate licences for operation of the Ammonia and TAN plants although the two premises will continue to be operated under an integrated management

framework.

4. Overview of Premises

4.1 Operational aspects

The Ammonia Plant processes natural gas from an offshore gas reserve to produce ammonia. The Ammonia Plant operates 24 hours a day, seven days a week and can produce 950,000 tonnes of anhydrous liquid ammonia per year using the Kellogg Brown and Root (KBR) Purifier Process.

The produced ammonia is stored at -33ºC in two 40,000 tonne tanks to keep it in liquid form. An above ground export pipeline and recirculation line is used to transport the refrigerated liquid ammonia between the premises and the Dampier Bulk Liquids Berth at the Port of Dampier, where it is loaded into ships for export. Description of the key stages of the ammonia manufacturing process is included below (as taken from the application, Yara 2019) and an indicative schematic of the stages included in Figure 1.

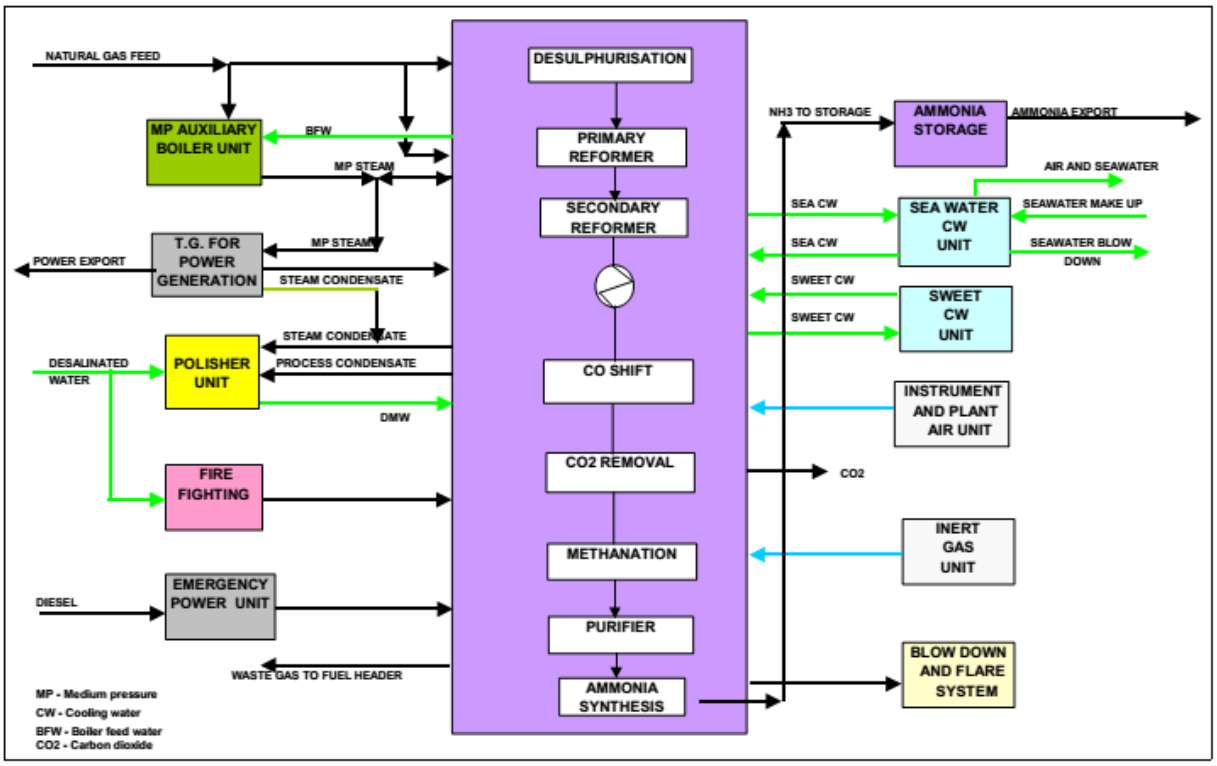

Figure 1. Indicative schematic flowsheet for the ammonia production process.

4.1.1 Feed pre-treatment/desulfurisation

Natural gas feed is directed to a feed gas knockout drum where liquids and solids are removed. Part of the natural gas is sent to fuel the package boiler and primary reformer. The remainder is fed to the desulfurisation unit via the convection section of the primary reformer for heating. The desulfurisation unit removes organic sulfur compounds from the heated gas by passing it over a catalyst bed of cobalt/molybdenum oxide.

4.1.2 Primary reforming

The desulfurised feed gas is mixed with medium pressure steam and is preheated in the convection section of the primary reformer. The hot mixed feed is distributed to the primary reformer catalyst tubes where it is reacted to form hydrogen, carbon monoxide (CO) and carbon

dioxide (CO_2). The combination of reactions are endothermic (i.e. require and absorb heat) with the duty supplied by fuel gas burners located between the rows of catalyst tubes.

4.1.3 Secondary reforming

The process gas leaving the primary reformer furnace contains about 52.3% hydrogen and 28% methane (dry volume basis). Air is injected in a special mixing and combustion chamber above a nickel catalyst bed to produce a 3:1 hydrogen to nitrogen synthesis gas. The gas is directed to a secondary reformer waste heat boiler where high pressure steam is produced to partially cool the gas.

4.1.4 Shift conversion

Carbon monoxide is reacted with steam to produce CO_2 and additional hydrogen. This reaction is favoured by high temperatures, but the maximum conversion of CO to CO_2 (equilibrium) is favoured by low temperatures. Both high and low temperature conversions utilise different catalysts. The high temperature shift conversion utilises iron oxide and the low temperature shift conversion utilises a copper based catalyst.

Heat recovered from the low temperature shift conversion is used to preheat high pressure boiler feed water and deaerator feed water in the methanator, and to provide heat for the CO_2 removal process.

4.1.5 Carbon dioxide removal

Carbon dioxide contained in the shifted process gas is removed by absorption in a liquid absorbent, methyl diethanolamine (MDEA) solution. The absorbent is stripped of CO_2 and regenerated for re-use. The recovered CO_2 is cooled and vented.

4.1.6 Methanation

Methanation occurs within a methanator feed/effluent exchanger where high temperature heat is recovered in the effluent by heat exchange against the feed gas. The gas then flows through the methanator where remaining carbon oxides combine with hydrogen over a nickel catalyst to form methane and water.

The methanator effluent is cooled by heat exchange with methanator feed and cooling water. The chilled gas flows to the synthesis gas driers containing solid desiccants. Exiting these driers, the water and CO and CO_2 content of the gas is reduced.

4.1.7 Cryogenic purification

Dried raw synthesis gas is cooled prior to entering the purifier rectifier column. This purifier column removes excess nitrogen, all of the methane and about 61% of the argon. The operation of the purifier is controlled by a hydrogen analyser on the synthesis gas to maintain the 3:1 hydrogen to nitrogen ratio. The only remaining contaminant in the make-up synthesis gas is about 0.27% argon. The synthesis gas is compressed to a suitable pressure required for the ammonia synthesis loop.

4.1.8 Ammonia synthesis

The synthesis gas is passed through the ammonia synthesis converter comprising of four beds of iron promoted conventional catalyst. The heat of reaction is recovered by the steam system in the ammonia converter effluent/steam generator and boiler feed water preheater. The converter effluent is cooled to condense most of the produced ammonia. The remaining synthesis gas is recycled to the converter, except for a small purge. The purge is recycled to the Purifier.

4.1.9 Refrigeration and storage

Ammonia is condensed from the converter effluent stream by chilling with ammonia refrigerant at four levels in the unitised chiller. The ammonia vapours are routed to the ammonia refrigeration compressor where the vapours are condensed. Cold liquid ammonia is used as a refrigerant. The refrigeration system is designed to deliver the ammonia product at minus 33°C. Cold ammonia is then pumped to the cryogenic storage tanks.

Produced liquid ammonia is stored in two double-walled, double-integrity 40 000 tonne tanks. Above ground pipelines are used to transport the refrigerated liquid ammonia to the adjacent TAN Plant and the Dampier Bulk Liquids Berth at the Port of Dampier, where it is loaded into ships for export.

4.1.10 Utilities and ancillary plant

Additional infrastructure which supports the operation of the Ammonia Plant is described below.

The Ammonia Plant has a flare system that provides the ability to combust gases during upset process conditions. A production flare is used to treat waste process gas and a storage flare to incinerate emissions of ammonia from the storage tank headspace.

Electrical power is supplied by a power plant with two 22 MW steam turbine generators. The two turbines are not required to operate at full load simultaneously, with one typically operating at 100% capacity and the other operating at 25% capacity.

A 150 tonnes per hour (tph) package boiler is used to generate steam for start-up and operations. A separate 50 tph package boiler is operated at a minimal rate of 10-20% to generate steam for operation and is also operated at up to full rate to generate steam for plant start-up. A 5 MW diesel generator also provides power for start-up and emergency power.

Cooling within the Ammonia Plant is provided by seawater supplied by the Water Corporation and desalinated water is supplied by an on-site desalination plant (three desalination trains with combined capacity of 1.4 GL per year).

Process effluent from the Ammonia Plant undergoes various treatment processes, depending on the source, before it is discharged to the MUBRL operated by Water Corporation. The MUBRL discharges received wastewater into marine waters at King Bay. Process effluent is also received onto the premises from the adjacent TAN Plant. The TAN Plant process effluent discharges directly into the Ammonia Plant process effluent pipework and is then combined with the Ammonia Plant process effluent before discharge to the MUBRL.

Stormwater and cooling tower blowdown water are directed to one of two sedimentation basins (Eastern and Western). The basins have been designed with capacity to contain stormwater from a 1 in 100 average recurrence interval (ARI) event. The basins are lined with 1.5 mm thick high density polyethylene (HDPE). In the case of excess stormwater from extreme events, the basins discharge to the tidal flats of King Bay. Monitoring of the stormwater quality is conducted before a discharge event occurs.

A domestic STP services the Ammonia Plant. The STP has previously discharged to two infiltration basins north of the Ammonia Plant however discharge ceased in late 2019 due to treated effluent quality being unable to achieve limits for discharges to land specified in the Existing Licence. Since ceasing discharge, the treated effluent has been stored in tanks on the premises and trucked offsite to disposal facility licensed to accept the liquid waste. As part of the new licence application, YPF proposes to convert the infiltration basins into a lined evaporation pond to evaporate treated effluent rather than discharge to land.

4.2 Infrastructure

The Ammonia Plant infrastructure, as it relates to Category 31 and 85 activities, is detailed in Table 4 and with reference to the Site Plans in Figure 2 and Figure 3.

Table 4 lists infrastructure associated with each prescribed premises category.

Table 4: Ammonia Plant Category 31 and 85 infrastructure

	Infrastructure	**Premises infrastructure map reference**
	Prescribed Activity Category 31	
Approximately 81 Terra Joules per day of natural gas is received via pipeline and processed to produce up 950,000 tonnes of anhydrous ammonia per year.		
1	Primary reformer	Figure 2 (Primary reformer)
2	Secondary reformer	
3	CO_2 stripper	Figure 2 (CO_2 stripper)
4	2 x 40,000 tonne cryogenic, double-walled Ammonia storage tanks	Figure 2 (Ammonia storage)
5	Flare system comprising Production and Storage flares	Figure 2 (Production and storage flares)
6	Venting system (front-end and back-end vents)	Figure 2 (Front end vent and back end vent)
7	Seawater cooling system	Figure 3 (Cooling tower blowdown)
8	Wastewater neutralisation tank	Figure 3 (Wastewater treatment plant)
9	Wastewater effluent sump	
10	Oil water separator	Figure 3 (Oil water separator)
11	Wastewater disposal via the (MUBRL)	Figure 3 (TAN plant MUBRL return line and Ammonia plant MUBRL return line)
12	2 x Chemical storage areas	Figure 2 (Chemical storage - Dangerous Goods Yard and Chemical storage – H_2SO_4 and NaOH)
13	Western sedimentation basin	Figure 3 (Western sedimentation basin and Eastern sedimentation basin)
14	Eastern sedimentation basin	
	Prescribed Activity Category 85	
Treatment of domestic wastewater generated at the Ammonia Plant is via a packaged STP. Treated water is disposed offsite to a licensed facility or on site via discharge to an evaporation pond (following		

	Infrastructure	Premises infrastructure map reference
construction of the pond).		
1	One rotating biological contactor STP (design capacity 36 m^3)	Figure 3 (Sewage treatment plant)
2	One Evaporation pond	Figure 3 (Evaporation pond)
	Directly related activities	
Transfer of process effluent (purified process condensate, chiller condensate and boiler blowdown) from the adjacent TAN Plant to the Ammonia Plant for discharge into the MUBRL.		
1	TAN Plant MUBRL return line	Figure 3 (TAN Plant MUBRL return line)
A captive power plant (steam turbine) uses exothermic heat generated in the ammonia production process to generate electricity. The packaged boilers provide medium pressure steam required for the ammonia production process. Desalination units provide cooling water used in the ammonia production process.		
1	2 x 22MW steam turbine generators	Figure 2 (Power plant)
2	Package boiler 1 - 150t steam boiler (connected to a package boiler stack)	Figure 2 (Package boilers)
3	Package boiler 2 - 50t steam boiler (connected to package boiler stack)	
4	Start-up heater	Figure 2 (Start-up heater)
5	5MW emergency diesel generator	Figure 2 (Diesel generator)
6	1.4 GL/year desalination plant comprising three desalination trains	Figure 3 (Desalination plant)

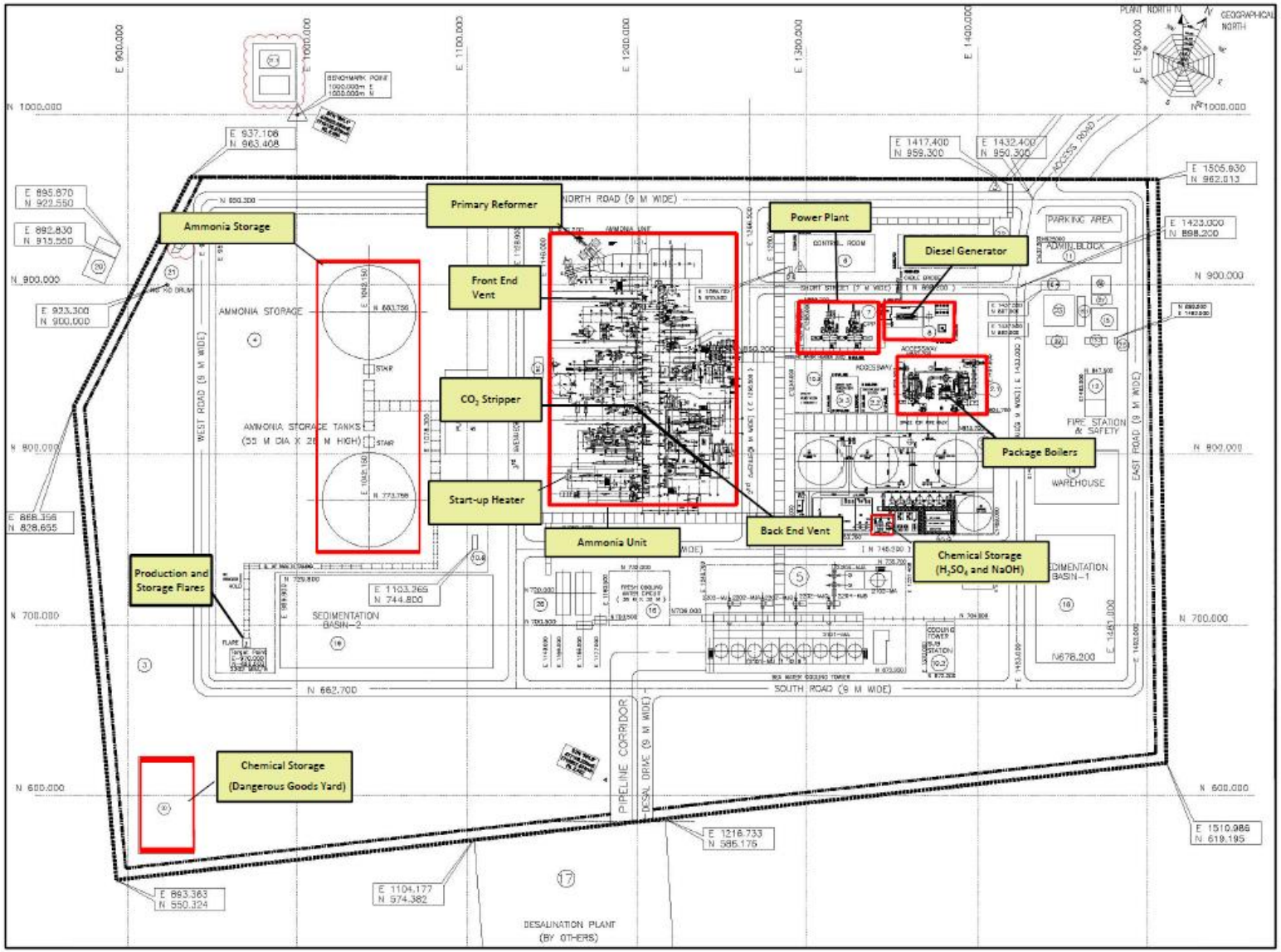

Figure 2. Premises infrastructure layout map 1

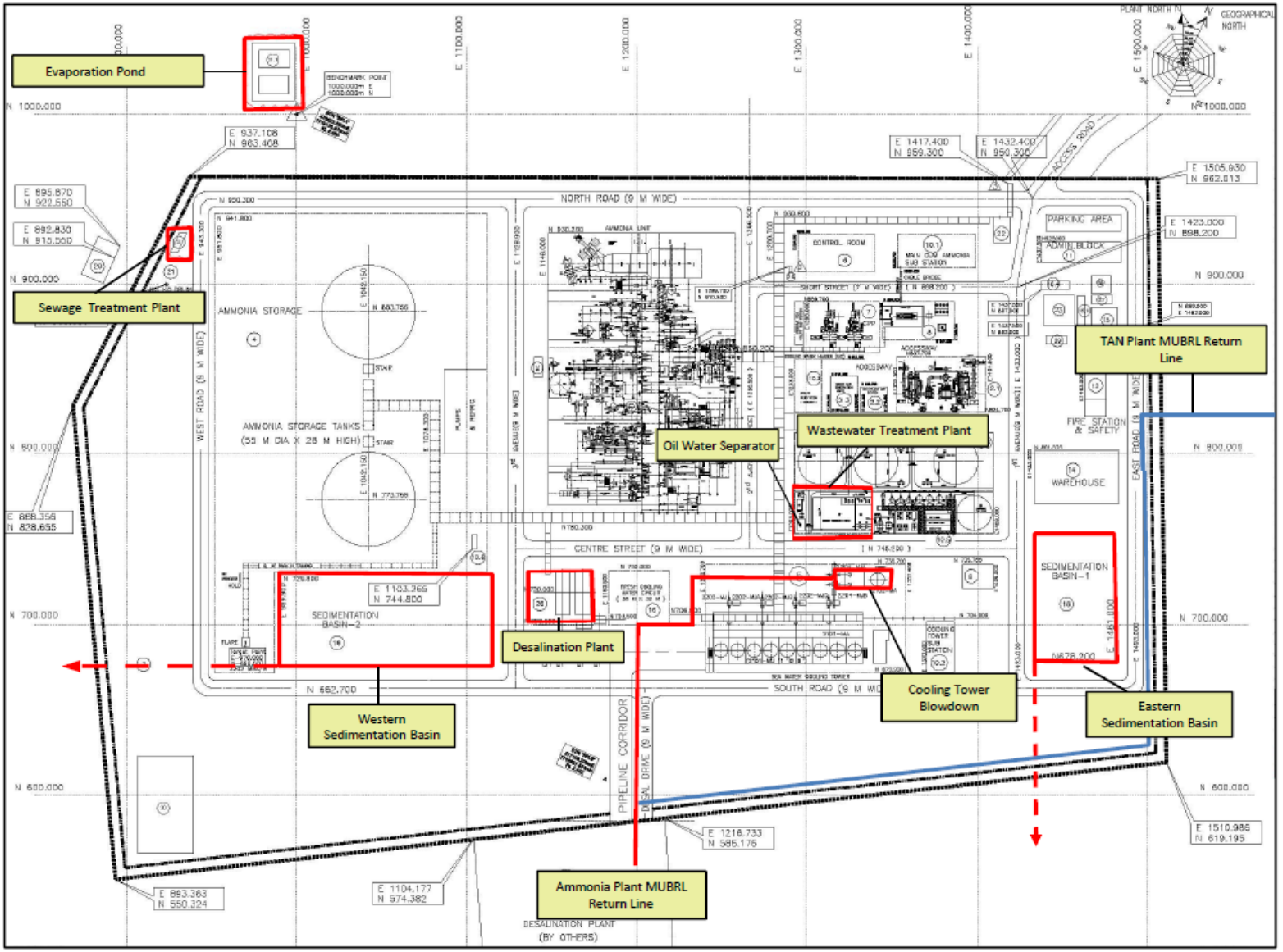

Figure 3. Premises infrastructure layout map 2

4.3 Works - Evaporation pond

A domestic STP services the Ammonia Plant. The STP was initially constructed in 2003 as part of the construction of the Ammonia Plant, however was replaced with a new rotating biological contactor plant in July 2016.

The Existing Licence authorises the discharge of treated effluent from the STP to two infiltration basins, each approximately 50 m x 10 m, only when discharge to land limits specified on the Existing Licence for the treated effluent are met. The Existing Licence contains discharge to land limits for Total Nitrogen (TN), Total Phosphorus (TP), biochemical oxygen demand (BOD), pH, total suspended solids (TSS) and *Escherichia coli* (E.coli). The limits are based on the manufacturer's performance criteria for the STP. However, since the installation and commissioning of the rotating biological contractor STP in 2016, the limits have not been consistently achieved for TN and TP and occasional exceedance of pH, TSS and E.coli limits have also occurred.

In response to the outcomes of a review of infiltrating treated wastewater (which was required in accordance with the requirements of condition 25 of the Existing Licence), a chemical dosing trial was successfully undertaken which reduced levels for TN and TP to below 30 mg/L and 8 mg/L respectively. However, a series of mechanical failures, resulting in a lack of flow to the STP, caused the bacteria in the STP to die. Since this occurrence TN and TP in the treated effluent have not returned to below the specified limits in the Existing Licence.

Consequently, treated effluent from the STP is currently being discharged into storage tanks pending collection and removal from the premises for disposal at an authorised facility offsite. Due to the performance issues associated with the STP. YPF has proposed to convert the existing infiltration basins into an evaporation pond to remove the need to discharge treated effluent to land. The infiltration basins will be backfilled with sand sourced on the site to the required level to suit the design depth for the evaporation pond. The sand which used to infill the basins will be compacted to 95% maximum modified dry density (MMDD) in layers no more than 300 mm thick. The evaporation pond will also extend into the area adjacent to the infiltration basins. The pond will be constructed from sand materials sourced on the premises and lined with HDPE.

The evaporation pond has been designed with sufficient capacity for treated effluent inflow of 18.9 m^3/day with allowance to also contain a 168 Hour 1% annual exceedance probability (AEP) rainfall event, with a 500 mm freeboard. While the design inflow is only half of the design capacity of the STP, the average throughput of the STP from August 2016 to December 2019 was 11 m^3/day. This has recently been reduced to an average of 5.6 m^3/day following implementation of the site wide leak rectification campaign in August 2019. The design parameters for the pond are detailed in Table 5.

Sludge build up in the pond will be removed on an as needed basis and disposed to a waste or landfill facility authorised to accept the waste, or disposed of in accordance with the *Western Australian Guidelines for biosolids management, Department of Environment and Conservation (December 2012).*

Table 5: Evaporation pond design specifications

Design feature	Specifications
Crest	51m x 51m, 2m wide
Toe	47.2m x 47.2m
Depth	0.94m
Slope of internal batters	1:2
HDPE Liner	2 mm thick liner overlying geotextile and anchored to the embankment via an anchoring trench
Geotextile	BIDIM A34 or similar

Design feature	Specifications
Compacted sand layer	100 mm thick, achieving a MMDD of at least 92%
Inlet pipeline	Existing inlet pipe, overlying conveyor rubber and anchored with a concrete anchor block
Spillway	2.9m wide, 0.08m deep spillway protected with 150mm thick rock pitching blended into the embankment
Fenced and gated compound	Existing infrastructure

Key Finding: The Delegated Officer has considered the proposed works and has found

1. Establishment of an evaporation pond in place of the existing infiltration basins will remove the need to discharge treated effluent to land and therefore remove one of the discharges to land associated with operation of the Ammonia Plant.
2. As YPF will no longer discharge treated effluent from the STP to the infiltration basins, this activity has not been assessed and is no longer authorised to occur through the conditions of the new licence.

4.4 Exclusions to the assessment

This assessment relates to the YPF Ammonia Plant only and therefore does not assess the emissions, discharges or risks associated with the operation of the adjacent YPN TAN Plant.

Potential environmental impacts associated with greenhouse gas emissions have been assessed under Part IV of the EP Act (Bulletin 1036) and are subject to the requirements of condition 7-1 to 7-3 of Ministerial Statement (MS) 586 (refer to section 5.1.2 for further details). The Delegated Officer has therefore determined not to duplicate this assessment and regulatory controls in accordance with the *Guidance Statement: Setting Conditions*.

5. Legislative context

Table 6 summarises approvals, excluding those granted under Part V of the EP Act, relevant to the assessment.

Table 6: Relevant approvals and tenure

Legislation	Number	Holder	Approval
Dangerous Goods Safety Act 2004	DGS017039	Yara Pilbara Fertilisers Pty Ltd	Dangerous Goods Site Licence issued 31 August 2011. Expiry 1 September 2021
	DPL001065		Dangerous Goods Pipeline Registration issued 22 May 2015. Expiry 1 June 2020.
Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007	Approved Safety Report		Safety Report approved by DMIRS on 14 May 2015.

Legislation	Number	Holder	Approval
Part IV of the EP Act (WA)	Ministerial Statement Number 586 (MS 586)	Yara Pilbara Fertilisers Pty Ltd (formerly Burrup Fertilisers Pty Ltd)	For construction and operation of an ammonia plant on the Burrup Peninsula. Granted 20 February 2002. MS 586 has undergone a number of amendments under section 45C of the EP Act. Amendments included alteration of Schedule 1 start-up steam generation, modifications to pipeline management and increases in production capacity and associated emissions and discharges specified in Schedule 1 of the statement. Regulation of air emissions (excluding CO_2) and wastewater discharges were removed from Schedule 1 of the statement on 5 August 2015 on the basis they are able to be regulated under Part V of the EP Act.
	Ministerial Statement Number 594 (MS 594) & previous Ministerial Statement Number 567 (MS 567)	Water Corporation	To construct and operate a seawater supply and desalination system to service the requirements of industry on the Burrup Peninsula. Multi-User Brine Return Line discharges to King Bay. MS 567 was granted on 22 June 2001 and subsequently amended via MS 594 on 5 June 2002.

5.1 Part IV of the EP Act

5.1.1 Background

The proposal to construct and operate the Ammonia Plant was referred to the Environmental Protection Authority (EPA) under Part IV of the EP Act on 2 March 2001 and was assessed through a Public Environmental Review (PER) assessment process. The EPA released its report and recommendation on the project (Bulletin 1036) in December 2001 and Ministerial approval for the proposal was granted through MS 586 on 20 February 2002. Various changes have been made to MS 586 since this time as described in Table 6.

The EPA's assessment of the proposal considered the following key environmental factors relevant to the construction and operation of the Ammonia Plant:

- impacts to terrestrial flora and fauna;
- gaseous emissions,
- greenhouse gas emissions;
- noise; and
- liquid waste disposal.

The EPA's assessment of the proposal considered that the process proposed for the Ammonia Plant was generally considered to be Best Available Technology (BAT) by the European Fertiliser Manufacture Association but that oxides of nitrogen (NOx) emissions from the plant do not meet BAT for new ammonia plants. The proponent committed to considering during detailed design, the feasibility of using low NOx burners in the reformer. Low NOx burners in the plant reformers were subsequently included in the plant design.

The EPA considered that while Aboriginal Culture and Heritage was a factor relevant to the Ammonia Plant, impacts from acidic precipitates on the rock faces of petroglyph sites had been considered elsewhere by the EPA therefore no further assessment of the impact of emissions on the factor relating to the proposal was undertaken. Further detail on the legislative framework for managing potential impacts on aboriginal rock art petroglyphs is provided in section 5.2.

An integral component of the operation of the Ammonia Plant is the supply of seawater and desalinated water, and the discharge of liquid waste to King Bay via the MUBRL, as part of the Water Corporation's Desalination and Seawater Supplies Project. The proposal for the Desalination and Seawater Supplies Project was initially assessed and granted Ministerial Approval via MS 567 on 22 June 2001. The approval was subsequently amended via MS 594 to allow for increased seawater supply, increased brine discharge and for treated wastewater discharge. The approval allows for the use of the MUBRL to supply seawater to industries on the Burrup and to discharge brine and industrial wastewater to King Bay.

5.1.2 Ministerial Statement 586

MS 586 was granted for the construction and operation of the Ammonia Plant and contains conditions that need to be considered in the assessment of emissions and discharges from the plant and the imposition of regulatory controls. The statement was updated in 2015 to increase the plant capacity and remove emission limits that could be appropriately regulated under Part V of the EP Act. A summary of relevant conditions is included in Table 7.

Table 7: Consideration of MS 586 conditions relevant to this application

Condition	Requirement	Delegated Officer considerations
1-1	The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions of this statement.	Schedule 1 specifies the maximum capacity of the Ammonia Plant as no more than 2,600 t/day. The assessed production capacity for the plant in the licence has therefore been limited to 950,000 tonnes per year to align with the Part IV assessment. Schedule 1 initially specified emission rates for key emissions to air including NO_x, CO, sulfur dioxide (SO_2), ammonia (NH_3) and volatile organic compounds (VOCs) as well as loads for wastewater discharges including ammonia, phosphorous nitrogen, methanol and heavy metals (negligible/background). These were removed in 2015 on the basis that they can be regulated under Part V of the EP Act. The Delegated Officer will therefore consider air emissions and wastewater discharges in the risk assessment for the application.
7-1 to 7-3	Prior to commencement of construction of the plant, the proponent shall prepare a Greenhouse Gas Emission Management Plan to the requirements of the Minister for the Environment and Heritage on advice of the EPA to: • ensure that "greenhouse gas" emissions from the project are adequately addressed and best available technologies are used to minimise total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product; and • mitigate "greenhouse gas" emissions in accordance with the Framework Convention on Climate Change 1992, and consistent with the National Greenhouse Strategy;	Greenhouse gas emissions have been considered, assessed and conditioned under Part IV of the EP Act. The Delegated Officer has therefore determined that no further assessment or control of greenhouse gas emissions from the Ammonia Plant is required under Part V of the EP Act.

	The proponent is required to implement the Greenhouse Gas Emission Management Plan and make the plan publicly available to the requirements of the Minister for the Environment and Heritage on advice of the EPA.	

5.1.1 Ministerial Statements 567 and 594

Ministerial Statement 567, as amended by MS 594, was granted for the construction and operation of the Water Corporation's Desalination and Seawater Supplies Project which includes provision of desalination plants and the provision of a seawater supply system, brine discharge to King Bay, and acceptance of treated industrial and domestic wastewater into the brine discharge stream. A revised Schedule 1 was included in MS 594 providing for increased seawater supply of 280 ML/day, increased brine discharge of up to 208 ML/day and allowing for discharge of treated process and domestic wastewater from facilities with environmental approval (up to 0.8 ML/day and 0.4 ML/day respectively from the Ammonia and TAN Plant) Ministerial Statement 594 also amended condition 2-1 of MS 567 by requiring the implementation of revised consolidated environmental management commitments detailed in Schedule 2 of MS 594, in place of commitments initially included in Schedule 2 of MS 567. Commitments requiring consideration in the assessment of brine and wastewater discharge from the Ammonia Plant (including the liquid waste stream received from the TAN plant) to the MUBRL are summarised in Table 8.

Table 8. Consideration of environmental management commitments in Schedule 2 of MS 594 relevant to this application

Reference No.	Requirement	Delegated Officer consideration
6	Brine and wastewater effluent will only be accepted from industrial process plants: 1. for which licence and/or Ministerial Conditions (Part IV and V) have been issued; 2. that have provided appropriate toxicity and environmental fate data for all components of the effluent to the satisfaction of the DEP (now DWER)/EPA; and 3. which only utilise DEP/EPA approved process additives (e.g. antiscalants, corrosion inhibitors, etc.).	Discharge of treated process wastewater and brine into the MUBRL for discharge into King Bay was considered by the EPA in Bulletin 1036 for the Part IV assessment of the Ammonia Plant, and in Bulletin 1044 for the s46 assessment undertaken for upgrades to the Water Corporation's Desalination and Seawater Supplies Project. Discharge into the MUBRL from the TAN plant was assessed by the EPA in Report 1379 and the report includes recommended criteria for discharge into the MUBRL. The EPA assessments recommend that limits for the quality of water discharged into the MUBRL are managed under Part V of the EP Act. As wastewater from the TAN plant is discharged into the Ammonia Plant pipework before entering the MUBRL, the risk assessment and controls for the Ammonia Plant will consider this wastewater stream and the EPA's recommended limits.
8	1. Prepare an Environmental Management Plan in consultation with the system users and DEP/EPA. The Plan will encompass: • Requirements for monitoring (of effluent, seawater, sediments and biota); • Requirements, evaluation and reporting; and • Mechanisms for joint management of the system by the proponent and system users. 2. Implement the plan	The Water Corporation developed the Burrup Peninsula Desalinated Water and Seawater Supplies Project: Operational Marine Environmental Management Plan (OMEMP). The plan outlines the approach for managing discharge of combined effluent streams into the MUBRL to achieve specified environmental objectives via a programme of infield and field-based monitoring. The specified environmental objectives are based on the EPA's Pilbara Coastal Water Quality Consultation Outcomes (DoE 2006) report which recommended

Reference No.	Requirement	Delegated Officer consideration
12	1. Brine emissions from Water Corporation desalination facilities will be controlled to the following: • Effluent discharge temperature to be less than 2C above the inlet seawater temperature for 80% of the time and not exceeding a maximum limit of 5C above unless otherwise agreed with DEP; • The concentration of oxidizing biocide in the effluent discharge to be less than 0.1mg/L; and • The concentration of anti-scalant in the effluent discharge to be less than 2mg/L, unless otherwise agreed with the DEP. 2. The proponent in conjunction with system users, will manage the total effluent discharge to meet the above criteria.	setting a high level of ecological protection for King Bay in areas outside of the MUBRL outfall mixing zone, and an area of low ecological protection within the mixing zone. The OMEMP sets end-of-pipe trigger levels which act as initial indicators that the environmental objectives may not being met. The triggers were back calculated from the high protection trigger levels (ANZECC 99% level of protection) and take into consideration the predicted dilutions achieved by the outfall at the current discharge rate. Although the OMEMP sets a framework for managing the cumulative discharge from the MUBRL and specifies water quality triggers for the combined effluent discharge, EPA Bulletin 1044 and the OMEMP recommend that the management of the discharges from each individual operator should be managed under the respective Part V licence or Ministerial conditions. MS 586 does not specify limits for discharge into the MUBRL therefore the Delegated Officer will consider the discharge in the risk assessment for this application.

Key Finding: The Delegated Officer notes that there is potential for regulatory duplication between Part IV and Part V of the EP Act. In setting regulatory controls, the Delegated Officer will consider the requirements of MS 586, MS 567 and MS 594 conditions and will avoid duplication in licence conditions.

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.

The Delegated Officer has reviewed the regulatory controls in MS 586, MS 567 and MS594, and the EPA's assessment and recommendations pertaining to environmental regulation and management under Part V of the EP Act, and has determined that the risk assessment will consider the following aspects as per the EPA's recommendations:

- discharges to air; and
- discharges to marine waters.

Appropriate regulatory controls will be included in the licence where determined by the risk assessment outcomes.

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

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

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

modelling studies. The scientific reports from these studies were independently peer reviewed by international experts in relevant disciplines.

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

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

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

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

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

The scope of the strategy is to:

- establish an Environmental Quality Management Framework, including the derivation and implementation of environmental quality criteria that are based on sound scientific information;
- develop and implement a robust program of monitoring and analysis to determine whether change is occurring to the rock art on Murujuga;
- identify and commission scientific studies to support the implementation of the monitoring and analysis program and management;
- establish governance arrangements to ensure that:
    - monitoring, analysis and reporting are undertaken in such a way as to provide confidence to the Traditional Owners, the community, industry, scientists and other stakeholders about the integrity, robustness, repeatability and reliability of the monitoring data and results; and

    - government is provided with accurate and appropriate recommendations regarding the protection of the rock art, consistent with legislative responsibilities; and
- develop and implement a communication strategy in consultation with stakeholders.

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

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

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

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

Through implementation of the Murujuga Rock Art Strategy, DWER has engaged a consultant to provide advice to support the development of an ambient air quality network suitable for monitoring human health impacts at Murujuga and neighbouring population centres. The study will takes into consideration the existing and future emissions from industry, shipping, vehicles, port operations and other anthropogenic activities in the region. The study scope includes making recommendations on suitable locations for monitoring stations, key pollutant sources to be monitored, instrument types required, meteorological monitoring requirements and ensuring compliance with Australian standards for air monitoring equipment. The outcomes of the study will inform decision making on establishment of a long-term coordinated ambient air quality network on Murujuga.

Information on monitoring and analysis of the Murujuga rock art will be published on DWER's website. This will include the strategy, annual reports detailing the results of data collection and analysis, reports from scientific studies, the reports of independent peer reviewers and annual reports on the implementation of the strategy.

Table 9 below includes a summary of current legislative framework relevant to the Murujuga rock art.

Table 9 Summary of State and Commonwealth legislation targeted at protecting rock art

Mechanism (and responsible government)	Date	Protections
Murujuga National Park (WA)	17 January 2013	Murujuga National Park is owned in freehold by the MAC. The land is leased back to the Western Australian Government as national park and is jointly managed by the MAC and the Department of Biodiversity, Conservation and Attractions (DBCA) in accordance with the policy direction provided by the Murujuga Park Council (MPC). MPC comprises representatives from the MAC, DBCA and a representative appointed by the Minister for Aboriginal Affairs. Increased protection of rock art is provided by applying the provisions of the *Conservation and Land Management Act 1984* (CALM Act) to formally protect the park's values. The Park is operated in accordance with the Murujuga National Park Management Plan 78 (2013) and the Murujuga Cultural Management Plant (2016) which focuses on protection and awareness of the cultural and natural values of the area. The Rangers of Murujuga Land and Sea Unit (MLSU) conduct the practical management of the Park and the surrounding sea country and islands along with DBCA staff.
Aboriginal Heritage Act 1972 (WA)	NA	Specific localities on the Burrup have been declared Protected Places under the *Aboriginal Heritage Act 1972*. Consent is required from the WA Minister for Aboriginal Affairs for any activity which will negatively impact Aboriginal heritage sites.
Burrup and Maitland Industrial Estates Agreement (WA)	January 2003	The State Government entered into the Burrup and Maitland Industrial Estates Agreement (the Burrup Agreement) with three Aboriginal groups (Ngarluma-Yindjibarndi, the Yaburara-Mardudhunera and the Woon-Goo-Tt-Oo). This agreement enabled the State Government to compulsorily acquire native title rights and interests in the area of the Burrup Peninsula and certain parcels of land near Karratha. The Burrup Agreement allows for industrial development to progress across southern parts of the Burrup Peninsula, provides for the development of a conservation estate (Murujuga National Park) and ensures the protection of Aboriginal heritage. The Department of Jobs, Tourism, Science and Innovation is the lead agency for the development of the Burrup Strategic Industrial Area and LandCorp is the estate manager.

Mechanism (and responsible government)	Date	Protections
Burrup and Maitland Industrial Estates Agreement Additional Deed (WA)	16 January 2003	The State Government committed to organise and fund a minimum four-year study into the effects of the industrial emissions on rock art within and in the vicinity of part of the industrial estate on the Burrup Peninsula. The four-year scientific rock art monitoring program, included: - Two studies for the monitoring of ambient concentrations of air pollutants and microclimate and deposition undertaken by CSIRO Atmospheric Research; and - Two further programs for artificial fumigation of rock surfaces and fieldwork on rock surface colour changes undertaken by CSIRO Manufacturing and Infrastructure Technology. Following completion of these studies, in 2009 the Burrup Rock Art Monitoring Management Committee recommended that the studies on ambient air quality and rock microbiology monitoring be suspended and only recommenced if warranted by a major increase in emissions or if evidence becomes available to require further monitoring.
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) – Listing of the Dampier Archipelago (which includes the Burrup Peninsular) as a National Heritage place (Cth)	3 July 2007	The Dampier Archipelago was assessed by the Australian Heritage Council in 2007 and found to meet five of the eight criteria for national heritage listing under the EPBC Act. The listing of the Dampier Archipelago 'recognised the extraordinary extent, diversity and significance of petroglyphs, standing stones and circular stone arrangements of the place'. National heritage listing means that any proposed action that could have a significant impact on the National Heritage listed portion of the Burrup Peninsula must be referred to the Commonwealth Minister for the Environment as a matter of national environmental significance for assessment and decision. Actions that commenced prior to 16 July 2000 (being the commencement date of the EPBC Act) are exempt from the assessment and approval provisions of the EPBC Act. The Ammonia Plant was referred to the Minister for Environmental and Heritage in March 2001 under the EPBC Act. The Minister decided that the proposal to construct and operate the Ammonia Plant on the Burrup Peninsula was not a controlled action and therefore not subject to further assessment or approval.
EPBC Act Conservation Agreements (Cth)	2007	At the time of listing on the National Heritage List, EPBC Act Conservation Agreements were signed by the then Commonwealth Minister for the Environment and Water Resources with Woodside Energy Ltd, and Rio Tinto (Hamersley Iron Pty Ltd and Dampier Salt Ltd). Under the Conservation Agreements, these companies provide funding for research, management and monitoring of the National Heritage values of the place.
The Deep Gorge Joint Statement (DGJS) (Cth)	July 2017	The DGJS, signed by the Australian Government, Woodside and Rio Tinto, reaffirms the commitments made under each of the bilateral Conservation Agreements to support the ongoing protection, conservation and management of the National Heritage values of Murujuga and the wider Dampier Archipelago.

Mechanism (and responsible government)	Date	Protections
Yara Pilbara Nitrates Pty Ltd EPBC Act Approval (EPBC 2008/4546) for the construction of the Technical Ammonium Nitrate Facility (Cth)	14 September 2011 (variations approved in 2013, 2014 and 2017)	The Commonwealth Minister for the Environment determined the proposal for the construction of the TAN Plant was a controlled action under the EPBC Act for likely impacts to the National Heritage Place. The Commonwealth Minister for the Environment approved the proposed action, with conditions relating to the protection of the National Heritage Place, including: • contribution of funds toward implementation of baseline rock art monitoring and public reporting of results; • contribution of funds toward implementation of an ongoing rock art monitoring program or engagement of a suitably qualified person to undertake the rock art monitoring using methodology approved by the Minister and public reporting of results; • undertaking a baseline ambient air quality monitoring program (NH_3, NOx, SOx and TSP) and public reporting of results; • ongoing ambient air quality monitoring program (NH_3, NOx, SOx and TSP) and public reporting of results; • compliance with limits set in the Part V licence issued under the EP Act; and • providing the Department of the Environment and Energy (DoEE) with a management plan in the event that accelerated changes in the rock art are detected.
Woodside Energy Ltd approval for Pluto Liquefied Natural Gas Development (WA)	December 2007	Offsets package for Pluto LNG required the rehabilitation/ restoration of degraded areas that fall both outside of the lease and outside of areas of potential industrial development. The program initiated as a result of this requirement aims to rehabilitate and restore degraded areas on the Burrup Peninsula. The program includes rock art site rehabilitation and restoration.

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

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

- Prior to the Murujuga Ambient Air Quality Monitoring Network and Murujuga Rock Art Monitoring Program being established, and when the opportunity arises, the ministerial conditions of other existing industrial facilities located on Murujuga should be changed via section 46 of the EP Act, to include a requirement to reduce the risk of impacts to rock art from air emissions.
- When the Murujuga Ambient Air Quality Monitoring Network and Murujuga Rock Art

Monitoring Program have been established the ministerial statements of existing industries should be changed via section 46 of the EP Act to remove any requirements for the proponents to undertake their own individual ambient air quality monitoring and / or rock art monitoring where necessary and include a requirement for the proponent to contribute to the airshed monitoring activities.

Key Findings: The Delegated Officer considered the legislative framework for assessment and management of potential impacts on the Burrup rock art petroglyphs and has determined:

1. There are multiple industries (including shipping within the Dampier Port) located on the Burrup and surrounds with discharges to air which could potentially have an adverse impact on the Murujuga rock art.
2. The Murujuga Rock Art Strategy has been finalised and is being implemented. The strategy establishes a long-term framework for the monitoring and analysis of changes to rock art on Murujuga and describes the management responses which will be triggered in the event adverse impacts on the rock art are identified.
3. Monitoring for impacts to the rock art will be implemented through the Murujuga Rock Art Monitoring Program. A contract has been awarded for the implementation of the monitoring program.
4. The monitoring program will be subject to independent peer review and information on monitoring and analysis of the Murujuga rock art will be made publicly available via DWER's website.
5. The conditions of EPBC approval 2008/4546 as amended, for the YPN TAN Plant are another regulatory tool for monitoring and reporting of potential impacts on the Murujuga rock art and ambient air quality.
6. The regulatory framework described is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required..
7. The Western Australian Government is considering establishment of a long-term coordinated ambient air quality network on Murujuga (Murujuga Ambient Air Quality Monitoring Network) and the surrounding areas for monitoring human health impacts and has commenced a study, through the Murujuga Rock Art Strategy, designed to investigate and make recommendations regarding the establishment of such a program.
8. The EPA considers the Murujuga Ambient Air Quality Monitoring Network and the Murujuga Rock Art Monitoring Program to be the most appropriate overarching systems through which the monitoring of ambient air quality and rock art should be coordinated. The EPA has made recommendation to the Minister for Environment that the ministerial conditions of other existing industrial facilities on Murujuga should be changed to reduce the risk of impact to rock art from air emissions to remove requirements for individual monitoring networks and instead contribute to air shed monitoring.

5.3 Contaminated sites

On 17 February 2016, the Ammonia Plant (Lot 564) was classified as possibly contaminated – investigation required under the *Contaminated Sites Act 2003* (CS Act). The classification relates to a release of approximately 11 kilolitres of process condensate from the CO_2 stripper stack resulting from a process upset in July 2015. The process condensate contained up to 37% of MDEA. Following the spill, MDEA was identified in shallow soil at depths of up to 0.2 m at concentrations up to 66,000 mg/kg. Remedial works were undertaken which involved excavation of the impacted soil however some residual contamination remained in the soil due to the proximity to infrastructure (located below sealed surfaces).

A targeted site investigation and an ecological and human health risk assessment have been completed for MDEA as part of the spill response and remedial works. The groundwater investigation completed as part of the targeted site investigation reported MDEA concentrations below the limit of reporting at all groundwater monitoring locations, however the limit of detection adopted by the laboratory undertaking the analysis was not sufficiently low to allow for meaningful comparison to be made to adopted screening guideline criteria. The Department therefore considers the nature and extent of MDEA impact to groundwater is currently unknown.

Site specific assessment criteria were derived for MDEA in soil (industrial land use) and for the protection of marine aquatic ecosystem. The criteria were deemed suitable by the Department of Health and DWER. The Department received a detailed site investigation addendum report in February 2020 which is under review to assess the adequacy of the investigation.

The Department has recommended that an ongoing Site Management Plan be prepared to monitor

and manage any potential on-site impacts relating to MDEA.

5.4 Other relevant approvals

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

The Ammonia Plant includes a number of infrastructure items used 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*.

The Ammonia Plant is subject to the requirements of Dangerous Goods licence DSG017039 and the requirements of the *Dangerous Goods Safety Act 2004.*

Key Finding: The Delegated Officer has reviewed the other relevant approvals and has found:

1. DMIRS is the primary regulatory authority for regulating public health risks associated with the storage and handling of dangerous goods, including the risk of explosion. Subject to DMIRS remaining the primary agency for regulating safety risks, there are therefore no requirements to assess safety risks (including explosion risks) in this Decision Report or insert conditions on the Licence to regulate these risks.

5.5 Part V of the EP Act

5.5.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and *Environmental Protection Regulations 1987* (EP Regulations). The guidance statements which inform this assessment are:

- Guidance Statement: Regulatory Principles (July 2015)
- Guideline: Decision Making (July 2019)
- Guidance Statement: Risk Assessments (February 2017)
- Guidance Statement: Environmental Siting (November 2016)
- Guidance Statement: Setting Conditions (October 2015)
- Guidance Statement: Licence Duration (August 2016)

5.5.2 Works approval and licence history

Table 10 summarises the works approval and licence history for the premises.

Table 10: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
W3589/2002/1	15 May 2002	New works approval for the construction of the Ammonia Plant.
W3791/2002/1	30 June 2003	Amended the previous works approval (largely relating to monitoring requirements).
W3838/2002/1	20 October 2003	New works approval for the construction of a sewage treatment facility to support the plant's construction.
R1571/2003/1	1 December 2003	New registration to operate the sewage treatment facility (Category 85). This was revoked and the sewage treatment facility included into the operating licence.
L7997/2002/1	25 April 2005	New licence issued.
L7997/2002/1	12 December	Licence amended to alter the detection limits for wastewater sampling.

Instrument	Issued	Nature and extent of works approval, licence or amendment
	2005	
L7997/2002/2	18 April 2006	Licence was reissued with amendments relating to monitoring and discharge requirements.
L7997/2002/3	19 April 2007	Licence review including a risk assessment of premises for Category 31.
L7997/2002/4	17 April 2008	Licence reissued.
L7997/2002/5	20 April 2009	Licence reissued.
L7997/2002/6	15 April 2010	Licence reissued with amendments to remove duplicate reporting conditions and update premises boundary.
L7997/2002/7	14 April 2011	Licence reissued.
L7997/2002/8	19 April 2012	Licence reviewed to incorporate a more comprehensive suite of conditions for monitoring and reporting emissions and discharges from the site.
L7997/2002/9	18 April 2013	Licence reissued.
L7997/2002/10	16 April 2014	Licence reissued.
L7997/2002/11	16 April 2015	Licence reissued.
W5920/2015/1	7 January 2016	New works approval for the replacement of its existing WWTP with a new rotating biological contactor WWTP.
L7997/2002/11	20 April 2016	Licence amended to align licence conditions with requirements of MS 586. MS 586 was amended in August 2015 under section 45C of the EP Act. The amendment authorised an increase in the nominated design capacity of the Ammonia Plant and extended the duration of the licence to 20 April 2020.
L7997/2002/11	28 June 2018	Licence amended to incorporate the operation of the TAN Plant constructed and commissioned under W4701/2010/1, and changes to the prescribed premises boundary to incorporate both the Ammonia Plant and the TAN Plant.
L7997/2002/11	2 April 2019	Licence amendment via an Amendment Notice to extend the date associated with TN and TP limits for discharges from the Premises WWTP from 1 April 2019 to 30 November 2019.
L9224/2019/1	20 April 2020	New licence issued in place of L7997/2002/1 for operation of the Ammonia Plant. L7997/2002/1 expires on 20 April 2020. L9224/2019/1 will take effect from 21 April 2020.

5.5.3 Compliance and complaints history

DWER's Incident and Complaints Management System (ICMS) is used to record complaints received and non-compliances requiring investigation. No recorded complaints have been received by DWER relating to the operation of the Ammonia Plant since the amendment to the existing licence in June 2018. The most recent annual environmental report (AER) submitted for the premises (2018 reporting year) states that five complaints were received by YPF during the 2018 reporting period. Three complaints related to high CO readings at the Woodside Karratha Gas Plant during an ammonia plant start up when venting was occurring. Two complaints related to an occurrence of ammonia odour at the Pilbara Port. These complaints occurred during start up and venting at the adjacent TAN plant so were not directly related to the Ammonia Plant.

Compliance inspections were undertaken by DWER on the premises in 2014, 2015, and 2016. A

summary of the inspection findings is provided below:

- An inspection undertaken on 15 May 2014 identified non-compliance with 12 conditions (mostly reporting conditions) and included three actionable non-compliances. Following a response from YPF to these findings, the Department confirmed that all agreed actions had been completed.
- An inspection undertaken on 28 May 2015 identified non-compliance with two conditions which have since been addressed through a licence amendment.
- An inspection undertaken on 6 April 2016 did not identify any compliance issues.
- An inspection undertaken on 10 October 2016 identified three instances of non-compliance with regulatory controls:
    - An unauthorised discharge of MDEA from the CO_2 stripper stack and subsequent release from the western sedimentation basin. Investigations conducted by YPF concluded that observations and monitoring data suggested no alteration to the environment had occurred as a result of the release. As an outcome of the investigation, the Department listed the site as potentially contaminated – investigation required under the CS Act (refer to section 5.3).
    - Three ammonia releases to atmosphere resulting from the activation of Pressure Safety Valves (PSVs). YPF implemented a number of improvements as a result of these releases. The risk associated with ammonia releases and assessment of regulatory controls are considered in section 9.6.
    - Exceedances of licence limits for discharges from the WWTP, specifically TN, TP, pH, BOD, TSP and pathogens (*E.coli*). The WWTP was upgraded and commissioned in December 2016; however, as per section 4.3 has been unable to consistently achieve specified nutrient limits. The licence holder has therefore included in the application a proposal to establish an evaporation pond for treated effluent to remove the requirement to discharge to land.

A requirement of the existing licence is the submission of an AER and annual audit compliance report (AACR). A review of the previous five reporting years has been undertaken and reported non-compliances are detailed in Table 11

Table 11: AACR summary 2014-2018

Reporting Year	Number of non-compliances reported	Summary details
2014	7	The environmental risk associated with the non-compliances was low and was addressed through subsequent licence amendments.
2015	5	The non-compliances were low risk and addressed through licence amendments or implementation of additional controls by YPF.
2016	7	Two of these non-compliances related to operation of, and discharges from the STP. Issues relating to the STP non-compliances were assessed and subject to regulatory controls through the 2018 amendment of L7997/2002/11. The remaining non-compliances were adequately addressed by YPF.
2017	8	Non-compliances related to operation of, and discharges from the STP, compliance with monitoring and reporting requirements specified in the licence, and discharge of cooling water to the sedimentation basins. Issues relating to the STP non-compliances were assessed and subject to regulatory controls through the 2018 amendment of L7997/2002/11. The remaining non-compliances were adequately addressed by YPF.

Reporting Year	Number of non-compliances reported	Summary details
2018	2	Non-compliances related to discharges to land from the STP not meeting the specified limits and not meeting all monitoring requirements for water discharged from the East Sedimentation Basin. Due to the STP being unable to achieve the limits specified in the licence for discharges to land, YPF ceased discharge of treated effluent to the infiltration basins in late 2019 and has applied to convert these into a lined evaporation pond through this licence assessment.

6. Modelling and monitoring data

6.1 Air emissions

6.1.1 2001 Modelling

Air emissions modelling for the Ammonia Plant was undertaken in August 2001 at the PER stage of the assessment process under Part IV of the EP Act. The modelling considered predicted emissions based on design specifications from the proposed plant and equipment. Cumulative impacts from existing and proposed (at the time) emissions sources in the Dampier and Karratha region were considered in this modelling assessment.

The 2001 modelling considered existing and proposed emission sources on the Burrup Peninsula and potential impacts on offsite receptors including recreation areas (Hearson Cove and Cowrie Cove), residential areas (Dampier and Karratha) and nearby industrial workforces.

The modelling assessment concluded that during normal operation of the Ammonia Plant, the ground level concentration (GLC) of NOx, SO_2, and particulates would remain within the assessment criteria at receptors. The modelling also concluded that the GLC of ammonia (NH_3) during normal operation would remain below the ambient assessment criteria of 600 µg/m^3 (3-minute average), as adopted from the *Victorian State Environmental Protection Policy* (CASANZ, 2000).

The impact of flaring activities was considered in the modelling assessment. The model assumed a single flare was installed (Storage Flare) to incinerate ammonia although it is noted that the plant was built with both a Production and Storage flare. The modelling conclusions in relation to flaring included:

- Maximum 1-hour NOx GLCs from flaring were predicted to reach 87 µg/m^3 (from DISPMOD model) and 286 µg/m^3 (from Ausplume model) under very stable light wind conditions (0.5 m/s and F-class stability). At Hearson Cove or King Bay, the maximum NOx GLC were predicted to be 59 µg/m^3.
- Maximum GLC were predicted to occur 700 m to the north of the Ammonia Plant with only a small area to the north and south of the plant expected to exceed the assessment criteria. Predicted GLC at identified receptors were within relevant the assessment criteria.
- A maximum 3-minute ammonia GLC of 1500 µg/m^3 (2.5 times the Victorian EPA Guideline assessment criteria) could occur if flaring occurs during worst case atmospheric dispersion conditions. At Hearson Cove or King Bay, the maximum ammonia concentration was predicted to be 250 µg/m^3 (42% of the assessment criteria).

Based on the modelling outcomes the potential for flaring to result in an exceedance of relevant criteria for NH_3 and NOx at sensitive receptors was considered unlikely.

6.1.2 2015 Updated Modelling

Updated modelling was undertaken in 2015 to support the request to amend MS 586 under section 45C of the EP Act. The model was undertaken using AERMOD and Karratha Airport meteorological

data. The model only considered emissions from the Ammonia Plant in isolation and did not include cumulative assessment of air quality impacts from other industries within the airshed.

Updated emissions data from a process mass balance was used as inputs to the model which examined potential impacts from emissions from the Ammonia Plant. The calculated emissions from the Ammonia Plant were supported by stack monitoring results from the Primary Reformer Furnace and Package Boiler.

Offsite receptors considered in the 2015 updated modelling assessment were:

- North Burrup (remote site);
- Woodside East (industrial)
- Burrup Rd
- Water Tanks
- Deep Gorge
- King Bay south (industrial)
- Karratha (residential)
- Hearson Cove (beach recreation);

The modelling predicted that during normal operation of the Ammonia Plant, the GLCs of NOx, SO_2, CO, NH_3 and particulates (as PM_{10}) were below the assessment criteria at these receptors and at all locations in the modelling domain (refer to Table 13). Potential impacts resulting from venting activities was also revised in the 2015 updated modelling which indicated resulting GLCs at receptors are below relevant assessment criteria (refer to Table 14). The sensitive receptor predicted by the modelling as being impacted by the highest GLCs was Hearson Cove.

Impact from flaring activities was not considered in the 2015 updated model. Operation of the Ammonia Plant has changed from that described in the PER, namely:

- the 2001 model assumed a single flare was installed (Storage Flare), whereas two flares are installed (Production and Storage Flares);
- the Production Flare incinerates waste process gas containing ammonia; and
- the Storage Flare is dedicated to incineration of gaseous ammonia that may be emitted intermittently from the liquid ammonia storage tanks with changes in headspace pressure.

These flares are components of the plant safety systems and are designed and operated to incinerate ammonia gas to N_2, CO_2 and water with minimal NOx formation and minimal unburnt ammonia remaining. Based on the low frequency of flaring and high efficiency of the flares, the resulting emissions are not considered to have a significant impact on modelling outcomes.

Ammonia Plant – 2015 modelling outcomes for normal operations

The Ammonia Plant operates for 24 hours per day and approximately 360 days per year with allowance for maintenance period of approximately one week per year. Atmospheric emission characteristics representative of normal operations are provided in

Table 12. The outcomes of the 2015 modelling for normal operation of the ammonia plant are presented in Table 13

Table 12: Atmospheric emission characteristics during normal operation of the Ammonia Plant (Environ 2015)

Source	Stack Height (m)	Stack Diameter (m)	Emission Volume Am^3/hr[1]	Exist velocity (m/s)	NOx[2] (g/s)	SO_2 (g/s)	PM_{10} (g/s)	CO (g/s)	NH_3 (g/s)
Primary Reformer Stack	36	3.5	520,000	15	17.13	0.23	0.91	10.08	$1.64x10^{-05}$
CO_2 Stripper Stack	60	0.8	162,000	77	NA	NA	NA	50	Not provided
Package Boiler Stack	30	3	104,300	4.1	6.92	0.13	0.36	4.15	NA

Note 1: Am^3/hr is at actual stack conditions.

Note 2: NOx expressed as 100% nitrogen dioxide (NO_2)

Table 13: GLCs (µg/m^3) resulting from normal operation of the Ammonia Plant and assessment against ambient criteria (Environ 2015)

Emission	Criteria (µg/m^3)	Averaging period	Deep Gorge (µg/m^3)	Karratha (µg/m^3)	Hearson Cove (µg/m^3)	Maximum on modelling grid (µg/m^3)	Maximum of criteria at receptors excluding background (%)	Background[1] (µg/m^3)	Maximum of criteria at receptors including background (%)
NOx (as NO_2)	246	1-hour	32	11	92	198	13	45.1	55.7
	61	Annual	0.7	0.06	2.2	15	1.1	6.3	13.9
SO_2	520	1-hour	0.5	0.2	1.4	3.6	0.1	0.4	0.3
	226	24-hour	0.1	0.02	0.3	1.3	0.04	0.3	0.3
	56	Annual	0.01	0.0009	0.03	0.2	0.02	0.2	0.4
CO	10300	8-hour	10	1.9	20	82	0.1	NR	0.1
NH_3	330	1-hour	$2x10^{-06}$	$5.0 x10^{-06}$	$6.8 x10^{-05}$	$1.9 x10^{-04}$	$6.1 x10^{-07}$	0.9	0.3
	180	Annual	$3.7 x10^{-07}$	$3.1 x10^{-08}$	$1.2 x10^{-07}$	$1.3 x10^{-05}$	$2.1 x10^{-07}$	NR	$2.1 x10^{-07}$
PM_{10}	50	24-hour	0.3	0.06	1.1	4.6	0.6	23.8	49.8

Note 1: Background figures have been included from *Burrup Peninsula Technical Ammonium Nitrate Production Facility Air Quality Assessment Update* (ERM 2012) and were not considered in the 2015 modelling assessment by Environ.

Ammonia Plant – 2015 modelling outcomes for start-ups, trips and shutdowns

Plant shutdowns are required in response to upset conditions, equipment failure or for maintenance; with start-ups then required to restore normal operations. Two types of shutdown and associated start-up events occur as part of normal plant operations:

- minor shutdowns or plant trips (partial and full plant shutdowns) which require cessation of natural gas feed to the reformer and isolation of other unit processes while the issue is resolved; and
- major shutdowns (referred to as turn-arounds) that occur nominally every four to five years for refurbishment/replacement of catalysts.

During such events venting of process gases will occur from the Front End Vent or the Back End Vent, depending on the location within the process that initiated the plant trip. Venting gives rise to increased CO emissions and other process gas emissions (further described in section 9.5). In addition to venting, NOx emissions occur from the Package Boiler and Primary Reformer Furnace stacks from natural gas combustion during such events. Higher steam demand from the Package Boiler during start-up results in an increase of NOx emissions compared to normal operations. Lower NOx emissions occur from the Primary Reformer Furnace for an ISBL or full ISBL/OSBL shutdown, where the furnace burners are turned down or off during the shutdown. Emissions from the furnace recommence once the reformer heating progresses during the start-up. NOx emissions are also generated from the Start-up Heater when a cold start-up occurs.

Start-up and shutdown scenarios were included in the 2015 modelling. The outcomes of the worst-case assessment are included in Table 14. In addition, for the 2018 amendment of L7997/2002/11 YPF provided an additional assessment of potential CO and NOx emissions resulting from start-ups, plant trips and shutdowns. The assessment used the maximum emission rates and durations from events and applied scaling factors to the 2015 updated modelling to determine predicted GLCs at Hearson Cove (Table 15). This assessment is considered conservative in that it assumes constant emission rates for an entire modelling year. As such actual GLC's are likely to be lower than those predicted. The assessments are considered conservative as it was assumed that start-up emission rates remain constant over the entire modelling year rather than short duration events occurring over a number of hours.

Table 14: GLCs (µg/m^3) resulting from worst-case Ammonia Plant start-up from minor shutdown (considering venting) and assessment against ambient criteria (Environ 2015)

Emission	Criteria (µg/m^3)	Averaging period	Deep Gorge (µg/m^3)	Karratha (µg/m^3)	Hearson Cove (µg/m^3)	Maximum on modelling grid (µg/m^3)	Maximum of criteria at receptors excluding background (%)	Background[1] (µg/m^3)	Maximum of criteria at receptors including background (%)
NOx (as NO_2)	246	1-hour	39	16	97	364	39	45.1	58
	61	Annual	1.0	0.08	2.8	16	4.6	6.3	15
SO_2	520	1-hour	1.9	0.4	2.8	8.5	0.54	0.4	0.62
	226	24-hour	0.3	0.03	0.7	2.7	0.31	0.3	0.44
	56	Annual	0.03	0.002	0.08	0.5	0.14	0.2	0.5
CO	10300	8-hour	4250	837	6719	20256	65	NR	
NH_3	330	1-hour	9.72×10^{-06}	$2.86- \times 10^{-06}$	3.12×10^{-05}	8.10×10^{-05}	<1	0.9	0.27
	180	Annual	1.5×10^{-07}	1.6×10^{-08}	8.6×10^{-07}	7.2×10^{-06}	<1	NR	
PM_{10}	50	24-hour	0.5	0.08	1.4	5.1	2.8	23.8	50.4

Note 1: Background figures have been included from Burrup Peninsula Technical Ammonium Nitrate Production Facility Air Quality Assessment Update (ERM 2012) and were not considered in the 2015 modelling assessment by Environ.

Table 15: Ammonia Plant startup, plant trips and shutdown scenarios - maximum ground level impacts (DWER 2018)

Event	Maximum CO emission rate (g/s)	Duration of maximum CO emission rate (hours)	Maximum CO GLC at Hearson Cove (µg/m^3)	Maximum[1] NOx emission rate (g/s)	Duration of maximum[1] NOx emission rate (hours)	Maximum NOx GLC at Hearson Cove (µg/m^3)
Full Plant Shutdown and Cold Start	8974	7	12613	47.4	10	181
Backend Trip and Hot Start	879	1	1236	50.1	9	192
Full ISBL Shutdown and Cold Start	12235	7	17196	50.7	10	194
Full ISBL Shutdown and Hot Start	7963	6	1192	52.6	14	201

Note 1: Maximum NOx emission is total of emissions from Primary Reformer Furnace, Package Boiler and Startup Heater

6.1.3 Cumulative assessment

Given the proximity, and interconnectedness of the Ammonia Plant and adjacent TAN plant, consideration is given to the cumulative impact of emissions to air from the plants when both are operating under normal operating conditions. The applicant has determined cumulative impacts by assuming that the modelled maximum GLCs for normal operation of each plant, adjusted for the difference between measured and modelled emission rates for the plant, will occur simultaneously at the receptors.

Maximum predicted GLCs from concurrent normal operations of the Ammonia and TAN Plants which were calculated through this method are shown in Table 16. The results shown are the sum of maximum predicted GLCs from 2015 modelling of the Ammonia Plant (Environ), and maximum predicted GLCs from 2012 modelling of the TAN Plant (ERM), which were scaled from maximum modelled GLCs based on differences between measured and modelled plant emission rates. The Delegated Officer has noted that the assessment of the cumulative impact of emissions was not consistent with the *Department of Environment Air Quality Modelling Guidance Notes (2006)* in that locations where maximum GLCs are predicted were not identified and the meteorological conditions that gave rise to the predicted maxima were not described.

However, the simultaneous occurrence of maximum predicted GLCs is unlikely to occur as the emission sources from each plant are separated by at least 390 m. Even for times of wind blowing along the axis of those stacks, the emissions from the stack nearest to the wind will already be diluted before the emissions from the next stack interact with the plume. The potential for maximum GLCs to occur from both sources at the same time and at the same location is considered unlikely. As such the Delegated Officer considers the assessment of the cumulative impact of emissions provided by the applicant provides a sufficiently conservative estimate of potential air quality resulting from concurrent normal operation of the Ammonia and TAN Plants.

Table 16: GLCs (µg/m^3) from combined emissions at Ammonia Plant and TAN Plant – normal operating conditions (DWER 2018)

Emission	Criteria (µg/m^3)	Averaging period	Deep Gorge	Dampier	Karratha	Hearson Cove	Maximum of criteria (%) excluding background	Background[1]	Maximum of criteria (%) including background
NOx (as NO_2)	246	1-hour	41	29	14	86	35	45	53.3
	61	Annual	0.97	0.42	0.11	2.51	4.1	6.3	14.4
SO_2	520	1-hour	1.56	1.25	0.62	4.37	0.8	0.4	0.9
	226	24-hour	0.31	0.12	0.06	0.94	0.4	0.3	0.5
	56	Annual	0.03	0.01	0.002	0.08	0.1	0.2	0.5
CO	10300	8-hour	49	17	9.4	99	1	N/R	1
NH_3	330	1-hour	14	3.2	1.06	27	8.2	0.9	8.5
	180	Annual	0.37	0.07	0.01	1.48	0.8	N/R	0.8
TSP	90	24-hour	1.21	0.76	0.36	2.85	3.2	18.9	24.2
PM_{10}	50	24-hour	0.60	0.38	0.18	1.42	2.8	23.8	50.4

Note 1: Background figures are taken from the *Burrup Peninsula Technical Ammonium Nitrate Production Facility Air Quality Assessment Update* (ERM 2012).

2: N/R: Not reported. No background concentrations considered

6.1.4 Key Findings

Key findings: The Delegated Officer has considered information relating to air emission modelling and has found:

1. 2001 and 2015 modelling of discharges to air from the Ammonia Plant has previously been reviewed by the Department.
2. Modelling of point source emissions to air from normal operating conditions, and worst case abnormal operating conditions (minor start-up) for the Ammonia Plant, demonstrated predicted GLCs at sensitive receptors will not exceed ambient air quality criteria.
3. The cumulative impact of point source emissions from the operation of both the Ammonia Plant and adjacent TAN Plant has also been determined based on the outcomes of modelling assessments undertaken for both plants and demonstrates predicted GLCs at sensitive receptors will not exceed ambient air quality criteria.
4. When considering maximum emission rates of CO and NOx measured for the Ammonia Plant during a series of start-up and shutdown events, the GLCs predicted to occur at Hearson Cove exceed (CO), or are close to exceeding (NOx), the National Environmental Protection Measure (NEPM) ambient air quality criteria. As the modelling assumes that the start-up/shut down event emission rate is constant for an entire modelling year (rather than a short duration event of, as measured, 14 hours or less) actual GLC's are likely to be lower than those predicted.
5. Emissions from flaring were only considered in the 2001 modelling assessment of plant emissions which considered operation of a single storage flare only. The Ammonia Plant was constructed with both a Production and Storage Flare which are designed and operated to incinerate ammonia gas to N_2, CO_2 and water with minimal NOx formation, and minimal unburnt ammonia remaining. Based on the low frequency of flaring and high efficiency of the flares, the resulting emissions are not considered to have a significant impact on modelling outcomes therefore the 2001 modelling outcomes for flaring scenarios are considered suitable to assess the risk associated with flaring of ammonia gas.

6.2 Noise emissions

An assessment of cumulative measured noise emissions relating to the operation of the Ammonia Plant and adjacent TAN plant was undertaken for the amendment of L7997/2002/11 to include operation of the TAN plant (DWER 2018). Cumulative assessment of noise from the two plants is relevant given their proximity to each other and in order to assess the impact of noise emissions associated with operation of the two plants.

The cumulative assessment was based on the results of noise monitoring undertaken between 30 May 2016 and 17 May 2017 during commissioning of the TAN Plant, when the Ammonia Plant was also operating, and is therefore representative of cumulative emissions.

The monitoring was reviewed by DWER's noise experts who concluded that the TAN Plant and Ammonia Plant are considered contributors to noise levels at Hearson Cove and that it is probable that the TAN Plant is the major contributor as it is closer; however, the noise monitoring information available does not confirm this.

The assessment compared ambient noise monitoring results at Hearson Cove to an aspirational target of 45 dB(A) at Hearson Cove based on a recommendation in EPA Bulletin 1077 which was related to an abandoned project. Approximately 62% of results from the monitoring program exceeded the aspirational target and it was estimated that approximately 41% of the exceedances were influenced by external noise sources.

Internal advice was sought regarding the relevance of the aspiration goal and the advice confirmed the goal is no longer relevant. The internal advice also recommended that ambient noise levels at Hearson Cove Beach could be minimised by ensuring that all industrial facilities located in proximity incorporate noise attenuation measures on all identified significant noise sources to reduce noise levels, as far as practicable, at their respective plant boundaries to below the 65 dB(A) specified noise level in the *Environment Protection (Noise) Regulations 1997* (EP (Noise) Regulations).

The majority of ambient noise monitoring results at Hearson Cove during the commissioning of the TAN plant were below 65 dB(A). On the few occasions exceedances did occur at Hearson Cove measured noise levels at the TAN Plant boundary were below 65 dB(A) indicating the ambient noise levels at Hearson Cove were influenced by other sources. Monitoring results at the south east boundary of the TAN Plant exceeded 65 dB(A) on one occasion during the

monitoring period.

Noise monitoring results indicated the TAN plant nitric acid plant compressor was the primary source of noise that may impact Hearson Cove and subsequently installation of external acoustic insulation to the compressor air inlet duct was undertaken in August 2017.

To monitor performance against the recommended 65 dB(A) boundary noise level, the existing licence included a condition requiring quarterly noise monitoring at four locations at the north, east, south and west boundaries of the TAN and Ammonia Plant premises. The results of monitoring undertaken at the licence specified locations are discussed in the risk assessment for noise emission in section 9.11. The recommended 65 dB(A) boundary noise level was also included as a limit within the licence. No exceedances of the limit have been recorded during the monitoring events conducted and all results are more than 5 dB(A) below the specified limit. Due to the operational down time of the Ammonia and TAN plants since monitoring was included in the existing licence, limited monitoring records are available, with only one noise monitoring event occurring when both plants were operating.

6.2.1 Key Findings

Key findings: The Delegated Officer has considered information relating to noise emissions and has found:

1. the Ammonia Plant and TAN Plant are major contributors to noise levels at Hearson Cove, a popular recreational area for residents of Karratha and Dampier. Cumulative noise resulting from concurrent operation of the two plants will therefore be considered in the risk assessment.
2. ensuring industrial facilities in proximity of Hearson Cove achieve noise levels below 65 dB(A) will minimise the likelihood of ambient noise impacting on amenity at this location.
3. the existing licence conditions require noise monitoring and compliance with a 65 dB(A) limit at the premises boundary.
4. to date, outside the commissioning period for the TAN Plant, only one monitoring event has occurred when Ammonia Plant and TAN Plant were operating concurrently.

6.3 Groundwater monitoring

A baseline groundwater investigation was conducted between 2003 and 2005 by Sinclair Knight Merz to characterise baseline water quality prior to commencing operation of the Ammonia Plant (SKM 2006). Six monitoring wells (BFA, BFB, BFC, BFD, BFE and BFF) were established in proximity to the Ammonia Plant prior to construction of the plant as part of the investigation. Nine sampling events were conducted as part of the investigation. Monitoring well BFA was dry throughout the investigation. BFB and BFC are within the southern part of the premises on a tidal flat so are likely to be subject to tidal influence. Infiltration basins associated with a temporary STP for construction impacted monitoring well BFF which showed increasing nutrient concentrations during the investigation. Monitoring well BFC, which is down gradient of BFF also showed elevated nitrogen levels although not to the same extent. The investigation outcomes also highlighted that there is natural variation in water quality and elevated metal concentrations in the Burrup area when compared with the *Department of Environment Guidelines – Draft Assessment Levels for Soil, Sediment and Water, V3, 2003* indicating the site specific criteria based on baseline water quality may be more appropriate for certain heavy metals (copper and nickel) and pH.

The average baseline groundwater quality results are summarised in Table 17.

Table 17: Summary of Ammonia Plant baseline groundwater quality (SKM 2006)

Parameter	units	BFB	BFC	BFD	BFE	BFF[1]
pH	pH units	6.9	7.5	6.9	7.3	7.6
Electrical conductivity @25ºC	µS/cm	170,444	111,800	172,556	160,200	4,900
Total dissolved solids	mg/L	142,556	84,000	144,556	131,600	3,140
Sodium	mg/L	40,666	24,400	41,389	39,800	574

Potassium	mg/L	1,444	736	1,466	1,600	13
Calcium	mg/L	1,093	627	1,183	1,310	274
Magnesium	mg/L	4,166	2,420	4,205	3,670	142
Chloride	mg/L	74,222	45,800	77,833	72,700	1,338
Carbonate	mg/L	<1	<1	<1	<1	<1
Bicarbonate	mg/L	87	262	102	215	340
Sulphate	mg/L	5,478	3,660	4,639	5,970	170
Nitrate	mg/L	10	30	3.3	0.4	74
Total persulphate nitrogen	mg/L	2.4	7	1.03	0.43	16.1
Total persulphate phosphorous	mg/L	0.03	0.05	0.06	0.03	0.06
Chromium	mg/L	0.011	0.008	0.009	0.005	0.00
Copper	mg/L	0.05	0.037	0.059	0.076	0.004
Nickel	mg/L	0.028	0.02	0.036	0.03	0.007
Zinc	mg/L	0.011	0.01	0.01	0.009	0.005
Total recoverable hydrocarbons	µg/L	Below limit of detection				

Note 1: due to the impacts of seepage from the nearby infiltration basin monitoring well BFF is not considered representative of baseline conditions.

The Existing Licence includes conditions requiring monitoring of groundwater. The premises groundwater monitoring program was revised in 2016 to ensure it was sufficient to identify potential groundwater contamination associated with the premises operations. YPF also developed trigger levels for groundwater quality based on baseline monitoring data. DWER's contaminated sites experts reviewed the revised program with consideration given to the:

- appropriateness of the construction and location of the groundwater monitoring wells;
- frequency of groundwater monitoring;
- monitoring procedures and parameters monitored; and
- trigger levels developed for the premises.

Key recommendations from the review included:

- improvements to monitoring procedures (collection through a flow-through cell) and bore construction to facilitate a better understanding of baseline groundwater conditions, depth to groundwater, and groundwater flow to assist with future assessment of risks to groundwater;
- measurement of in-situ groundwater physiochemical parameters in the field as their characteristics change over very short timescales;
- alignment of monitoring procedures with the *National Environmental Protection (Assessment of Site Contamination) Measure 1999*;
- recommendations for additional parameters to be measured including by-products of MDEA which represent a potential risk to human health;
- developing suitable groundwater trigger levels; and
- further investigation requirements adequately assess potential impacts to soil, surface water, groundwater, and any identified ecological receptors associated with contamination on the premises. Investigation would be regulated under the CS Act.

In response to the review YPF installed additional up-gradient groundwater monitoring wells. Recommended improvements to monitoring procedures including use of a flow-through cell, in-situ measurement of groundwater physiochemical parameters and extension of the suite of analytical parameters monitored were also incorporated into the existing licence during the 2018 amendment. YPF also advised in the application that a new monitoring well BFG has been installed down gradient of the STP infiltration basins to replace monitoring well BFB which was decommissioned due to safety and access concerns.

The 2016 groundwater monitoring review and the AER for the period 1 January 2018 to 31 December 2018 were reviewed to assess current trends in groundwater quality at the premises. Observation include:

- Electrical conductivity remains within trigger levels and shows little variation at all monitoring wells;
- copper at monitoring well BFE was elevated but results show an overall decreasing trend since 2011. All other bores below trigger levels;
- nickel at monitoring well BFE exceeds trigger levels, likely due to its location on the tidal flats. Other monitoring wells located on the tidal flats have similar nickel concentrations to BFE;
- total nitrogen at monitoring well BFE continues to exceed the trigger level although only slightly. Total nitrogen at monitoring well BFF increased above the trigger level in late 2017 and 2018 monitoring events. Total nitrogen has decreased in monitoring wells BFB and BFC since peaks in 2016 and 2017 respectively, although neither have exceeded the trigger levels;
- phosphorous at monitoring well BFF initially exceeded the trigger level but has reduced significantly since 2015 however one exceedance of trigger levels occurred in the 2018 reporting period. Total phosphorous at the other monitoring locations remains below the trigger levels;
- zinc levels at monitoring wells BFF and BFC have exceeded trigger levels in the past however spikes in zinc concentrations appear to be common throughout all groundwater wells with a return to below trigger levels by the next monitoring event;
- analytes consistently below limit of detection during monitoring events include N-nitrosodiethanolamine (NDELA), N-nitrosodimethylamine (NDMA), N-nitrosopiperazine (NPz), Dimethylnitramine and total recoverable hydrocarbons; and
- MDEA was below limit of detection (1 µg/L) with exception of one monitoring event at BFF in September 2018, (2 µg/L).

Further investigations of groundwater have been undertaken in response to contaminated sites status. Refer to section 5.3 for detail of the studies undertaken.

6.3.1 Key findings

Key findings: The Delegated Officer has considered information relating to groundwater and has found:

1. new monitoring wells were established up-gradient of the premises prior to the 2018 licence amendment that provide suitable reference background water quality information.
2. the groundwater monitoring network is accordingly considered to be adequate.
3. a new monitoring well BFG has been installed to replace monitoring well BFB. It is downgradient of the infiltration basins and in closer proximity than BFB was to this source. The location of the new monitoring well is considered to be appropriate.
4. YPF continue to provide within AERs for the premises comparison of groundwater monitoring results with trigger levels developed based on background water quality. YPF use the trigger levels as an indicator of potential impact to groundwater associated with premises operations.

5. trigger levels have not been developed for new monitoring wells US1, US3 and BFG. The Delegated Officer recommends YPF develop suitable trigger levels for new monitoring wells to assist in detection of groundwater quality impacts.

7. Consultation

The application for a licence was made available for public comment on DWER's website on 13 November 2019 and was advertised in *The West Australian* on 18 November 2019.

Eight direct interest stakeholders were notified of the application including the City of Karratha, Department of Biodiversity, Conservation and Attractions, Department of Mines, Industry Regulation and Safety, Water Corporation, Friends of Australian Rock Art, Hon. Robin Chapple MLA, Murujuga Aboriginal Corporation, and Dr John Black.

Submissions closed on 5 December 2019. Eight public submissions were received by DWER regarding the application. A summary of the public submissions and stakeholder comments is included in Appendix 3.

8. Location and siting

8.1 Siting context

The Ammonia Plant is located on the Burrup Peninsula within the Burrup Strategic Industrial Area, a heavy industrial estate. Non-industrial land to the north and south of the premises form part of the Murujuga National Park (and the Dampier Archipelago National Heritage Listed Place), which is recognised for its cultural significance and ecological and biological diversity. Other industrial premises immediately adjacent to the Ammonia Plant include the YPN TAN plant and a desalination plant (not operational) owned by the Water Corporation. Other major industrial premises are located within the Burrup Strategic Industrial Area.

8.2 Residential and sensitive receptors

The distances to residential, industrial and other sensitive receptors are detailed in Table 18.

Table 18: Receptors and distance from the premises

Residential, industrial and sensitive premises	Distance from the premises
Hearson Cove beach (recreational area) (zoned conservation recreation and natural/landscapes City of Karratha Planning Scheme No.8)	1,200 m south east
Deep Gorge (recreational area) (zoned conservation recreation and natural/landscapes City of Karratha Planning Scheme No.8)	1,000 m south.
Industrial receptor – Pilbara Port Authority lease area (multiple users) including ammonia loading facilities (zoned strategic industry City of Karratha Planning Scheme No.8)	1,200 m west
Industrial receptor – Pluto LNG Project (zoned strategic industry City of Karratha Planning Scheme No.8)	1,300 m north west

Residential, industrial and sensitive premises	Distance from the premises
Industrial receptor – Karratha Gas Plant (zoned strategic industry City of Karratha Planning Scheme No.8)	2,700 m north west
Industrial receptor – Parker Point Iron Ore Port (zoned strategic industry City of Karratha Planning Scheme No.8)	4,500 m south west
Residential Premises – Dampier townsite	6.9 km south west
Residential Premises – Karratha townsite	11.5 km south-south east

8.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or emissions and discharges from the Premises (refer to DWER *Guidance Statement: Environmental Siting*). The distances to specified ecosystems are shown in Table 19. Table 19 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

Table 19: Environmental values

Specified ecosystems	Distance from the Premises
Parks and Wildlife Managed Lands and Waters	Murujuga National Park - 500 m from the boundary of the Ammonia Plant to the north, 800 m to the east and 900 m to the south.
Threatened Ecological Communities and Priority Ecological Communities	A number of priority ecological communities have been identified approximately 1.2 km and 2.6 km west and 800 m south of the Ammonia Plant. These include the Burrup Peninsula rock pool and rock piles communities. The Burrup Peninsula rock pile communities consist of short range endemic land snails.
Biological component	**Distance from the Premises**
Threatened/Priority Flora	No threatened or priority flora have been identified on the premises.
Threatened/Priority Fauna	State and Commonwealth listed threatened species of fauna have been identified within a 10 km radius of the Premises. Twenty four migratory species have also been identified. Most threatened species within the area include marine animals which may use areas off Hearson Cove for feeding, breeding, nesting or resting (EPBC Referral, 2008).
Other relevant ecosystem values	**Distance from the Premises**
King Bay – mangroves and marine ecosystem	A supratidal flat is located directly adjacent to the premises boundary to the south. Mangrove community is located 1,000 m east. The waters of King Bay are afforded a high level of ecological protection with the exception of a one hectare

Specified ecosystems	Distance from the Premises
	area surrounding the MUBRL outfall, where industry discharges occur in King Bay and the surrounding Mermaid Sound. These areas have been afforded a low level of ecological protection and moderate level of ecological protection respectively (DoE 2006).
Hearson Cove – marine tidal ecosystem	1300 m south east
National Heritage Listed place – Dampier Archipelago (including the Burrup Peninsula) (ID 105727)	The Dampier Archipelago including the Burrup Peninsula is listed on the National Heritage List due to the presence of rock engravings and other Aboriginal heritage sites such as stone arrangements. The nearest rock art is 400 m from the premises.

8.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 20.

Table 20: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Surface water (supra-tidal flat between King Bay and Hearson Cove)	The supra-tidal flat between King Bay and Hearson Cove is subject to flooding from storm surge events. A 1:100 year storm is expected to result in a storm surge of 5 mAHD. The premises is elevated to protect against storm surge.	Supra-tidal flats which connect to King Bay. Mangrove community located 1,000 m east of the boundary of the Ammonia Plant.
Groundwater	Depth to groundwater at the premises is generally shallow and follows surface topography ranging from a maximum of 11 mbgl in the northern, more elevated areas to a minimum of 0.2 mbgl in the southern part of the premises near the supra-tidal flat area). Variation is driven by tidal variation and rainfall. Groundwater flow is in a southerly to east south easterly direction toward the supratidal flats. Groundwater monitoring indicates that groundwater salinities follow topographical gradients. Salinity is brackish (1,000 mg/L) in the north and increases towards the tidal flats (>40,000mg/L). The Premises is located within the Pilbara Groundwater Area and Pilbara Surface Water Area (proclaimed under the RIWI Act).	Groundwater is located predominantly in fractured rock aquifers. The upper aquifer in this region is the low permeability, unconfined Pilbara Fractured Rock Aquifer. Groundwater recharge occurs when rainfall events infiltrate the fractured surface rock or from surface water flows. Water is not used for potable or industrial use. Groundwater flows towards the supra-tidal flats which connect to King Bay. A mangrove community is located 1,000 m east of the premises boundary.

8.5 Soil type

The Premises is partially located within a supra-tidal salt flat that forms an east-west trending valley at approximately 4 mAHD that divides the Burrup Peninsula into two separate units from King Bay in the west to Hearson Cove in the east. The invert of this valley is comprised of marine

sediment. In and around the Premises, the landform includes hill slopes, occasional small rock outcrops (Gidley Granophyre), and tidal flats.

The Ammonia Plant has been constructed on approximately 0.5 to 1 m depth of constructed ground which consists of brown/orange loamy/clay with abundant gravels and cobbles of lithic/mafic origin overlying a red/brown to grey sandy clay material. These materials appear to be derived from the colluvial soil and rock in the area.

Table 21 details soil types and characteristics relevant to the assessment.

Table 21: Soil and sub-soil characteristics

Soil type classification	Distance from Premises
Acid sulfate soil (ASS) risk	Located within an area of high to moderate and moderate to low risk of ASS within 3 m of the surface

8.6 Meteorology

8.6.1 Wind direction and strength

Wind roses generated using meteorological data from Karratha Airport are presented below.

Figure 4 shows the annual wind rose based on the five year average annual wind direction and strength.

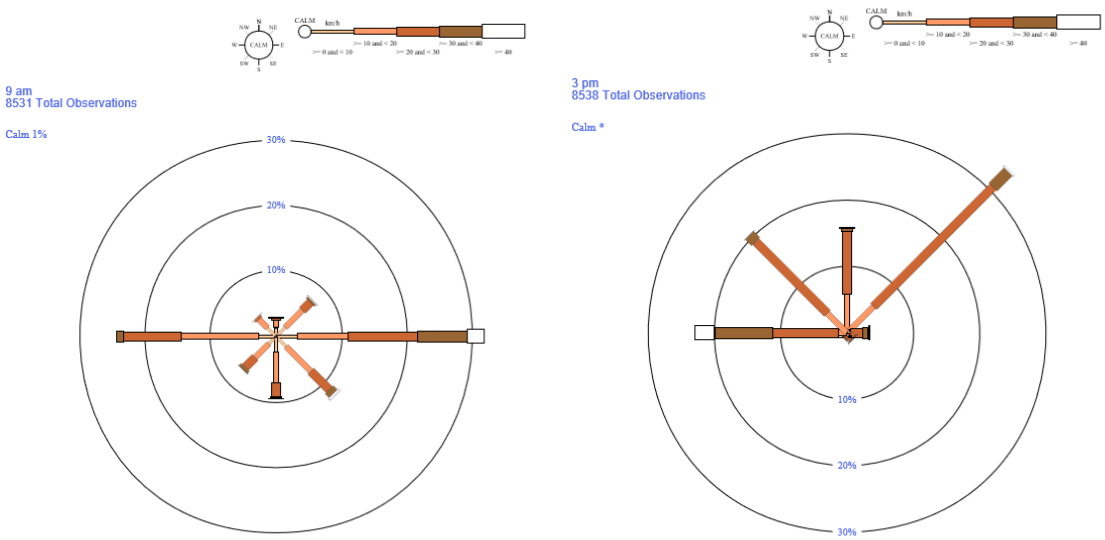

Figure 4. Wind Rose, Karratha Airport based annual average

(Sourced from www.bom.gov.au on 19 February 2020)

As shown in Figure 4, the predominant wind direction is from the west indicative of onshore coastal breezes. During summer and spring, winds are typically from the west but are predominantly from the east and north east in winter. Autumn is characterised by variable winds from all directions.

The highest wind speeds are associated with winds from the west and west-northwest. Lowest speeds are associated with winds from southerly directions and mostly occur during the night and early morning.

On average, two cyclones cross the Pilbara coast per year in summer. During cyclones, damaging winds, heavy swells and torrential rain causing flooding can be experienced. It is

important to note that this wind rose shows historical wind speed and wind direction data at the Karratha Airport weather station and should not be used to predict future data.

8.6.2 Rainfall and temperature

The climate experienced at the Premises is typical of the Pilbara, being fine and warm from May to November with low rainfall. The summers are typically hot with periodic rainfall heavy during cyclonic conditions from December to March, with warmer winds from the northwest and southwest.

The nearest Bureau of Meteorology climate station to the project area is at Karratha airport (approximately 9 km south of the premises). Mean monthly maximum temperatures at Karratha range from 36.2 °C in March to 26.24 °C in July and mean minimum temperatures range from 26.9 °C in January to 13.8 °C in July. Mean monthly rainfalls vary from 0.4 mm in October to 75.4 mm in February. Mean annual rainfall is 292.4 mm. Annual evaporation is approximately 3,200 mm.

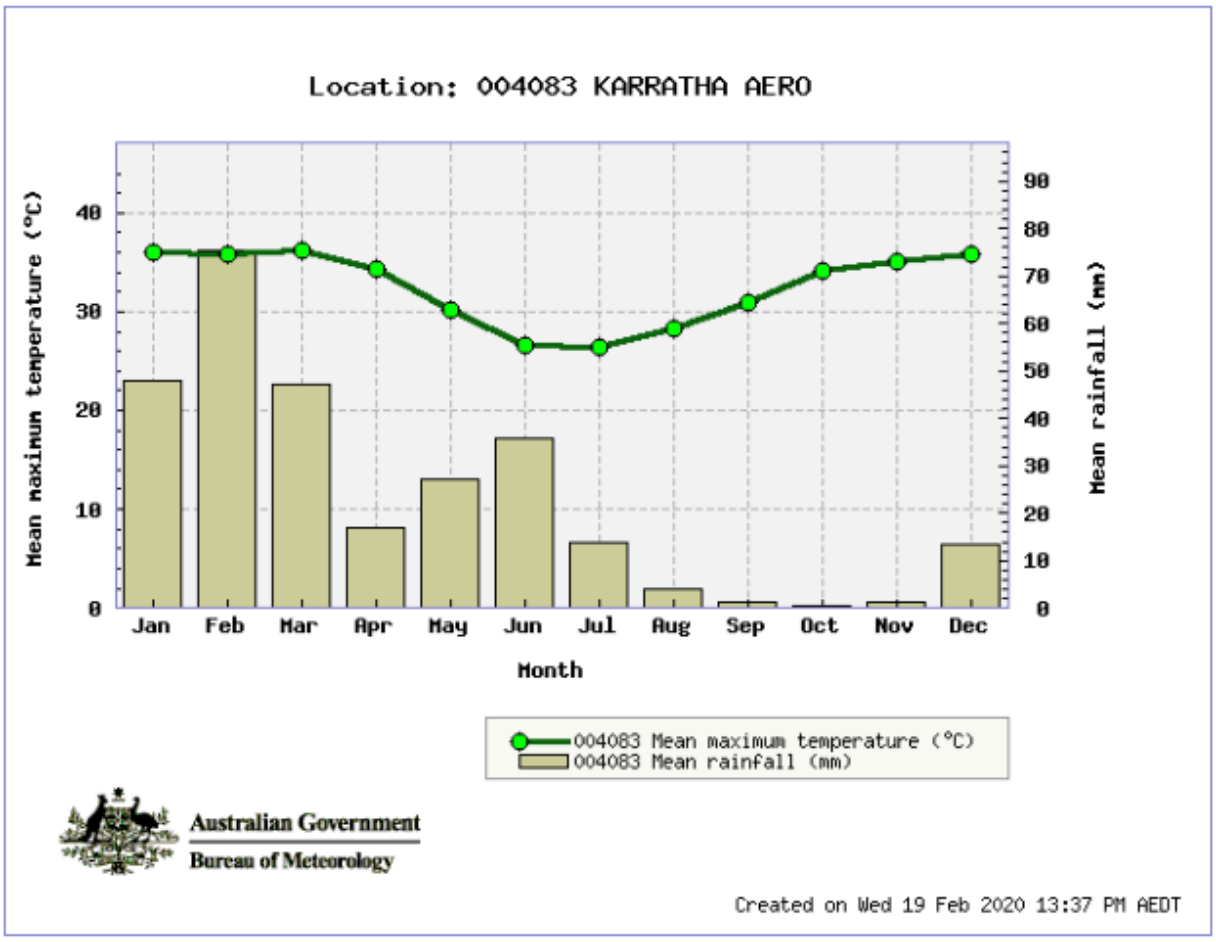

Figure 5. Mean temperature and rainfall at Karratha airport

9. Risk assessment

9.1 Determination of emission, pathway and receptor

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

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 22, Table 23, and Table 24.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 22, Table 23, and Table 24 below.

Table 22: Identification of emissions, pathway and receptors during normal operation of the Ammonia Plant

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Normal operation of the Ammonia Plant using the KBR Purifier Process to covert natural gas feed into ammonia and waste products	• Primary reformer furnace • Package boilers • CO_2 stripper	Point source emissions to air • NOx, CO, SO_2, PM • CO and CO_2	Hearson Cove (1.2 km south east) and Deep Gorge (1 km south) - recreational areas Residential areas at Dampier (6.9 km south west) and Karratha (11.5 km south-south east) Industrial workforce at Pilbara Port Authority (1.2 km west) and Woodside facilities (1.3 km north west)	Air / wind dispersion	Public health and amenity impacts	Yes	See detailed risk assessment in section 9.4 The Delegated Officer has determined that potential environmental impacts associated with emission of CO_2 (a greenhouse gas) have been assessed under Part IV of the EP Act and subject to requirements of condition 7-1 to 7-3 of MS 586 requiring the proponent to prepare and implement a Greenhouse Gas Emission Plan.
	Production flare (flaring of waste process gases containing NH_3 as required)	Point source emissions to air NOx, CO_2, NH_3, H_2O. N_2					
	Storage flare (intermittent flaring of NH_3 emitted from tanks due to changes in headspace pressure)	Point source emissions to air NOx, N_2, CO_2, NH_3, H_2O	National Heritage Listed place – Dampier Archipelago (closest rock art engraving are 400 m)		Acceleration of natural weathering/alteration/degradation of the rock art	No	The Delegated Officer has determined that the regulatory framework described in section 5.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		

	Wastewater effluent sump which collects following streams prior to disposal via seawater outfall:
	• Process condensate
	• CO_2 removal purge
	• Boiler blowdown
	• Outflow from the oil interceptor which collects following streams:
	  ○ Gland condenser steam condensate
	  ○ Intercoolers
	• Wastewater from curbed potentially oil contaminated areas
		Potentially contaminated water which may contain elevated TDS, TSS and hydrocarbons	Groundwater (<3mBGL) and dependent ecosystems	Direct discharge/ infiltration	Groundwater contamination	Yes	Emissions to land may occur as a result of loss of containment, spillages or planned discharges from sedimentation basins to tidal mud flats. See detailed risk assessment in section 9.7

	Oil containment sump which collects oil from the oil interceptor outlet	Hydrocarbons					

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	Drains which collect following wastewater streams: • Laboratory wastewater (neutralized) • Demineraliser drains • Regenerated demineraliser wastewater (neutralized)	Potentially contaminated water which may contain elevated TDS and TSS					
	Eastern and Western sedimentation basins discharging to the King Bay tidal flats The sedimentation basins receive: • stormwater; and • cooling tower blowdown	Potentially contaminated water which may contain elevated TSS, hydrocarbons and MDEA					
	General plant area (spills of hydrocarbons or chemicals)	Environmentally hazardous substances such as hydrocarbons, MDEA, sulfuric acid (H_2SO_4), caustic (NaOH), liquid NH_3					

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	General plant area (waste storage areas)	Contaminated wastes including: • Spent catalysts, resins, filter media, desiccants • Stablised biosolids from the STP; and • Domestic and commercial waste comprising recyclable, organic and residual materials					
	Ammonia storage tanks (leakage from)	NH_3				No	The Delegated Officer considers risks associated with leakage from the ammonia storage tanks were previously assessed, and approved, under Part IV of the EP Act. The Ammonia Plant is classed as a Major Hazard Facility and therefore required to adhere to regulatory controls administered by DMIRS. The Delegated Officer considers DMIRS is the relevant regulatory authority to assess and manage risk associated with releases from ammonia storage.

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	Cooling circuit pipelines	Saline water with elevated TDS	Vegetation	Direct discharge	Decline in vegetation health	Yes	See detailed risk assessment in section 9.7
	Operating equipment within the premises including operating plant and ancillary equipment, vehicles, and generators, fans, pumps and compressors.	Noise	Hearson Cove (1.2 km south east) and Deep Gorge (1 km south) - recreational areas Residential areas at Dampier (6.9 km south west) and Karratha (11.5 km south-south east) Industrial workforce at Pilbara Port Authority (1.2 km west) and Woodside facilities (1.3 km north west)	Air / wind dispersion	Public health and amenity impacts	Yes	See detailed risk assessment in section 9.11
	Operating light sources within the Ammonia Plant during night time operation.	Light	Hearson Cove (1.2 km south east) and Deep Gorge (1 km south) - recreational areas Terrestrial species including reptiles, amphibians, birds and mammals present in surrounding areas	Air	Amenity impact Disruption and disorientation of terrestrial species active at night	No	The Delegated Officer has determined that light emissions during operation are not likely to cause impact to the amenity of receptors, or have a significant impact on terrestrial species in the surrounding area considering the location and presence of other industrial premises in the vicinity.

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Discharge of wastewater to the marine environment	Seawater outfall via MUBRL operated by Water Corporation: • Cooling tower blowdown • Jacket water blowdown • Outflow from the wastewater effluent sump • Wastewater from wastewater and neutralisation pits • Desalination plant reject water stream	Potentially contaminated wastewater which may have elevated temperature, salinity, nutrients, methanol, antiscalents and biocides	King Bay marine ecosystem	Direct discharge to marine environment	Degradation of marine water quality and ecological impact to marine fauna	Yes	See detailed risk assessment in section 9.9
	Eastern and Western sedimentation basins discharging to the King Bay tidal flats The sedimentation basins receive: • stormwater; and • cooling tower blowdown	Potentially contaminated water which may contain elevated TSS, hydrocarbons and MDEA					See detailed risk assessment in section 9.10

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Power generation	2 x 22MW captive steam turbine generators operating at 100% and 25% capacity	NA	NA	NA	NA	No	The Delegated Officer has determined that during normal operations the steam turbines are used for captive power generation relying on process heat (steam) generated and do not burn additional fuel. As such emissions from power generation during normal operations have been assessed under emissions from the package boilers.
Operation of STP and disposal of treated effluent	Evaporation pond	Treated wastewater containing elevated nutrients (TN and TP), BOD, TSS and and E.coli.	Groundwater approximately 3 mbgl	Direct discharge to land and infiltration to groundwater	Groundwater contamination	Yes	See detailed risk assessment in section 9.8
		Odour	Hearson Cove (1.2 km south east) and Deep Gorge (1 km south) - recreational areas	Air / wind dispersion	Public amenity impacts	No	The Delegated Officer has determined that odour emissions arising from evaporation of treated effluent are not likely to impact public amenity due to the distance to the nearest receptors.

Risk Events (normal operations)						Continue to detailed risk assessment	Reasoning
Activities/Sources		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Transfer of refrigerated (volatile) liquid NH_3 via pipeline	Leakage from the product pipeline carrying refrigerated (volatile) liquid NH_3 between the Premises and the Dampier Public Wharf	NH_3	Hearson Cove (1.2 km south east) and Deep Gorge (1 km south) - recreational areas Residential areas at Dampier (6.9 km south west) and Karratha (11.5 km south-south east) Industrial workforce at Pilbara Port Authority (1.2 km west) and Woodside facilities (1.3 km north west)	Air / wind dispersion	Public health and amenity impacts	No	Only a portion of the 4.3km long pipeline falls within the premises boundary. Pipelines were originally assessed in the EPA approval. A section 45C amendment to MS 586, granted on 5 August 2015, removed the reference to ammonia pipelines from the proposal key characteristics. An earlier s45C amendment to MS 586, dated 11 Sep 2006, noted that isolation valves exist along the pipelines in accordance with the premises' export licence and Dangerous Goods Storage licence. The PER document for the Ammonia Plant noted that the pipelines will only contain ammonia during the ship loading process, which occurs once every fortnight over a duration of approximately 35 hours. The Delegated Officer considers the existing regulatory instruments which apply to the transfer adequately considered, and regulate liquid ammonia transfer.

Table 23: Identification of emissions, pathway and receptors - Ammonia Plant startup, shutdown and upset conditions

Risk Events (abnormal operations - startup, shutdown and upset conditions)						Continue to detailed risk assessment	Reasoning
Activities/Sources		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Hot or cold startup of the Ammonia Plant	• Package boilers • Primary reformer • Start-up heater • Diesel generator	Point source emissions to air Combustion emissions NOx, SO_2, CO, PM_{10}	Hearson Cove (1.2 km south east) and Deep Gorge (1 km south) - recreational areas Residential areas at Dampier (6.9 km south west) and Karratha (11.5 km south-south east) Industrial workforce at Pilbara Port Authority (1.2 km west) and Woodside facilities (1.3 km north west)	Air / wind dispersion	Public health and amenity impacts	Yes	See detailed risk assessment in section 9.5 The Delegated Officer considers the diesel generator is a minor emission source, operated for a limited period of time and will therefore unlikely have any offsite impact on air quality.
	• Font- end vent • Back-end vent	Point source emissions to air H_2, N_2, Ar and CH_4					
Plant trip and shutdown	Back-end vent	H_2, N_2					
	Front-end vent	H_2, N_2, CH_4, CO, CO_2					

Risk Events (abnormal operations - startup, shutdown and upset conditions)						Continue to detailed risk assessment	Reasoning
Activities/Sources		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Ammonia storage	Storage flare (flaring due to refrigeration plant failure)	NOx, NH_3, N_2, H_2O, CO_2	National Heritage Listed place – Dampier Archipelago (closest rock art engraving are 400 m)		Acceleration of natural weathering/alteration/degradation of the rock art	No	The Delegated Officer has determined that the regulatory framework described in section 5.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.
	Pressure safety valves on storage tanks	NH_3					See detailed risk assessment in section 9.6
		Odour				No	Potential impact to receptors associated with emissions of NH_3 have been assessed under emissions to air. While odour is an indicator of presence of ammonia, the key risk lies to human health and has been accordingly assessed under other sections.

Table 24: Identification of emissions, pathway and receptors during construction of the evaporation pond

Risk Events						Continue to detailed risk assessment	Reasoning
Activities/Sources		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction of evaporation pond	Earthworks to construct the evaporation pond	Noise	Hearson Cove (1.2 km south east) and Deep Gorge (1 km south) - recreational areas Residential areas at Dampier (6.9 km south west) and Karratha (11.5 km south-south east) Industrial workforce at Pilbara Port Authority (1.2 km west) and Woodside facilities (1.3 km north west)	Air / wind dispersion	Public health and amenity impacts	No	The Delegated officer considered the potential for dust and noise emissions to arise as a result of the construction earthworks at the evaporation pond and determined the activity will be of short duration, and due to the distance to sensitive receptors they will not be impacted by the emissions. The general provisions of the EP Act and the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations) will apply.
		Fugitive dust					

9.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 25 below.

Table 25: 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 26 below.

Table 26: Risk criteria table

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

^ Determination of areas of high conservation value or special significance should be informed by the *Guidance Statement: Environmental Siting.*

* In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*

"onsite**"** means within the Prescribed Premises boundary.

9.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 27 below:

Table 27: Risk treatment table

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

9.4 Risk Assessment – point source emissions to air during normal operation of the Ammonia Plant

9.4.1 Description of point source emissions to air during normal operation of the Ammonia Plant risk event

Key point source air emission sources of NOx and CO from the Ammonia Plant during normal operation include the primary reformer stack and the package boiler stack. Minor amounts of SO_2 and particulate matter (PM) are also emitted from these sources during normal operation. The CO_2 stripper stack is also a source of CO emissions. The start-up heater and diesel generator are used for start-up of the plant (and emergency power in the case of the diesel generator) and therefore do not contribute to emissions during normal operation of the plant.

The Ammonia Plant has been designed and constructed with a storage and production flare to enable flaring of NH_3 and waste process gas containing NH_3 as required during normal operating conditions. Venting of NH_3 therefore does not occur during normal operating conditions. As per section 6.1.2 the flare is designed and operated to incinerate the gas to N_2, CO_2 and water vapour with minimal NOx formation and minimal unburnt NH_3 remaining. Due to the low frequency and high efficiency of the flares they are not expected to make a significant impact on emissions during normal operation of the Ammonia Plant. Ammonia emissions resulting from normal operation of the Ammonia plant are very low therefore are not considered further for this risk event, but are for more relevant risk events in sections 9.5 and 9.6.

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

9.4.2 Identification and general characterisation of emission

Combustion of natural gas occurs within the primary reformer and package boilers at the

Ammonia Plant produces emissions primarily of NOx and CO and minor emissions of PM and SO_2. Reactions within the primary reformer also contribute to production of CO emissions. The process of regenerating MDEA within the CO_2 stripper results in generation and release of CO and CO_2 (as per section 4.4 impacts associated with greenhouse gas emissions are not considered in this assessment).

Emissions from these key sources are monitored in accordance with Existing Licence conditions with results reported to DWER on an annual basis in YPF's AER. The Existing Licence includes emission limits of 180 mg/m^3 and 300 mg/m^3 NOx as (NO_2) for the primary reformer stack and package boiler stack respectively. No reports of limit exceedances have been received by DWER relating to point source emissions to air from the premises.

Since 2016 only NOx monitoring has been required as it is the primary emission. Previously emission monitoring has been undertaken via CEMS however the CEMS were decommissioned as they did not comply with the CEMS code therefore results were not reliable. New CEMS, compliant with the CEMS code, were installed on the primary reformer and package boiler stacks in late 2019. The CEMS are awaiting final RATA testing before commencing emission monitoring therefore no CEMS results are currently available for characterisation of emissions.

The applicant provided the maximum stack monitoring concentrations reported in AERs from 2014 to 2017 (Table 28).

Table 28: Identification and general characterisation of emission

Emissions	Primary reformer (mg/m^3)	CO_2 stripper (mg/m^3)	Package boilers (mg/m^3)
NOx as NO_2	106	NA	140
SO_2	9.4	NA	<2.6
CO	63.5	330	32

Model predicted maximum GLCs resulting from normal operation of the Ammonia Plant are discussed in section 6.1.2 (Table 13). This section also includes cumulative predicted GLCs associated with normal operation of both the Ammonia and TAN plants in Table 16.

The results indicate predicted GLC at sensitive receptors are not predicted to exceed the ambient air quality criteria during normal operation of the Ammonia Plant or when the Ammonia Plant and adjacent TAN plant are operating concurrently under normal operating conditions.

9.4.3 Description of potential adverse impact from the emission

There is potential for air emissions associated with normal operations of the Ammonia Plant to impact on ambient air quality and to cause environmental and public health impacts through dispersion in air. The potential adverse impacts from exposure to gases emitted from the Ammonia Plant are described below.

Nitrogen oxides

Both short-term exposure and long-term exposure to increased levels of NOx may cause respiratory irritation and associated effects. The short-term effects of NOx 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. NO_2 has an odour and is an acidic gas

which can contribute to acid rain.

Carbon monoxide

CO is an odourless, colourless gas. When present at concentrations exceeding health criteria, it can cause respiratory symptoms and sudden illness or death in extreme cases. Exposure to CO at high concentrations for short periods may affect the amount of oxygen in the bloodstream resulting in vital organs such as the brain, nervous tissues and heart not functioning properly. Common symptoms of exposure to high concentrations of CO include fatigue, loss of concentration and dizziness. Children and babies are at greater risk because their bodies are smaller and still developing.

Sulfur dioxide

Short-term and long-term exposure to increased levels of SO_2 may 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, where 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. It can irritate the nose, throat, and airways, and can cause coughing, wheezing, and shortness of breath.

Particulate Matter

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 PM are influenced by the chemical composition of the particles, mass concentration of airborne particles and duration of exposure.

9.4.4 Criteria for assessment

The NEPM sets ambient air quality standards for CO, NO_2, and SO_2 for the protection of human health and well-being. These standards are outlined in Table 29. 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.

Table 29: NEPM (Ambient Air) assessment criteria

Pollutant	Averaging period	Maximum concentration		Goal (maximum allowable exceedances)
		ppb	µg/m^3	
NO_2	1-hour	120	246	1 day a year
	Annual	30	62	None
CO	8-hour	9000	11,250	1 day a year
SO_2	1-hour	200	572	1 day a year
	24-hours	80	226	1 day a year
	Annual	20	57	None

Pollutant	Averaging period	Maximum concentration		Goal (maximum allowable exceedances)
		ppb	µg/m^3	
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

9.4.5 Applicant controls

Specific engineering and management controls adopted by the applicant for the Ammonia Plant, and considered by the Delegated Officer are summarised in Table 30.

Table 30: Applicant's engineering and management controls for air emissions

Infrastructure	Engineering/ Management controls
Ammonia Plant	Design features and operational practices which minimise emissions to air include: • Plant has been designed and established with process controls for plant reliability to minimise plant startup, shutdown and process trips; • Adoption of excess air process; • Use of low sulfur gas from the North-West Shelf (noted that this is not within the control of the applicant); • Minimal venting and flaring from the plant during normal operations. • Waste process gases containing ammonia are directed to the Production Flare as required during normal operations to minimise the need for venting.
Primary reformer	Installed with low NOx burner. CEMS installed on the stack for monitoring of NOx.
Package boilers	Installed with low NOx burners. CEMS installed on the stack for monitoring of NOx. 50t package boiler is only operated at full rate during startup events or upset conditions and otherwise operates at 10-20%. 150t package boiler also typically operates at 10-20% and at full rate typically only during startup events or upset conditions.
Startup heater	Installed with low NOx burner. Not operated for normal operation of the plant, only for startup events.
Emergency diesel generator	Not operated for normal operation of the plant, only for startup events or emergency power.

CEMS were installed and commissioned for both the Primary Reformer and Package Boiler stacks in November 2019. However, due to a shutdown of the Ammonia Plant in November 2019 performance testing was delayed. Performance testing was undertaken on the package boiler CEMS in February 2020 and is planned to be undertaken on the primary reformer CEMS in April 2020. CEMS data were therefore not available for assessment of the application.

9.4.6 Key findings

Key findings: The Delegated Officer has reviewed the information regarding point source emissions to air during normal operation and has found:

1. CEMS has now been installed on the package boiler and primary reformer stacks allowing for continuous monitoring and recording of NOx emissions from the stacks. Recorded data will provide greater certainty of NOx emissions during normal operations as well as start-up and shutdown events.
2. GLCs at all sensitive receptors are predicted to remain within ambient air quality criteria during normal operation of the Ammonia Plant in isolation and when the Ammonia and TAN plants are concurrently operated under normal operating conditions.
3. There are no emissions from the start-up heater or emergency diesel generator during normal operations as these are used for start-up and emergency power only (only applicable to the generator).
4. The contribution of emissions from flaring of NH_3 and waste process gas during normal operations is minimal and therefore emissions from flaring are more appropriately assessed for non-routine operating conditions.

Ammonia emissions are not considered in the risk assessment for point sources emissions to air during normal operating conditions because emission rates are sufficiently low to exclude them from this assessment (refer to

5. Table 12 and Table 13). Risk of ammonia emissions is considered for abnormal operating conditions where there is potential for emissions to occur.

9.4.7 Consequence

Air quality modelling results indicate the sensitive receptor likely to experience the greatest impact to air quality as a result of emissions from the Ammonia Plant is Hearson Cove. The following assessment is based on predicted air quality impact at this receptor.

The modelling indicates that, amongst the receptors considered, the highest 1-hr and annual GLC of NO_2 are predicted to be 56% and 14% of the assessment criteria, respectively when considering background concentration. Excluding background concentrations from the assessment the contribution of the Ammonia Plant in isolation is 13% and 1% of the1-hr and annual criteria, respectively. The highest cumulative impact of point source emissions (excluding background) associated with normal operation of the Ammonia and TAN Plants predicted for sensitive receptors was 35% and 4% of the 1-hour and annual criteria, respectively.

Including background concentrations, GLCs of SO_2 at the nearest sensitive receptor are predicted to be less than 0.5% of the relevant 1-hr, 24-hr and annual assessment criteria during normal operation of the Ammonia Plant in isolation, and <1% during concurrent normal operation of the TAN Plant.

The highest predicted GLC of CO from concurrent operation of the Ammonia and TAN Plants is 1% of the 8-hr criterion. Background concentration is not included as it was not determined for the modelling assessments but is expected to be very low. The Pilbara Air Quality Monitoring study (DoE 2002) found the highest CO concentration was < 4% of the NEPM.

The Ammonia Plant is predicted to contribute <1% of the ambient air quality criteria of PM_{10} when considered in isolation, and <3% when cumulative emissions from the TAN Plant are considered. Background GLC of PM_{10} is predicted to be approximately 48% of the criteria therefore cumulative normal operation of the two plants does not significantly increase concentrations.

Considering the assessment above the Delegated Officer has determined the consequence of point source emissions to air from normal operation of the Ammonia Plant as below:

Ambient air quality criteria for NOx are at risk of not being met. There is the potential for low

level health impacts. The Delegated Officer considers the consequence of NO_X emissions to be **Moderate**.

Ambient air quality criteria for CO, SO_2 and PM_{10} are met and there is unlikely to be impact to health or amenity associated with emissions from the premises. The Delegated Officer considers the consequence of CO, SO_2 and PM_{10} emissions to be **Slight**.

9.4.8 Likelihood of risk event

The likelihood of impact to public health or exceedance of relevant criteria is dependent on meteorological conditions occurring which are conducive to poor dispersion and directed towards receptors. The Delegated Officer considers the likelihood for impact to public health or exceedance of relevant criteria as a result of point source emissions to air under normal operations to be:

- NOx: **Possible**
- Particulates: **Unlikely**
- CO: **Rare**
- Sulfur dioxide: **Rare**

9.4.9 Overall rating of emissions to air during normal operation of the Ammonia Plant risk event

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the risk rating of point source emissions to air causing environmental or public health impacts during normal operations for various contaminants as below:

- Nitrogen oxides: **Medium risk**
- Particulates: **Low Risk**
- CO: **Low Risk**
- Sulfur dioxide: **Low Risk**

9.5 Risk Assessment – point source emissions to air during abnormal Ammonia Plant operating conditions (start-up, shutdown, plant trips and flaring)

9.5.1 Description of point source emissions to air abnormal operating conditions risk event

Start-up events typically result in increased combustion emissions including NOx, CO, SO_2 and PM as a result of increased natural gas combustion in the boilers and start-up heater, and diesel combustion in the diesel generator. Shut-down events typically result in decreased combustion emissions due to drop in steam demand.

Plant trips (partial and full plant shutdowns) occur when process conditions step outside safe limits and the process safety control system automatically activates a range of control measures to ensure plant safety is maintained at those times. Venting of process gases (H_2, N_2, Ar, CH_4, CO, CO_2, and H_2O) will occur from the Front End Vent or the Back End Vent, depending on the location within the process that initiated the plant trip, to stabilise the plant or take down the process safely. Venting also occurs during start-up events and gives rise to increased CO emissions.

In the event the ammonia storage tank refrigeration plant fails, continuous flaring of boil-off gas

(NH_3) from the ammonia storage tanks will be required. Combustion of NH_3 within the flare produces by-products of N_2, CO_2, water vapour, NOx and remaining unburnt NH_3 which are discharged from the flare.

Emissions released from the point sources described above during abnormal operating conditions are transported through the atmosphere via dispersion and can impact on the air quality at sensitive receptors potentially causing adverse health impact to the sensitive receptors.

9.5.2 Identification and general characterisation of emission

A description of typical plant start-up, shutdown and plant trip events which occur at the Ammonia Plant is provided in Table 31.

Table 31: Typical startups, plant trips and shutdowns occurring at the Ammonia Plant

Event	Description
Full ISBL shutdown and cold start	Required for plant maintenance OSBL facilities remain on-line
Full ISBL shutdown and hot start	Restart begins within 24 hours
Full plant shutdown (ISBL & OSBL) and hot start	Restart begins within 24 hours
Full plant shutdown (ISBL & OSBL) and cold start	Entire plant is shutdown and restart begins after a maintenance period
Backend trip and hot start	Plant (ISBL) trips anywhere from CO_2 removal onwards and restart begins within 24 hours
Backend trip and cold start	Plant (ISBL) trips anywhere from CO_2 removal onwards and restart begins after a maintenance period
Planned Shutdown	Plant (ISBL and/or OSBL) is taken offline when planned (e.g. for major required maintenance or a turnaround period)
Backend trip with a hot start into a purifier bypass	The purifier bypass scenario at steady state where the plant can run inefficiently without the purifier online, with venting and increased boiler output

Note: ISBL = inside battery limits, OSBL = outside battery limits

Emissions resulting from abnormal operating conditions were considered in the 2015 modelling for the Ammonia Plant (see section 6.1.2). This assessment considered emissions from the primary reformer, package boiler, start-up heater and front-end vent during start-up (Table 32). Model inputs were based on mass balance calculations and supported by stack testing data where available. For the modelled scenario predicted GLCs did not exceed the ambient air quality criteria at any sensitive receptor and maximum GLCs occurred close to the premises boundary (Table 14).

Table 32: Atmospheric emission characteristics during start up of the Ammonia Plant (Environ 2015)

Source	Stack Height (m)	Stack Diameter (m)	Exist velocity (m/s)	NOx[2] (g/s)	SO_2 (g/s)	PM_{10} (g/s)	CO (g/s)
Primary Reformer Stack	36	3.5	15	8.4	0.038	0.446	4.45
Package Boiler Stack	30	3	4.1	11.88	0.223	0.628	7.14

Start-up Heater	32	2.2	4.1	4.51	0.26	0.241	2.71
Front End Start-up Vent	60	2	58	0	0	0	7627

Note 1: Am^3/hr is at actual stack conditions.

Note 2: NOx expressed as 100% nitrogen dioxide (NO_2)

As per section 6.1.2 YPF assessed potential CO and NOx emissions resulting from start-ups, plant trips and shutdowns using the maximum emission rates and durations from events and the 2015 updated modelling to determine predicted GLCs at Hearson Cove. The modelling predicts an exceedance of the assessment criteria for CO (Table 15) but this is considered unlikely given the modelling approach which assumed constant emission rates for the entire modelling year.

The 2001 modelling considered the scenario of flaring of NH_3 boil-off gas from the storage flare due to a refrigeration plant failure. Predicted maximum GLC of both NOx and NH_3 at Hearson Cove were within the assessment criteria considered (6.1.1).

9.5.3 Description of potential adverse impact from the emission

Potential health and environmental impacts associated with NOx, CO, SO_2 and PM are described in section 9.4.

There are no direct adverse impacts expected to occur as a result of emission of other process gases via venting (H_2, N_2, CH_4, CO, CO_2, H_2O and Ar), or by-product gases (CO_2, N_2 and H_2O) emitted during flaring of NH_3 as these are atmospheric gases, emitted into the atmosphere via tall stacks or vents and where they are expected to disperse.

Ammonia

Ammonia is a colourless gas that has an intense and irritating odour (detectable at levels as low as 5 ppm), and is corrosive. Potential health impacts associated with exposure include irritation to eyes, the throat and nose at low concentrations of 5-25 ppm. Higher concentrations may cause severe irritation and breathing difficulty and overexposure can be fatal (>1,000 ppm).

9.5.4 Criteria for assessment

The ambient air quality outlined in Table 29 in section 9.4.4 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. There are no criteria set in the NEPM for ammonia therefore the Delegated Officer considers the criteria set in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (330 $\mu g/m^3$ or 460 ppb over a 1-hour averaging period) to be relevant to the assessment of risk to public health and therefore apply to human receptors located outside the premises.

9.5.5 Applicant controls

Specific engineering and management controls adopted by the applicant and considered by the Delegated Officer are summarised below:

- Continuous flaring of ammonia vapours (boil-off gas) from the ammonia storage tanks is required in the event of refrigeration compressor failure which is anticipated to occur only in a total blackout scenario. The Ammonia Plant includes built-in redundancy in the system (power and refrigeration) to minimise the likelihood of this occurring.
- The Storage flare is a high efficiency flare designed and operated to combust NH_3 to N_2, CO_2 and water vapour with minimal NOx formation and minimal unburnt NH_3 minimising the discharge of these gases during abnormal operating conditions.

- The start-up heater has been installed with a low NOx burner to minimise NOx emissions associated with start-up scenarios.
- Gas detectors are deployed at multiple locations around the Premises, which trigger an alarm in the control room if ammonia is detected above a threshold (15 ppm high alarm and 25 ppm high-high alarm).
- Handheld gas detectors are used to conduct perimeter checks should a complaint be received or issue identified.
- Process controls maintain plant reliability and reduce requirements to vent or flare including scheduled maintenance programs. Vent positions (open or closed) are monitored to calculate to volumes of gas vented.

9.5.6 Consequence

Emission rates of CO have been measured to be highest for a Full ISBL shut down and cold start of the Ammonia Plant. Modelling predicts that GLCs of CO at Hearson Cove may be up to 167% of the NEPM criteria (Table 15) during such an event if it occurs during worst case meteorological conditions. Emission rates of NOx have been measured to be highest for a Full ISBL shut down and hot start of the Ammonia Plant. Modelling predicts that GLCs of NOx at Hearson Cove may be up to 82% of the NEPM criteria during such an event if it occurs during worst case meteorological conditions (Table 15). The Delegated Officer has therefore determined that air quality assessment criteria are at risk of not being met. Therefore, the Delegated Officer considers the consequence of CO and NOx emissions during abnormal operating conditions to be **Moderate**.

The maximum modelled GLC of NH_3 at Hearson Cove due to flaring of boil-off gas from the storage tanks during a refrigeration plant failure was 42% of the assessment criteria 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 NH_3 emissions to be **Minor**.

Ambient air quality criteria for SO_2 and PM_{10} are met and there is unlikely to be impact to health or amenity associated with emissions during abnormal operating conditions. The Delegated Officer considers the consequence of SO_2 and PM_{10} emissions to be **Slight**.

9.5.7 Likelihood of Risk Event

The Delegated Officer considers that impact to receptors could occur during flaring if ammonia is not completely combusted. Taking into consideration the predicted low frequency of flaring from the storage flare, and low probability that flaring activities will be inefficient, the Delegated Officer considers the likelihood of flaring emissions resulting in an exceedance of the assessment criteria for ammonia and subsequently impacting the health of public receptors is **Unlikely.**

The Delegated Officer considers that the likelihood of other emissions resulting from startups, shutdowns or process trips (considering venting) exceeding the NEPM criteria and subsequently impacting the health of public receptors is**:**

- NOx and CO: **Possible**
- PM: **Unlikely**
- SO_2: **Rare**

9.5.8 Overall rating of point source emissions during abnormal operating conditions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the overall rating for the risk of point source emissions during start-up, shutdown and process trips or flaring of ammonia gases is:

- NH_3, NOx and CO: **Medium**
- SO_2 and PM: **Low**

9.6 Risk Assessment – fugitive ammonia emission to air

9.6.1 Description of fugitive ammonia emissions to air risk event

Fugitive ammonia releases can occur as a result of a leak or rupture in the Ammonia Plant, leaks in the refrigerated ammonia storage tanks or ammonia export pump, leaking/ruptured valves on the liquid ammonia storage tanks, and the pipeline carrying liquid ammonia from the Ammonia Plant to the TAN Plant. Ammonia releases may also occur from storage tanks via pressure safety valves etc. The risk of these incidents is considered in this assessment.

Fugitive NH_3 released from the Ammonia Plant infrastructure is transported through the atmosphere via dispersion and can impact on air quality potentially causing adverse health impact to nearby sensitive receptors.

Catastrophic failure of the ammonia storage tanks is considered to be the event with the highest risk which was considered at the Part IV EPA assessment stage for the Ammonia Plant in Bulletin 1036. A preliminary risk assessment was undertaken, which concluded that individual risk contours met the relevant risk criteria; and that, due to plant design and control systems, the level of public risk (at Hearson Cove) was significantly less than the EPA criteria. The Ammonia Plant is classed as a Major Hazard Facility and therefore is required to adhere to regulatory controls administered by DMIRS. Accordingly this assessment does not consider catastrophic failure scenarios as DMIRS is the relevant regulatory authority to assess and manage this risk.

9.6.2 Identification and general characterisation of emission

The volume of ammonia that can potentially be released from pressure safety valves or leaks is variable and will depend on the nature of the issue and the time taken to identify and rectify it.

Table 33 includes a summary of incidents of ammonia releases from pressure safety valves which YPF reported to DWER since 2016. Minor fugitive releases due to leaks from infrastructure are not typically reported to DWER unless they involved a large release. DWER has not received notification of any such events.

Table 33: Summary of incidents relating to unabated release of Ammonia

Date	Description
21/12/2017	Ammonia release caused by faulty level transmitter leading to manual globe valve from the 125-MD column to the back end vent of the ammonia plant remaining open for approximately 2.5 hours. Approximately 2 tonnes of ammonia vented. No complaints received.
25/5/2017	Ammonia release due to lifting of pressure safety valves on the south ammonia storage tank releasing 1,249kg of ammonia to atmosphere.
3/6/2016	Ammonia release due to pressure safety valve on the south ammonia storage tank lifting prematurely releasing approximately 900kg of ammonia to atmosphere in 18 minutes before isolation. Site response team were activated. No one was affected by the release.

Date	Description
30/5/ 2016	Ammonia release due to pressure safety valve on the south ammonia storage tank lifting prematurely releasing 988kg of ammonia to atmosphere in 36 minutes before isolation. Site response team were activated. No one was affected by the release.
25/3/2016	Ammonia release due to pressure safety valve on the south ammonia storage tank lifting prematurely releasing 1,200kg of ammonia to atmosphere before isolation. Site response team was activated. No one was affected by the release.

9.6.3 Description of potential adverse impact from the emission

Ammonia is a colourless gas that has an intense and irritating odour (detectable at levels as low as 5 ppm), and is corrosive. Potential health impacts associated with exposure include irritation to eyes, the throat and nose at low concentrations of 5-25 ppm. Higher concentrations may cause severe irritation and breathing difficulty and overexposure can be fatal (>1,000 ppm).

A large release of ammonia could result in the development of toxic cloud which could potentially drift for long distances.

9.6.4 Criteria for assessment

There are no criteria set in the NEPM for ammonia therefore the Delegated Officer considers the criteria set in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (330 µg/m^3 or 460 ppb over a 1-hour averaging period) to be relevant to the assessment of risk to public health and therefore apply to human receptors located outside the premises.

Other criteria which can be considered in the assessment of ambient ammonia concentration are the *Safe Work Australia National Exposure Standards* for ammonia as follows:

- time weighted average (the maximum average concentration a person can be safely exposed calculated over an eight hour working day for a five day period) – 25 ppm; and
- short term exposure limit (the maximum average concentration a person can be safely exposed to calculated over a 15 minute period) – 35 ppm.

The Delegated Officer notes that these standards are applicable to worker health and therefore are not directly applicable to public health but are considered in the context of boundary monitoring undertaken on the premises in accordance with the Existing Licence conditions.

9.6.5 Applicant controls

The premises has gas detectors which trigger an alarm if ammonia is detected. The alarms have a high trigger of 15 ppm and a high-high trigger of 25 ppm. Gas detectors are installed at identified risk areas throughout the Ammonia Plant as well as around the premises boundary. Handheld gas detectors are also available onsite and are used to conduct perimeter, source and offsite checks in the event of a complaint to establish the presence of ammonia. Additional controls include:

- Ammonia storage tanks are double walled and double-integrity. Water curtains are provided to further mitigate the risk of a release from the tanks.
- To minimise the need for venting of NH_3 boil-off gas from the storage tanks, the gas is recirculated via refrigeration compressors back into the storage tanks.

- The plant has been designed utilising the following safety systems:
    - Dedicated safety instrumentation systems;
    - Fail-safe trip systems;
    - Automatic plant shutdown if certain operating parameters are exceeded;
    - Provision of emergency manual trip stations;
    - Ammonia flare system;
    - Nitrogen purge facilities;
    - Firefighting facilities;
    - Isolation valves on transfer pipelines; and
    - Emergency power system.
- YPN implements a risk based inspection and preventative maintenance program for the Ammonia Plant.
- Rounds are conducted twice per shift by operators which include identification of small leaks and recording into the premises maintenance management system.
- The premises is a Major Hazard Facility and therefore has a DMIRS approved Emergency Management Plan and conducts regular training exercises in emergency response.

9.6.6 Key findings

Key findings: The Delegated Officer has considered information relating to unabated fugitive releases of ammonia and has found:

1. Issues with pressure release valves have been a recurrent reason identified by YPF as causing release of ammonia from storage tanks.
2. YPF undertook a detailed investigation in 2016 in response to the premature activation of a storage tank pressure safety valve and identified a number of contributory and significant non-contributory factors. Corrective actions based on investigation report recommendations were completed. The Department has not received any further notification of ammonia releases from pressure safety valves.
3. YPF has ambient ammonia detectors which can detect potentially harmful concentrations of ammonia at the premises boundary.
4. The Part IV assessment for the Ammonia Plant has previously determined suitability of the activities and determined that potential risks associated with ammonia release are acceptable.
5. The Ammonia Plant is classified as a Major Hazard Facilities and subject to regulation by DMIRS. DMIRS are responsible for public safety relating to such facilities. The Delegated Officer has determined that the risk of explosion, catastrophic plant failure and large scale ammonia release from the premises is sufficiently regulated by DMIRS and has not considered the risk of these events further.

9.6.7 Consequence

If an ammonia release occurs as a result of a leak or pressure safety release within the Ammonia Plant, storage tanks or transfer pipelines, then the Delegated Officer has determined that public at sensitive receptors locations may experience mid-level adverse health impacts. Therefore, the Delegated Officer considers the consequence of a fugitive ammonia release to be **Major**.

9.6.8 Likelihood of Risk Event

With consideration afforded to the Applicant's controls and distance to nearby receptors, the Delegated Officer considers that the likelihood a fugitive ammonia release will have an

adverse impact on receptors is **Rare.**

9.6.9 Overall rating of fugitive ammonia emission to air

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the overall rating for the risk of fugitive emissions of ammonia to air causing public health impacts during operation is **Medium**.

9.7 Risk Assessment – emissions to land (contaminated water and environmentally hazardous materials)

9.7.1 Description of emission to land risk events

Emissions of contaminated water and environmentally hazardous materials to land can result in contamination of soil and groundwater or the marine environment (King Bay) via direct discharge, or infiltration and groundwater flow.

Emissions to land may occur on the premises as a result of breaches of containment or transfer infrastructure which stores or transfers contaminated water and environmentally hazardous materials. Potential sources include:

- potentially contaminated stormwater and cooling water blow down in the eastern and western sedimentation basins;
- saline water from the pipeline carrying it in the seawater cooling circuit;
- process wastewater collected within the wastewater and neutralisation pits prior to discharge into the MUBRL;
- waste oil in the containment sumps which collect oil from the oil interceptor outlets on the premises; and
- hydrocarbon storage facilities, including diesel and hydrocarbon wastes (such as waste oil).

Breaches could include overtopping, pipeline rupture, leaks or spills, seepage from ponds or sumps. Planned discharge of water within the sedimentation basins also occurs a number of times per year. There is a risk of contamination of cooling water if leaks of MDEA and NH_3 heat exchangers with various parts of the process plant including liquids containing MDEA and NH_3. There is a risk of contamination of cooling water if leakage occurs on both sides of the heat exchanger.

Emissions to land can also occur from storage, handling and disposal of solid waste streams generated on the premises. These include spent catalysts, resins, filter media, desiccants and other domestic and commercial waste. On average spent catalysts from various stages in the ammonia production process need to be disposed of every three to ten years. Spills of environmentally hazardous materials including MDEA, sulfuric acid (H_2SO_4), caustic (NaOH) and liquid NH_3 could also occur.

9.7.2 Identification and general characterisation of emission

Key contaminants expected in the process wastewater streams include heavy metals, hydrocarbons, suspended and dissolved solids, ammonia, and MDEA. Contaminated stormwater streams may contain hydrocarbons and other process chemicals (MDEA, ammonia/ nitrogen). Other wastewater streams which could potentially be released to the

environment as a result of premises activities include cooling tower blowdown, and reverse osmosis reject streams, which can have higher solids concentration (electrical conductivity). Key contaminations in the premises solid waste streams are heavy metals.

Table 34 characterises the various waste streams discharged offsite as described in the PER document for the Ammonia Plant.

Table 34: Waste streams generated during normal operation of the Ammonia Plant

Waste stream	Location of Discharge
Demineraliser drains	Drain
Raw water filter backwash	
Steam condensate	
Laboratory wastewater (neutralised)	
Process condensate	Wastewater effluent sump[1]
CO_2 removal purge	
Boiler blowdown	
Process condensate	Oil containment sump and wastewater effluent sump[1] via the oil interceptor. Oil is transferred to a vacuum truck for offsite disposal.
Gland condensate/ steam condensate	
Intercoolers	
Curbed potentially oil contaminated areas	Wastewater effluent sump[1] via oil interceptor
Stormwater	Eastern and western sedimentation basins
Cooling tower blowdown	
Rejected osmosis condensate waste	
Mixed bed regeneration	
Rejected clean process condensate	
Spent catalysts, resins, filter media, desiccants associated with ammonia production process	Disposed offsite
Solid waste/ special waste: Heat exchanger sludge Oil residue and sludge from ammonia stripper	

Note 1: Wastewater from the wastewater effluent sump is subsequently discharged into the MUBRL

9.7.3 Description of potential adverse impact from the emission

Depth to groundwater at the Premises is variable with upstream bores showing up to 11 mBGL and those on the tidal flats often less than 0.2 mBGL. There is potential for contaminated water or environmentally hazardous materials to degrade local groundwater quality if discharged to land and infiltration to groundwater occurs. Improper storage/ disposal of spent catalysts, resins and other solid waste streams can also lead to soil contamination and infiltration to groundwater.

Groundwater flows in a south-easterly direction. The hydraulic gradient is steeper to the north of the Ammonia Plant, and becomes shallower to the south and south-east as the topography flattens. While groundwater contours indicate flow to the south-east, the sediments in the supratidal flats south of the premises have been identified to have a higher hydraulic conductivity than the surrounding geology. Therefore, there is the potential for some groundwater flow to occur to the south-west towards King Bay. Groundwater dependent ecosystems may be impacted by degradation in groundwater quality.

9.7.4 Criteria for assessment

The *Australian and New Zealand Environment and Conservation Council (ANZECC) 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 inshore marine environment, which is the closest environmental receptor for groundwater discharging from beneath the premises. The environmental values in relation to groundwater, as specified in the *National Environment Protection (Assessment of Site Contamination) Measure 1999* are considered to be appropriate criteria to assess ambient groundwater quality.

YPF has developed trigger levels for individual bores based on baseline groundwater quality. Groundwater monitoring results are compared with the trigger criteria as an indicator of groundwater contamination resulting from the premises activities.

9.7.5 Applicant controls

Specific engineering and management controls adopted to minimise the risk of emissions to land resulting from containment failure are summarised below:

- The drainage system has been designed to transfer flows during a 1 in 50 year event and the sedimentation basins are designed to withstand a 1 in 100 year event.
- The eastern and western sedimentation basins are lined with 1.5 mm thick HDPE to achieve a permeability of less than 1×10^{-9} m/s.
- The contaminated storm water collection system includes sealed bunded collection areas.
- The sedimentation ponds and seawater cooling pipeline are inspected by operators on a daily basis during daily rounds of the premises.
- The premises has bunded storage areas for MDEA, H_2SO_4 and NaOH.
- Ammonia storage tanks are double walled.

9.7.6 Key findings

Key finding: The Delegated Officer has considered information relating to emissions to land and has found:

1. The Ammonia Plant was classified on 17 February 2016 as possibly contaminated - investigation required under section 13 of the CS Act. Actions and ongoing investigations relating to the contamination are being managed in accordance with the CS Act.
2. Review of historical groundwater monitoring data associated with the operation of the Ammonia Plant has identified that metals (including copper, nickel, and zinc) are present in groundwater bores downgradient of the Premises at concentrations exceeding assessment levels for marine waters as published in *'Assessment and management of Contaminated Sites' (DER, 2014).* The 2006 baseline groundwater investigation (section 6.3) did however identify that there is natural variation in water quality and elevated metal concentrations in the Burrup area and that site specific criteria based on baseline water quality may be more appropriate for certain heavy metals (copper and nickel) and pH, and that zinc levels fluctuate in individual bores.
3. YPF should continue to use and refine trigger levels for groundwater to allow for early detection of potential contamination. The Delegated Officer notes trigger levels are yet to be defined for new monitoring wells.
4. The applicant requested that the MDEA derivatives (by-products) included in the Existing Licence groundwater monitoring requirements (N-nitrosodiethanolamine (NDELA), N-nitrosodimethylamine (NDMA), N-nitrosopiperazine (NPz) and Dimethylnitramine) be removed from the monitoring requirements as they have not been detected, and only low concentrations of MDEA have been detected on occasion. The derivatives are included in the scope of the contaminated site investigation of the premises. Therefore the Delegated Officer considers the derivatives can be removed from the monitoring suite as monitoring of groundwater for MDEA will provide for detection of potential impact to groundwater associated with MDEA.
5. Emissions associated with storage, handling, or transfer of solid wastes and environmentally hazardous materials can be managed under the general provisions of the EP Act and the *Environmental Protection (Unauthorised Discharges) Regulations 2004.* Disposal of spent catalysts/ resins/ desiccants/ special wastes offsite will be subject to requirements under the EP (Controlled Waste) Regulations and any regulatory requirements which apply to the offsite waste disposal site.

6. To avoid regulatory duplication, bulk storage of chemicals on the premises has not been considered in the risk assessment as the premises is subject to regulation by DMIRS for Dangerous Goods storage and as a Major Hazard Facility.

9.7.7 Consequence

If emissions to land occur as a result of breached containment infrastructure, then the Delegated Officer has determined that low level offsite impact could occur. Therefore, the Delegated Officer considers the consequence of emissions to land to be **Moderate**.

9.7.8 Likelihood of Risk Event

The Delegated Officer has determined that low level offsite impact could occur at some time as a result of emissions to land therefore, the Delegated Officer considers the likelihood of discharges to land causing groundwater contamination off the premsies to be **Possible**.

9.7.9 Overall rating of emissions to land (contaminated water and environmentally hazardous materials)

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the overall rating for the risk of emissions to land due to containment breaches is **Medium**.

9.8 Risk Assessment – emissions to land (treated effluent)

9.8.1 Description of emissions to land from STP effluent risk event

A rotating biological contactor STP is located on the premises for treatment of domestic wastewater flows from the premises. The STP produces treated effluent requiring disposal. The STP has been unable to meet design criteria for the treated effluent therefore the wastewater stream contains elevated levels of nutrients TN and TP but has been able to achieve criteria for TSS, BOD and E.coli. The effluent has previously been disposed via infiltration basins but due to discharge criteria being unable to be achieved to TN and TP, the applicant has proposed to construct an evaporation pond for disposal of the treated effluent.

There is potential for discharge to land of treated effluent if the evaporation pond overflows due to insufficient capacity or seepage occurs from the pond. Infiltration of the discharge could result in degradation of groundwater quality in proximity to the infrastructure.

9.8.2 Identification and general characterisation of emission

The STP has a design capacity of 36 m^3/day however based on the previous three years of average throughput actual inflows are not expected to be greater than an average of 11 m^3/day.

As per section 4.3, historically the STP has been unable to achieve design criteria for nutrient levels in the treated effluent. Other water quality parameters were generally met. Comparison of the discharge to land limits for treated effluent in the Existing Licence (as based on STP design criteria) compared with the average measured nutrient levels in the effluent are included in Table 35. Chemical dosing trials were undertaking in 2019 to improve the water quality resulting in nutrient levels in treated effluent decreasing to below 30 mg/L TN and 8 mg/L TP, however mechanical failures resulting in a lack of flow to the STP caused the bacteria in the unit to die, and YPF have been unable to return concentrations of TN and TP to these levels therefore treated effluent is expected to be similar in composition to the 2016-2018 results.

Table 35: Discharge to land limits for STP treated effluent in the existing performace compared with measured results

Emission point	Parameter	Limit (including units)	WWTP actual performance (average August 2016 to August 2018)
Discharge point to infiltration basin	Total nitrogen	25 mg/L	74.8 mg/L
	Total phosphorus	5 mg/L	10.3 mg/L
	Biochemical oxygen demand	20 mg/L	NA
	pH	6.5 – 8.5	
	Total suspended solids	30 mg/L	
	E.coli	10,000 cfu/100mL	

9.8.3 Description of potential adverse impact from the emission

There is potential for seepage and infiltration of treated effluent to groundwater if it is discharged to land. Elevated nutrients in the effluent can result in elevated nutrient concentrations in local groundwater. The depth to groundwater at the premises is variable at up to 11 mBGL in upstream bores to less than 0.2 mBGL at the tidal flats. The hydraulic gradient is steeper to the north and becomes shallower to the south and south-east as the topography flattens. Groundwater flows in a south-easterly direction toward the tidal flats. While groundwater contours indicate flow to the south-east, the sediments in the supratidal flats south of the plant have been identified to have a higher hydraulic conductivity than the surrounding geology. Therefore, there is the potential for some groundwater flow to occur to the south-west towards King Bay. Groundwater dependent ecosystems of the tidal flats may be impacted by elevated nutrient levels.

9.8.4 Criteria for assessment

The criteria for secondary treated wastewater treatment plants as specified in the *National Water Quality Management Strategy, Australian Guidelines for Sewerage Systems - Effluent Management 1997* are considered appropriate.

9.8.5 Applicant controls

As per the discussion in section 4.3, the STP on the premises has been unable to achieve the design performance criteria therefore YPF has proposed to cease discharge of treated effluent to land via the existing infiltration basins and construct an evaporation pond for disposal of the effluent.

The design specifications intended to minimise the risk of discharge of treated effluent from the evaporation pond to land, which have been considered by the Delegated Officer are:

- the evaporation pond has been designed with sufficient capacity for treated effluent inflow of 18.9 m^3/day with allowance to also contain a 168 Hour 1% AEP rainfall event and 500 mm freeboard. Inflows are not expected to exceed an average of 11 m^3/day; and
- the evaporation pond will be lined with 2 mm thick HDPE liner overlying geotextile and anchored to the embankment via an anchoring trench.

Operational controls intended to minimise the risk of discharge of treated effluent from the evaporation pond to land, which have been considered by the Delegated Officer are:

- the pond has been designed, and will be operated with a minimum 500 mm freeboard; and
- the pond has been designed with an emergency spillway to allow for controlled overflow in an extreme rainfall event to prevent embankment failure.

9.8.6 Key findings

Key finding: The Delegated Officer has considered information relating to emissions to land (treated effluent) and has found:

1. Treated effluent will no longer be discharged to land and infiltrated. Treated effluent will instead be discharged to a lined evaporation pond (to be constructed) which will be established at the same location as the existing infiltration basins.
2. Treated effluent will be stored in tanks and removed for offsite disposal at a licensed facility until the construction of the evaporation pond is complete.
3. The evaporation pond has been designed with a capacity which has taken into consideration maximum expected effluent inflow, significant and typical rainfall events, evaporation rates and an allowance for freeboard therefore is considered to have adequate design capacity.
4. The pond design includes allowance for storage of a 168 Hour 1% AEP rainfall event, plus a freeboard 500 mm. The treated effluent within the pond would be significantly diluted by rainfall in the case of an emergency overflow therefore contaminant levels are expected to be insignificant, and overflow as a result of a significant rainfall event does not present a risk to the environment.

9.8.7 Consequence

If discharge to land of treated effluent occurs, then the Delegated Officer has determined that there will be minimal impact to groundwater at a local scale. Therefore, the Delegated Officer considers the consequence of discharge of treated effluent to land to be **Minor**.

9.8.8 Likelihood of Risk Event

Based on the applicant's controls and nature of treated effluent the Delegated Officer has determined that the likelihood of offsite impact at a local scale from treated effluent occurring will be **Rare.**

9.8.9 Overall rating of treated effluent emissions to land

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the overall rating for the risk of discharge to land of treated effluent is **Low**.

9.9 Risk Assessment – emissions to marine waters (discharge via MUBRL)

9.9.1 Description of emissions to marine waters via the MUBRL risk event

The premises receives effluent from the TAN plant into the premises pipework for disposal via the Water Corporation's MUBRL. The TAN and Ammonia Plant effluents are combined before being discharged into the MUBRL. The wastewater streams which make up the TAN and Ammonia Plant effluents are described in

Table 36. The MUBRL discharges the received wastewater into marine waters at King Bay. Impact to the ecology of the marine environment can occur as a result of the discharge if contaminant levels, temperature or salinity are sufficiently high.

Prior to discharge into the MUBRL, wastewater streams are treated to reduce concentrations of TDS, chlorine, biocides, ammonia, methanol, phosphorous and nitrogen to levels as low as reasonably practical. The treatment plant comprises a steam stripper and chemical effluent treatment plant.

During abnormal operations, leakage from heat exchangers in the Ammonia Plant can potentially release MDEA or liquid ammonia into the cooling water discharged into MUBRL.

Table 36: Wastewater streams discharged to MUBRL

Plant	Process Wastewater	Volume	Brine	Volume
Ammonia Plant	• Wastewater from air compressor intercoolers (4 m^3/hour) • Reformer jacket water blowdown (4 m^3/hour but only when tripping on high conductivity) • Reformer steam drum boiler blowdown (2.5 m^3/hour) recycled into jacket water pit and recovered unless tripping on high conductivity • Package boiler blowdown (2 m^3/hour) recycled into jacket water pit and recovered unless tripping on high conductivity	12.5 m^3/hour (0.3 ML/day)	Cooling tower blowdown (includes discharge from three desalination units)	2,000 m^3/hr (48 ML/day)
TAN Plant	• Purified process condensate • Chiller condensate • Boiler blowdown	14.48 m^3/hr 0.35 ML/day	Blowdown from cooling water system	353.4 m^3/hr (8.48 ML/day)
TOTAL TO MUBRL	**Process wastewater**	27 m^3/hr **0.65 ML/day**	**Brine**	2354 m^3/hr **56.48 ML/day**

9.9.2 Identification and general characterisation of emission

Table 37 below summarises the monitoring results for discharge from the Ammonia Plant into the MUBRL for the years 2016 to 2018 as reported in the AER.

Table 37: Monitoring data for wastewater discharged from the Ammonia Plant into MUBRL

Parameter	Units	Output monitoring from Ammonia Plant discharge point (min and max monthly average value reported in 2018 AER)
pH	-	7.37-8.26
Conductivity	µS/cm	57,602-101,516
Ammonia	µg/L	40-2280
Total Phosphorus	µg/L	10 to 130
Arsenic (III)	µg/L	All results below or at limit of detection (As-III) 1.5 to 5.8 (As-V)
Chromium	µg/L	All results at or below limit of detection (Cr-III) 1.5 - 4 (Cr-VI)
Copper	µg/L	0.6 - 7
Lead	µg/L	0.3-5.5
MDEA	mg/L	Five results above limit of detection ranging from 0.2 to 1.6
Nickel	µg/L	All results except two of 6.25 µg/L were below limit of detection
Vanadium	µg/L	0.6 to 2.5
Zinc	µg/L	2-64.8

All records for arsenic III, cadmium, chromium III, cobalt, lead, mercury, selenium and silver, were at or below the limit of detection.

Limited records for effluent discharged from the TAN Plant into the MUBRL are available due to the plant not having consistent operation to date. Table 38 summaries available data from the 2018 AER period.

Table 38: Monitoring data for wastewater discharged from the TAN Plant into MUBRL

Parameter	Units	Output monitoring from TAN Plant discharge point (min and max monthly average value reported in 2018 AER)
pH	-	7.85-8.51
Conductivity	µS/cm	24,692-62,153
Ammonia	µg/L	100-515
Total Phosphorus	µg/L	120 to 310
Arsenic (III and V)	µg/L	Below limit of detection (As-III) 0.5 to 2.8 (As-V)
Chromium	µg/L	8.5 (Cr-III) Below limit of detection (Cr-VI)
Copper	µg/L	0.6
MDEA	mg/L	Two results above limit of detection, 0.2 and 1.6
Nickel	µg/L	All results except two of 6.3 µg/L were below limit of detection
Vanadium	µg/L	All results except two of 0.5 and 0.7 were below limit of detection

All records for arsenic III, cadmium, chromium VI, cobalt, lead, MDEA, mercury, selenium, silver, and zinc were below the limit of detection.

9.9.3 Description of potential adverse impact from the emission

Nutrients, elevated salinity, and toxic heavy metals in wastewater discharged from MUBRL can potentially degrade marine water quality with associated impacts on marine ecology and mangrove population if the water quality does not meet the specified Ecological Quality Objectives for King Bay. Elevated temperature of wastewater discharged can cause thermal pollution by increasing ambient temperature of marine water affecting the marine environment. MDEA is also toxic to aquatic animals.

9.9.4 Criteria for assessment

Discharge of wastewater via the MUBRL is managed by Water Corporation and is subject to requirements of MS 594 (refer to section 5.1.1). The *Burrup Peninsula Desalinated Water and Seawater Supplies Project: Operational Marine Environmental Management Plan* (OMEMP) developed by Water Corporation, as required by MS 594, outlines the approach for managing the discharge of combined effluent to the MUBRL to achieve specified environmental objectives via a program of in-field and field-based monitoring.

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

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

Table 39: Trigger levels for discharges via the MUBRL

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

9.9.5 Applicant controls

Specific engineering and management controls adopted to ensure the quality of wastewater discharged into the MUBRL from the premises is suitable for discharge to King Bay are summarised below:

- chemical treatment and precipitation of the cooling tower blowdown with the aim to reduce chlorine, bromine and other biocides to non-detectable levels;
- steam stripping of process condensate and reformer jacket water blowdown, and recycle of polished water to prevent the discharge of ammonia and methanol in the wastewater stream;
- demineralisation and recycle of blowdowns from the package boilers and primary reformer; and
- monitoring is undertaken at two separate locations prior to the discharge point to confirm if water quality limits are met. Parameters which are continuously monitored (flow, temperature, pH, electrical conductivity, dissolved oxygen) are visible in the control room with alarm triggers in place to notify operators of limit exceedances so flow can be stopped if necessary.

9.9.6 Key findings

Key findings: The Delegated Officer has considered information relating to discharge of industrial wastewater via MUBRL and has found:

1. Although the OMEMP sets a framework for managing the cumulative discharge from the MUBRL and specifies water quality triggers for the combined effluent discharge, EPA Bulletin 1044 and the OMEMP recommend that the management of discharges from each individual operator should be regulated under the respective licences or Ministerial Statements.
2. MS 594 and MS 870 do not contain regulatory controls for the discharge and recommend regulation under the licence.
3. EPA Report 1379 for the TAN Plant recommends the following criteria for the licence:
    I. Process condensate wastewater discharged from the TAN Plant into the MUBRL to not contain greater than 15 ppm of nitrogen from NH_3 and to not contain greater than 15 ppm nitrogen from NH_4NO_3;
    II. Seawater blowdown discharged from the TAN Plant into the MUBRL to have oxidising biocide concentration of less than 0.1 mg/L and a scale inhibitor (anti-scalant) concentration of up to 1.2 ppm;
    III. Installation and operation of a sodium metabisulphite dosing station to decompose oxidising biocides to the required concentration prior to discharge into the MUBRL;
    IV. Monitoring contaminants prior to discharge into the MUBRL to ensure compliance with the ANZECC/ARMCANZ 2000 guidelines with contingency measures put in place in the event that trigger levels are exceeded; and
    V. Reporting of monitoring results.
4. The Ammonia Plant and the TAN Plant are major contributors of wastewater discharged to the MUBRL. Review of the data presented in the most recent AER demonstrates that the quality of wastewater discharged into the MUBRL can meet the required water quality criteria.

9.9.7 Consequence

Considering the information above, the Delegated Officer has determined that emissions to the marine environment associated with process wastewater and brine discharged from the TAN Plant and the Ammonia Plant to the MUBRL are likely to result in minimal offsite impacts and that specific environmental criteria set are likely to be met. Therefore, the Delegated Officer considers the consequence of marine discharges to be **Minor.**

9.9.8 Likelihood of Risk Event

The Delegated Officer considers the likelihood that marine discharges will not satisfy the specified environmental criteria and adversely impact the receiving environment to be **Unlikely.**

9.9.9 Overall rating of emissions to marine waters via the MUBRL

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the overall rating for the risk of emissions to marine water causing environmental or ecological impacts during normal operations is **Medium.**

9.10 Risk Assessment – emissions to marine waters (discharge from eastern and western sedimentation basins)

9.10.1 Description of emissions to marine waters via eastern and western sedimentation basins risk event

The western and eastern sedimentation basins receive contaminated stormwater and cooling tower blowdown associated with Ammonia Plant operations. Water received in the basins can have elevated concentration of suspended solids, hydrocarbons and MDEA as a result of leaks or spills within the plant that are washed in by stormwater flows.

The basins are designed to withstand rainfall from a 1 in 100-year event. The basins discharge water into King Bay tidal flats via dedicated pipelines. The quality of water discharged from the basins to the tidal flats can impact on the ecology of the King Bay marine ecosystem.

9.10.2 Identification and general characterisation of emission

On average, discharge from the sedimentation basins occurs two to three times per year, and discharge events are typically less than 24 hours in duration.

The Existing Licence requires monitoring of water within the sedimentation basins prior to discharge and during a discharge event which has a duration greater than 24 hours. The AER covering the reporting period 1 January 2018 to 31 December 2018 reports that there were thirteen releases of wastewater from the sedimentation basins into King Bay tidal flats over the 2017 and 2018 reporting periods which is higher than average. Discharge volumes and the results of water sampling undertaken prior to each release are shown in Table 40.

All the monitoring results are below the limits on the Existing Licence for discharges to land from the sedimentation basins. One limit exceedance occurred during the 2016 reporting period when a MDEA result of 41 mg/L occurred exceeding the licence limit of 1 mg/L. An investigation was completed to assess the environmental impact which found that the release of MDEA was deemed to have not caused environmental harm, and therefore was not considered a pollution event by YPF. The high level of MDEA in the sedimentation basins was caused by a spill on the premises which was transferred via stormwater flow into the basins.

Table 40: Water quality analysis results for wastewater discharged from eastern and western sedimentation basins

Emission point	Date released	Approximate release volume (kL)	Monitoring results (parameter, limit)			
			Total Suspended Solids	pH	Total Recoverable Hydrocarbons	MDEA
Licence Limit			**80 mg/L**	**6 - 9**	**15 mg/L**	**2 mg/L**
W2	9-10 February 2017	13,750kL	8	7.40	<0.25[1]	<0.1
	8-9 March 2017	12,600kL	42	8.40	<0.28	<0.1
	11 September2017	11,000kL	11	8.40	<0.28	<0.1
	14-16 September 2017	33,500kL	6	8.40	<0.28	<0.1
	4-6 October 2017	29,600kL	11	8.40	<0.28	<0.1

	22 December 2017	9,500kL	23	NA	<0.28	<0.1
	6-12 April 2018 (2 sample events)	115,000kL	26 15	8.45 8.41	<0.28 <0.28	<0.1 <0.1
	21 June 2018	8,000kL	9	8.83	<0.28	0.5
	27 November 2018	11,000kL	27	8.25	<0.25	<0.1
W3	8 February 2017	6,000kL	2	8.40	<0.25[1]	<0.1
	10 February 2017	6,000kL	2	8.40	<0.25[1]	<0.1
	17 February 2018	4,580kL	65	8.63	NA	<0.1
	21 June 2018	2,500kL	21	8.96	<0.28	<0.1

[1] Total Petroleum Hydrocarbons analysed for February releases. Method changed to Total Recoverable Hydrocarbons from 27 February 2017

9.10.3 Description of potential adverse impact from the emission

There is potential for degradation of marine water quality and potential impacts to marine ecology if discharge water has elevated contaminant levels. Hydrocarbons and MDEA are toxic to aquatic organisms and therefore could cause marine fauna death if there are elevated levels in discharge.

9.10.4 Criteria for assessment

The *ANZECC Guidelines for Fresh and Marine Water Quality* (99% level of protection) and the specified ecological and environmental objectives based on the *Pilbara Coastal Water Quality Consultation Outcomes (DoE 2006)* report are appropriate guidelines. The point source emission limits to marine water set in the Existing Licence, as indicated in Table 40 above, are appropriate criteria for the assessment of potential impacts.

9.10.5 Applicant controls

Specific management controls adopted are discussed below:

- Wastewater samples are collected prior to discharge for analysis; however, it is noted that analytical results are not necessarily available prior to discharge and any actions taken or investigations carried out are retrospective.
- A breach of the Existing Licence limit for MDEA occurred in 2016, YPF undertook a corrective action, and sealed the MDEA bund. Rainwater collected in the bund is now removed and disposed offsite to reduce the risk of further limit exceedances occurring.
- No further exceedances of the MDEA limit for water discharged from the sedimentation basins have occurred since 2016.

9.10.6 Key findings

Key findings: The Delegated Officer has considered information relating to discharge from sedimentation basins and has found:

1. There is potential for wastewater discharged from sedimentation basins to have elevated concentration of contaminants which may exceed the Existing Licence limits.
2. Potential environmental impacts associated with the discharge will depend on the volume and duration of the discharge event and the concentration of contaminants within the discharge.
3. While wastewater sampling is conducted prior to discharge, analytical results are not always available prior to discharge occurring. Any investigation of exceedances and corrective actions are likely to be retrospective in most instances.
4. The applicant has proposed an increased limit of 5 mg/L for MDEA on the basis that the limit of detection for MDEA at the on-site laboratory is higher than the existing licence limit of 1 mg/L. The Delegated Officer considers it necessary for the applicant to undertake on site testing due to monitoring being required to be undertaken no more

than 1 hour before a discharge event and the remote location of the premises. The Delegated Officer considers that the limit was set on the basis that MDEA is toxic to marine animals therefore any increase to account for laboratory limitations should be based on those limitations and therefore considers a limit of 2 mg/L to be acceptable.

9.10.7 Consequence

Considering the information above, the Delegated Officer has determined that discharge from the sedimentation basins to the King Bay tidal flats may exceed the specified environmental criteria and could cause low level offsite impacts at a local scale. Therefore, the Delegated Officer considers the consequence of discharge to the marine environment from the sedimentation basins to be **Moderate**.

9.10.8 Likelihood of Risk Event

The Delegated Officer has determined that the likelihood of discharge water not meeting the specified environmental criteria is **Possible**

9.10.9 Overall rating of emissions to marine waters (discharge from eastern and western sedimentation basins)

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the overall rating for the risk of emissions to marine water causing environmental or ecological impacts during abnormal operations is **Medium**.

9.11 Risk assessment - noise emissions

9.11.1 Description of risk of noise emissions

Noise emissions arise from normal operation of the Ammonia Plant due to:

- operation of major plant and ancillary equipment;
- onsite vehicle movement (loaders, trucks etc.); and
- onsite operation of generators, pumps, fans, compressors, etc.

Noise from the premises may impact the amenity of people using public access areas, such as Hearson Cove, in the proximity to the premises.

9.11.2 Identification and general characterisation of emission

The Existing Licence requires noise emission monitoring to be undertaken on a quarterly basis. The noise monitoring results reflect the cumulative noise at the boundary of the Ammonia Plant and the adjacent TAN Plant if it is undertaken when both plants are in operation. Due to the operational downtime of both plants however only one reported monitoring event occurred when both plants were in operation. The results of noise monitoring undertaken since 2018 are included in Table 41. The highest result was recorded at the Ammonia Plant western boundary when both plants were in operation, however is only marginally greater than the highest result recorded when only the Ammonia plant was operating. Monitoring results are highest at N1 which is the monitor located closest to plant infrastructure. All results are more than 5 dB(A) below the licence limit of 65 dB(A).

Table 41: Results of noise monitoring undertaken at the Ammonia and TAN Plant premises boundaries 2018-2019

Date	Operational status	Average LA10 (dB)			
		N1	N2	N3	N4
16/10/18	Ammonia plant only operating	58.7	52.8	45.8	37.5
20/12/2018	Ammonia plant only operating	58	55.7	57.9	50.4
8/3/2019	Ammonia plant only operating	57.9	53.8	54.7	46.2
7/6/2019	Ammonia Plant utilities operating and TAN Plant operating	55.1	51.9	47.5	44.8
1/7/2019	Ammonia and TAN Plants both operating	58.8	54.4	53.8	49.8

NOTE 1 – Monitoring locations N1 and N2 are in closest proximity (west and south) to the Ammonia Plant. Monitoring location N3 is located midway between and north of the Ammonia and TAN Plants, and N4 is east of the TAN Plant.

9.11.3 Description of potential adverse impact from the emission

Regular exposure to consistent elevated noise levels may cause health impacts such as hearing impairment, irritability, and hypertension. Noise emissions from the premises are expected to be consistent with other industries which are located in the area zoned 'strategic industry' by City of Karratha Planning Scheme No. 8.

Deep Gorge is the nearest recreational area located approximately 1,000 m south of the premises. Hearson Cove is another recreational area accessed by members of the public, located 1,200 m south east of the premises boundary. Noise emissions may impact the amenity of people in these recreational areas.

9.11.4 Criteria for assessment

As per discussion in section 6.2, the EPA recommended an aspirational goal of an ambient noise level of 45 dB(A) at Hearson Cove in Bulletin 1077. The Department's noise experts concluded that the goal is no longer relevant and that ambient noise levels at Hearson Cove Beach could be minimised by ensuring that all industrial facilities located in proximity reduce noise levels at their respective plant boundaries to below the 65 dB(A)

The following assessment criteria has therefore been adopted at the premises boundary.

Table 42: Noise assessment criteria specified in the EP (Noise) Regulations

Type of premises receiving noise	Time of day	LA_{10} (dB)
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours	65

A review of records in the DWER's ICMS did not identify any noise related complaints from the community relating to normal operation of the Ammonia Plant.

9.11.5 Applicant controls

Noise mitigation measures implemented on the Premises include the following:

- Equipment such as compressors and pumps are located within enclosures, cases, blankets or are situated in a building as required;

- Silencers installed on vents;
- Pipework with acoustic cladding;
- Relief system for flow/ acoustically induced vibration and fatigue;
- Repairing, modifying or replacing high noise generating items; and
- Selecting machinery with minimum noise levels.

9.11.6 Key findings

Key findings: The Delegated Officer has considered the results of ambient noise emissions monitoring as presented in the application and the advice received and has found:

1. The TAN Plant and the Ammonia Plant are major contributors to noise levels at Hearson Cove. Cumulative noise from the operation of the two plants has therefore been considered in this risk assessment.
2. Only one exceedance of the noise criteria of 65 dB(A) was recorded the SE boundary of the TAN Plant during commissioning monitoring which was likely due to operation of the TAN Plant.
3. Subsequent to the exceedance, external acoustic insulation was installed on the nitric acid plant compressor air inlet duct in the TAN Plant as it was identified as a significant source of noise.
4. Only one boundary monitoring event has occurred, post commissioning of the TAN Plant, when both plants were in operation. There are therefore insufficient monitoring records to conclude that the existing licence limit of 65 dB(A) can be consistently complied with. Compliance with the limit will minimise the likelihood of noise emissions impacting on sensitive receptors.
5. During the 2018 amendment of the existing licence, YPF committed to develop and conduct a revised noise monitoring program which identifies the representative noise at Hearson Cove. Advice on the scope of the program was provided in the Decision Report for the 2018 amendment (DWER 2018). At the time of this assessment YPF had not provided details of the proposed program to the Department as the Ammonia and TAN plants have had limited time when both were operating. With the TAN plant expected to recommence operation in 2020, it is the Department's expectation that the revised noise monitoring program will be developed and submitted for consideration.

9.11.7 Consequence

Considering the results of ambient noise monitoring conducted during commissioning of the TAN Plant, and ambient noise monitoring conducted in 2018 and 2019 when one or both plants were operation, the Delegated Officer has determined that cumulative noise emissions associated with operation of the TAN and Ammonia Plants may cause low level impact to amenity at the nearest receptors. Therefore, the Delegated Officer considers the consequence of noise emissions to be **Minor.**

9.11.8 Likelihood of risk event

The Delegated Officer considers that cumulative noise emissions from the TAN and Ammonia Plants could impact the amenity of sensitive receptors at some time. Therefore, the likelihood is **Possible.**

9.11.9 Overall rating of risk of noise emissions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 25) and determined that the overall rating for the risk of noise emissions impacting amenity of receptors during normal operations is **Medium.**

9.12 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 43 below. Controls are described further in section 10.

Table 43: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
1.	Point source emissions to air during normal operating conditions NO, SO_2, CO, PM	Primary reformer stack, package boiler stack, CO_2 stripper stack, Production and storage flares	Air/wind Environmental/ Public Health impacts	See section 9.4.5	NOx: **Medium risk** CO, SO_2 and PM: **Low risk** PM: **Low risk**	Acceptable subject to regulatory controls
2.	Point source emissions to air during abnormal operating conditions NO, SO_2, CO, PM, NH_3	Primary reformer stack, package boiler stack, start-up heater, diesel generator, storage flare, front and back end vents	Air/wind Environmental/ Public Health impacts	9.5.5	NOx, CO and NH_3: **Medium risk** SO_2 and PM: **Low risk**	Acceptable subject to regulatory controls
3.	Fugitive emissions to air (NH_3)	Ammonia storage tank vents and valves Ammonia transfer pipeline leaks	Air/wind Public Health impacts	See section 9.6.5	**Medium Risk**	Acceptable subject to regulatory controls
4.	Emissions to land Contaminated water, hydrocarbons, chemicals (MDEA, liquid NH_3)	Wastewater storage/ collection sump Waste oil collection sump Sedimentation basins Waste storage areas Chemical/ hydrocarbon storage areas	Direct Discharge/ seepage Degradation of local groundwater quality Potential impact on surface water/marine quality due to local groundwater flow direction	See section 9.7.5	**Medium Risk**	Acceptable subject to regulatory controls
5.	Emissions to land Nutrients	Newly constructed evaporation pond once in service	Direct discharge Degradation of local groundwater quality Potential impact on surface water/marine quality due to local groundwater flow direction	See section 9.8.5	**Medium Risk**	Acceptable subject to regulatory controls, including design specifications

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor** **(Impact)**			
6.	Emissions to marine waters (MUBRL) Wastewater streams (process wastewater and brine)	Wastewater streams from the TAN and Ammonia Plant discharged into MUBRL which discharges to King Bay	Direct discharge Degradation of marine water quality and ecological impact to marine fauna	See section 9.9.5	**Medium Risk**	Acceptable subject to Licence Holder controls conditioned
7.	Emissions to marine waters Stormwater and cooling water (TSS, MDEA, hydrocarbons)	Discharge from Western and Eastern sedimentation Basins into King Bay tidal flats	Direct discharge Degradation of marine water quality and ecological impact to marine fauna	See section 9.10.5	**Medium Risk**	Acceptable subject to regulatory controls
8.	Noise Emissions	Operation of the Ammonia Plant (cumulative assessment with adjacent TAN Plant)	Air/ Wind dispersion Public amenity impacts	See section 9.11.5	**Medium Risk**	Acceptable subject to regulatory controls

10. Regulatory controls

A summary of regulatory controls determined to be appropriate for the Risk Event is set out in Table 19. The risks are set out in the assessment in section 10 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 44: Summary of regulatory controls to be applied

		Controls (references are to sections below, setting out details of controls)		
		Infrastructure and equipment (10.1.1, 10.3.1 and 10.5.1)	Monitoring and Reporting Requirements (10.1.3, 10.3.2, 10.3.3, 10.4.2, 10.5.3, 10.6.2 and 10.7)	Specified emissions and limit (10.1.2, 10.2.1, 10.4.1, 10.5.2, and 10.6.1)
Risk Items (see risk analysis in section 9)	Point Source emissions to air – Normal Operations	●	●	●
	Point Source emissions to air- Abnormal operations	●	●	●
	Fugitive ammonia emissions	●	●	●
	Emissions to land- contaminated water and environmentally hazardous substances	●	●	
	Emissions to land- STP effluent	●	●	
	Emissions to marine water (MUBRL)	●	●	●
	Emissions to marine water (Sedimentation basins)	●	●	●
	Noise emissions		●	●

10.1 Licence controls - point source emissions to air

Conditions relating to point source emissions to air have been retained from the Existing Licence as there has been no change to the activity and the assessed level of risk has not increased since the 2018 risk assessment for the premises.

10.1.1 Infrastructure and equipment

Infrastructure operational requirements which are intended to reduce or minimise point source emissions to air are specified for relevant infrastructure in condition 1.

Requirements for the primary reformer and production and storage flares are as per the Existing Licence. Additional requirements have been specified for the emergency diesel generator and start-up heater (that were not included in the Existing Licence) as the design intent of the plant is for this infrastructure to only operate during start-up or for emergency supply (diesel generator only) therefore it has not been assessed as contributing to emissions from the plant during normal operation. The licence specifies when the infrastructure is able to be operated (during start up or for emergency power).

Grounds: Predicted emissions and impact on air quality takes into consideration engineering design and management measures intended to minimise or reduce air emissions. Accordingly, emission control technology incorporated into emission sources, and management controls to minimise emissions, are specified as operational requirements for infrastructure.

10.1.2 Specified emissions and limits

Condition 5 is included in the licence to authorise the emissions which have been considered and assessed in this decision report to be discharged to air via the primary reformer stack, package boiler stack, CO_2 stripper stack, start-up heater stack, emergency diesel generator, front-end and back-end vents and production and storage flares. The locations of the emission points are illustrated in the Map of authorised discharge point locations in Schedule 1 of the issued licence.

The emergency diesel generator has been included in the licence to authorise emission from this source although combustion emissions from the generator will be minimal due to its low frequency of operation. SO_2 has also been added as an authorised emission for the Package boiler stack and Primary reformer stack. It was not specified in the Existing Licence but small amounts are emitted.

Condition 6 specifies limits that apply to the point source emissions to air. Limits have been retained from the Existing Licence.

Table 45: Point source emission to air limits

Stack reference	Parameter	Recommended Limit (mg/m^3)
Primary reformer stack – A5	NOx	180
Package Boiler Stack – A6	NOx	300

Grounds: Emissions of NOx, primarily from the primary reformer and package boiler stacks, have been assessed as medium risk. Limiting point source emissions to air through limits is key to ensuring that GLCs at the receptors remain within specified criteria to protect public health.

Emission limits specific to start-up of the Ammonia plant have not been specified. The Delegated Officer considers it appropriate to review the emissions profile available from reliable CEMS data once sufficient data from the newly installed CEMS is available for assessment. This will enable point source emission limits to be reviewed and revised or additional limits for start-up applied if the review determines changes to be necessary.

Additional emission sources (emergency diesel generator) and emissions (SO_2) have been included in the table of authorised discharge points to ensure all potential emissions considered in the assessment are included.

Emissions of NOx have been assessed as medium risk during normal operation. Height of an

emission point is one of the tools to aid in dispersion of the contaminant plume and to minimise ground level impacts. Stack heights are therefore specified in the licence.

10.1.3 Monitoring requirements

The licence includes monitoring requirements for discharges to air in condition 10 and locations in the Map of monitoring locations in Schedule 1 of the issued licence. NOx is the only point source emission to air via stacks assessed at medium risk during both normal and abnormal operation of the plant therefore only NOx monitoring is specified.

As the CEMS installed on the Primary reformer and Package boiler stacks were awaiting completion of final RATA testing at the time of this assessment, quarterly stack monitoring for NOx emissions from the primary reformer stack and package boiler stack have been retained in the licence. A timeframe for commencement of CEMS monitoring (and cessation of stack monitoring) has also been specified in the licence to ensure there is no further delay to commencement of continuous monitoring of emissions from the Ammonia Plant in accordance with the CEMS code.

Other monitoring requirements specified in the licence to ensure collection of representative and accurate monitoring data include:

- Requirement for the licence holder to undertake ongoing operation, maintenance and compliance for the CEMS installed in accordance with the CEMS Code;
- Requirement to ensure that any stack sampling is undertaken at sampling locations in accordance with the Australian Standard *AS4323.1 Stationary Source Emission Method 1: Selection of sampling positions*;
- Requirement that any non-continuous sampling and analysis is undertaken by a holder of NATA accreditation relevant to the methods of sampling and analysis; and
- Requirement to separate monitoring events by a specified period.

Grounds: NOx emissions have been assessed as medium risk, and limits applied therefore monitoring is required to demonstrate emissions remain within assessed levels and limits.

The Existing Licence required the licence holder to undertake stack sampling quarterly for the Ammonia Plant until CEMS was installed which was required to be completed by 30 September 2019. CEMS had been installed on both the primary reformer stack and package boiler stack at the time of this assessment however RATA testing had not been completed. Quarterly testing has therefore been retained as a requirement in the licence until the CEMS is operational. A new date for commencement of continuous monitoring is also included

Ongoing compliance requirements to demonstrate continued acceptability and accuracy of the CEMS in accordance with the CEMS Code are specified in the licence to ensure accurate data collection.

Sulfur dioxide and PM emissions have both been assessed as low risk during normal and abonormal operating conditions therefore no specified monitoring or limits have been applied for these emissions. Ammonia and CO emissions were both assessed as medium risk during abnormal operating conditions due predicted GLCs associated with flaring and venting of the gases. The Delegated Officer found that the modelling was conservative therefore the likelihood of GLC exceeding the criteria is low. Monitoring is not included for flaring due to the safety risk associated with such an activity. Ambient quality monitoring is considered a suitable method to detect when NH_3 emissions have increased on the premises (refer to section 10.2.1 for further details). Monitoring has also not been specified for CO as the key source of CO emissions during abnormal events are the vents. Monitoring of gas concentrations emitted from vents during abnormal operating conditions is not practical and volume monitoring is a more suitable measure to assess the potential for impact to receptors. YPF conduct process monitoring to determine the volume of CO emitted from vents during process conditions. A requirement to

report gas volumes from venting during abnormal operating conditions is included in the AER (refer to section 10.7 for further details).

10.2 Fugitive emissions to air (ammonia)

Conditions relating fugitive ammonia emissions to air have been retained from the Existing Licence as there has been no change to activities and the assessed level of risk has not increased since the 2018 risk assessment for the premises.

10.2.1 Monitoring requirements

Under section 72 of the EP Act, the licence holder is required to notify the Department as soon as practicable of an event that has caused or is likely to cause pollution, material environmental harm or serious environmental harm.

The requirement for the licence holder to continuously monitor ambient air for ammonia which may be released from venting or inefficient flaring at locations at the premises boundary is retained from the Existing Licence. Continuous monitoring of ambient air quality is required with alarms that are activated at 35ppm, initiating investigations into the cause. The inclusion of this requirement in the licence affords an additional level of protection from potential health impacts and is justified as a control based on previous releases, detailed in section 9.6.2.

Monitoring requirements are specified in condition 15 and locations in the Map of monitoring locations in Schedule 1 of the issued licence.

Grounds: Fugitive releases of ammonia are considered medium risk, predominantly due the potential for major consequences to public health to occur as a result. Continuous monitoring is intended to identify the presence of ammonia in air at the premises boundary to trigger investigation of the source of the ammonia as ambient concentrations should be low during normal operation of the plant. Potential impacts associated with a release of ammonia will depend on the nature of leak/ release, the time taken to identify and rectify the issue, and the location of the release. The trigger level for alarm activation is based on the Short Term Exposure Level (15-minute average) specified by Safe Work Australia. Exceedance of the criteria does not mean there is an imminent threat of health impact rather continued exposure at the concentration level or higher levels could result in impact to health.

10.3 Emissions to land

With the exception of conditions which authorise discharge of treated effluent from the STP to land, conditions relating emissions to land have been retained from the Existing Licence as the assessed level of risk has not increased since the 2018 risk assessment for the premises. Additional conditions relating to the construction and operation of the evaporation pond have been included on the licence as treated effluent will be evaporated rather than infiltrated on the premises.

10.3.1 Infrastructure and equipment

Infrastructure controls to prevent groundwater contamination have been retained from the existing licence and are based on controls implemented by the licence holder. These include

- Use of eastern and western sedimentation basins for storage of stormwater flows and cooling tower blowdown and liner specifications; and
- Use of evaporation pond or storage tanks for storage of treated effluent, liner specifications for the evaporation pond (when complete and in operation), and operational freeboard (new requirements).

A new operational control requiring daily inspections of the seawater cooling circuit pipeline has been included in place of a leak detection system. This has been implemented because

the pipeline has not previously had a leak detection system installed and the varying pipeline diameters make flow loss difficult to detect through such a system.

Additional controls for construction of the evaporation pond have been included in condition 2 of the licence. The controls are based on the design parameters provided by the applicant which are intended to ensure the evaporation pond has sufficient capacity and lining to minimise the likelihood of discharges to land of the treated effluent which will be discharged to the pond. The licence holder is also required to submit a compliance report following completion of the works and prior to operating the infrastructure.

Grounds: This risk associated with emissions to land was assessed as medium as there is potential for groundwater contamination to occur if contaminated stormwater and environmentally hazardous substances are not stored within appropriate, maintained storage infrastructure. Infrastructure controls intended to prevent or detect discharges to land or containment losses are therefore included as operational controls in the licence to minimise the likelihood of significant releases occurring.

Construction requirements are specified in the licence for the evaporation pond based on the applicant's design criteria to ensure the pond is constructed with sufficient capacity and lining to minimise the likelihood of discharge of treated effluent to land. Reporting requirements to provide confirmation that the construction of the evaporation pond meets the licence requirements have been included to enable to Department to confirm the infrastructure is fit for purpose before operation of the pond commences.

10.3.2 Monitoring requirements

Monitoring of treated effluent discharged from the STP was previously required to ensure water quality met limits set for discharge to land via the infiltration basins. Treated effluent is no longer authorised for discharge to land in the issued licence, however monitoring requirements for treated effluent have been retained at a reduced frequency in condition 19 to provide confirmation that the STP is operating effectively. The monitoring location is specified in the Map of monitoring locations in Schedule 1 of the issued licence.

Grounds: Treated effluent quality monitoring has been retained to monitor the performance of the STP.

10.3.3 Ambient groundwater monitoring

The groundwater monitoring requirements from the Existing Licence have been largely retained in the issued licence as there has been no change to the assessed level of risk since the 2018 risk assessment for the premises. A new monitoring well, BFG has been installed as a replacement up-gradient of monitoring well BFB, which has been decommissioned due to safety and access concerns. Monitoring for MDEA derivatives has not been retained in the issued licence.

Groundwater monitoring requirements were revised during the 2018 amendment of the existing licence. The revised requirements were guided by Schedule B2 of the NEPM 2013 and included updates to the monitoring network and the following sampling and analysis requirements:

- pH, electrical conductivity, total dissolved solids, dissolved oxygen, redox potential and temperature;
- total alkalinity;
- major cations/ions;
- total and dissolved metals (Al, Cd, Cr(III), Cr(VI), Cu, Ni, Pb, and Zn);
- MDEA and potential degradation products for selected primary compounds (nitramines and nitrosoamines);

- nutrients;
- hydrocarbons;
- option for in-situ groundwater physiochemical parameters (electrical conductivity, redox potential, pH, temperature and dissolved oxygen) to be measured in the field;
- collection of field parameters in a flow-through cell to avoid contact between groundwater and the atmosphere. A flow-through cell will enable continuous measurement and monitoring of key parameters during purging to identify when a representative sample may be obtained;
- sampling to be undertaken in accordance with relevant Australian Standard and analysis to be completed by a NATA accredited laboratory for the required methodology, except where an exemption specifies;
- specification that limits of reporting are below the site-specific trigger values YPF has developed for the monitoring wells; and
- specification that 'ultra-trace' analysis should be used where possible due to the possible matrix interference with saline groundwater samples and consequential increase of the limits of reporting.

Grounds: Premises operations have been assessed as having a medium risk of causing impact local groundwater. Given the location of the premises and proximity to a sensitive marine environment, ambient groundwater quality monitoring is considered a key operational control tool to assess for ongoing impact to groundwater associated with the premises operations. Quarterly monitoring events have been specified to ensure timely detection of potential impacts.

Groundwater quality trigger values have been developed by YPF for some of the parameters for bores BFB, BFC, BFE and BFF, on the basis of maximum background water quality plus 10% for each monitoring well. The Delegated Officer considers it appropriate to review trigger levels established by YPF and consider these for inclusion as licence limits when sufficient monitoring data is available for comparison with the proposed criteria.

Monitoring for MDEA derivatives has not been included in the issued licence as the contaminated site investigation of the premises includes adequate monitoring and assessment of MDEA derivatives. Continued monitoring for MDEA in groundwater allows for detection of potential new sources of impact to groundwater from MDEA use and storage on the premises.

10.4 Emissions to marine waters (MUBRL)

Conditions relating to emissions to marine waters from the MUBRL have been retained from the existing licence as there has been no change to the activity and the assessed level of risk has not increased since the 2018 risk assessment for the premises.

10.4.1 Specified emissions and limits

Emission points for discharging into the MUBRL and the wastewater streams that can be discharged into the MUBRL through these emissions points are specified in condition 7 and the limits which apply to the water quality in condition 8.

The locations of the emission points are illustrated in the Map of authorised discharge point locations in Schedule 1 of the issued licence.

Grounds: Discharge of process wastewater into MUBRL has been previously assessed under Part IV of the EP Act and discharge from the Ammonia Plant is currently managed via the Existing Licence. The Ammonia Plant and TAN Plant discharge is also subject to a contractual arrangement between the licence holder and the Water Corporation. EPA Bulletin 1044 and the OMEMP developed by Water Corporation in accordance with the ministerial statement recommends that management of the discharge into MUBRL from each operator should be

managed under respective Part V licence conditions. Given that process effluent from the TAN plant is accepted onto the Ammonia Plant premises, and the monitoring location for the TAN plant effluent is also located on the Ammonia Plant premises, limits and monitoring are suitable for inclusion in the Ammonia Plant licence.

In specifying the emission limits for contaminants authorised to be discharged into the MUBRL, regard has been given to:

- Ecological Quality Objectives set for King Bay as recommended in the Pilbara Coastal Water Quality Consultation Outcomes 2006 report;
- requirements of MS 586 and the OMEMP;
- recommendations in EPA Report 1379 for the TAN Plant that:
    - Process condensate wastewater discharged from TAN Plant into MUBRL to not contain greater than 15 ppm of nitrogen from NH_3 and to not contain greater than 15 ppm nitrogen from NH_4NO_3;
    - Seawater blowdown discharged from the TAN Plant into the MUBRL to have oxidising biocide concentration of less than 0.1 mg/L and a scale inhibitor (anti-scalant) concentration of up to 1.2 ppm;
- biocide is not discharged to the MUBRL as it is only used in closed water circuits on the premises therefore will not be present in discharge to the MUBRL; and
- anti-scalent concentrations in wastewater discharged to Kind Bay via the MUBRL are calculated based on the volume of anti-scalant used and are reported to Water Corporation on a monthly basis.

10.4.2 Monitoring requirements

Monitoring requirements for discharges to the MUBRL are specified in condition 16 and locations in the Map of monitoring locations in Schedule 1 of the issued licence.

The following requirements are specified in the licence relating to monitoring of waters discharged to the MUBRL:

- monitoring points and parameters for wastewater discharged into the MUBRL from the Ammonia Plant and the TAN Plant;
- requirements to ensure that any wastewater sampling is conducted in accordance with relevant Australian Standards and anlaysis is NATA accredited;
- allowance for in-field analysis of relevant parameters which are continuously monitored; and
- monitoring/ sampling frequency.

Total recoverable hydrocarbons were added to the monitoring suite based on Water Corporation's recommendation and there being potential for hydrocarbons to be present within wastewater discharged to the MUBRL.

MDEA monitoring is not specified for wastewater received from the TAN plant as there is no use or storage of MDEA on the adjacent premises, only on the Ammonia plant premises.

Grounds: EPA Bulletin 1044 and the OMEMP recommends that management of the discharge into MUBRL from each operator should be managed under respective Part V licence conditions. The premises receives wastewater from the TAN plant into the premises pipework which discharges into the MUBRL. Separate monitoring locations are present on the premises for monitoring of TAN plant discharge and Ammonia Plant discharge into the MUBRL therefore requirement apply to each wastewater stream. Ongoing monitoring of wastewater quality discharged into the MUBRL is a key control to determine continued acceptability of discharge

streams with the trigger levels/ parameters in the OMEMP and the emission limits set in the licence.

10.5 Emissions to marine waters (discharge from eastern and western sedimentation basins)

Conditions relating to emissions to marine waters from the eastern and western sedimentation basins have been retained from the existing licence as there has been no change to the activity and the assessed level of risk has not increased since the 2018 risk assessment for the premises.

10.5.1 Infrastructure

Infrastructure requirements have been retained from the Existing Licence in condition 1. The requirements ensure only specified wastewater streams are stored within the eastern and western sedimentation basins, and therefore may be discharged from the infrastructure to marine waters.

10.5.2 Specified emissions and limits

Emissions which have been assessed in this decision report and are authorised to be discharged to the marine environment via the sedimentation basins are specified in condition 7 and limits for contaminants within the discharge water are specified in condition 8. The Applicant requested the MDEA limit of 1 mg/L specified in the Existing Licence be increased to 5 mg/L to allow for testing to be undertaken by the on-site laboratory. The licence allows for monitoring to be undertaken by the on-site laboratory however the limit of detection for the laboratory equipment is 2 mg/L. The Delegated Officer has determined to increase the limit to 2 mg/L in line with the limitation of the laboratory equipment.

The conditions are necessary to ensure the risk of discharge water quality causing impact to the marine environment is minimised.

10.5.3 Monitoring

For each discharge event, the licence holder will be required to undertake monitoring of water within the ponds for potential contaminants no more than one hour prior to discharge and every 24-hours during the discharge. The purpose of this monitoring is to confirm compliance with specified limits and minimise the potential for offsite impacts.

Monitoring requirements are specified in condition 16 and locations in the Map of monitoring locations in Schedule 1 of the issued licence.

Grounds: The risk of discharges from sedimentation basins was considered Medium. There is potential for wastewater discharged from sedimentation basins to have elevated contaminant concentrations which could impact on the receiving environment dependant on the volume of discharge, duration and concentration of contaminants. Water quality limits and monitoring are required to ensure the risk of discharge water quality causing impact to the marine environment is minimised.

10.6 Noise emissions

Conditions relating to noise emissions have been retained from the Existing Licence as there has been no change to activities on the premises and the assessed level of risk has not increased since the 2018 risk assessment for the premises.

10.6.1 Limit

A noise limit of 65dB(A) is specified in condition 9 of the licence at specified monitoring locations.

Grounds: Noise emissions from premises operations have the potential to impact amenity of users at Hearson Cove. Technical advice recommended that industry incorporate best practice noise attenuation measures on all identified significant noise sources to achieve a noise level of 65dB(A) at respective plant boundaries.

10.6.2 Monitoring

Quarterly boundary noise monitoring is specified in condition 20 of the issued licence using the methods described in the EP (Noise) Regulations. The location of noise monitors are as depicted in the Map of monitoring locations in Schedule 1 of the issued licence.

Grounds: Monitoring is required to demonstrate compliance with the specified emission limit.

10.7 Record keeping and Reporting

Conditions relating to record keeping and reporting have been retained from the existing licence as there has been no change to activities on the premises or increase to the assessed level of risk since the 2018 risk assessment for the premises which necessitate a change to these conditions.

Record keeping requirements are specified in condition 22 and 23 to ensure the applicant retains suitable records of its activities. Notification requirements are included in condition 25 of the licence to provide a framework and requirements for reporting of limit exceedances. Reporting of limit exceedances informs DWER of incidents which may impact on the risk assessment for the premises and whether performance is in line with expectations. Exceedance of a limit does not indicate that there is an imminent threat to the public or environment therefore the timeframe for notification is set at seven days to allow time for investigations and actions relating to the exceedance to be undertaken and reported.

The premises is in close proximity to Dampier and Karratha communities, and recreational areas popular with residents. Activities on the premises may impact on the health or amenity of public in these areas. Condition 24 is therefore 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 monitoring of discharges to air, discharges to the marine environment, ambient air quality at the premises boundary (NH_3), treated effluent, noise and groundwater must be undertaken. The results of the monitoring are required to be submitted to DWER in the form of an AER. Submission of an AER allows DWER 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 27 specifies the timeframe for submission of the AER, the information which must be included in the report and the format the information is to be provided in. Information to be reported includes monitoring data and interpretation of that data, characteristics and emissions of start-up and shutdown events, complaint details and ambient air quality exceedance responses. Reporting of gas venting volumes during start up and shutdown events is an inclusion in the licence as it aids in understanding of the frequency of events, and quantity of emissions during such events to inform ongoing review of the risk of the premises.

The applicant is also required by condition 26 to submit an AACR each year to demonstrate whether the licence conditions have been complied with in the preceding year.

11. 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 46 provides a summary of the conditions to be applied to this licence and how they relate to conditions of the existing licence.

Table 46: Summary of conditions to be applied

New licence condition reference	Grounds	Existing licence condition
Infrastructure and equipment Conditions 1-4	The condition is valid, risk-based and contain appropriate controls on infrastructure requirements.	Condition 2 Additional requirements have been added for construction and operation of new infrastructure and to clarify operational requirements not previously included.
Discharges to air Conditions 5, 6, 10-15,	These conditions are valid, risk-based and consistent with the EP Act.	Conditions 3 – 12 Changes include removal of requirements to install CEMS which has already been installed and change of timeframe to change from quarterly to CEMS monitoring and addition of the diesel generator as an emission point.
Discharges to marine waters Condition 7-8, 16-17	These conditions are valid, risk-based and consistent with the EP Act.	Conditions 13, 14, 15, 16. Limit for MDEA in sedimentation basin discharge increased from 1 mg/L to 2 mg/L due to laboratory analysis limitations
Discharges to land Condition 19 and 21 (process monitoring)	These conditions are valid, risk-based and consistent with the EP Act.	Conditions 17-20, 25-26 Conditions relating to treated effluent discharge removed and monitoring frequency decreased.
Ambient groundwater Monitoring Condition 18 and 21	These conditions are valid, risk-based and consistent with the EP Act.	Condition 21 MDEA derivatives removed from groundwater monitoring suite. New monitoring well BFG added to replace BFB
Noise emissions Conditions 9 and 20-21	These conditions are valid, risk-based and consistent with the EP Act.	Conditions 22-24 No changes
Records and reporting Conditions 22 to 27	Reporting conditions are valid, risk-based and consistent with the EP Act.	Conditions 27-31 No changes

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

12. Applicant's comments

The Applicant was provided with the draft Decision Report and draft licence on 19 March 2020. The Applicant provided comments on 7 April 2020 which are summarised, along with DWER's response, in Appendix 2.

13. Conclusion

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

This assessment has assessed the risks posed by emissions and discharges resulting from the continued operation of the Ammonia Plant. The assessment has resulted in a licence with risk based regulatory controls.

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.

The licence issued as a result of this application supersedes all previously authorised licences and amendment notices issued in relation to the premises.

James Milne
A/Senior Manager, Process Industries
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1 Key documents

	Document title	In text ref	Availability
1.	Licence L7997/2002/11 – Yara Pilbara Fertilisers and Yara Pilbara Nitrates	L7997/2002/11	accessed at www.dwer.wa.gov.au DWER records (A1701710)
2.	Decision Report L7997/2002/11 – Yara Pilbara Fertilisers and Yara Pilbara Nitrates	DWER 2018	
3.	Licence application form and supporting document: Application for new licence. Yara Pilbara Fertilisers	NA	DWER records (DWERDT219727)
4.	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.		accessed at www.dwer.wa.gov.au
5.	DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.		
6.	DER, August 2016. *Guidance Statement: Licence duration.* Department of Environment Regulation, Perth.		
7.	DER, February 2017. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.		
8.	DWER, June 2019. *Guideline: Decision Making*. Department of Water and Environmental Regulation, Perth.		
9.	DWER, June 2019. *Guideline: Industry Regulation Guide to Licensing*. Department of Water and Environmental Regulation, Perth.		
10.	DWER, February 2019, *Murujuga Rock Art Strategy*. Department of Water and Environmental Regulation, Perth.		
11.	Ministerial Statement 586	MS 586	accessed at www.epa.wa.gov.au
12.	Ministerial Statement 567	MS 567	
13.	Ministerial Statement 594	MS 594	
14.	EPA Bulletin 1036	Bulletin 1036	
15.	EPA Bulletin 1044	Bulletin 1044	
16.	Consolidated Approval Notice Proposed Technical Ammonium Nitrate Production Facility EPBC 2008/4546	EPBC 2008/4546	accessed at www.environment.gov.au

	Document title	In text ref	Availability
17.	European Commission Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers (European Commission, 2007).	NA	Accessed at http://eippcb.jrc.ec.europa.eu/reference/BREF/lvic_aaf.pdf
18.	Monitoring of Ambient Air Quality and Meteorology during the Pilbara Air Quality Study 2002, Department of Environment, Perth WA	DoE 2002	accessed at www.dwer.wa.gov.au
19.	Pilbara Coastal Water Quality Consultation Outcomes 2006, Department of Environment, Perth WA	DoE 2006	accessed at www.epa.wa.gov.au
20.	Yara Pilbara Fertilisers Ammonia Plant Air Quality Assessment 2015, Environ, Perth WA	Environ 2015	DWER records (A909964)
21.	Burrup Peninsula Technical Ammonium Nitrate Production Facility Air Quality Assessment Update 2012, ERM, Perth WA	ERM 2012	DWER records (A1126301)
22.	Burrup Technical Ammonium Nitrate Production Facility Air Quality Management Plan 2013, Yara, Perth WA	NA	accessed at https://www.yara.com.au/about-yara/about-yara-australia/pilbara/yara-pilbara-nitrates/
23.	Burrup Peninsula Desalinated Water and Seawater Supplies Project: Operational Marine Environmental Management Plan	OMEMP	accessed at www.watercorporation.com.au
24.	Burrup Ammonia Plant Consolidated Baseline Groundwater Report	SKM 2006	DWER records (A1147203)

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

Condition	Summary of Applicant's comment	DWER response
1 (Table 1)	The applicant provided clarification on the following items in the table and requested updates to the report based on the clarifications: • the operational strategy for the package boilers (both boilers operated at part load during normal operation and up to full load during start-up) and emission controls (low NOx burners); and • leak detection is not in place on the seawater cooling circuit pipeline due to the differing pipeline diameters in the circuit making it difficult to measure loss of flow as a result of a leak. Instead of leak detection the Applicant conducts daily visual inspections of the pipeline. The applicant also requested the production limit for the STP be increased from 18.9 m^3/day to 36 m^3/day to align with the assessed design capacity of the STP. While production will generally be significantly lower than the STP design capacity at times it will increase for short durations due to plant turn arounds when personnel numbers increase The applicant requested the operational requirements for the pilot light reflect that the pilot light may on occasion be extinguished due to weather events such as cyclones.	The Delegated Officer considered the clarifications provided by the applicant and has updated Table 1 to include specification of NOx emission control for the package boilers, and replaced the requirement for leak detection on the seawater cooling circuit with daily visual inspections which are considered an appropriate control for detecting leaks from the pipeline. The Delegated Officer also considers that based on the location and flows through the pipeline, leaks are likely to be readily identified by operators at the plant. The Delegated Officer also amended the production limit for the STP in Table 1 from 18.9 m^3/day to 36 m^3/day to reflect the design capacity of the STP. The Delegated Officer considers other operational controls relating to storage of treated effluent minimise the likelihood of discharge occurring. The Delegated Officer determined not the amend the operational controls for the pilot light to reflect potential for extinguishing in high wind events such as a cyclone as there are suitable defences in the EP Act for emissions which occur as a result of an accident or emergency, such as a cyclo.
8 (Table 6) and 16 (Table 9)	The applicant requested averaging periods for discharge to marine waters limits and monitoring are aligned for flow, temperature, pH or electrical conductivity.	The Delegated Officer determined not to change the averaging periods as they are not intended to be aligned for monitoring and limits. DWER requires all monitored results to be recorded and provided in the AER based on the recorded results therefore averging periods reflect the frequency of collection. However, the limits are specified based on the Water Corporation OMEMP and apply to different averaging periods. Monitoring results are able to

Condition	Summary of Applicant's comment	DWER response
		be averaged over different periods for different purposes such as limits.
16 (Table 9)	The applicant requested: • removal of MDEA monitoring for W4 (TAN Plant MUBRL return line) as there is no use of MUBRL on the TAN plant premises; • monitoring frequency for WSB and ESB be increased from 1 hour before discharge to 24 hours before discharge so there is sufficient time for sample analysis to be completed and results obtained prior to discharge; and • units for TSS, TRH and MDEA are specified in mg/L not µg/L to align with the units for the associated limits for WSB and ESB.	The Delegated Officer considers MDEA monitoring is not required for wastewater from the MUBRL as the chemical is not stored or handled on the premises. Therefore an exclusion has been included in Table 9 to reflect that MDEA monitoring is not required for W4. The Delegated Officer determined not to alter the frequency of monitoring for discharge from the WSB and ESB as monitoring should be as close to the discharge event as possible so that there is unlikely to be a large fluctuation in water quality, in the timeframe between sampling and discharge. The applicant is able to establish its own internal controls, such as additional sampling and analysis to provide confidence that discharge limits will be met. Units were updated for TSS and TRH as requested by the applicant, however units for MDEA were retained in µg/L to ensure detection and reporting of MDEA at sufficiently low levels.
18 (Table 10)	The applicant requested: • removal of monitoring requirements for MDEA derivatives in groundwater as to date, no MDEA derivatives have been detected in any groundwater samples and MDEA is only rarely detected and at very low concentrations suggesting no ongoing environmental impact. Therefore, monitoring of MDEA in groundwater is considered sufficient to monitor for any potential impact to groundwater from operations; • clarification be included that only in-situ field measurements are to be taken through a flow-through cell; and	The Delegated Officer considered the request to remove MDEA derivative from the list of parameters to be monitored in groundwater. The Delegated Officer has determined to remove the derivatives on the basis that its monitoring is related to the potentially contaminated site status of the premises and that the derivatives are included in the scope of the contaminated site investigation. Monitoring of groundwater for MDEA will provide for detection of potential impact to groundwater associated with MDEA. The footnotes relating to the monitoring specified in Table 10 were updated to clarify that only analysis of in-field samples is required to be undertaken through a flow-through cell which is in alignment with Schedule B2 of the NEPM (Assessment of Site Contamination). Updates were also made to the footnotes to specify a reference for the trigger values for which the limits of reporting are required to be lower than, and to clarify that ultra-

Condition	Summary of Applicant's comment	DWER response
	• removal or clarification of requirements for limits of reporting needing to be lower than site specific trigger values and for ultra trace analysis.	trace analysis should be used if matrix interference raises limits of reporting (where it is possible as high dissolved solids can impact on the ability for this method to be used).
Schedule 1	The applicant provided updated premises, infrastructure, authorised discharge point and monitoring location maps for inclusion in the licence.	The maps in schedule 1 were updated accordingly.
Decision report, miscellaneous sections	The applicant provided clarification on the following items in the decision report and requested updates to the report based on the clarifications: • YPN ownership structure; • the operating strategy for the package boilers; • infrastructure names; • licence numbers; • visual inspections rather than leak detection on the seawater cooling circuit; • fugitive ammonia alarm trigger levels; and • STP operational controls. The applicant also provided details of additional controls for preventing and minimising emissions of environmentally hazardous substances and contaminated water which included bunding, visual inspections and the DMIRS approved emergency management plan.	The information provided by the applicant has been considered by the Delegated Officer and has been added or amended in relevant sections of the decision report where required.
Decision report and licence, miscellaneous sections	The applicant identified typographical errors and/or omissions in the licence and decision report.	Typographical error and omissions were updated in the licence and decision report.

Appendix 3 Summary of comments on the application for licence from stakeholders and public submissions

Summary of comments	DWER response
Stakeholders have submitted that they are concerned that the plant does not comply with best practice/implement best available technology and that the applications do not incorporate the precautionary principle or the principle of intergenerational equity. DWER is required by legislation to have regard to these principles.	Construction and operation of the Ammonia Plant was assessed by the EPA under Part IV of the EP Act. The EPA assessment considered relevant environmental factors and whether the proposal could be managed to meet the EPA's objectives for the factors considered. The EPA concluded that "*the proposal is capable of being managed in an environmentally acceptable manner such that it is most unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions".* The EPA's findings relating to the proposal considered that the process proposed for the Ammonia Plant was generally considered to be Best Available Technology (BAT) by the European Fertiliser Manufacture Association but that NOx emission from the plant did not meet BAT for new ammonia plants. The proponent committed to considering during detailed design, the feasibility of using low NOx burners in the reformer. Low NOx burners in the plant reformers and boilers were subsequently included in the plant design. Best available technology was therefore incorporated into the plant at the time of its construction. DWER's regulatory framework which applies to the assessment of applications under Part V of the EP Act incorporates the precautionary principle. The framework is based around undertaking a risk based assessment of emissions and their potential impacts to the environment and public health. Suitable controls are determined based on the outcome of the risk assessment to ensure activities do not pose an unacceptable risk. The risk assessment undertaken for the Ammonia Plant has not identified that there is a threat of serious or irreversible damage. Intergenerational equity is equally supported by this approach as it ensures that environmental and public health values are protected into the future.

Summary of comments	DWER response
	The precautionary principle states that where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. As discussed in section 5.2, the findings of the recent EPA inquiry into changing implementation condition 5-1 in MS 870 (TAN Plant) to protect rock art are relevant to consideration of the application of the precautionary principle. As documented in EPA Report 1648 the inquiry found that "*there is currently no compelling scientific evidence which indicates that there is an immediate material threat of serious or irreversible damage to rock art from cumulative industrial air emissions within the Murujuga airshed"*. To ensure there is a framework in place for protection of the Murujuga rock art into the future DWER, in conjunction with the MAC, is implementing the Murujuga Rock Art Strategy. The EPA also recommended in EPA Report 1648 that ministerial conditions of existing industrial facilities located on Murujuga should be changed via section 46 of the EP Act, to include a requirement to reduce the risk of impacts to rock art from air emissions.
The best practice pollution controls are focussed on point source emissions and do not consider other emission sources such as loading and transport of product.	In accordance with DWER's *Regulatory Best Practice Principles* regulatory decisions will be made proportionate to the level of risk posed to public health, the environment and water resources. There is limited potential for emissions associated with loading and transport of liquid ammonia as transfer occurs directly from the storage tanks into a delivery pipeline, as required, for ship loading. The pipeline is largely located outside the premises boundary and transport of ammonia is not a prescribed activity therefore it is not subject to regulation under Part V of the EP Act. Operation of the pipeline has been assessed under Part IV of the EP Act and is also subject to regulation by DMIRS in accordance with Dangerous Goods Pipeline Registration DPL001065. The pipeline delivering ammonia to the adjacent TAN plant is also subject to regulation by DMIRS in accordance with Dangerous Goods Pipeline Registration DPL001133.
Stakeholders have raised concern that rock art (petroglyphs) on Murujuga is already being damaged by acidic emissions and requested that the applicant be required to further reduce emissions from the plant to as close to zero as technically possible to meet the obligations of the precautionary principle.	In accordance with DWER's *Regulatory Best Practice Principles* regulatory decisions will be made proportionate to the level of risk posed to public health, the environment and water resources. As per earlier response in this table, the EPA has considered damage to rock art in its inquiry into condition 5-1 of MS 870 (TAN Plant), and as per the

Summary of comments	DWER response
Increase in the acidity of rock surfaces will dissolve the rock surface patina which is essential for the preservation of petroglyphs. Industrial and shipping emissions which are causing an increase in the acidity of rock surfaces on Murujuga include: • emissions of SO_2 and NO_2 which form sulfuric and nitric acids, and when combined with salt water spray can also form hydrochloric acid; and • emissions of nitrogenous compounds (nitrogen dioxide, nitrous oxide, ammonia, ammonium nitrate particles) which stimulate the growth of bacteria, fungi and lichens that produce organic acids lowering the pH of the rock surface. Stakeholders have submitted that technology is available which can reduce emissions to zero. Specifically, that Yara International state SO_2 from ships can be reduced to 0 ppm and using Selective Catalytic Reduction (SCR) systems; and NOx can be reduced by 98% on any industrial plant. Placing several of the SCR systems or scrubber systems in series within a venting outlet would therefore result in emissions being reduced to near zero. The new licence must require the applicant to use the technology to reduce emissions to near zero.	findings documented in EPA Report 1648, "*there is currently no compelling scientific evidence which indicates that there is an immediate material threat of serious or irreversible damage to rock art from cumulative industrial air emissions within the Murujuga airshed"*. In line with the precautionary approach, to ensure there is a framework in place for protection of the Murujuga rock art into the future DWER, in conjunction with the MAC, is implementing the Murujuga Rock Art strategy which establishes the regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs (further details are in section 5.2 of this Decision Report). As per the risk assessment in section 9.1 (Table 22 and Table 23), the Delegated Officer determined that the regulatory framework described in section 5.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required. The Ammonia Plant was assessed by the EPA under Part IV of the EP Act with the finding made that process proposed for the Ammonia Plant was generally considered to be BAT by the European Fertiliser Manufacture Association but that NOx emissions from the plant do not meet BAT for new ammonia plants. Low NOx burners were subsequently included in the plant design to reduce NOx emissions from primary reformer, package boilers and start-up heater. As per sections 9.4, 9.5 and 9.6, the risk associated SO_2 and PM emissions from the plant during normal and abnormal operation is considered to be low and the risk associated with NOx, CO and NH_3 is considered to be medium during normal and/or abnormal operating conditions. In accordance with DWER's regulatory framework (*Guidance Statement: Risk Assessments*) a medium level of risk is acceptable and likely to be subject to some regulatory controls. Accordingly controls including monitoring, limits and infrastructure requirements to minimise emissions (NOx) have been included in the licence

Summary of comments	DWER response
	as per justification in sections 10.1 and 10.2. The level of risk does not justify further control to require the licence holder to reduce emissions as there is no immediate threat to public health associated with the emissions. Suitable emission control is dependent on a number of factors including the relevance to the infrastructure it is applied to, the fuel source and ambient conditions, amongst other considerations. The technology that the stakeholder submissions refer to in relation to abatement of SO_2 emissions from ship fuel combustion is not contextually relevant nor applicable to the Ammonia Plant. Commitments in MS 586 required YPF to investigate and report on the feasibility of meeting BAT for the reformer gas emissions. As an outcome to the investigation the use of low-NOx burners for NOx control in the primary reformer furnace, package boilers and start up heater at the Ammonia Plant was found to be appropriate emission control technology.
Stakeholders have submitted that a licence should not be granted for the ammonia plant until the requirements to install a CEMS for NO_2 monitoring is met and that normal plant operations should not resume until the system has been thoroughly tested.	As per section 9.4.5, CEMS installation was completed on the primary reformer and package boiler stacks in November 2019. The plant needs to be operational in order for RATA testing of the equipment to be completed. Quarterly monitoring of emissions has been retained in the licence until the CEMS is operational. There is no immediate threat to public health associated with NOx emissions therefore no justification to prevent operation of the plant. All predicted GLCs of NO_2, at the receptor considered to experience the greatest impact from air emissions (Hearson Cove), which were determined through modelling and considered in the Decision Report are within the NEPM criteria.
Stakeholders have submitted that it is not acceptable for the area in King Bay where the MUBRL discharges wastewater from the plant to be designated a low level of ecological protection, as threatened and migratory species occur in the area which could be impacted by discharges.	As per section 9.9.4 the levels of ecological protection for King Bay have been taken from the *Pilbara Coastal Water Quality Consultation Outcomes (DoE 2006)* report. The low level of ecological protection only applies to the 40 m (approximately 1 ha) mixing zone around the MUBRL outfall. A high level of ecological protection applies beyond this zone.
Stakeholder submissions raised that 'Doctors for the Environment' state that NO_2 values as low as 9 ppb cause asthma in children and	Assessment of the risk associated with air emissions, including NOx is detailed in sections 9.4, 9.5 and 9.6 of this Decision Report. The assessment

Summary of comments	DWER response
that reducing NO_2 emissions from the plant is therefore important for the health of local workers, residents and people visiting Deep Gorge and Hearson Cove, as well as for the preservation of the Burrup rock art. Model predictions in the application suggest this concentration will be exceeded on an annual mean level at all local sites including Karratha. Peak hourly rates are ten times annual rates and can pose an immediate health risk. The proximity of the TAN plant to Hearson Cove and Deep Gorge continues to be a concern to human health and safety, both for the public and workers, given the potential for toxic gas releases into the air (especially CO and NO_2), frequent westerly winds and 365 days/year operation.	has been undertaken in accordance with DWER's regulatory framework (*Guidance Statement: Risk Assessments*) with the level of risk associated with NOx emission found to be medium. Relevant criteria for air emissions were taken from the NEPM which is considered the appropriate criteria to apply. A medium level of risk is acceptable and likely to be subject to some regulatory controls. Accordingly controls including monitoring, limits and infrastructure requirements to minimise emissions (NOx) have been included in the licence as per justification in sections 10.1 and 10.2. The Western Australian Government is considering the establishment of a long-term, coordinated ambient air quality monitoring network on Murujuga and in the surrounding area suitable for monitoring human health impacts. The introduction of a centralised and coordinated monitoring network will expand the knowledge base to manage the air quality in the region and result in more informed decision-making. A consultant has been engaged to provide advice on suitable monitoring locations, pollutant sources to be monitored and instrumentation and siting for ambient air monitoring. A coordinated approach to monitoring and management of air emissions from industries located on the Burrup is considered the most appropriate approach.
Satellite imagery taken by the Sentinel-5P (P for precursor) shows high concentrations of NO_2 over the Burrup Peninsula, Dampier and Karratha for the 7 November 2019 showing the extent of emissions from industry on Murujuga and other areas of the region. The satellite measures the concentration of NO_2 in the column of air to the ground. The extremely high concentration of NO_2 over Murujuga and Karratha may suggest the high concentrations of NO_2 is the cause for the anecdotal 'Karratha respiratory syndrome'. This is a threat to human health and therefore the licence should authorise virtually zero emissions of NO_2.	The derived NO_2 concentrations from Sentinel-5P satellite data are based on tropospheric NO_2 vertical column density. Although most NO_2 sources are suggested to be related to ground level or point source anthropogenic activities, the satellite data have limitations in identifying that emissions are from a single industrial activity. The resolution of the data file is 7 km x 3.5 km and there are multiple large industries (Pluto LNG Plant, Karratha Gas Plant, port activities, and the adjacent TAN plant) contributing NOx emissions within the Burrup region therefore it is not possible to attribute concentrations to a source. While it appears feasible to calculate gridded emissions from satellite data alone, the limitation is the resolution of the data file which covers more than one operation. Data from the Sentinel-5P are best used to indicate the regional NO_2 concentrations and are not appropriate for assessing emissions for one premises when multiple emission sources are present in proximity to the premises.
The applications include modelling of air emissions and cumulative impacts but how do the emissions (especially NOx) translate to	The regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs is described in section 5.2.

Summary of comments	DWER response
cumulative acidic deposition on the rock art and biodiversity of the Burrup Peninsula. This impact needs to be assessed before it's too late to stop the destruction of the rock art.	The Delegated Officer considered the potential for air emissions to impact on rock art (Table 22 and Table 23) and concluded that the regulatory framework described in section 5.2 s appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required. The Murujuga Rock Art Strategy provides for establishment of an atmospheric deposition network which will provide data on the composition and concentration of contaminants that are potentially transferred from the atmosphere to the rock surfaces.
Stakeholders have submitted that monitoring and reporting of emissions should be undertaken by an independent body of scientists and not by Yara.	It is usual practice for the Department to specify that a licence holder undertakes monitoring and reporting of data. To ensure the accuracy and validity of monitoring data, licence conditions specify that all non-continuous sample collection and/or analysis is undertaken by a holder of a current NATA accreditation for the methods of sampling and/or analysis. Non-NATA accredited analysis is allowed where, field collection and analysis of samples is required due to laboratory holding times being unable to be met. Sampling in accordance with relevant methods is also specified in the licence to ensure representative samples are collected. As the stakeholder comment also relates to rock art monitoring it is highlighted that as per the discussion in section 5.2 the rock art monitoring program being undertaken under the Murujuga Rock Art strategy is being undertaken by a consultant, in close consultation with the MAC, and the program and outcomes will be subject to independent peer review.
Emissions monitoring should be undertaken in real time with reporting of monitoring data and exceedances made available for public scrutiny. The licences should include a requirement for alarm systems which immediately notify Yara, government and the public of breaches of	Publicly available real-time monitoring data can be useful in facilitating public participation and increasing public understanding of emissions and their regulation. However, publication of real-time data is only useful if it can be meaningfully interpreted by the public. To achieve this, the published data should directly relate to impact criteria applied at sensitive receptor locations.

Summary of comments	DWER response
maximum limits (such as through public website reporting).	However, the ambient monitoring specified in the licence conditions is not designed to achieve this goal. Rather, it is designed as an operational tool where a concentration is set to trigger early warning alerts and investigation action to identify and rectify the source of discharge to minimise the likelihood of offsite impacts. The limits within the licence are not indicators of an imminent threat to the public or environment, rather they are intended to limit emissions to levels below which impacts to health and/or the environment are not expected to occur. Therefore exceedance of a limit does not warrant immediate notification. Rather, an appropriate response to minimise the risk associated with a limit exceedance is for the licence holder to identify an exceedance has occurred, investigate and rectify the cause of the exceedance and report this information as per the conditions of the licence. Section 72 of the EP Act contains provisions to notify DWER of waste discharges that have caused or are likely to cause pollution, material environmental harm or serious environmental harm as soon as practical after the discharge therefore the licence does not duplicate such a requirement. Real-time data displays are only meaningful in the context of continuous monitoring with relatively short averaging periods, so that trends of elevated emissions and exceedances can be observed and detected when they occur. Data that are collected less frequently, such as at monthly or quarterly intervals are not suitable for real-time displays and are more usefully observed for trends over longer periods of 12 months or more.
Penalties should be included in the licence for breaches of maximum emission limits or licence conditions to ensure there is incentive for emissions reduction technology to remain effective over time.	Penalties for breaching conditions of the licence are not specified within the instrument as the EP Act includes provisions for offences and penalties for contravening licence conditions.
The risk assessment for the existing licence assigned a medium risk for air emissions at Hearson Cove and residential areas at Dampier and Karratha, and the workforce at surrounding industrial and port premises. A medium risk is not acceptable and indicates more stringent emissions standards and regulation are required in the licence to reduce human and environmental health risks.	Risk associated with point source air emissions from normal and abnormal operation of the Ammonia Plant, and fugitive ammonia emissions has been assessed in sections 9.4, 9.5, and 9.6 of the Decision Report. The level of risk is based on the potential consequences of air emissions and likelihood these consequences will occur. In accordance with DWER's regulatory framework (*Guidance Statement: Risk Assessments*) a medium level of risk is acceptable and likely to be subject to some regulatory controls. Accordingly controls including monitoring, limits and infrastructure requirements to

Summary of comments	DWER response
	minimise emissions (NOx) have been included in the licence as per justification in sections 10.1 and 10.2.
The risk assessment for the existing licence has assigned a medium risk associated with potentially contaminated stormwater and treated wastewater entering King Bay and the groundwater. More stringent regulation is required to reduce the risk of impact to marine ecosystems and biodiversity.	The licence includes limits and monitoring requirements for key contaminants which may be present within wastewater and stormwater discharged from the premises to King Bay via the MUBRL and sedimentation basins. Discharge of wastewater or stormwater which exceeds the specified limits is not authorised. The limits are intended to ensure protection of the marine environment.
The existing licence for operation of the TAN and ammonia plants is inadequate for protecting the Murujuga rock art for future generations. Strict controls must be applied to acidic and nitrogenous emissions from the plants if the petroglyphs are to be preserved. The reasons for the inadequacy of the existing licence were set out in the appeal against the licence and DWER did not provide an adequate response or explanations in relation to the specific and detailed matters raised. All grounds for appeal remain relevant to the current licence application and must be answered in relation to the scientific information presented.	The regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs is described in section 5.2. The Delegated Officer considered the potential for air emissions to impact on rock art (Table 22 and Table 23) and concluded that the regulatory framework described in section 5.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required.
The frequency of monitoring in the existing licence is averaged over 60 minutes which does not comply with the CEMS code which requires monitoring of NOx at an average of 15 minutes or less.	The reference to the CEMS Code refers to cycle times, not averaging times for monitoring. Cycle time is defined in the CEMS Code as the time it takes to complete a measurement or cycle of measurements from all analysers in a time-shared system. The averaging period specified in the licence, in contrast, relates to the time period over which measurements or data points are averaged, implying that multiple data points are collected, which are used to calculate an average. In a time shared system, this would mean that at least four data points (every 15 minutes) would be collected over a 60-minute period. The specification of a 60-minute averaging time in the licence does not mean that only one data point is collected over 60 minutes. The requirement for averaging data over a 60-minute period therefore does not

Summary of comments	DWER response
	create inconsistencies with the CEMS Code.
Stakeholders have submitted that previous CSIRO studies should not be used as a basis for decision making as there is published research refuting the CSIRO data analysis (e.g. Rock Art Research, 2017, vol. 34, p.130-148). Yara continues to rely on the EPA finding that "there is sufficient time for the monitoring and evaluation activities associated with the Murujuga Rock Art Monitoring Program to be undertaken and for definitive information in regard to whether cumulative industrial air emissions within the Murujuga airshed are adversely affecting rock art to be obtained". Stakeholders disagree with the above position as current scientific evidence shows the increase in rock surface acidity close to industry is already dissolving the patina within which the rock art is engraved (irreversible damage) which is needed to preserve the rock art for future generations. The rock art is at risk of further impact if measures are not taken to prevent further emissions on the Burrup. Until a new monitoring program is established on the Burrup that provides quantifiable and repeatable results acidic emission must be reduced to near zero to protect the rock art.	The regulatory framework for assessing and managing potential impacts on Murujuga's rock art petroglyphs is described in section 5.2. The Delegated Officer considered the potential for air emissions to impact on rock art (Table 22 and Table 23) and concluded that the regulatory framework described in section 5.2 is appropriate for assessing and managing potential impacts to rock art as there are multiple industries located on Murujuga and surrounds which could potentially impact rock art, therefore a coordinated approach is most appropriate. The Murujuga Rock Art Strategy establishes the long term basis for coordinated monitoring and analysis of changes to rock art on Murujuga and, if appropriate, implementation of management or mitigation measures. Information from the monitoring will be used to determine whether further regulation of emissions from industries operating on Murujuga and surrounds is required. The risk assessment in section 9.4 and 9.5 shows air emissions do not pose an unacceptable risk of public health impact therefore, in accordance with DWER's regulatory framework, there is no basis for requiring emissions to be reduced. Limits have been included on the licence for NOx emissions which are considered to be the most significant.
DBCA reviewed the application in relation to its roles and responsibilities under the *Conservation and Land Management Act 1984* (CALM Act) or the *Biodiversity Conservation Act 2016* (BC Act). DBCA did not propose any specific comment in regards to the licence application.	No response required.
The City of Karratha reviewed the application and advised they have no objection to, or comment to make, in regards to the application	No response required.
The Water Corporation reviewed the application and provided comment that consideration should be given to including the following additional monitoring requirements for discharge to the MUBRL	Metals, salinity, inline water quality parameters and MDEA are already included in the monitoring suite in the Existing Licence which has been retained for the new issued licence.

Summary of comments	DWER response
• Hydrocarbons • Metals • Chlorophyll-a • Salinity • Ammonia • Methanol • MDEA • Disinfectant (Chlorine/Bromine) • Water quality inline parameters (pH, temperature, conductivity, flow rate, oxidation/reduction, turbidity) The Water Corporation also advised that discharge of STP effluent to the MUBRL should not be permitted without an additional amendment to the licence supported by assessment of water quality and environmental compliance risks associated with the inclusion of the effluent stream in discharge to the MUBRL.	Chlorophyll-a is considered to be highly unlikely to be present within the wastewater streams discharged to the MUBRL. The OMEMP specifies that marine water quality monitoring for chlorophyll-a will be undertaken with no specific monitoring requirements for discharge from the MUBRL. As per the controls described in section 9.9.5, chemical treatment is undertake to reduce chlorine, bromine and other biocides to non-detectable levels and steam stripping is undertaken to remove ammonia and methanol in the wastewater stream. These contaminants are highly unlikely to be present within the wastewater discharge to the MUBRL, and the monitoring suite has not been expanded to include these requirements, noting that monitoring of Ammonia as ammoniacal nitrogen is already included. Total recoverable hydrocarbons have been added to the monitoring suite, recognising the potential for their presence within the wastewater streams discharged to the MUBRL. The licence only authorises discharge of STP effluent to the evaporation pond or storage tanks pending offsite disposal.

Attachment 1: Issued Licence L9224/2019/1