Government of Western Australia
Department of Water and Environmental Regulation

# Licence

| | |
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| **Licence Number** | L7997/2002/11 |
| **Licence Holder** | Yara Pilbara Fertilisers Pty Ltd (ACN 095 441 151) and Yara Pilbara Nitrates Pty Ltd (ACN 127 391 442) |
| **Registered business address** | Level 5, 182 St Georges Terrace PERTH WA 6000 |
| **File Number** | DER2013/001374 |
| **Duration** | 21 April 2015 to 20 April 2020 |
| **Date of amendment** | 29 June 2018 |
| **Prescribed Premises** | Category 31: chemical manufacturing<br>Category 85: sewage facility |
| **Premises** | Yara Pilbara Fertilisers and Yara Pilbara Nitrates<br>Village Road<br>BURRUP WA 6714<br>Part of Lot 564 on Plan 31023 and Part of Lot 3017 on Plan 50979<br>As defined by the coordinates in Schedule 1 |

This Licence is granted to the Licence Holder, subject to the following conditions, on 29 June 2018 by:

[redacted]

***Ed Schuller***
***A/Director Regulatory Services (Environment)***
an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

# Explanatory notes

These explanatory notes do not form part of this Licence.

## Defined terms

Definition of terms used in this licence can be found at the start of this licence. Terms which are defined have the first letter of each word capitalised throughout this licence.

## Department of Water and Environmental Regulation

The Department of Water and Environmental Regulation (DWER) is 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 *Environmental Protection Act 1986* (WA) (EP Act). The Department also monitors and audits compliance with licences, takes enforcement action and develops and implements licensing and industry regulation policy.

## Licence

Section 56 of the EP Act provides that an occupier of prescribed premises commits an offence if emissions are caused or increased, or permitted to be caused or increased, or waste, noise, odour or electromagnetic radiation is altered, or permitted to be altered, from prescribed premises, except in accordance with a works approval or licence.

Categories of prescribed premises are defined in Schedule 1 of the *Environment Protection Regulations 1987* (WA) (EP Regulations).

This licence does not authorise any activity which may be a breach of the requirements of another statutory authority including, but not limited to the following:

- conditions imposed by the Minister for Environment under Part IV of the EP Act;
- conditions imposed by DWER for the clearing of native vegetation under Part V, Division 2 of the EP Act;
- any requirements under the *Waste Avoidance and Resource Recovery Act 2007;*
- any requirements under the *Environmental Protection (Controlled Waste) Regulations 2004*; and
- any other requirements specified through State legislation.

It is the responsibility of the licence holder to ensure that any action or activity referred to in this licence is permitted by, and is carried out in compliance with, other statutory requirements.

The licence holder must comply with the licence. contravening a licence condition is an offence under s.58 of the EP Act.

## Responsibilities of a Licence Holder

Separate to the requirements of this licence, general obligations of licence holders are set out in the EP Act and the regulations made under the EP Act. For example, the licence holder must comply with the following provisions of the EP Act:

- the duties of an occupier under section 61; and
- restrictions on making certain changes to prescribed premises unless the changes are in accordance with a works approval, licence, closure notice or environmental protection notice (s.53).

Strict penalties apply for offences under the EP Act.

## Reporting of incidents

The licence holder has a duty to report to DWER all discharges of waste that have caused or are likely to cause pollution, material environmental harm or serious environmental harm, in accordance with s.72 of the EP Act.

## Offences and defences

The EP Act and its regulations set out a number of offences, including:

- Offence of emitting an unreasonable emission from any premises under s.49.
- Offence of causing pollution under s.49.
- Offence of dumping waste under s.49a.
- Offence of discharging waste in circumstances likely to cause pollution under s.50.
- Offence of causing serious environmental harm (s.50a) or material environmental harm (s.50b).
- Offence of causing emissions which do not comply with prescribed standards (s.51).
- Offences relating to emissions or discharges under regulations prescribed under the ep act, including materials discharged under the *Environmental Protection (Unauthorised Discharges) Regulations 2004 (WA).*
- Offences relating to noise under the *Environmental Protection (Noise) Regulations 1997 (WA).*

Section 53 of the EP Act provides that a licence holder commits an offence if emissions are caused, or altered from a prescribed premises unless done in accordance with a works approval, licence or the requirements of a closure notice or an environmental protection notice.

Defences to certain offences may be available to a licence holder and these are set out in the EP Act. Section 74A(b)(iv) provides that it is a defence to an offence for causing pollution, in respect of an emission, or for causing serious environmental harm or material environmental harm, or for discharging or abandoning waste in water to which the public has access, if the licence holder can prove that an emission or discharge occurred in accordance with a licence.

This licence specifies the emissions and discharges, and the limits and conditions which must be satisfied in respect of specified emissions and discharges, in order for the defence to offence provision to be available.

## Authorised Emissions and Discharges

The specified and general emissions and discharges from Primary Activities conducted on the prescribed premises are authorised to be conducted in accordance with the conditions of this licence.

Emissions and discharges caused from other activities not related to the Primary Activities at the premises have not been conditioned in this licence. Emissions and discharges from other activities at the premises are subject to the general provisions of the EP Act.

## Amendment of licence

The licence holder can apply to amend the conditions of this licence under s.59 of the EP Act. An application form for this purpose is available from DWER.

The CEO may also amend the conditions of this licence at any time on the initiative of the CEO without an application being made.

Amendment notices constitute written notice of the amendment in accordance with s59B(9) of the EP Act.

## Duration of Licence

The licence will remain in force for the duration set out on the first page of this licence or until it is surrendered, suspended or revoked in accordance with s.59A of the EP Act.

## Suspension or revocation

The CEO may suspend or revoke this licence in accordance with s.59A of the EP Act.

## Fees

The Licence Holder must pay an annual licence fee. Late payment of annual licence fees may result in the licence ceasing to have effect.

Late fees are a component of annual licence fees and should a licence holder fail to pay late fees within the time specified the licence will similarly cease to have effect.

# Definitions and interpretation

## Definitions

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

**Table 1: Definitions**

| Term | Definition |
|---|---|
| Annual Audit Compliance Report | means a report in a format approved by the CEO as presented by the licence holder or as specified by the CEO (guidelines and templates may be available on the Department's website). |
| Annual Period | means a 12 month period commencing from 1 January until 31 December. |
| ACN | Australian Company Number |
| AS 4323.1 | means the Australian Standard AS4323.1 *Stationary Source Emissions Method 1: Selection of sampling positions* |
| AS/NZS 2031 | means the Australian Standard AS/NZS 2031 Selection of containers and preservation of water samples for microbiological analysis |
| AS 5667.1 | means the Australian Standard AS/NZS 5667.1 *Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples* |
| AS 5667.10 | means the Australian Standard AS/NZS 5667.10 *Water Quality – Sampling – Guidance on sampling of waste waters* |
| AS/NZS 5667.11 | means the Australian Standard AS/NZS 5667.11 *Water Quality – Sampling – Guidance on sampling of groundwaters* |
| ATU | Aerobic Treatment Unit |
| CEMS | Continuous Emission Monitoring System |
| CEMS Code | means the document *"Continuous Emission Monitoring System (CEMS) Codes for Stationary Source Air Emissions*", March 2016, Department of Environment Regulation, Perth WA |
| CO | Carbon Monoxide |
| CEO | means Chief Executive Officer.<br>CEO for the purposes of notification means:<br>Director General<br>Department Administering the *Environmental Protection Act 1986*<br>Locked Bag 33 Cloisters Square<br>PERTH WA 6850<br>info@dwer.wa.gov.au |
| 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. |
| HDPE | High Density Polyethylene |

| Term | Definition |
|---|---|
| Inspector | means an inspector appointed by the CEO in accordance with s.88 of the EP Act. |
| Licence | refers to this document, which evidences the grant of a Licence by the CEO under s.57 of the EP Act, subject to the Conditions |
| MDEA | Methyl diethanolamine |
| MUBRL | Multi User Brine Return Line |
| NATA | National Association of Testing Authorities |
| $NH_3$ | Ammonia |
| NOx | Nitrogen Oxides |
| PM | Particulate Matter |
| Primary Activities | refers to the prescribed premises activities listed on the front of this licence as described in Schedule 2, at the locations shown in Schedule 1 |
| Startup – Primary Reformer Furnace (Ammonia Plant) | The period from when the furnace burners are ignited to when the vent valve on the Ammonia Recovery Unit is closed |
| Startup – Package Boiler (Ammonia Plant) | The period from when the boiler burners are ignited to when the vent valve on the Ammonia Recovery Unit is closed |
| Startup – TAN Plant | The period between the ignition of the Ammonia reactor and the activation of the DeNOx reactor |
| TAN | Technical Ammonia Nitrate |
| TSP | Total Suspended Particulate |
| USEPA | United States (of America) Environmental Protection Agency |
| USEPA Method 2 | means USEPA Method 2 *Determination of Stack Gas Velocity and Volumetric Flow Rate (type s pitot tube)* |
| USEPA Method 7E | means USEPA Method 7E *Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)* |
| USEPA Method CTM 027 | means Conditional Test Method 027 – Procedure for Collection and Analysis of Ammonia in Stationary Sources |
| USEPA Method 10 | means USEPA Method 10 *Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)* |
| Usual working day | means 0800-17000 hours, Monday to Friday excluding public holidays in Western Australia |

## Interpretation

In this Licence:

(a) the words ‘including’, ‘includes’ and ‘include’ will be read as if followed by the words ‘without limitation’;

(b) where any word or phrase is given a defined meaning, any other part of speech or other grammatical form of that word or phrase has a corresponding meaning;

(c) where tables are used in a Condition, each row in a table constitutes a separate Condition;

(d) any reference to an Australian or other standard, guideline or code of practice in this Licence means the version of the standard, guideline or code of practice in force at the time of granting of this Licence and includes any amendments to the standard, guideline or code of practice which may occur from time to time during the course of the Licence; and

(e) unless specified otherwise, any reference to a section of an Act refers to that section of the EP Act.

# Conditions

## Emissions

**1.** The licence holder must not cause any emissions from the Primary Activities on the premises except for specified emissions and general emissions described in Table 2 subject to the exclusions, limitations or requirements specified in Table 2.

**Table 2: Authorised emissions table**

| Emission type | Exclusions/Limitations/Requirements |
|---|---|
| **Specified Emissions** | |
| Discharges to air | Subject to compliance with conditions 2 to 12 |
| Discharge to surface water | Subject to compliance with condition 2 and conditions 13 to 16 |
| Discharge to land | Subject to compliance with condition 2 and conditions 17 to 20 |
| **General Emissions (excluding Specified Emissions)** | |
| Emissions which arise from the Primary Activities set out in Schedule 2 | Emissions excluded from General Emissions are:<br>• Unreasonable Emissions; or<br>• Emissions that result in, or are likely to result in, Pollution, Material Environmental Harm or Serious Environmental Harm; or<br>• Discharges of Waste in circumstances likely to cause Pollution; or<br>• Emissions that result, or are likely to result in, the Discharge or abandonment of Waste in water to which the public has access; or<br>• Emissions or Discharges which do not comply with an Approved Policy; or<br>• Emissions or Discharges which do not comply with a prescribed standard; or<br>• Emissions or Discharges which do not comply with the conditions in an Implementation Agreement or Decision; or<br>• Emissions or Discharges the subject of offences under regulations prescribed under the EP Act, including materials discharged under the *Environmental Protection (Unauthorised Discharges) Regulations 2004*. |

## Infrastructure and equipment

**2.** The licence holder must ensure that the infrastructure and equipment listed in Table 3 and located at the corresponding infrastructure location is maintained in good working order operated in accordance with the corresponding operational requirement set out in Table 3.

**Table 3: Infrastructure and equipment controls table**

| Site infrastructure and equipment | Operational requirements | Infrastructure location |
|---|---|---|
| Wastewater treatment plant | Treatment capacity must not exceed 36 $m^3$/day | Schedule 1: Map of infrastructure locations |
| Aerobic treatment units | Treatment capacity must not exceed 10.8 $m^3$/day | |
| Western sedimentation basin | Storage of stormwater and cooling tower blowdown water<br>Lined with 1.5 mm thick HDPE to achieve a permeability of less than 1 x $10^{-9}$ m/s | |
| Eastern sedimentation basin | | |
| Infiltration basins | • Treated domestic wastewater to be only discharged if it meets the wastewater quality criteria specified in condition 18; and<br>• Infiltration must occur at a rate that ensures there is no pooling of water on the soil surface. | |
| Contaminated surface water pond | Storage of process effluent including treated wastewater from the TAN Plant ATUs<br>Lined with 1.5 mm thick HDPE to achieve a permeability of less than 1 x $10^{-9}$ m/s | |
| TAN prilling plant | • Three stage scrubbing system to comprise of following components:<br>o Independent scrubber for prilling tower air emissions;<br>o Rotary brush scrubber for bleed air emissions;<br>o Final scrubber for rotary brush scrubber air emissions. | |
| Nitric acid plant | Catalytic abatement system | |
| Primary reformer | Low NOx burners | |
| Startup heater | Low NOx burners | |
| Production flare and storage flare | Pilot lights must be lit at all times during plant operation.<br>Ammonia directed to the flare must be combusted | |
| Seawater cooling circuit pipeline | Leak detection system | |

## Discharges to air

**3.** The licence holder must ensure that emissions specified in Table 4 are discharged only from the corresponding discharge point and only at the corresponding discharge point location set out in Table 4.

**Table 4: Authorised discharge points to air**

| Emission | Discharge point | Discharge point height (m) | Discharge point location |
|---|---|---|---|
| **TAN Plant** | | | |
| $NH_3$, PM | Common stack | 70 | Schedule 1: Map of discharge point locations<br>Discharge point A1 |
| NOx, $NH_3$ | Nitric acid plant stack | 54 | Schedule 1: Map of discharge point locations<br>Discharge point A2 |
| $NH_3$ | Unit 32 Prill tower vent | 80 | Schedule 1: Map of discharge point locations<br>Discharge point A3 |
| $NH_3$ | Unit 12 absorber vent | 50 | Schedule 1: Map of discharge point locations<br>Discharge point A4 |
| **Ammonia Plant** | | | |
| NOx, PM, CO | Primary reformer stack | 36 | Schedule 1: Map of discharge point locations<br>Discharge point A5 |
| NOx, CO | Package boiler stack | 30 | Schedule 1: Map of discharge point locations<br>Discharge point A6 |
| CO, $CO_2$ | $CO_2$ stripper stack | 60 | Schedule 1: Map of discharge point locations<br>Discharge point A7 |
| NOx, PM, $SO_2$ | Start-up heater stack | 30 | Schedule 1: Map of discharge point locations<br>Discharge point A8 |
| $H_2$, $N_2$ | Back-end vent (Vent A) | 60 | Schedule 1: Map of discharge point locations<br>Discharge point A9 |

| Emission | Discharge point | Discharge point height (m) | Discharge point location |
|---|---|---|---|
| $H_2$, $N_2$, $CH_4$, | Front-end vent (Vent B) | 35 | Schedule 1: Map of discharge point locations<br>Discharge point A10 |
| NOx, $NH_3$ | Production flare | 35 | Schedule 1: Map of discharge point locations<br>Discharge point A11 |
| NOx, $NH_3$ | Storage flare | 35 | Schedule 1: Map of discharge point locations<br>Discharge point A12 |

## Emission limits

**4.** The licence holder must ensure that emissions from the discharge point listed in Table 5 for the corresponding parameter do not exceed the corresponding limit ($mg/m^3$) when monitored in accordance with condition 6.

**Table 5: Discharges to air limits**

| Discharge point | Emission | Limit ($mg/m^3$) |
|---|---|---|
| **TAN Plant** | | |
| Common stack (A1) | PM | 15 |
| | $NH_3$ | 10 |
| Nitric acid plant stack (A2) | NOx (as $NO_2$) | 103[1] |
| | $NH_3$ | 0.75[1] |
| | $N_2O$ | 196[1] |
| **Ammonia Plant** | | |
| Primary reformer stack (A5) | NOx (as $NO_2$) | 180[1] |
| Package boiler stack (A6) | NOx (as $NO_2$) | 300[1] |

Note 1: emission limits for the Nitric acid plant stack, Primary reformer stack, and Package boiler stack do not apply during Start-up.

**5.** The licence holder must ensure that emissions from the discharge point listed in Table 6 for the corresponding parameter do not exceed the corresponding limit ($mg/m^3$) during Start-up for the corresponding maximum period, as monitored in accordance with condition 6.

**Table 6: Discharges to air limits – Start-up**

| Discharge point | Emission | Limit (mg/m$^3$) | Maximum period |
|---|---|---|---|
| Nitric acid plant stack (A2) | NOx (as $NO_2$) | 1540 | 2 hours |
| | $NH_3$ | 11.5 | |

## Monitoring of discharges to air

**6.** The licence holder must monitor emissions:

(a) from the discharge point;

(b) at the corresponding monitoring location;

(c) for the corresponding parameter;

(d) at the corresponding frequency;

(e) for the corresponding averaging period;

(f) in the corresponding unit; and

(g) using the corresponding method

as set out in Table 15 in Schedule 3.

**7.** The licence holder must ensure that:

(a) monthly monitoring is undertaken such that there are at least 15 days in between the days on which samples are taken; and

(b) quarterly monitoring is undertaken such that there are at least 45 days in between the days on which samples are taken.

**8.** The licence holder must ensure that sampling required by condition 6 is undertaken at sampling locations in accordance with the current version of AS 4323.1 or relevant part of the CEMS Code.

**9.** The licence holder must ensure that all non-continuous sampling and analysis undertaken required by condition 6 is undertaken by a holder of NATA accreditation for the relevant methods of sampling and analysis.

**10.** For any CEMS operated in accordance with condition 6 the licence holder must ensure that the CEMS is operated, maintained and calibrated in accordance with the CEMS Code.

## Monitoring of ambient air

**11.** The licence holder must monitor the air for concentrations of the parameter listed in Table 16 in Schedule 3:

(a) at the corresponding monitoring location;

(b) in the corresponding unit;

(c) at no less that the corresponding frequency;

(d) for the corresponding averaging period;

(e) using the corresponding sampling method; and

(f) the corresponding analytical method

as set out in Table 16 in Schedule 3.

### Specified actions – installation of CEMS

**12.** The licence holder must install and commission CEMS that satisfy the requirements in Table 7 by 30 September 2019.

**Table 7: CEMS installation requirements**

| Discharge point | Monitoring location | Parameter | Frequency | Averaging period | Unit | Method |
|---|---|---|---|---|---|---|
| Primary reformer stack (A5) | Schedule 1: Map of discharge point locations<br>Discharge point A3 | Volumetric flow rate | Continuous | 1 minute and 60 minute | $m^3/s$ | CEMS installed and calibrated in accordance with the CEMS Code |
| Package boiler stack (A6) | Schedule 1: Map of discharge point locations<br>Discharge point A4 | Oxides of nitrogen | | | $mg/m^3$ | |

## Discharges to marine waters

**13.** The licence holder must ensure that emissions specified in Table 8 are discharged only from the corresponding discharge point and only at the corresponding discharge point location set out in Table 8.

**Table 8: Authorised discharge points to marine waters**

| Emission | Discharge point | Discharge point location |
|---|---|---|
| Process effluent (Ammonia Plant) | MUBRL | Schedule 1: Map of discharge point locations<br>Discharge Point MUBRL |
| Stormwater and cooling tower blowdown | Western sedimentation basin to King Bay tidal flats | Schedule 1: Map of discharge point locations<br>Discharge Point WSB |
| | Eastern sedimentation basin to King Bay tidal flats | Schedule 1: Schedule 2: Map of discharge point locations<br>Discharge Point ESB |
| Process effluent (TAN Plant) | MUBRL | Schedule 1: Map of discharge point locations<br>Discharge Point MUBRL |

### Emission limits

**14.** The licence holder must ensure that emissions from the discharge point listed in Table 9 for the corresponding parameter do not exceed the corresponding limit (units specified) when monitored in accordance with condition 15.

**Table 9: Discharge to marine waters limits**

| Discharge point | Parameter | Limit (including units) | Averaging period |
|---|---|---|---|
| Ammonia Plant and TAN Plant input to MUBRL<br>(MUBRL) | Temperature | Less than 5°C above ambient seawater temperature | 80th percentile of daily averages |
| | | Less than 2°C above ambient seawater temperature 80% of the time | |
| | pH | 6.9 – 8.3 | Monthly |
| | Electrical conductivity | 75 000 µs/cm | |
| | Ammonia as ammoniacal nitrogen ($NH_3$-N) | 30 164 µg/L | Monthly rolling average |
| | Arsenic (III) | 140 µg/L | |
| | Arsenic (V) | 275 µg/L | |
| | Cadmium | 36 µg/L | |
| | Chromium (III) | 459 µg/L | |
| | Chromium (VI) | 8.5 µg/L | |
| | Cobalt | 61 µg/L | |
| | Copper | 11 µg/L | |
| | Lead | 134 µg/L | |
| | Mercury | 1.4 µg/L | |
| | Nickel | 427 µg/L | |
| | Selenium | 183 µg/L | |
| | Silver | 49 µg/L | |
| | Vanadium | 3050 µg/L | |
| | Zinc | 419 µg/L | |
| Western sedimentation basin to King Bay tidal flats (WSB)<br>Eastern sedimentation basin to King Bay tidal flats (ESB) | Total suspended solids | 80 mg/L | N/A |
| | pH | 6 – 9 | |
| | Total recoverable hydrocarbon | 15 mg/L | |
| | MDEA | 1 mg/L | |

### Monitoring of discharges to surface water

**15.** The licence holder must monitor emissions:

(a) from the discharge point;

(b) at the corresponding monitoring location;

(c) for the corresponding parameter;

(d) at the corresponding frequency;

(e) for the corresponding averaging period;

(f) in the corresponding unit; and

(g) using the corresponding method

as set out in Table 17 in Schedule 3.

**16.** The licence holder must ensure that weekly monitoring is undertaken such that there are at least four days in between the days on which samples are taken.

## Discharges to land

**17.** The licence holder must ensure that emissions specified in Table 10 are discharged only from the corresponding discharge point and only at the corresponding discharge point location set out in Table 10.

**Table 10: Authorised discharges to land**

| Emission | Discharge point | Discharge point location |
|---|---|---|
| Treated wastewater | Infiltration basins | Schedule 1: Map of discharge point locations<br>Discharge Point WWTP |

### Emission limits

**18.** The licence holder must ensure that emissions from the discharge point listed in Table 11 for the corresponding parameter do not exceed the corresponding limit (units specified) when monitored in accordance with condition 19.

**Table 11: Discharge to land limits**

| Discharge point | Parameter | Limit |
|---|---|---|
| Infiltration basins (WWTP) | Total nitrogen | 25 mg/L applicable after 1 April 2019 |
| | Total phosphorus | 5 mg/L applicable after 1 April 2019 |
| | Biochemical oxygen demand | 20 mg/L |
| | pH | 6.5 – 8.5 |
| | Total suspended solids | 30 mg/L |
| | *E.coli* | 10,000 cfu/100mL |

### Monitoring of discharges to land

**19.** The licence holder must monitor emissions:

(a) from the discharge point;

(b) at the corresponding monitoring location;

(c) for the corresponding parameter;

(d) at the corresponding frequency;

(e) for the corresponding averaging period;

(f) in the corresponding unit; and

(g) using the corresponding method

as set out in Table 18 in Schedule 3.

**20.** The licence holder must ensure that monthly monitoring is undertaken such that there are at least 15 days in between the days on which samples are taken.

## Ambient groundwater monitoring

**21.** The licence holder must monitor the groundwater for concentrations of the parameters listed in Table 19 in Schedule 3:

(a) at the corresponding monitoring location;

(b) in the corresponding unit;

(c) at no less that the corresponding frequency;

(d) for the corresponding averaging period;

(e) using the corresponding sampling method; and

(f) the corresponding analytical method

as set out in Table 19 in Schedule 3.

## Noise emissions

### Emission limits

**22.** The licence holder must ensure that noise emissions do not exceed the limit of 65 dB(A) when monitored in accordance with condition 23.

### Monitoring

**23.** The licence holder must monitor noise:

(a) at the corresponding monitoring location;

(b) in the corresponding unit;

(c) at no less that the corresponding frequency;

(d) for the corresponding averaging period;

(e) using the corresponding sampling method; and

(f) the corresponding analytical method

as set out in Table 20 in Schedule 3.

**24.** The licence holder must ensure that quarterly monitoring is undertaken such that there are at least 45 days in between the days on which samples are taken.

## Improvements

### Wastewater Disposal

**25.** The Licence Holder must conduct a review on the potential impacts and adequacy of infiltrating treated wastewater which includes:

(a) The development of a local conceptual model (CSM) of the existing infiltration system, based on the CSM developed for the Ammonia Plant, to identify the expected pathway and receptors for infiltrated nutrients;

(b) A review of groundwater quality based on available groundwater monitoring data to identify any evidence of nutrient contamination in the vicinity of the infiltration system;

(c) Contaminant fate and transport modelling based on a range of aquifer parameters to address the uncertainty in site conditions;

(d) Review of expected nutrient concentrations at sensitive receptors and the associated ecological risk;

(e) Identification of improvements in the wastewater treatment system;

(f) Consideration of alternative effluent disposal options including, but not necessarily limited to reuse, discharge to the MUBRL or irrigation; and

(g) Schedule for implementation of identified improvements, upgrades or alternative disposal options, resulting from the review.

**26.** The Licence Holder must provide a report on the outcomes of condition 25 to the CEO by 30 September 2018.

## Records and reporting

### Record keeping

**27.** The licence holder must maintain accurate and auditable books including the following records, information, reports and data required by this licence:

(a) the calculation of fees payable in respect of this licence;

(b) the maintenance of infrastructure required to ensure that it is kept in good working order in accordance with condition 2 of this licence;

(c) monitoring undertaken in accordance with conditions 6, 11, 15, 19, 21 and 23 of this licence; and

(d) complaints received under condition 29 of this licence.

In addition, the books must:

(e) be legible;

(f) if amended, be amended in such a way that the original and subsequent amendments remain legible and are capable of retrieval;

(g) be retained for at least three years from the date the books were made; and

(h) be available to be produced to an Inspector or the CEO.

## Non-compliance notification

**28.** The licence holder must, within seven days of becoming aware of any non-compliance with conditions 4, 5, 14, 18, and 22 of this licence, notify the CEO in writing of that non-compliance and include in that notification the following information:

(a) which condition was not complied with;

(b) the time and date when the non-compliance occurred;

(c) if any environmental impact occurred as a result of the non-compliance and if so what that impact is and where the impact occurred;

(d) the details and result of any investigation undertaken into the cause of the non-compliance;

(e) what action has been taken and the date on which it was taken to prevent the non-compliance occurring again; and

(f) what action will be taken and the date by which it will be taken to prevent the non-compliance occurring again.

## Complaints management

**29.** The licence holder must record the following information in relation to complaints received relating to emissions from the premises:

(a) the name and contact details of the complainant (if provided);

(b) the time and date of the complaint;

(c) the complete details of the complaint and any other concerns or other issues raised; and

(d) the complete details and dates of any action taken by the licence holder to investigate or respond to any complaint.

## Annual Audit Compliance Report

**30.** The licence holder must submit to the CEO by no later than 90 days after the end of each annual period an Annual Audit Compliance Report in the approved form, which details any non-compliance by the licence holder with any condition of this licence during the previous annual period.

## Annual environmental report

**31.** The licence holder must submit to the CEO by no later than 90 days after the end of each annual period, an annual environmental report for the previous annual period for the conditions listed in Table 21 in Schedule 4, and which provides information in accordance with the corresponding requirement set out in Table 21.

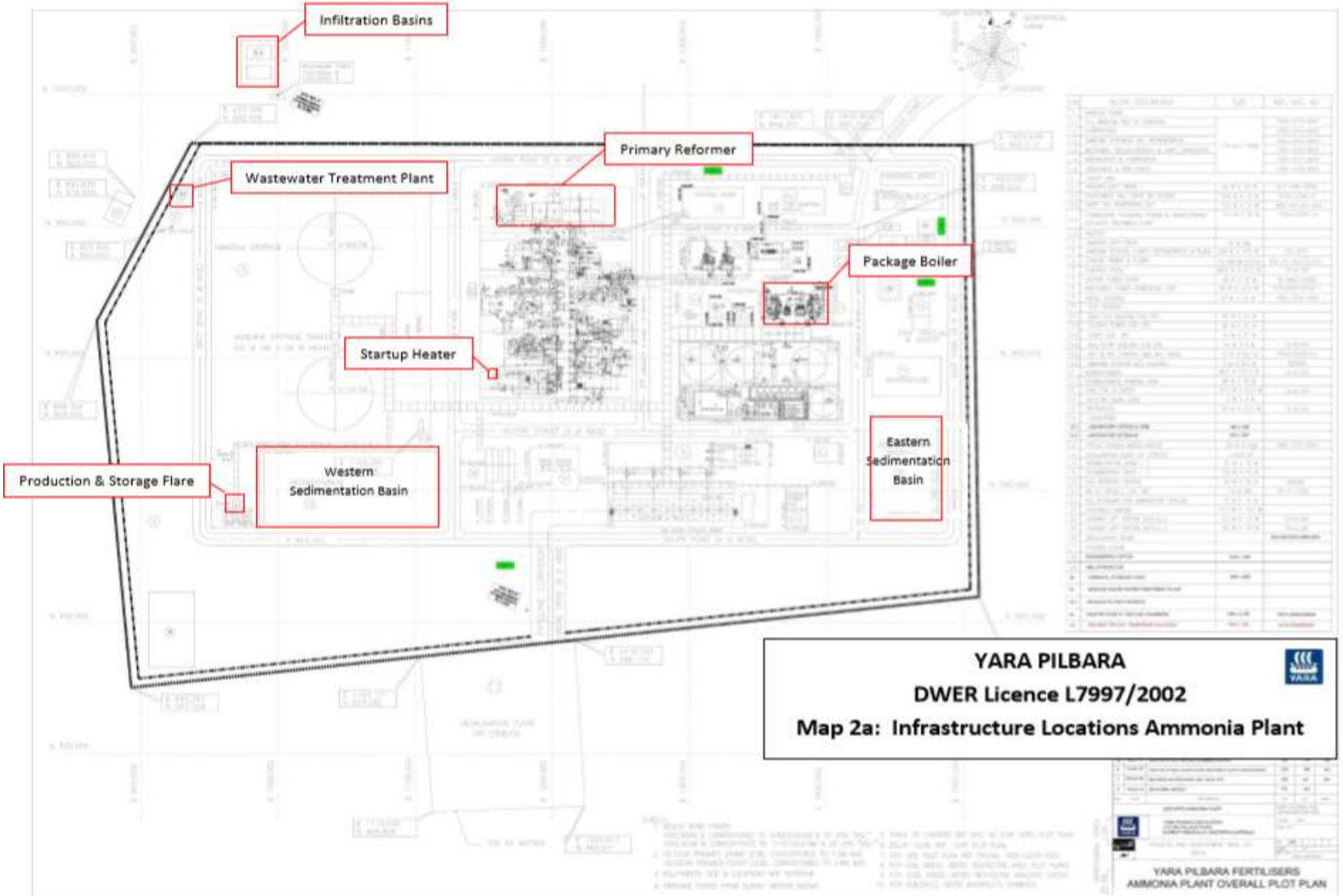
# Schedule 1: Maps

## Premises map

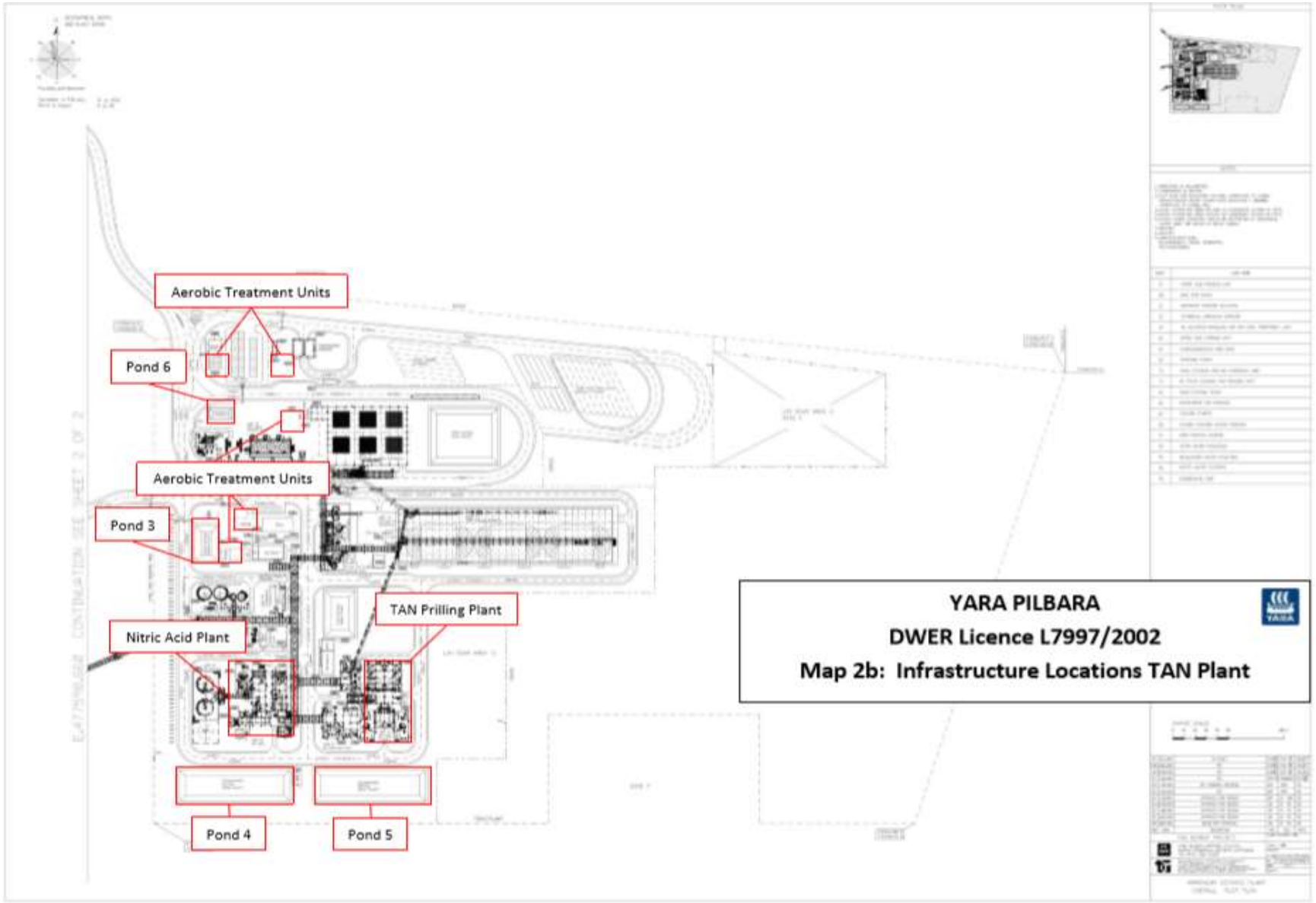
The premises are shown in the map below. The premises boundary is defined by the coordinates within.

# Maps of infrastructure locations

## Ammonia Plant



## TAN Plant


Aerobic Treatment Units
Pond 6
Aerobic Treatment Units
Pond 3
TAN Prilling Plant
Nitric Acid Plant
Pond 4
Pond 5
YARA PILBARA
DWER Licence L7997/2002
Map 2b: Infrastructure Locations TAN Plant

## Map of discharge point locations

## Map of monitoring locations

## Schedule 2: Primary Activities

At the time of assessment, emissions and discharges from the following Primary Activities were considered in the determination of the risk and related conditions for the premises.

The Primary Activities are listed in Table 12:

**Table 12: Primary Activities**

| Primary Activity | Premises production or design capacity |
|---|---|
| Category 31: Ammonia production facility (Ammonia Plant) | 950,000 tonnes per year |
| Category 31: Technical ammonium nitrate production facility (TAN Plant)<br>Nitric acid plant: 760 Tonnes per day<br>Ammonium nitrate solution plant: 965 Tonnes per day<br>TAN prilling plant: 915 Tonnes per day | 350,000 tonnes per year |
| Category 85: Domestic wastewater treatment plant | 36 cubic metres per day |

### Infrastructure and equipment

The Primary Activity infrastructure and equipment situated on the Premises is listed in Table 13 and Table 14.

**Table 13: Infrastructure and equipment – TAN Plant**

| Infrastructure and equipment | Plan reference |
|---|---|
| Liquid ammonia pipeline between TAN Plant and the Ammonia Plant : 710m long | Schedule 1: Maps of infrastructure locations |
| Bagged TAN storage building: 1800 tonnes | |
| Bagged TAN staging area: 7000 tonnes | |
| Bulk TAN storage building: 12,000 tonnes | |
| TAN bagging facility | |
| Truck bulk loading system | |
| Nitric acid storage: two tanks with total capacity of 3000 cubic metres | |
| Ammonium nitrate solution storage: one tank with a capacity of 500 tonnes | |
| Wastewater discharge pipeline connecting the TAN Plant to the Water Corporation's Multi User Brine Return Line (MUBRL) | |

**Table 14: Infrastructure and equipment – Ammonia Plant**

| Infrastructure and equipment | Plan reference |
|---|---|
| Ammonia storage: two cryogenic, double-walled, double integrity tanks with a capacity of 40,000 tonnes each | Schedule 1: Maps of infrastructure locations |
| Two steam turbine generators with a capacity of 22 MW each<br>(One operating at 100% capacity and one operating at 25% capacity) | |
| Two emergency diesel generators | |
| One 50 tonne per hour package boiler for start-up and one 150 tonne package boiler for operations | |
| Wastewater discharge pipeline connecting the Ammonia Plant to the MUBRL | |

# Schedule 3: Monitoring

## Monitoring of discharges to air

**Table 15: Monitoring of discharges to air**

| Discharge point | Monitoring location | Parameter | Frequency | Averaging period | Unit [1,2,3] | Method [4,5] |
|---|---|---|---|---|---|---|
| Common stack (A1) | Schedule 1: Map of monitoring point locations<br>Monitoring point A1 | Flow rate | Quarterly | 60 minutes | $m^3/s$ | USEPA Method 2 |
| | | PM | | | $mg/m^3$<br>g/s | USEPA Method 17 |
| | | $NH_3$ | | | | USEPA CTM 027 |
| Nitric acid plant stack (A2) | Schedule 1: Map of monitoring point locations<br>Monitoring point A2 | Flow rate | Continuous | 60 minutes | $m^3/s$ | CEMS |
| | | NOx (as $NO_2$) | | | $mg/m^3$<br>g/s | |
| | | $NH_3$ | | | | |
| | | $N_2O$ | | | | |
| Primary reformer stack (A5) and Package boiler stack (A6) | Schedule 1: Map of monitoring point locations<br>Monitoring point A5 and A6 | Flow rate | Quarterly until 30 September 2019 | 60 minutes | $m^3/s$ | USEPA Method 2 |
| | | NOx (as $NO_2$) | | | $mg/m^3$<br>g/s | USEPA Method 7E |
| Primary reformer stack (A5) and Package boiler stack (A6) | Schedule 1: Map of monitoring point locations<br>Monitoring point A5 and A6 | Flow rate | Continuous after 30 September 2019 | 60 minutes | $m^3/s$ | CEMS |
| | | NOx (as $NO_2$) | | | $mg/m^3$<br>g/s | |

Note 1: All units are referenced to STP dry.
Note 2: Concentrations for the common stack and nitric acid plant stack to be corrected to STP at 17% oxygen on a dry basis.
Note 3: Concentrations for the primary reformer stack and package boiler stack to be corrected to STP at 3% oxygen on a dry basis.
Note 4: Duplicate sample runs conducted consecutively on the same sampling day.
Note 5: Where any USEPA method refer to USEPA Method 1 for the sampling plane, this must be read as a referral to AS/NZS 4323.1:2001.

## Monitoring of ambient air

**Table 16: Monitoring of ambient air concentrations**

| Parameter | Monitoring location | Unit | Frequency | Averaging Period | Sampling Method | Analytical Method |
|---|---|---|---|---|---|---|
| $NH_3$ | Schedule 1: Map of monitoring locations<br>Monitoring locations AA1, AA2, AA3, AA4, AA5, AA6 and AA7 | ppm | Continuous | NA | Diffusion<br>Visible and audible alarm at 35 ppm | Electrochemical |

## Monitoring of discharges to marine waters

**Table 17: Monitoring of discharges to marine waters**

| Discharge point | Monitoring location | Parameter [2] | Frequency | Averaging period | Unit | Method | |
|---|---|---|---|---|---|---|---|
| | | | | | | Sampling | Analysis |
| MUBRL | Schedule 1: Map of monitoring point locations<br>Monitoring points W1 and W4 | Flow [1] | Continuous | NA | $m^3$/day | AS5667.1-1998<br>and<br>AS5667.10-1998 | NATA accredited |
| | | Temperature [1] | | | $^0C$ | | |
| | | pH [1] | | | NA | | |
| | | Electrical conductivity [1] | | | µs/cm | | |
| | | Dissolved oxygen [1] | Weekly | Spot sample | % | | |
| | | Ammonia as ammoniacal nitrogen ($NH_3$-N) | Daily | Weekly composite of daily spot sample | µg/L | | |
| | | Total Phosphorous | | | | | |
| | | Arsenic (III) | | | | | |
| | | Arsenic (V) | | | | | |
| | | Cadmium | | | | | |
| | | Chromium (III) | | | | | |
| | | Chromium (VI) | | | | | |
| | | Cobalt | | | | | |
| | | Copper | | | | | |
| | | Lead | | | | | |
| | | Mercury | | | | | |
| | | Nickel | | | | | |
| | | Selenium | | | | | |
| | | Silver | | | | | |
| | | Vanadium | | | | | |
| | | Zinc | | | | | |
| | | MDEA [3] | | | | | |

| Discharge point | Monitoring location | Parameter [2] | Frequency | Averaging period | Unit | Method | |
|---|---|---|---|---|---|---|---|
| | | | | | | Sampling | Analysis |
| WSB and ESB | Schedule 1: Map of monitoring point locations<br>Monitoring point W2 and W3 | Total suspended solids | Maximum of one hour before discharge and every 24 hours after that for the duration of the discharge | Spot sample | µg/L | | |
| | | pH [1] | | | NA | | |
| | | Total recoverable hydrocarbons | | | µg/L | | |
| | | MDEA [3] | | | | | |

Note 1: In-field non-NATA accredited analysis permitted.
Note 2: All metals must be analysed as total and filterable.
Note 3: Non-NATA accredited laboratory analysis permitted.

## Discharges to land

**Table 18: Monitoring of discharges to land**

| Discharge point | Monitoring location | Parameter | Frequency | Averaging period | Unit | Method | |
|---|---|---|---|---|---|---|---|
| | | | | | | Sampling | Analysis |
| Infiltration basins | Schedule 1: Map of monitoring point locations<br>Monitoring point L1 | Flow | Continuous | NA | m3/day | AS5667.1:1998<br>and<br>AS5667.10:1998<br>and<br>AS/NZS 2031:2001 | NATA accredited |
| | | Total nitrogen | Monthly | Spot sample | µg/L | | |
| | | Total phosphorus | | | | | |
| | | Biochemical oxygen demand | | | | | |
| | | pH | | | NA | | |
| | | Total suspended solids | | | µg/L | | |
| | | *E.coli* | | | cfu/100mL | | |

## Ambient groundwater monitoring

### Table 19: Monitoring of ambient groundwater concentrations

| Parameter [1,4,5,6] | Monitoring location | Unit | Frequency | Averaging Period | Method | |
|---|---|---|---|---|---|---|
| | | | | | Sampling | Analytical |
| pH [2] | Schedule 1: Map of monitoring locations<br>Monitoring points BFB, BFC, BFE, BFF, US1, US2, US3, DS1, DS2, DS3, DS4, DS5, DS6, DS7 and DS8 | NA | Quarterly | Spot sample | AS/NZS 5667.11 | NATA accredited |
| Electrical conductivity [2] | | µS/cm | | | | |
| Redox potential [2] | | mV | | | | |
| Temperature [2] | | $^{o}$C | | | | |
| Dissolved Oxygen [2] | | % | | | | |
| MDEA [3] | | µg/L | | | | |
| N-nitrosodiethanolamine (NDELA) [3] | | | | | | |
| N-nitrosodimethylamine (NDMA) [3] | | | | | | |
| N-nitrosopiperazine (NPz) [3] | | | | | | |
| Dimethylnitramine[3] | | | | | | |
| Ammonia as ammoniacal nitrogen ($NH_3$-N) | | | | | | |
| Nitrate and nitrite | | | | | | |
| Aluminium | | | | | | |
| Cadmium | | | | | | |
| Chromium (III) | | | | | | |
| Chromium (VI) | | | | | | |
| Copper | | | | | | |
| Nickel | | | | | | |
| Lead | | | | | | |
| Sulfate | | | | | | |
| Total dissolved solids | | | | | | |
| Total Kjeldal nitrogen | | | | | | |
| Total nitrogen as N and total oxidised | | | | | | |
| Total recoverable hydrocarbons | | | | | | |
| Total phosphorus as P | | | | | | |
| Total organic carbon | | | | | | |
| Total alkalinity | | | | | | |
| Major cations (K+, Na+, $Ca^{2}$+,$Mg^{2}$+) | | | | | | |
| Zinc | | | | | | |

Note 1: All samples must be measured and collected in a flow-through cell,
Note 2: In-field non-NATA accredited analysis permitted.
Note 3: Non-NATA accredited laboratory analysis permitted.
Note 4: Limits of reporting must be lower than the site-specific trigger values set for groundwater contaminants.
Note 5: Ultra-trace analysis must be included.
Note 6: Metal samples are to be filtered for analysis

## Noise emissions

**Table 20: Monitoring of noise**

| Parameter | Monitoring location | Unit | Frequency | Averaging Period | Monitoring method |
|---|---|---|---|---|---|
| Noise<br>$L_{A\ 10}$ | Schedule 1: Map of monitoring locations<br>Monitoring locations N1, N2, N3 and N4 | dB | Quarterly | Not less than 15 minutes, and not more than 4 hours | Part 3 – Noise measurement<br>*Environmental Protection (Noise) Regulations 1997* |

# Schedule 4: Annual Environmental Report

**Table 21: Reporting requirements - Annual Environmental Report**

| Condition | Requirement |
|---|---|
| 6<br>Monitoring of discharges to air | Tabulated monitoring data results and time-series graphs in Microsoft Excel format for each monitoring location showing concentrations of all parameters over a minimum three year period (where sufficient data allows).<br>An interpretation of the monitoring data including comparison to historical trends and emission limits.<br>Copies of original monitoring, laboratory and analysis reports submitted by third parties. |
| | A summary of Ammonia Plant startup and shutdown events including dates, times, durations, reasons for each event, characterisation and quantification of gases vented during each event, and commentary on how the emissions compared with inputs used in previous modelling for the Ammonia Plant. |
| 11<br>Ambient air monitoring | Summary of alarm threshold exceedances and actions taken. |
| 15<br>Monitoring of discharges to surface water | Tabulated monitoring data results and time-series graphs in Microsoft Excel format for each monitoring location showing concentrations of all parameters over a minimum three year period (where sufficient data allows).<br>An interpretation of the monitoring data including comparison to historical trends and emission limits.<br>Copies of original monitoring, laboratory and analysis reports submitted by third parties. |
| 19<br>Monitoring of discharges to land | |
| 21<br>Groundwater monitoring | |
| 23<br>Noise monitoring | |
| 29<br>Complaints | Summary of complaints received and any action taken to investigate or respond to any complaint |

# Application for Licence Amendment

**Division 3, Part V *Environmental Protection Act 1986***

| | |
|---|---|
| **Licence Number** | L7997/2002/11 |
| **Applicant** | Yara Pilbara Fertilisers Pty Ltd and<br>Yara Pilbara Nitrates Pty Ltd |
| **ACN** | 095 441 151 and 127 391 442 |
| **File Number** | DER2013/001374 |
| **Premises** | Yara Pilbara Fertilisers and Yara Pilbara Nitrates<br>Village Road<br>BURRUP WA 6714<br>Legal description -<br>Part of Lot 564 on Plan 31023 and Part of Lot 3017 on Plan 50979<br>As defined by the coordinates in Schedule 1 of the Amended Licence |
| **Date of Report** | 29 June 2018 |
| **Status of Report** | Final |

# Table of Contents

# 1. Definitions of terms and acronyms

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

**Table 1: Definitions**

| Term | Definition |
|---|---|
| AS 1726 | means the current version of the Australian Standard AS 1726- Geotechnical site investigations . |
| AS4323.1 | means Australian Standard 4323.1- Stationary source emissions- Method 1: Selection of sampling positions |
| AS/NZS5667.1 | means the Australian Standard AS/NZS 5667.1 Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples |
| AS/NZS5667.10 | means the Australian Standard AS/NZS 5667.10 *Water Quality – Sampling – Guidance on sampling of waste waters* |
| AS/NZS5667.11 | means the Australian Standard AS/NZS 5667.11 *Water Quality – Sampling – Guidance on sampling of groundwaters* |
| Annual Audit Compliance Report | means a report in a format approved by the CEO as presented by the licence holder or as specified by the CEO (guidelines and templates may be available on the Department's website). |
| Annual Period | means a 12 month period commencing from 1 January until 31 December. |
| Assessment and Management of Contaminated Sites, DER, 2014 | means the Guideline: Assessment and management of contaminated sites, December 2014 as published by the (then) Department of Environment Regulation, Government of Western Australia |
| Assessment of Site Contamination NEPM | means *National Environmental Protection (Assessment of Site Contamination) Measure 1999* |
| $BOD_5$ | Biochemical Oxygen Demand expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 Deg. Celsius |
| CEMS | Continuous Emissions Monitoring System |
| CEMS Code | Continuous Emissions Monitoring System (CEMS) Code for stationary Source Air Emissions, published by the Department of Environment Regulation Government of Western Australia, March 2016 |
| CEO | means Chief Executive Officer.<br>CEO for the purposes of notification means:<br>Director General<br>Department Administering the *Environmental Protection Act 1986*<br>Locked Bag 33 Cloisters Square<br>PERTH WA 6850<br>info@dwer.wa.gov.au |
| cfu/100mL | Means colony forming units per 100mL |
| CO | means Carbon monoxide |
| $CO_2$ | means Carbon dioxide |

| Term | Definition |
|---|---|
| CS Act | means Contaminated Sites Act 2003 (WA) |
| 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. |
| Ecological Risk Assessment | has the same meaning as given in the Assessment of Site Contamination NEPM |
| Freeboard | means the distance between the maximum water surface elevations and the top of retaining banks or structures at their lowest point |
| HDPE | High Density Poly Ethylene |
| HNO3 | Nitric Acid |
| Inspector | means an inspector appointed by the CEO in accordance with s.88 of the EP Act. |
| MDEA | methyl diethanolamine |
| $mg/m^3$ | milligrams per cubic meter |
| MUBRL | Multiuser Brine Return Line which is managed by the Water Corporation and discharges to King Bay |
| NATA | means National Association of Testing Authorities, Australia |
| NATA accredited | means in relation to the analysis of a sample that the laboratory is NATA accredited for the specified analysis at the time of the analysis |
| NEPM | National Environmental Protection Measure |
| $NH_3$ | Ammonia |
| NH4NO3 | Ammonium Nitrate |
| Noise Regulations | Environmental Protection (Noise) Regulations 1997 (WA) |
| Normal operating conditions – Ammonia Plant | Any operation of a particular process, excluding startup and shutdown, where the plant is operating. |
| Normal operating conditions – TAN Plant | Any operation of a particular process, excluding startup and shutdown, where the plant is operating. |
| NOx | means oxides of nitrogen, calculated as the sum of nitric oxide and nitrogen dioxide and expressed as nitrogen dioxide |
| $NO_2$ | Nitrogen dioxide |
| $N_2O$ | Nitrous Oxide |
| NO | Nitric Oxide |
| Plant trip | A partial plant shutdown that occurs when process conditions step outside safe limits |
| Primary Activities | refers to the prescribed premises activities listed on the front of this licence as described in Schedule 2, at the locations shown in Schedule 1 |
| PM | Particulate Matter |
| PM10 | used to describe particulate matter that is smaller than 10 microns (µm) in diameter |

| Term | Definition |
|---|---|
| ppmv | Means a concentration expressed on a volume per volume basis and generally only used for atmospheric or gaseous measurements and reporting |
| QA/QC | Means Quality Assurance/ Quality Control |
| 'quarterly' | means the 4 inclusive periods from 1 April to 30 June, 1 July to 30 September, 1 October to 31 December and in the following year, 1 January to 31 March |
| shut-down | means the period when plant or equipment is brought from normal operating conditions to inactivity |
| SKM 2006 Report | means the Consolidated Baseline Groundwater Report – Burrup Fertilisers Pty Ltd, Burrup Ammonia Plant, 15 February 2006, authorised by SKM and as referenced in the *15.087-WQM Procedure Review-LR-Rev3* prepared by WSP Environmental for Yara Pilbara Nitrates and submitted to the Department on 30 June 2016 |
| $SO_2$ | means Sulfur dioxide |
| 'spot sample' | means a discrete sample representative at the time and place at which the sample is taken |
| 'stack test' | means a discrete set of emission samples taken from an exhaust gas stack over a representative period at normal operating conditions |
| Startup – Primary Reformer Furnace (Ammonia Plant) | The period from when the furnace burners are ignited to when the vent valve on the Ammonia Recovery Unit is closed |
| Startup – Package Boiler (Ammonia Plant) | The period from when the boiler burners are ignited to when the vent valve on the Ammonia Recovery Unit is closed |
| Startup – TAN Plant | The period between the ignition of the Ammonia reactor and the activation of the DeNOx reactor |
| STP | means standard temperature and pressure ($0^o$ Celsius and 101.325 kilopascals respectively), dry; |
| TAN | Technical Ammonium Nitrate |
| TSP | Total Suspended Particulate |
| TSS | Total Suspended Solids |
| USEPA | means United States (of America) Environmental Protection Agency |
| USEPA Method 2 | means the USEPA Method 2 *Determination of stack gas velocity and volumetric flow rate (type S pilot tube)* |
| USEPA Method 5 | means the USEPA Method 5 *Determination of particulate matter emissions from stationary sources* |
| USEPA Method 7E | means the USEPA Method 7E *Determination of Nitrogen Oxides Emissions from Stationary Sources* (*Instrumental Analyser Procedure*) |
| USEPA Method 10 | means the USEPA Method 10 Determination of carbon monoxide emissions from stationary sources |
| USEPA Method 17 | means the USEPA Method 17 Determination of particulate matter emissions from stationary sources |

| Term | Definition |
|---|---|
| USEPA CTM 027 | means the USEPA Conditional Test Method 027 *Procedure for collection and analysis of ammonia in stationary sources* |
| USEPA CTM 038 | means the USEPA Conditional Test Method 038 Measurement of ammonia emissions from highway, nonroad and stationary use diesel engines by extractive fourier transform infrared (FYIR) spectroscopy |
| Usual Working Day | means 0800 – 1700 hours, Monday to Friday excluding public holidays in Western Australia |
| µS/cm | means microsiemens per centimetre. |

# 2. Purpose and scope of assessment

Yara Pilbara Fertilisers Pty Ltd (Yara Fertilisers) holds Licence L7997/2002/11 (Existing Licence) granted on 25 April 2005 under Part V of the *Environmental Protection Act 1986* (EP Act) for the operation of the Yara Fertilisers ammonia manufacturing plant (Ammonia Plant) on the Burrup Peninsula. The plant is authorised to produce 950,000 tonnes of ammonia per year.

A Works Approval (W4701/2010/1) was granted by the then Department of Environment Regulation on 25 July 2013 to Yara Pilbara Nitrates Pty Ltd (Yara Nitrates) for the construction of a Technical Ammonium Nitrate Production Facility (TAN Plant). The TAN Plant is located adjacent to the Ammonia Plant and will process ammonia from the Ammonia Plant to produce 350,000 tonnes per year of solid technical ammonium nitrate (TAN) prills.

An application to amend the Existing Licence has been received from Yara Pilbara Nitrates Pty Ltd (Yara Nitrates) for the operation of the TAN Plant, including changes to the prescribed premises boundary to incorporate both the Ammonia Plant and the TAN Plant.

In addition to the licence amendment application to include the TAN Plant operations, emissions and discharges from the existing Ammonia Plant have been reassessed where relevant. This Decision Report also includes assessment of changes requested by the Licence Holder relating to the regulation of wastewater treatment plant servicing the Ammonia Plant.

## 2.1 Application details

Works Approval W4701/2010/1 was granted on 25 July 2013 to Yara Nitrates for the construction and commissioning of the TAN Plant. Following construction, Yara submitted a licence amendment application on 30 March 2016 to incorporate the operation of the TAN Plant on the Existing Licence. Table 2 lists the documents submitted during the assessment process which relate to the amendment application.

Subsequent to the application submission, Yara requested the following changes to be considered through the licence amendment process:

- Review of the emission limits specified for the domestic wastewater treatment plant (WWTP) servicing the Ammonia Plant;
- Authorisation for use of the western and eastern sedimentation basins to contain overflow of cooling tower blowdown.
- Installation and operation of a third desalination unit; and
- Decommissioning of groundwater monitoring well BFD and replacement with new bore DS7.

The application also considers other key documents which have informed the re-assessment of

emissions and discharges from current operations detailed in section 5. Appendix 1 lists the documents considered during the assessment process.

**Table 2: Documents and information submitted during the assessment process**

| Document/information description | Date received |
|---|---|
| *Application Form: Application for amendment to Existing Licence*, Yara Pilbara Nitrates, 29 March 2016 | 30 March 2016 |
| *Application for a licence under the Environmental Protection Act 1986 L7997/2002/11 Response to Letter dated 30 May 2016*, Yara Pilbara, 17th June 2016 (Further information to support licence amendment application) | 17 June 2016 |
| Email correspondence: Additional information – YP coordinates, authored by Susan Giles, Yara Pilbara Fertilisers | 20 June 2016 |
| Email correspondence: 0086269 YPNPL Modelling input files, authored by Susan Giles, Yara Pilbara Fertilisers | 14 July 2016 |
| Correspondence: *Yara Pilbara Fertilisers Pty Ltd L7997/2002/11 Licence*, authored by Brian Howarth, Yara Pilbara Amendment (requesting review of Wastewater Treatment Plant licence limits during assessment of the licence) | 2 November 2017 |
| Correspondence: Response to Application for an amendment to licence L7997/2002/11 under the Environmental Protection Act 1986 – Request for Further Information, authored by Brian Howarth, Yara Pilbara Fertilisers | 15 January 2018 |
| Correspondence: Proposal to install a third desalination unit at Yara Pilbara Fertilisers Pty Ltd, authored by Brian Howarth, Yara Pilbara | 14 February 2018 |
| Correspondence: Yara Pilbara Fertilisers Pty Ltd L7997/2002/11 Licence Amendment, authored by Brian Howarth, Yara Pilbara (requesting monitoring bore replacement – BFD) | 22 March 2018 |
| Email correspondence: Maps for licence, authored by Vicki Hood, Yara Pilbara | 13 June 2018 |
| Email correspondence: Air emissions and Attachment – combined GLC's normal operations, authored by Susan Giles, Yara Pilbara Fertilisers | 15 June 2018 |
| Correspondence: *Yara Pilbara Fertilisers Pty Ltd Emissions Limits* (including Attachment – NOx Emissions Assessment), authored by Brian Howarth, Yara Pilbara Fertilisers | 21 June 2018 |
| Email correspondence: Ambient monitoring locations, authored by Vicki Hood, Yara Pilbara | 21 June 2018 |
| Email correspondence: Map 3 Discharge Points and Map 4 Monitoring Locations, authored by Vicki Hood, Yara Pilbara | 26 June 2018 |

# 3. Background

The Ammonia Plant is located on Lot 564 Village Road, Burrup and has been operational since 2006.

Yara Fertilisers is a wholly owned subsidiary of Yara Pilbara Holdings Pty Ltd, of which Yara International ASA is the sole owner. In 2012, Yara International ASA acquired controlling stake of the Ammonia Plant and the Existing Licence was transferred to Yara Fertilisers as the legal occupier of the Premises. Prior to this, the Ammonia Plant operated under the company name Burrup Fertilisers Pty Ltd.

Yara Nitrates, who hold control over the TAN Plant, is a joint venture between parent companies Yara International ASA (50%) and Orica Limited (50%).

Works Approval W4701/2010/1 was granted on 25 July 2013 to Yara Nitrates for the construction and commissioning of the TAN Plant on Lot 3017 and Lot 3018 on Plan 50979. The TAN Plant is categorised as a chemical manufacturing premises and processes ammonia from the Ammonia Plant to TAN prill.

A licence amendment application has been received from Yara Nitrates to amend the Existing Licence to include the operation of the TAN Plant. As Yara International ASA has a stake in each company, for the purpose of this licence, both Yara Nitrates and Yara Fertilisers have applied to be joint occupiers of the Premises.

Table 3 lists the prescribed premises categories applied for in Yara Nitrates application for licence amendment.

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

| **Classification of Premises** | **Description** | ***Approved 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. | 350,000 tonnes per year (TAN Plant)<br>760 tonnes per day (nitric acid plant)<br>965 tonnes per day (ammonium nitrate solution plant)<br>915 tonnes per day (TAN prilling plant) |

Table 4 lists the prescribed premises categories in the Existing Licence.

**Table 4: Prescribed Premises Categories in the Existing Licence**

| **Classification of Premises** | **Description** | ***Approved 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 (Ammonia Plant)<br>No more than 2600t/day (Ammonia Plant) |
| Category 85 | Sewage facility: premises -<br>(a) On which sewage is treated (excluding septic tanks); or<br>(b) From which treated sewage is discharged onto land or into waters. | 36 cubic metres per day (WWTP servicing the Ammonia Plant)<br>10.8 cubic metres per day (Aerobic treatment Units (ATU) servicing the TAN Plant) |

# 4. Overview of Premises

## 4.1 Operational aspects

### 4.1.1 Ammonia Plant

Yara Fertilizers process 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 KBR Purifier Process. 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. Figure 1 shows an indicative schematic flowsheet of the ammonia manufacturing process.

Key emissions from the Ammonia Plant include point source emissions to air, mainly nitrogen oxides from the primary reformer and package boiler stacks. Emissions to air (process gases comprising hydrogen, nitrogen, and argon) also occur from the Back End Vent (Vent A) and emissions comprising of hydrogen, nitrogen, methane , carbon monoxide, carbon dioxide and water from the Front End Vents (Vent B) during startup and shutdown of the plant. A Production Flare is available to treat waste process gas and a Storage Flare installed to incinerate emissions of ammonia that may occur for the storage tank headspace. Further details relating to air emissions associated with normal, startup and shutdown operation of the Ammonia Plant are included in Section 6.1 of this decision report.

Process wastewater from the plant is discharged to the Multi-User Brine Return Line (MUBRL) operated by Water Corporation for disposal into King Bay. A domestic WWTP services the Ammonia Plant; the WWTP was upgraded in 2016 and treated wastewater is disposed of via infiltration on site.

Figure 1 below indicates a schematic flow diagram of the Ammonia production process.

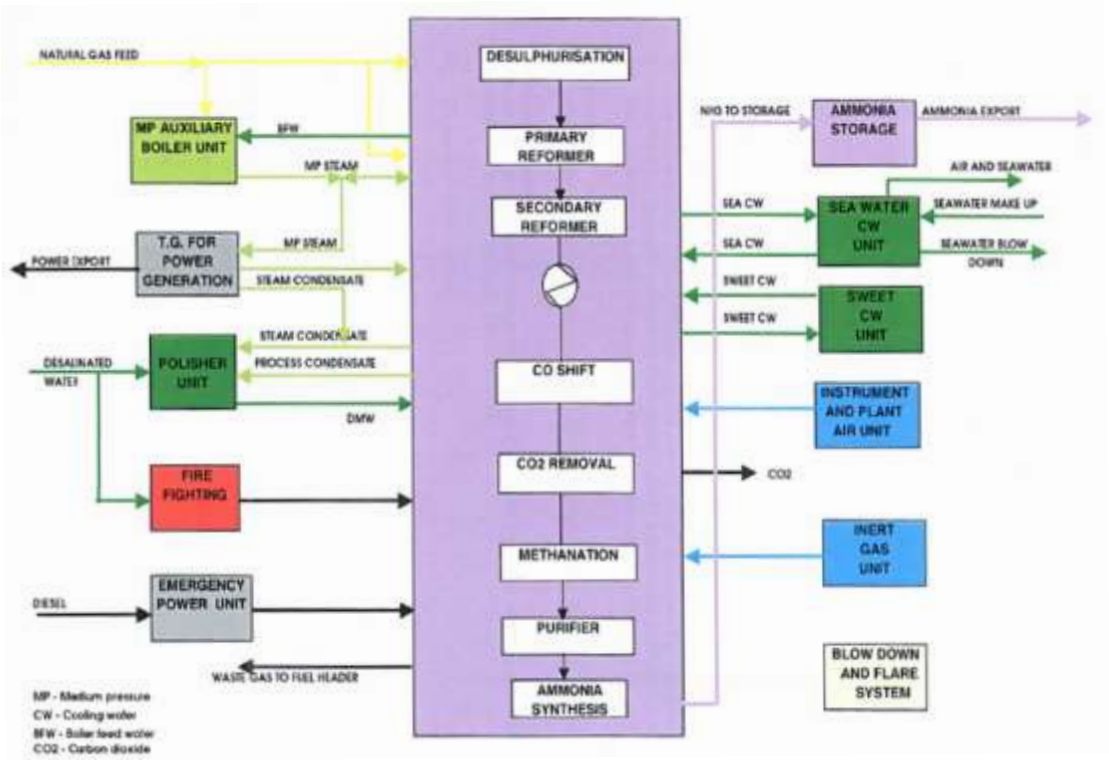



**Figure 1. Indicative schematic flowsheet for the ammonia production process.**

### 4.1.2 TAN Plant

The TAN Plant is designed to operate 24 hours per day, seven days a week and is capable of producing approximately 350,000 tonnes per year of TAN. The main feedstock for the process is liquid ammonia, which is transferred via pipeline from the adjacent Ammonia Plant.

The TAN Plant features three major process units, each producing a separate product in the manufacturing process:

- A dual pressure process nitric acid plant to convert ammonia and atmospheric air (into nitric acid);
- An ammonium nitrate solution plant to convert ammonia and nitric acid into ammonium nitrate solution, which is either converted to a TAN prill or sold as a product; and
- A TAN prilling plant to convert ammonium nitrate solution into TAN prills (final product).

Prills are manufactured in a prilling tower where ammonium nitrate solution flows by gravity to prilling nozzles which form droplets that crystallise as they fall from the top of the tower. Prills exiting the prill tower are directed to a drying section, which uses rotating drum dryers to reduce excess moisture. Dried prills are screened before being fed to a fluidised bed cooler. Oversized and fine prills are removed and recycled whilst on-spec material is cooled to optimal storage temperature and directed to a coating drum where anti-caking agents are sprayed on.

The prill product leaving the TAN Prilling Plant is conveyed to a bulk storage building or directly to a truck loading area. The bulk TAN storage building has the capacity to store up to 12,000 tonnes of TAN in separate bulk piles to mitigate fire and explosion risks.

Bulk TAN is only transported to consumers by trucks, which are loaded using a system consisting of front-loaders, bucket elevators and silos in combination with a truck weighing system. Approximately 25 trucks will operate each day for the transport of product (including bulk, bagged and liquid products).

Key emissions associated with operation of the TAN Plant include point source emissions to air of nitrogen oxides, ammonia, and particulates (ammonium nitrate). Emissions from the prilling tower are combined with emissions from drum dryers and fluid bed cooler prior to entering a drying/ cooling scrubber and subsequently being discharged from a common stack. Emissions from nitric acid plant stack include nitrogen oxides and ammonia. The TAN Plant includes process vents on the Unit 32 Prill Tower and Unit 12 Absorber for intermittent venting of ammonia during normal operations and startup conditions.

Process wastewater is discharged to the MUBRL. Several ATUs are used to treat domestic wastewater. Treated domestic wastewater is stored in contaminated surface water ponds onsite.

Further details relating to air emissions associated with normal and startup and shutdown of the TAN Plant are included in Section 6.1 of this decision report.

## 4.2 Infrastructure

The Ammonia Plant and TAN Plant infrastructure as it relates to Category 31 and 85 activities is detailed in Table 5 with major infrastructure referenced in the Ammonia Plant and TAN Plant Site Plans at Appendix 4.

Table 5: **Ammonia and TAN Plant Category 31 and 85 infrastructure**

| | Infrastructure | Site Plan Reference |
|---|---|---|
| **Prescribed Activity Category 31 (Ammonia Plant)** | | |
| 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 and secondary reformers | Site Plan Reference – Ammonia Plant |
| 2 | $CO_2$ stripper | |
| 3 | Ammonia storage tanks (2 x 40,000t) | |
| 4 | Production and Storage Flares | |
| 5 | Venting system (front-end and back-end vents) | |
| 6 | Seawater cooling system | |
| 7 | Wastewater neutralisation tank | |
| 8 | Wastewater effluent sump | |
| 9 | Oil containment sump | |
| 10 | Wastewater disposal via the Multi-User Brine Return Line (MUBRL) | |
| 11 | Chemical storage | |
| 12 | Western sedimentation basin | |
| 13 | Eastern sedimentation basin | |
| 14 | Liquid ammonia pipeline | |
| **Prescribed Activity Category 31 (TAN Plant)** | | |
| Ammonia is received via pipeline from the Ammonia Plant to produce nitric acid, ammonium nitrate solution and TAN prill. | | |
| 1 | Nitric acid plant | Site Plan Reference – TAN Plant |
| 2 | Ammonium nitrate solution plant | |
| 3 | TAN prilling plant | |
| 4 | Bulk TAN storage building (12,000 metric tonnes) | |
| 5 | Bagged TAN storage building (1,800 metric tonnes) | |
| 6 | TAN bagging facility | |
| 7 | Truck bulk loading system (TAN and ammonium nitrate solution) | |
| 8 | Nitric acid buffer storage (two storage tanks with a total capacity of 3,000$m^3$) | |
| 9 | Ammonium nitrate solution storage (500 metric tonnes) | |

| | Infrastructure | Site Plan Reference |
|---|---|---|
| 10 | Off-spec treatment area | |
| 11 | Off-spec storage area for the temporary storage of product that does not meet specification requirements | |
| 12 | Seawater cooling tower and closed loop cooling system | |
| 13 | Wastewater disposal via the MUBRL | |
| 14 | Clean water pond 1 (42.35m x 32.9m x 2.9m)<br>Clean water pond 2 (51.3m x 60.8m x 2.9m)<br>Clean water pond 3 (32.8m x 20.8m x 2.9m)<br>Clean water pond 6 (15.6m x 10.8m x 1.5m) | |
| 15 | Contaminated surface water ponds 4 and 5 (both 99.8m x 29.0m x 2.85m)<br>Sized to accommodate wastewater flow of 9735 t/year and additional flows in connection with tropical cyclones. | |
| **Prescribed Activity Category 85** | | |
| Treatment of domestic wastewater generated at the Ammonia Plant via a packaged WWTP with treated wastewater disposed of via two infiltration beds.<br>Treatment of domestic wastewater generated at the TAN Plant via ATUs with treated wastewater discharged into the contaminated surface water pond. | | |
| 1 | Packaged sewage treatment plant | - |
| 2 | ATUs servicing the TAN Plant | - |
| 3 | Infiltration basins | Site Plan Reference – Ammonia Plant<br>Infiltration Basins |
| **Directly related activities** | | |
| 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 | Captive power plant (22MW) | - |
| 2 | 150t steam boiler (connected to a package boiler stack) | Site Plan Reference – Ammonia Plant |
| 3 | 50t steam boiler (connected to package boiler stack) | |
| 4 | Startup heater | |
| 5 | Onsite desalination units (3) | - |

## 4.3 Exclusions to the Premises

The Prescribed Premises boundary (as requested through the licence amendment) encompasses the parts of Lot 3017 on Plan 50979 and Lot 564 on Plan 31023 on which the Ammonia Plant and TAN Plant are situated.

# 5. Legislative context

Table 6 summarises approvals relevant to the assessment. Approvals granted under Part V of the EP Act (WA) are summarised in Table 9.

**Table 6: Relevant approvals and tenure**

| Legislation | Number | Subsidiary | Approval |
|---|---|---|---|
| *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* | EPBC 2008/4546 | Yara Pilbara Nitrates Pty Ltd (previously named Burrup Nitrates Pty Ltd) | Conditional approval was issued on 14 September 2011 (EPBC 2008/4546). Variations to the approval were issued on 18 December 2013, 10 February 2014 and 12 September 2017. |
| *Dangerous Goods Safety Act 2004* | DGS017039 | Yara Pilbara Fertilisers Pty Ltd | Dangerous Goods Site Licence issued 31 August 2011. Expiry 1 September 2021 |
| | DPL001065 | | Danger Goods Pipeline Registration issued 22 May 2015. Expiry 1 June 2020. |
| *Dangerous Goods Safety Act 2004* | DGS021976 | Yara Pilbara Nitrates Pty Ltd | Dangerous Goods Site Licence issued 23 February 2015. Expiry 23 February 2020. |
| | SMA000031 | | Security Sensitive Ammonium Nitrate (SSAN) Manufacture Licence issued 23 February 2015. Expiry 23 February 2020. |
| | SIE000049 | | SSAN Import/Export Licence issued 23 October 2017. Expiry 23 October 2022. |
| | DPL001133 | | Dangerous Goods Pipeline Registration issued 13 May 2015. Expiry 13 May 2020. |
| Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007 | Approved Safety Report | Yara Pilbara Fertilisers Pty Ltd | Safety Report approved by DMIRS on 14 May 2015. |
| Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007 | Approved Safety Report | Yara Pilbara Nitrates Pty Ltd | Safety Report approved by DMIRS on 26 May 2015. |
| Part IV of the EP Act (WA) | Ministerial Statement Number 870 (MS 870) | Burrup Nitrates Pty Ltd | For construction and operation of a technical ammonium nitrate production facility within the King Bay/Hearson Cove |

| Legislation | Number | Subsidiary | Approval |
|---|---|---|---|
| | | | Industrial Estate on the Burrup Peninsula. Granted 11 July 2011. |
| | Ministerial Statement Number 586 (MS 586) | Burrup Fertilisers Pty Ltd | For construction and operation of an ammonia plant on the Burrup Peninsula. Granted 20 February 2002. |
| | Section 45C amendments | | MS 586 was amended on 13 December 2005 and 11 September 2006. Amendments included alteration of Schedule 1 start-up steam generation and modifications to pipeline management. |
| | | | Schedule 1 of MS 586 was amended to authorise an increase in production capacity and associated emissions and discharges. Regulation of emissions and discharges were referred to Part V of the EP Act (WA). Granted on 5 August 2015 |
| | 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. Granted on 22 June 2001 and amended on 5 June 2002. |

## 5.1 Federal legislation - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The TAN Plant proposal was determined to be a controlled action under the EPBC Act. Assessment of the proposal was undertaken under the bilateral agreement between the State and Commonwealth environment departments and conditional approval was issued on 14 September 2011 (EPBC 2008/4546). Variations to the approval were approved under the EPBC Act on 10 February 2014 and 12 September 2017. Conditions relate to:

- Discharge criteria for wastewater discharged to the MUBRL with reference to requirements of MS 594;
- Restricted application of larvicide and adulticide;
- Deterring birds from entering water ponds;
- Protection of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place (National Heritage Place) via the implementation of following management plans:
    - Construction Environmental Management Plan;
    - Operational Environmental Management Plan;
    - Aboriginal Heritage Management Plan;
    - Hazardous Materials Management Plan; and
    - Emergency Response Management Plan.

- Restricted access with respect to work carried out in the National Heritage Place;
- Requirements for undertaking ambient air quality monitoring for specific gases and dust for not less than 24 months from the commencement of construction until the expiry of the approval; and
- Requirements for annual surveys of rock art with a 2 km radius of the Premises to identify any changes to be undertaken either by Yara Nitrates or through the provision of an annual pro-rata amount for the Burrup Rock Art Monitoring Program.

## 5.2 Part IV of the EP Act

### 5.2.1 Background

The Environmental Protection Authority (EPA) provides the Government with advice on the environmental acceptability of development proposals and statutory planning schemes. Development proposals include industry proposals. The EPA considers proposals referred to it and decides whether or not they require formal environmental impact assessment (EIA), and if so at what level. The EPA will consider a proponent's documentation, any public input, and advice from relevant experts and agencies to determine whether a proposal should be implemented and if so, whether conditions should be placed on a proponent to ensure appropriate environmental management.

At the completion of the assessment, the EPA prepares a report and recommendations for the Minister for Environment. This report is also made publicly available and is open for a public appeal period. The Minister for Environment then considers the EPA's report and any public appeals before determining, in consultation with other Ministers, whether the proposal or scheme should be allowed to proceed and, if so, under what conditions.

The Ammonia Plant was assessed under Part IV of the EP Act and is subject to conditions under MS 586, as amended. Key proposal characteristics and supporting air emissions modelling assessments as considered in the Part IV assessments of the proposal for the Ammonia Plant and the TAN Plant inform this risk assessment.

The TAN Plant was also assessed under Part IV of the EP Act and is subject to conditions under MS 870, as amended. The scope and details of EPA's assessment of the TAN Plant proposal are detailed in EPA Report 1379 published in January 2011. The EPA's assessment considered the following key environmental factors relevant to the TAN Plant operation:

- Air quality,
- Biodiversity,
- Surface water and groundwater; and
- Liquid waste disposal.

The Part IV assessment considered the impact of atmospheric emission on rock art and concluded that it is unlikely that the relatively small quantities of nitrogen dioxide and ammonia that would be emitted from the TAN Plant would have a significant impact on rock art in the surrounding areas.

An integral component of the operation of the Ammonia Plant and TAN 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. Water Corporation holds MS 594 for the use of the MUBRL to discharge industrial wastewater to King Bay.

### 5.2.2 Ministerial Statement 870 (TAN Plant)

MS 870 contains conditions that need to be considered in the assessment of emissions and discharge from the TAN Plant and the imposition of regulatory controls. These are summarised in Table 7.

**Table 7: Consideration of MS 870 conditions relevant to this application**

| Condition | Requirement | Delegated Officer consideration |
|---|---|---|
| 1-1 | The proponent shall implement the proposal as documented and described in schedule 1 of this statement subject to the conditions and procedures of this statement. | Specifications detailed in Schedule 1 relate to the design capacity of the plant and specified rates for emissions to air.<br>EPA Report 1379 recommends regulation of emissions under Part V of the EP Act; however, emissions rates are specified under the key characteristics table of MS 870 (Schedule 1). |
| 5-1 | The proponent shall adopt and implement best practice pollution control technology as determined by the Chief Executive Officer of the Department of Environment and Conservation (DEC) on advice of the CEO to minimise all relevant emissions from the TAN prilling plant. | The assessment of best practice pollution control focuses on point source emissions to air rather than fugitive dust sources. |
| 5-2 | Prior to construction, the proponent shall prepare and implement an ambient air monitoring programme to the satisfaction of the CEO on the advice of the Chief Executive Officer of the DEC. | |
| 8-3 | The proponent shall design, construct, and locate groundwater monitoring bores to the satisfaction of the CEO on advice of the DEC and the Department of Water, having regard for the outcomes of the hydrogeological studies required by condition 8-1 and the Department of Water's Water Quality Protection Note 30 on Groundwater Monitoring Bores. | Groundwater monitoring requirements under MS 870 have been considered in determination of risk associated with potential emissions and discharges. |
| 8-4 | The proponent shall sample/monitor all groundwater bores required by Condition 8-3 every six months and shall set groundwater monitoring trigger values at a value of 10% above the baseline contaminant concentrations obtained from the hydrogeological studies required by condition 8-1. | |

| Condition | Requirement | Delegated Officer consideration |
|---|---|---|
| 8-5 | In the event that monitoring required by condition 8-4 indicates an exceedance of trigger levels:<br>1. The proponent shall report such findings to the CEO within 7 days of the exceedance being identified;<br>2. The proponent shall provide evidence which allows determination of the cause of the exceedance;<br>3. If determined by the CEO to be project attributable, the proponent shall submit actions to be taken to address the exceedance within 7 days of the determination being made to the CEO;<br>4. The proponent shall implement actions to address the exceedance and shall continue until such time as the CEO determines that the remedial actions may cease; and<br>5. The proponent shall submit bi-annually, or at a frequency defined to the satisfaction of the CEO, the results of monitoring required by condition 8-4 to the CEO, until such time as the CEO determines that reporting may cease. | |

### Review of condition 5-1

Based on recommendations made in EPA Report 1379, MS 870 contains overarching conditions that address the impacts of air emissions on rock art. Since the original assessment in 2011, a number of uncertainties in the design, data collection, and analysis elements of the rock art monitoring program completed by CSIRO have been raised. Subsequent independent reviews confirmed that considerable improvements could be made to the existing rock art monitoring program.

In November 2017, the Minister for Environment requested the DWER to review compliance of MS 870 with reference to potential Condition 5-1: Air Quality. The purpose of the review was to determine whether contemporary best practice pollution control technology was being implemented at the TAN Plant. Subsequent to a desktop technical review and a site visit in March 2018, DWER concluded that contemporary best practice pollution control technology has been incorporated in the design of the TAN Plant.

Following the review of conditions, the Minister for Environment requested the EPA on 17 April 2018 to review MS870 under section 46 of the EP Act. 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".*

## 5.3 Legislative framework for assessing and managing potential impacts on rock art petroglyphs

The Burrup Peninsula is a unique ecological and archaeological area containing one of the largest collections of Aboriginal engraved rock art in the world. In 2002, the State 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. These studies included measurements of air quality, microclimate, dust deposition, colour change, mineral spectrometry, microbiological analyses, accelerated weathering studies and air dispersion modelling studies.

In 2009, subsequent to a review of the investigation findings, the BRAMMC 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.

The *Draft Burrup Rock Art Strategy* has been designed by DWER to provide a long-term framework for the protection of rock art. The strategy focuses on:

- areas of monitoring and analysis required to determine whether change is occurring to the rock art located on the Burrup Peninsula;
- undertaking monitoring and analysis with suitable scientific rigour to deliver reliable results;
- new studies to determine the current pollution load on the Burrup Peninsula, the source of that pollution, and the pollution load that may result in deterioration of the rock art; and
- governance arrangements.

Table 8 below includes a summary of current legislative framework relevant to rock art.

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

| **Mechanism**<br>**(and responsible government)** | **Date** | **Protections** |
|---|---|---|
| Murujuga National Park established, covering the Northern Burrup Peninsula (WA) | 17 January 2013 | Increased protection of the rock art by applying the provisions of the *Conservation and Land Management Act 1984* (CALM Act).<br>The focus of the Murujuga National Park management Plan (2013) is to ensure protection and awareness of the cultural and natural values of the area.<br>Management of Murujuga National Park is administered by 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 Murujuga Aboriginal Corporation, DBCA and a representative appointed by the Minister for Aboriginal Affairs.<br>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) | Various | Specific localities on the Burrup have been declared Protected Places under the *Aboriginal Heritage Act 1972*.<br>Consent is required from the Western Australian Minister for Aboriginal Affairs for any activity which will negatively impact Aboriginal heritage sites. |

| Mechanism (and responsible government) | Date | Protections |
|---|---|---|
| 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.<br><br>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.<br><br>The Department of Jobs, Tourism, Science and Innovation is the lead agency for the development of the Burrup Strategic Industrial Area and LandCorp is the estate manager. |
| Burrup and Maitland Industrial Estates Agreement Additional Deed (WA) | 16 January 2003 | The State Government committed to organise and fund a minimum four-year study into the effects of the industrial emissions on rock art within and in the vicinity of part of the industrial estate on the Burrup Peninsula.<br><br>The four-year scientific rock art monitoring program, included:<br>- Two studies for the monitoring of ambient concentrations of air pollutants and microclimate and deposition undertaken by CSIRO Atmospheric Research; and<br>- Two further programs for artificial fumigation of rock surfaces and fieldwork on rock surface colour changes undertaken by CSIRO Manufacturing and Infrastructure Technology.<br><br>Following completion of these studies, in 2009 the Burrup Rock Art Monitoring Management Committee (see below) 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 as a National Heritage place (Cth) | 3 July 2007 | Any proposed action that could have a significant impact on the National heritage listed portion of the Burrup Peninsula must be referred to the Australian Government Minister for the Environment and Energy as a matter of national environmental significance for assessment and decision.<br><br>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. |
| EPBC Act Conservation Agreements (Cth) | Various | 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 with Hamersley Iron Pty Ltd and Dampier Salt Ltd (Rio Tinto). Under the Conservation Agreements, these companies provide funding for research, management and monitoring of the National Heritage values of the place. |

| 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 | Approval includes conditions related to:<br>- Undertaking rock art and air quality monitoring programs, including the reporting of results; and<br>- Providing the Department of the Environment and Energy (DotEE) with a management plan in the event that changes to 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.<br>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. |

## 5.4 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). Lot 3017 is not currently registered as a contaminated site under the CS Act.

## 5.5 Other relevant approvals

### 5.5.1 Planning approvals

The Premises are currently zoned strategic industry under the City of Karratha Planning Scheme No.8. A planning application for the TAN Plant was referred to the Shire of Roebourne (now City of Karratha) on 2 August 2012. The application was referred to the Pilbara Joint Development Assessment Panel and approval was granted on 31 October 2012. Approval was subject to conditions relating to a range of aspects, including visual impact, pest management, landscaping, noise, lighting, vehicle parking and access, erosion, areas to be sealed and drained, mosquito management, air quality including dust management and cultural heritage.

Of particular note is the requirement for Yara to comply with the recommendation in EPA Bulletin 1077 for an aspirational noise level of 45dB(A) at Hearson Cove to be achieved to preserve the recreational and environmental amenity of the location during operations. EPA Bulletin 1077 was produced as a result of the EPA's assessment in 2002 of a proposal by Methanex Australia Pty Ltd to establish a methanol complex on the Burrup Peninsula. This proposal was abandoned and never commenced.

### 5.5.2 Department of Mines, Industry Regulation and Safety

Both the Ammonia Plant and the TAN Plant include a number of infrastructure items used for the storage and processing of chemicals. Both premises are considered a Major Hazard Facility and are subject to the requirements of the *Dangerous Good Safety (Major Hazard Facilities) Regulations 2007*.

The appropriate dangerous goods licences have been obtained by both Yara Fertilisers and Yara Nitrates under the *Dangerous Goods Safety Act 2004* (refer to Table 6).

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

1. Conditions regulating to the impact of industrial air emissions on the Burrup rock art are imposed on the premises under Part IV of the EP Act. Under section 57(4)(b) of the EP Act (Part V), licence conditions "*may not be contrary to or otherwise than in accordance with*" Ministerial Statement 870.
2. The Governance Framework being developed by DWER under the Burrup Rock Art Strategy will provide monitoring and reporting mechanisms to assess potential adverse impacts on the rock art.

   The proposed Rock Art Strategy will focus on new studies to determine the current pollution load on the Burrup Peninsula, the source of that pollution and any pollution load that may result in deterioration of the rock art.

   The proposed strategy and conditions of EPBC approval 2008/4546 as amended, are another regulatory tool for assessment and management of potential impacts on the Burrup Rock Art.
3. This Decision Report does not further consider impacts on rock art associated with air emissions from the Premises on this basis. It is noted that a review under section 46 of the EP Act (Part IV) has been requested by the Minister, regarding a potential change to implementation condition 5-1 Air Quality to protect rock art. DWER will consider the findings of that review should a change in conditions occur as a result.
4. The Department of Mines, Industry Regulation and Safety (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.

## 5.6 Part V of the EP Act

The DWER regulates industrial emissions and discharges to the environment through a works approval and licensing process under Part V of the EP Act.

Industrial premises with potential to cause emissions and discharges to air, land or water are known as Prescribed Premises and trigger regulation under the EP Act. Prescribed premises categories are outlined in Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations).

The EP Act requires a works approval to be obtained before constructing a Prescribed Premises and makes it an offence to cause an emission or discharge unless a licence or registration is held for the premises.

### 5.6.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations. The guidance statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles (July 2015)*
- *Guidance Statement: Decision Making (February 2017)*
- *Guidance Statement: Risk Assessments (February 2017)*
- *Guidance Statement: Environmental Siting (November 2016)*

- *Guidance Statement: Setting Conditions (October 2015)*
- *Guidance Statement: Land Use Planning (February 2017)*
- *Guidance Statement: Licence Duration (August 2016)*

### 5.6.2 Works approval and licence history

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

**Table 9: Works approval and licence history**

| Instrument | Issued | Nature and extent of works approval, licence or amendment |
|---|---|---|
| W3589/2002/1 | 15 May 2002 | New works approval for 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 | 15 April 2005 | New application. |
| L7997/2002/1 | 12 December 2005 | Licence amended to alter the detection limits for wastewater sampling. |
| 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 | 15/04/2010 | Licence reissued with amendments to remove duplicate reporting conditions and update premises boundary. |
| L7997/2002/7 | 14/04/2011 | Licence reissued. |
| L7997/2002/8 | 19/04/2012 | Licence reviewed to incorporate a more comprehensive suite of conditions for monitoring and reporting emissions and discharges from the site. |
| W4701/2010/1 | 25 July 2013 | New works approval for the construction and commissioning of the TAN Plant. Amendment notices were issued to extend the duration of the works approval to allow sufficient time to complete commissioning following delays. |
| | Amended 23 June 2016 | |
| | Amended 10 November 2016 | |
| | Amended 30 November 2017 | |

| | | |
|---|---|---|
| L7997/2002/9 | 18 April 2013 | Licence re-issue |
| L7997/2002/10 | 16 April 2014 | Licence re-issue |
| L7997/2002/11 | 16 April 2015 | Licence re-issue |
| | Amended<br>20 April 2016 | Licence Holder applied to amend licence conditions to align 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. |
| W5920/2015/1 | 7 January 2016 | New works approval for the replacement of its existing WWTP with a new rotating biological contactor WWTP. |

### 5.6.3 Key and recent works approvals

Works Approval W4701/2010/1 was granted on 25 July 2013 to Yara Nitrates for the construction and commissioning of the TAN Plant. On 19 February 2016, Yara submitted the compliance document required by the works approval certifying that the works had been constructed in accordance with the conditions of the works approval.

Commissioning of the TAN Plant commenced on 22 February 2016. The works approval was amended on 23 June 2016, 10 November 2016, and 13 December 2017 to extend the duration of the works approval following delays in the commissioning. The extended duration allowed Yara to complete commissioning and for DWER to complete the licence amendment process (see below).

On 19 September 2017, Yara notified the DWER that practical completion of commissioning of the TAN Plant was completed on 15 September 2017. On 29 September 2017, Yara submitted the report (Commissioning Report) required by the works approval.

Since the submission of the Commissioning Report, Yara Nitrates have confirmed that the market conditions have changed and that the TAN Plant will not be operating on campaign basis rather will be operating continuously. This assessment has considered continuous operations.

### 5.6.4 Key and recent licence amendments

The Existing Licence applies to the operation of the Ammonia Plant and is due to expire on 20 April 2020. The licence was previously subject to renewal on an annual basis. The licence was amended on 20 April 2016 at the request of Yara Fertilisers to alter conditions to align with the recent amendment of MS 586 and increase the nominated design capacity to 950,000 tonnes per year. No changes to infrastructure were required to achieve the increased production rate. Yara Fertilisers advised that although the plant has a nameplate capacity of 770,000 tonnes per year, it could achieve greater rates depending on operating conditions and efficiency (e.g. catalyst performance).

The Existing Licence included two improvement requirements (IRs) as below:

- Improvement requirement IR1 required the Yara to submit a report confirming if the continuous emissions monitoring systems (CEMS) for the primary reformer and package boiler stacks on the Ammonia Plant could be operated, maintained and calibrated in accordance with the DWER's Guideline: *Continuous Emission Monitoring System (CEMS) Code for Stationary Source Air Emissions* (CEMS Code). On 30 June 2016, Yara confirmed that these CEMS could not comply with the CEMS Code and submitted a proposal for using alternative predictive monitoring method instead of CEMS. The proposal has been considered in further detail in section 6.1.5.
- Improvement requirement IR2 required Yara to undertake a review of its groundwater monitoring program. On 30 June 2016, Yara submitted documentation providing details

of the review undertaken. The information provided by Yara has been considered in further detail in section 6.3 and section 9.9 of this Decision Report.

### 5.6.5 Clearing of native vegetation

Clearing of native vegetation for the construction of the Ammonia Plant and TAN Plant were approved under Part IV of the EP Act.

## 5.7 Compliance inspections and compliance history

### 5.7.1 Compliance Inspections

The DWER has undertaken compliance inspections at the Ammonia Plant in the last four years. A summary of the inspection findings is provided below:

- The 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 Yara Fertilisers to these findings, the Department confirmed that all agreed actions had been completed.
- The inspection undertaken on 28 May 2015 identified non-compliance with two conditions which have since been addressed through a licence amendment.
- The inspection undertaken on 6 April 2016 did not identify any compliance issues.
- The inspection undertaken on 10 October 2016 identified three instances where the Licence Holder was not compliant with regulatory controls:
    - An unauthorised discharge of methyl diethanolamine (MDEA) from the $CO_2$ stripper stack and subsequent release from the western sedimentation basin. Investigations conducted by Yara 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.
    - Three ammonia releases to atmosphere resulting from the activation of Pressure Safety Valves (PSVs). Yara implemented a number of improvements as a result of these releases. The risk associated ammonia releases and assessment of regulatory controls are considered in section 10.
    - Exceedances of licence limits for discharges from the WWTP, specifically total nitrogen, phosphorus, pH, biochemical oxygen demand, total suspended solids (TSP) and pathogens (*E.coli*). The WWTP was upgraded and commissioned in December 2016; however, Yara has advised that this system cannot comply with Existing Licence limits. As part of this licence amendment application, Yara has requested that the discharge limits and monitoring frequency for the wastewater treatment plant are reassessed.

### 5.7.2 Annual Audit Compliance Reports

A requirement of the Existing Licence is the submission of an Annual Environmental Report (AER) and Annual Audit Compliance Report (AACR). A review of the previous four reporting years has been undertaken and reported non-compliances are detailed below:

**2014 Report:**

Yara identified seven non-compliances in the AACR for the 2014 reporting period. The environmental risk associated with the non-compliances which were not reported was determined to be low. These non-compliances have been addressed through licence amendments.

**2015 Report:**

In the AACR for the 2015 period Yara identified five non-compliances. These non-compliances have been addressed through licence amendments or by the implementation of additional controls by Yara.

**2016 Report:**

In the AACR for the 2016 period Yara identified seven non-compliances. Two of these non-compliances related to operation of and discharges from the wastewater treatment plant, discussed in section 5.7.1. Yara has submitted a request to amend conditions relating to the wastewater treatment plant and discharges to the sedimentation basin. Other identified non-compliances have been adequately addressed by Yara.

**2017 Report**

The AACR for the 2017 reporting period identified non-compliance against eight conditions. Treated wastewater quality limits specified in Condition 2.4.2 were exceeded 24 times during the reporting period. Yara has submitted a request to amend conditions relating to the wastewater treatment plant and discharges to the sedimentation basin.

Other key non-compliance included a period of three days, between 9 and 11 February 2017, when the wastewater output from the domestic WWTP exceeded the design capacity specified in the licence. This non-compliance was not reported to DWER at the time of the event. In the AACR Yara identified the ingress of water into the septic holding tank as the root cause. The tank was replaced in September 2017, however no information relating to potential impacts on groundwater was provided. Potential impacts on groundwater have been assessed in section 9 of this Decision Report.

### 5.7.3 Compliance History

The DWER's Incident and Complaints Management System (ICMS) is used to record complaints received and non-compliances requiring investigation. A number of complaints and self-reported incidents have been recorded for Yara Fertilisers and Yara Nitrates and are considered in this report, where appropriate.

### 5.7.4 TAN Plant commissioning – reportable events

Yara reported three incidents during commissioning of the TAN Plant:

- 30 April 2016 - elevated NOx emissions from the nitric acid plant stack. NOx concentrations averaged 1436 mg/m$^3$ for 4.5 hours;
- 6 March 2017 - spill of approximately 2.18 tonnes of ammonium nitrate solution adjacent to the contaminated surface water pond. Groundwater monitoring results have shown elevated nitrates, which Yara indicates may be a result of this spill; and
- 30 June 2017 - leak of unknown quantity of ammonium nitrate contaminated water from Pond 2.

Consideration has been given to these events in the assessment of emissions and discharges in section 9 of this report.

# 6. Modelling and monitoring data

## 6.1 Air emissions

### 6.1.1 Air emissions modelling undertaken for the Ammonia Plant

**2001 Modelling**

Air emissions modelling for the Ammonia Plant was undertaken in August 2001 at the Public Environmental Review (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, sulfur dioxide ($SO_2$), and particulates (PM) 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).

Based on this modelling the potential for flaring to result in an exceedance of relevant criteria for ammonia was considered extremely unlikely. Maximum NOx concentrations were predicted to occur 700 m to the north of the Ammonia Plant with only a small area to the north and south expected to exceed the NEPM standard.

**2015 Updated Modelling**

Updated modelling was undertaken in 2015 to support the request to amend MS 586 under section 45C of the EP Act. 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 (EPBC Condition 9 ambient monitoring site)
- Water Tanks (EPBC Condition 9 ambient monitoring site)
- Deep Gorge (EPBC Condition 9 ambient monitoring site)
- King Bay south (industrial)
- Karratha (residential)
- Hearson Cove (beach recreation);

The modelling predicted that during normal operation of the Ammonia Plant, the ground level concentrations (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. The outcomes of this updated modelling are considered in the risk assessment, section 9. 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.

Impacts 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 $N_2$ and water, with minimal NOx formation. The significance of Storage and Production Flare emissions is considered in the Risk Assessment, section 9.

## Ammonia Plant - normal operations

The Ammonia Plant operates for 24 hours per day and 350 days per year. Atmospheric emissions characteristics representative of normal operations are as identified in Table 10. Results from stack monitoring conducted in the previous three years inform the emission characteristics in Table 10.

**Table 10 Atmospheric emissions characteristic of normal operation of the Ammonia Plant**

| 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) | VOC (g/s) | $PM_{10}$ (g/s) | CO (g/s) |
|---|---|---|---|---|---|---|---|---|---|
| Primary Reformer Furnace | 3.5 | 520,000 | 15 | 17.1 | 0.23 | 0.00002 | 0.91 | 10.1 | 3.5 |
| $CO_2$ Stripper | 60 | 0.76 | 162,000 | 77 | 0 | 0 | 0 | 0 | 50 |
| Package Boiler | 30 | 3 | 104,300 | 4.1 | 6.9 | 0.13 | 0 | 0.36 | 4.2 |

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

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

## Ammonia Plant - Startups, trips and shutdowns

A cold startup occurs when the plant has been down for more than eight to ten hours. Under cold startups, the package boiler is fired on gas to produce the maximum 100 tonnes per hour of steam needed before the ammonia production process is stabilised. Additionally, the startup heater is operated to heat the gases. As steam generation within the ammonia process becomes available, the gas burners to the boiler are manipulated and the process optimised. Startup is considered complete once the process is stabilised, ammonia is being produced and the vent valve on the Ammonia Recovery Unit is closed.

The Ammonia Plant or parts within can be shut down at various times in response to plant trips (upsets) and maintenance requirements. Major shutdowns are required every 4-5 years to replace catalysts in the various stages of the process.

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 will occur from

the Front End Vent or the Back End Vent, depending on the location within the process that initiated the plant trip. Yara has provided a summary of plant startups, trips and shutdowns that occurred from January 2017 to May 2018 are provided in Table 11.

**Table 11: Details of Ammonia Plant startups, plant trips and shutdowns from 2017-current**

| Event | Description |
|---|---|
| Full ISBL shutdown and<br>cold start | Required for plant maintenance<br>OSBL facilities remain on-line |
| Full ISBL shutdown and hot start | Where the restart begins within 24 hours |
| Full plant shutdown (ISBL & OSBL) and hot start | Where restart begins within 24 hours |
| Full plant shutdown (ISBL & OSBL) and cold start | Where the entire plant is shutdown and restart begins after a maintenance period |
| Backend trip and hot start | Where the ISBL trips anywhere from $CO_2$ removal onwards and restart begins within 24 hours |
| Backend trip and cold start | Where the ISBL trips anywhere from $CO_2$ removal onwards and restart begins after a maintenance period |
| Planned Shutdown | Where the 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

The scenarios in Table 11 result in venting of process gases (not ammonia) from the Back or Front End Vents. Emissions from venting are considered in the Risk Assessment, section 9.

In addition to venting, NOx emissions occur from the Package Boiler and Primary Reformer Furnace stacks from natural gas combustion. Higher steam demand from the Package Boiler during startup 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 startup. NOx emissions are also generated from the Startup Heater.

Yara have conducted a detailed assessment of potential CO and NOx emissions resulting from startups, plant trips and shutdowns as described in Table 11. It is noted that GLCs are calculated by the application of dilution factors from the 2015 updated modelling, rather than re-modelling these emissions. 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.

**Table 12: Ammonia Plant startup, plant trips and shutdown scenarios - maximum ground level impacts**

| 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

### 6.1.2 Approach used in the Part IV assessment for the TAN Plant and Works Approval W4701

Air emissions from the proposed TAN Plant were assessed at the PER stage under Part IV of the EP Act. EPA Report 1379 notes the following relating to the air emissions assessment undertaken by Yara:

- Cumulative impacts of other industrial sources in the region had not been properly addressed;
- Cumulative air quality modelling for $NH_3$ was not undertaken;
- The 1-hour average GLCs of $NH_3$ were expected to be below applicable assessment criteria at Hearson Cove, Deep Gorge, Dampier, and Karratha when the TAN Plant is considered in isolation and is operating under normal or abnormal operating conditions; and
- Emissions of carbon monoxide (CO) and ammonium nitrate dust (as $PM_{10}$) from the TAN Plant were not considered.

The report also noted the following in relation to $NO_2$ emissions from the TAN Plant:

- To account for other existing sources of $NO_2$ on the Burrup Peninsula, Yara proposed a background concentration of 0.06 ppm (approximately 112.9 µg/m$^3$). This proposed figure was derived from a 1-hour average GLC of $NO_2$ of 0.02 ppm as measured by the then Department of Environmental Protection in 1999 during the Pilbara Air Quality Study. This figure was then multiplied by three to obtain a figure of 0.06 ppm.
- The1-hour average background concentration of $NO_2$ derived by Yara was inappropriate. Potential ground level impacts of NOx at receptors during normal and abnormal operation of the TAN Plant were subsequently assessed using the conservative concentration of 167 µg/m$^3$.
- Using the revised figure, the EPA assessed that 1-hour average GLC of $NO_2$ at Hearson Cover during normal operation of the TAN Plant would be approximately 70% of the assessment criteria (246 µg/m3). During abnormal operating conditions, the GLC of $NO_2$ was estimated to reach approximately 82% of the assessment criteria.

The proposal for the TAN Plant was granted approval at the time providing that:

- Yara adopted and implemented best practice pollution control technology to minimise $NH_3$ and TSP emissions from the TAN prilling plant common stack; and
- Emissions from the TAN Plant are regulated through Part V of the EP Act commensurate with the use of best practice pollution control technology.

The EPA noted that the expected $NO_X$ stack emission concentration from the nitric acid plant stack was consistent with the best practice emission concentrations listed in the:

- *European Fertilizer Manufacturers Association (EFMA) Best Available Techniques for Pollution Prevention and Control in the European Fertilizer Industry Booklet No. 2: Production of Nitric Acid (*EFMA Booklet No. 2*)*; and
- *European Commission Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers* (European Commission, 2007).

However, the EPA also noted that the expected $NH_3$ and $PM_{10}$ stack emission concentrations from the TAN prilling plant common stack would be above the best practice emission concentrations listed in the *EFMA Best Available Techniques for Pollution Prevention and Control in the European Fertilizer Industry Booklet No. 6: Production of Ammonium Nitrate and Calcium Ammonium Nitrate* (EFMA Booklet No. 6); and the European Commission, 2007 reference document.

As a result, the EPA recommended that Condition 5-1 in Ministerial Statement 870 be imposed on the Licence Holder as follows:

*5-1 The proponent shall adopt and implement best practice pollution control technology as determined by the Chief Executive Officer of the Department of Environment and Conservation (DEC) on advice of the CEO to minimise all relevant emissions from the TAN Plant ammonium nitrate prilling plant.*

The works approval assessment undertaken for construction of the TAN Plant used the criteria set in the Part IV assessment. Some of the proposed emission sources which were considered in the original modelling assessment for the Ammonia Plant had not been constructed at the time of the works approval assessment (e.g. Plenty River and Syntroleum). As a result, it was assessed that cumulative emissions from normal operation of the TAN Plant would not contribute to exceedances of the assessment criteria at receptors.

## Normal operation of the TAN Plant as described in the PER

The TAN Plant consists of three major process components which are designed to operate independently of each other. In the PER, normal operations for each component were considered as below:

- Nitric acid plant – 95% availability (approximately 345 days per year);
- Ammonium nitrate solution plant - 95% availability (approximately 345 days per year); and
- TAN prilling plant - 90% availability (approximately 329 days per year).

**Table 13 Atmospheric emissions characteristic of normal operations of the TAN Plant (as considered in the EPA assessment)**

| Source | NOx (g/s) | $NO_2$ (g/s)[1] | $PM_{10}$ (g/s)[2] | $NH_3$ (g/s) | CO (g/s) |
|---|---|---|---|---|---|
| Nitric acid plant | 4.2 | 2.1 | -- | 0.02 | 1.3 |
| TAN prilling tower | | 0 | 0.8 | 0.6 | |
| Nitric acid storage tank vent A | 0.04 | 0.02 | | | |
| Nitric acid storage tank vent B | 0.04 | 0.02 | | | |
| Power generation | 2.1 | 1.1 | 0.058 | | 0.66 |

Note 1: A 50% conversion of NOx to $NO_2$ has been assumed.
Note 2: Emissions of ammonium nitrate dust from the prilling tower have been assessed as $PM_{10}$.

Nitric acid emissions can produce off-vapours from the neutralisation reactor in the TAN Plant. These are designed to be condensed back into the process, therefore, no emissions are expected from this source.

## TAN Plant – Non-routine operations

Plant shutdowns may be required in response to upset conditions or for maintenance, with start-ups then required to restore normal operations. Significant process venting or flaring is not required. The closed-loop design of the TAN process plant generally only provides for discharges of major emissions through controlled emission sources.

The following non-routine operating scenarios were considered in the PER:

- Cold startup once per year (annual maintenance), with the startup expected to take approximately six hours duration;
- Planned annual maintenance shut downs;
- Biannual shut down of the Nitric Acid Plant for catalyst replacement; and
- Emergency shutdown which would result in the majority of emissions being released via the nitric acid plant stack. Emergency shutdowns are anticipated to be rare and are expected to be less than one hour in duration. Maximum emissions from the nitric acid plant stack during emergency shutdowns are expected to comprise up to 26 g/s of NOx and 0.07 g/s of $NH_3$.

**Table 14 Atmospheric emissions characteristic of non-routine operations of the TAN Plant (as considered in the EPA assessment)**

| Source | NOx (g/s) | $NO_2$ (g/s) [1] | $PM_{10}$ (g/s) [2] | $NH_3$ (g/s) | CO (g/s) |
|---|---|---|---|---|---|
| Nitric acid plant | 39 | 19.4 | | 0.1 | 1.3 |
| TAN prilling tower | | | 2.4 | 1.6 | |
| Nitric acid storage tank vent A | 0.04 | 0.02 | | | |
| Nitric acid storage tank vent B | 0.04 | 0.02 | | | |
| Power generation | 2.1 | 1.1 | 0.058 | | 0.66 |

Note 1: A 50% conversion of NOx to NO2 has been assumed.

Note 2: Emissions of ammonium nitrate dust from the prilling tower have been assessed as $PM_{10}$.

### 6.1.3 Revised air quality modelling undertaken for TAN Plant

Subsequent to the granting of Works Approval W4701, Yara initiated a revised air quality modelling assessment in 2012 for the TAN Plant based on the manufacturer's guarantees on discharge concentrations. The *Draft Burrup Peninsula Technical Ammonium Nitrate Production Facility Air Quality Assessment Update Report, reference:0086269*, *dated August 2012, authored by Environmental Resources Management Australia for Burrup Nitrates Pty Ltd* (Updated Report), was submitted for consideration as part of the current licence amendment application.

Key considerations regarding the updated air quality assessment included the following:

- The CALPUFF model was used to model emissions from the TAN Plant in addition to emissions from other industrial sources on the Burrup Peninsula which were not active at the time of the background monitoring;
- The modelling included use of RIVAD and ISORROPIA equations which consider the chemical transformation of nitrogen species and inorganic gas particle equilibrium respectively;
- Actual meteorological data from 2009 was used;
- Dispersion modelling undertaken considered five additional sensitive receptors;
- Modelled species included $SO_2$, sulfate ($SO_4$), nitrogen oxide (NO), $NO_2$, nitric acid ($HNO_3$), nitrogen trioxide ($NO_3$), $NH_3$, TSP, $PM_{10}$ and $PM_{2.5}$;
- Air emissions dispersion modelling was undertaken using the CALPUFF model, as opposed to the Ausplume model which was used in the PER document submitted previously for Part IV assessment;
- The background $NH_3$ concentration was set to 3 ppb throughout the year; and
- Modelling undertaken considered two scenarios (normal operations and non-routine operations). Emissions for non-routine operations were modelled as occurring continuously (i.e. conservatively).

## Summary of findings presented in the Updated Report

Predicted GLCs of $NO_2$ and $NH_3$ have decreased in the Updated Report compared to the data submitted at the PER stage of the proposal. The decrease in the predicted GLCs of $NO_2$ is attributed to:

- The use of measured background concentrations together with emissions from additional industry to provide a more realistic representation of expected concentrations compared to the previous study, which predicted background concentration to be 300% of measured 1999 levels; and
- The CALPUFF modelling takes account of chemical reactions that result in the formation $NO_2$ in the atmosphere from the breakdown and subsequent oxidation of other nitrogen compounds.

The decrease in the predicted GLCs of $NH_3$ was attributed to:

- Overall predicted emissions of $NH_3$ from the TAN Plant process had decreased slightly compared to the design estimates considered in original assessment; and
- Chemical algorithms included in the CALPUFF dispersion modelling account for the reaction and breakdown of $NH_3$ during dispersion which was not accounted for in the PER assessment.

Table 14 and Table 15 below show predicted GLCs of pollutants modelled using the CALPUFF model during normal operations and non-routine operating conditions of the TAN Plant.

The results indicate that for normal operations predicted concentrations for all modelled species were below the adopted assessment criteria.

Predictions for non-routine operations indicate that maximum GLCs may result in an exceedance of the $NO_2$ 1-hour criteria, however modelling does not anticipate an exceedance of any ambient criteria at receptors. Non-routine operations were expected to occur for up to six non-continuous hours per year, i.e. not continuously for a year as modelled. The potential for coincidence of worst-case atmospheric conditions and abnormal operations was considered to be limited.

Figure 2 below shows the contribution of various industrial sources to the 99.9$^{th}$ percentile concentration of $NO_2$ predicted for a location that coincides with human habitation (within Dampier). This indicates that the contribution of the TAN Plant is expected to be less than 1 µg/m$^3$ or approximately 1% of the predicted $NO_2$ concentration at this location.

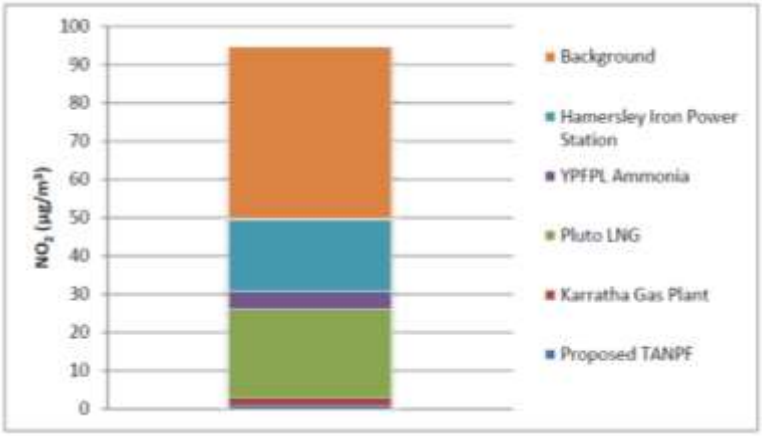



**Figure 2: Source apportionment of predicted concentrations for the maximum 99.9$^{th}$ percentile model result in an area of identified human sensitive receptors (Dampier), as presented in the PER**

In relation to the potential for air emissions from the TAN Plant to cause human health impacts, the Updated Report notes the following:

- The contribution of the TAN Plant will be less than 1 µg/$m^3$ or approximately 1% of the predicted ambient $NO_2$ concentration; and
- The contribution of the TAN Plant to the concentration of pollutants in areas of human habitation is small and would not be discernible from natural hourly variation observed during ambient monitoring. The Updated Report concluded that the TAN Plant is not likely to impact human health.

**Table 15. Predicted ground level concentrations (including background) during normal operations of the TAN Plant (2012 Updated Modelling)**

| | $NO_2$ | | $SO_2$ | | | TSP | $PM_{10}$ | $PM_{2.5}$ | | $NH_3$ | $HNO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\mu g/m^3$ | | $\mu g/m^3$ | | | $\mu g/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ | | $\mu g/m^3$ | $\mu g/m^3$ |
| **Averaging Period** | **1-hr** | **1-yr** | **1-hr** | **24-hr** | **1-yr** | **1-yr** | **24-hr** | **24-hr** | **1-yr** | **1-hr** | **1-hr** |
| Searipple Rd (Karratha) | 60.1 | 6.5 | 1.6 | 0.6 | 0.2 | 19.0 | 24.9 | 0.1 | 1.0 | 1.0 | 1.4 |
| Balmoral Rd (Karratha) | 55.5 | 6.5 | 1.2 | 0.6 | 0.2 | 18.9 | 24.6 | 0.0 | 0.8 | 1.1 | 1.2 |
| Dampier | 83.9 | 7.1 | 6.1 | 2.1 | 0.3 | 19.0 | 26.4 | 0.1 | 2.6 | 1.2 | 2.7 |
| Hearson Cove | 88.2 | 8.7 | 4.8 | 1.4 | 0.3 | 19.2 | 26.8 | 0.3 | 3.0 | 3.4 | 4.0 |
| Deep Gorge | 94.3 | 7.6 | 5.5 | 1.7 | 0.3 | 19.1 | 26.6 | 0.2 | 2.7 | 2.2 | 9.0 |
| Maximum | 186.2 | 10.2 | 13.1 | 3.9 | 0.7 | 19.3 | 30.2 | 0.4 | 6.4 | 7.0 | 22.3 |
| **Background** | **45.1** | **6.3** | **0.4** | **0.3** | **0.2** | **18.9** | **23.8** | **n/r** | **n/r** | **0.9** | **0.9** |
| **Criteria** | **246[1]** | **62[1]** | **571[1]** | **229[1]** | **57[1]** | **90[2]** | **50[1]** | **25[1]** | **8[1]** | **330[2]** | **90[2]** |

Note 1: NEPM Ambient Air
Note 2: Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.
Note 3: GLC values include background concentrations modelled.
Note 4: The Table above does not include Acid Deposition Rates which were also modelled by the Licence Holder, as potential impacts on Rock Art are not included in the scope of the Risk Assessment.
Note 5: NR = Note Reported

**Table 16. Predicted ground level concentrations during non-routine operations of the TAN Plant (2012 Updated Modelling)**

| | $NO_2$ | $SO_2$ | | $PM_{10}$ | $PM_{2.5}$ | $NH_3$ | $HNO_3$ |
|---|---|---|---|---|---|---|---|
| | $\mu g/m^3$ | $\mu g/m^3$ | | $\mu g/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ | $\mu g/m^3$ |
| **Averaging Period** | **1-hr** | **1-hr** | **24-hr** | **24-hr** | **24-hr** | **1-hr** | **1-hr** |
| Searipple Rd (Karratha) | 63.73 | 1.6 | 0.6 | 25.3 | 0.1 | 1.6 | 1.7 |
| Balmoral Rd (Karratha) | 64.33 | 1.2 | 0.6 | 26 | 0.2 | 2 | 1.3 |
| Dampier | 89.63 | 6.1 | 2.1 | 26.5 | 0.9 | 2.7 | 3.6 |
| Hearson Cove | 154.63 | 4.8 | 1.4 | 32.9 | 0.3 | 13.5 | 2.5 |
| Deep Gorge | 130.63 | 5.5 | 1.7 | 27.7 | 0 | 7.7 | 11.1 |
| Maximum | 300.03 | 13.1 | 3.9 | 38.5 | 1.8 | 31.8 | 31.6 |
| **Criteria** | **246[1]** | **523[1]** | **209[1]** | **50[1]** | **25[1]** | **330[2]** | **90[2]** |

Note 1: NEPM Ambient Air
Note 2: Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales
Note 3: GLC values include background concentrations modelled.
Note 4: The Table above does not include Acid deposition Rates which were also modelled by the Licence Holder.

### Review of the Updated Report

The Updated Report has been reviewed by the Department's air quality experts. The review concluded that:

- The modelling methodology used in the Updated Report was appropriate;
- The background $NO_2$ concentration used in the modelling is conservative and the assessment is an improvement on previous attempts and includes more realistic values;
- The use of monthly averages for background concentrations used for 1-hour modelling of $HNO_3$ and $NH_3$ is not appropriate; however, exceedances of the relevant ambient criteria appears unlikely given the stated low emission rates;
- Decommissioning of the Parker Point power station will reduce the levels of $NO_2$ emitted into the air shed; however, it is not possible to quantify the improvements without further modelling;
- Modelling of non-routine operations appears to be conservative and representative of worst case scenarios for the project. Although peak emissions during non-routine operations are expected to be significantly higher than the normal operating conditions, modelling suggests that ambient air quality assessment criteria will still be achieved at sensitive receptors; and
- While modelling predicts maximum ground level $NO_x$ concentrations above the assessment criteria during non-routine operations, these exceedances are not predicted to occur at sensitive receptors.

## 6.1.4 Assessment of air emissions data from the commissioning of the TAN Plant

The stack emissions data (CEMS and monthly stack monitoring) as presented in the Commissioning Report has been reviewed in the context of previous air emissions modelling information available. The review has identified that:

- Emission rates for $NH_3$ and NOx derived from monthly stack testing during commissioning are between 1.2 g/s and 2.2 g/s for NOx, and 0.003 g/s and 0.02 g/s for $NH_3$. These numbers compare favorably with those assessed at the works approval stage (and as discussed in sections above);
- Statistical analysis of NOx emission rates derived from CEMS time series data, excluding non-operational periods, concludes:
    - Emission rates were 1.48 g/s as the 95$^{th}$ percentile value, and 6.61 g/s as the 99$^{th}$ percentile. The value of 4.2 g/s used in the original modelling study to represent normal operations is between the 98$^{th}$ and 99$^{th}$ percentile, indicating that for this period, the plant was producing lower emissions than those assumed in the previous assessment; and
    - The maximum emission rate was 81 g/s, which is much higher than the maximum emissions used to characterize abnormal operations. There would be potential for short-term elevated GLCs if these concentrations were to occur post commissioning. However, it is noted that these high concentrations occurred in the early commissioning period and were much higher than adjacent readings; the hourly averages were also comparable to the maximum emission rates modelled.
- Statistical analysis of the CEMS data shows that emission rates considered in the original modelling assessment were conservative; and
- Statistical analysis of the time series data shows that higher emissions during abnormal operations are likely to be produced for less than 0.01% of time. Also, the higher

emission rates noted are for periods of less than an hour. Modelling scenarios comprised startup emission rates for the entire year, which is the standard and conservative approach to a modelling assessment. This validates the modelling assumptions.

Some ammonia is intermittently vented from process vents on the Unit 32 Prill Tower and Unit 12 Absorber during normal operations. The Licence Holder has advised details are as follows:

Unit 32 Prill Tower vent:

- Once per day for 10 minutes
- Design emission rate of 0.2 kg $NH_3$ per hour, equates to total 33 g for 10 minute period per day

Unit 12 vent:

- Design is 2.5 kg/h (not continuous)
- Actual venting rate for normal operations during commissioning was zero kg/h
- Total emission for plant startup estimated as 40 kg.

### 6.1.5 Assessment of compliance with improvement requirements of Existing Licence

Yara previously identified that the existing CEMS units installed on the primary reformer stack and the package boiler stack on the Ammonia Plant did not comply with the CEMS Code as required by the Existing Licence. An improvement requirement (reference IR1) was included on the licence requiring Yara to undertake a review of the CEMS to confirm compliance with the CEMS Code. If deficiencies were identified, Yara was requested to provide timeframes for implementing improvements to demonstrate compliance.

Information received from Yara on 30 June 2016 confirmed that the CEMS on the primary reformer and package boiler stack do not meet the requirements of the CEMS Code and that equipment upgrades would not be possible until 2017. An interim approach to monitoring emissions to air was proposed and a number of options investigated including an increased frequency of stack testing and undertaking semi-continuous monitoring using an instrumental gas analyser. Neither option was considered feasible by Yara for providing long term data trends.

An alternative approach to determining emissions was proposed involving the use of a predictive emissions monitoring system (PEMS), which uses emission factors and key process parameters, which are constantly metered and recorded, to calculate emission concentrations.

## Key Findings

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

1. Prior to the licence amendment granted in 2016, Yara only carried out annual stack sampling at the Ammonia Plant. This does not provide sufficient data needed to characterise the emissions profile during all normal operating conditions, which is required when establishing a PEMS.
2. A key factor in determining whether a PEMS can be used as an alternative monitoring methodology for regulatory reporting and compliance measurement purpose is to assess whether the PEMS proposed will have the same or better precision and reliability when compared to a CEMS. At this stage, Yara has not provided this evidence.
3. In the absence of a specific local guidance, United States Environmental Protection

Authority (USEPA) document *Volume 40 of the Code of Federal Regulations (CFR), Part 75, subpart E - Continuous Emission Monitoring, Alternative Monitoring Systems* contains relevant guidance on the use of PEMS.

4. USEPA document *Performance Specification 16 - Specifications and Test Procedures for Predictive Emission Monitoring Systems in Stationary Sources* includes further guidance on quality assurance and quality control requirements for PEMS.

### 6.1.6 Independent review of TAN Plant Commissioning Report data, air quality modelling, and human health impacts

DWER engaged Benchmark Toxicology Services (BTS) to undertake an independent peer review of information relating to emissions from the TAN Plant with respect to potential human health impacts.

This review considered the following documents:

- Works Approval Commissioning Report (including Appendix 5), Yara Pilbara Nitrates, 22 September 2017;
- Ambient air quality assessment (modelling of stack emissions), Environmental Resources Management Australia, 2012;
- A review of the Works Approval Commissioning Report, John L Black Consulting, March 2018;
- A response to a review of the Works Approval Commissioning Report submitted by John L Black Consulting, Strategen Environmental, 4 April 2018; and
- A letter report to Friends of Australian Rock Art described as a brief qualitative opinion of potential human health risks associated with ammonium nitrate plant emissions, University of Adelaide Exposure Science and Health, 5 February 2018.

The assessment and conclusions of this review are consistent with this assessment. Full details are available in the report: *Peer review of documents for an application of licence of an existing industrial premises currently being assessed by the Department of Water and Environmental Regulation*, dated 22 June 2018 from Benchmark Toxicology Services. This report is included as Appendix 5 of this Decision Report.

#### Key Findings

**Key finding:** The Delegated Officer has considered information in the independent review and has found:

1. Nitrogen Dioxide emissions from the TAN Plant during normal operations result in ambient air concentrations below ambient air quality guidelines. This is supported by monitoring data obtained during commissioning and updated air modelling undertaken by ERM in 2012.
2. Assumptions by Dr John Black regarding estimated concentrations of nitrogen dioxide based on photographic evidence are not scientifically justified.
3. Conclusions in the Dr John Black Report regarding NOx exceedances of ambient air quality guidelines are not scientifically justified. Stack emissions are not an appropriate health risk measure as there is no consideration of dose or exposure.
4. The release of nitrogen dioxide, as photographed, or estimated ambient air concentration resulting from the concurrent 15min average stack emissions was not likely to cause adverse health impacts to people exposed to the event.
5. The findings of this review are consistent with DWER's assessment of emissions from

the TAN Plant, as detailed in the Decision Report.

## 6.2 Noise emissions

Yara conducted noise monitoring during commissioning of the TAN Plant as required by Works Approval W4701/2010/1. The monitoring results, reflective of cumulative ambient noise emission levels at receptors, were submitted in the works approval Commissioning Report.

Noise monitoring was completed between 30 May 2016 and 17 May 2017 and involved:

- Daily attended 'spot' measurements at Hearson Cove and the Premises boundary;
- Attended measurements at Hearson Cove conducted during TAN Plant performance testing that included $^1/_3$ octave band analysis; and
- Continuous monitoring on the south-eastern boundary of the Premises and at Deep Gorge between 27 April and 4 May 2017.

Noise monitoring at Hearson Cove returned results that the aspirational target of 45 dB(a) established in EPA Bulletin 1077 was exceeded on 308 occasions (62%) during the program. These results did not differentiate between noise from the TAN Plant and noise from other sources. Of the results, Yara estimated that 125 measurements (41% of the exceedances) were influenced by external noise sources. As such the report concluded that it was difficult to determine the actual noise impact of the TAN Plant's contribution to the cumulative noise levels at Hearson Cove.

Background results were obtained during periods when the TAN Plant was shut down. Noise impacts at Hearson Cove have been inferred from the continuous monitoring results obtained at Deep Gorge as this location is a similar distance from the TAN Plant. The results indicate that the nitric acid plant compressor is the primary source of noise that may impact Hearson Cove. To mitigate the impact of noise from the compressor, Yara installed external acoustic insulation to the compressor air inlet duct in August 2017. There has not been any subsequent monitoring to determine the effectiveness of this control measure.

Noise monitoring results in the Commissioning Report have been reviewed by the Department's noise experts. This review identified the following:

- The data and conclusions of the noise monitoring are reasonable; and
- Both the TAN Plant and Ammonia Plant are considered contributors to noise levels at Hearson Cove. 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.

Internal advice was obtained regarding the relevance of the 45 dB(A) aspirational goal at Hearson Cove as referenced in EPA Bulletin 1077, given this related to an abandoned project. The advice confirmed that this aspirational goal should be considered obsolete based on the following:

- EPA Bulletin 1077 was published over 15 years ago;
- Three of the four industrial development proposals that were included in the cumulative noise modelling (on which the aspirational goal was based) were never built; and
- The TAN Plant was not included in this cumulative noise modelling.

The advice also concluded that cumulative 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 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).

Review of the noise monitoring data collected during commissioning of the TAN Plant indicates

that ambient noise levels at Hearson Cove during the TAN Plant commissioning were below the 65 dB(A) level, except for a few occasions. Noise levels measured at the south-eastern boundary of the Premises exceeded the 65 dB(A) level on one occasion (19 October 2016); however, the noise level at Hearson Cove for that day was 48 dB(A). On other occasions when the noise levels at Hearson Cove exceeded 65 dB(A), measured noise levels at the Premises boundary were below 65 dB(A), indicating that ambient noise levels at Hearson Cove were influenced by other sources other than the TAN Plant.

The results of the noise monitoring and the expert advice have been considered in the risk assessment detailed in section 9 of this report. During the course of consultation for this licence amendment process, Yara has committed to complete boundary noise monitoring to ensure compliance with the EP (Noise) Regulations.

## 6.3 Emissions to groundwater (land)

MS 870 and associated conditions for the TAN Plant include requirements for Yara to undertake detailed hydrogeological studies to quantify groundwater quality, groundwater flow directions, and the depth to groundwater beneath the Premises and surrounding areas. Further requirements relating to the design, construction and location of groundwater monitoring bores, sampling, and establishment of trigger levels were also prescribed. The relevant requirements are considered in further detail under the Regulatory Controls section of this Decision Report.

MS 586 and associated conditions for the Ammonia Plant do not stipulate any such requirements relating to the management of potential of groundwater impacts associated with the operation of the plant. Monitoring of potential emissions to groundwater from the Ammonia Plant is regulated under the Existing Licence. During the licence amendment undertaken in April 2015, the Delegated Officer determined that the existing groundwater monitoring program associated with the Ammonia Plant was not sufficient to effectively manage potential risks of groundwater contamination from the Premises operations. Therefore, an improvement requirement (reference IR2) was included on the Existing Licence requiring Yara Fertilisers to undertake a review of the existing groundwater monitoring program associated with the Ammonia Plant.

The *Draft Groundwater Data Review and Groundwater Monitoring Procedure* (Document No.200-200-PRO-YPF-0019) was submitted to the DWER in June 2016. The document was reviewed by the Department's contaminated sites experts who undertook a review of the:

- Appropriateness of the construction and location of the groundwater monitoring wells;
- Frequency of groundwater monitoring;
- Monitoring procedures and parameters monitored; and
- Trigger levels.

Historical groundwater data was also reviewed to identify existing impacts of contamination from operations of the Ammonia Plant. The data indicates that metals (including copper, nickel and zinc) are present in groundwater bores down gradient of the Premises at concentrations exceeding assessment criteria for marine waters published in DWER's Guideline: *Assessment and Management of Contaminated Sites 2014*; however, the review concluded that the information was not sufficient to determine if any clear trends in groundwater quality were emerging for metals or other chemicals of concern (such as ammonia and nitrate). Potential sources of contamination or risks to human health could not be identified.

Key recommendations from the review include:

- Improvements to monitoring procedures and bore construction to facilitate a better understanding of baseline groundwater conditions, depth to groundwater, and groundwater flow. This information will assist with future assessments of risks to groundwater;

- Alignment of monitoring procedures with the *National Environmental Protection (Assessment of Site Contamination) Measure 1999*;
- Recommendations for parameters to be measured;
- Recommendations relating to development of relevant trigger levels consistent with the approach stipulated in MS 586 for the TAN Plant; and
- Recommendations relating to further investigation to adequately assess potential impacts to soil, surface water, groundwater, and any identified ecological receptors.

Since this assessment was completed in 2016, Yara has provided additional information which addresses some of the abovementioned recommendations. Yara has also committed to continuing with groundwater investigations and identification of relevant trigger levels.

Recommendations from the review are considered in further detail under the Regulatory Controls section of the Decision Report.

### 6.3.1 Key findings

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

1. There is potential for managing cumulative impacts on groundwater due to operation of the Ammonia Plant and the TAN Plant through licence conditions.
2. Further work is required to determine appropriate trigger levels, covering both the Ammonia Plant and TAN Plant.

# 7. Consultation

The application for the licence amendment was advertised in *The West Australian* on Monday 11 July 2016. Eight direct interest stakeholders were notified including the City of Karratha, the then Department of Parks and Wildlife (now Department of Biodiversity, Conservation and Attractions), Water Corporation, Friends of Australian Rock Art, Hon. Robin Chapple MLA, and Dr John Black.

Sixty two submissions were received by the DWER. A summary of the submissions and the Delegated Officer's consideration of them is contained in Appendix 2.

DWER undertook a series of meetings and workshops with the Licence Holder throughout the assessment period. The topics covered included:

- Groundwater and previous improvement requirements;
- Wastewater Treatment Plant Requirements;
- Discharges to Land;
- Noise; and
- Air emissions and monitoring.

Where additional information was provided by the Licence Holder which informed this assessment, documents have been listed in Table 2.

# 8. Location and siting

## 8.1 Siting context

The Ammonia Plant and TAN Plant are located on the Burrup Peninsula, 11 km north-west of Karratha. The Premises are located within the Burrup Strategic Industrial Area; a well-established strategic heavy industrial estate. Non-industrial land to the north and south of the Premises form part of the Murujuga National Park, which is recognised for its cultural significance and ecological and biological diversity.

## 8.2 Residential and sensitive premises

The distance to residential and sensitive receptors are shown in Table 16.

**Table 17. Receptors and distance from prescribed activity.**

| Residential and Sensitive Premises | Distance from Prescribed Activity |
|---|---|
| Hearson Cove beach<br>(zoned conservation recreation and natural/landscapes City of Karratha Planning Scheme No.8) | 900 m to the southeast (measured from the eastern wall of the bulk storage shed) |
| Deep Gorge (recreational area)<br>(zoned conservation recreation and natural/landscapes City of Karratha Planning Scheme No.8) | 1,000 m south of the boundary of the TAN Plant. |
| Industrial receptor – Pilbara Port Authority lease area (multiple users) including ammonia loading facilities<br>(zoned strategic industry City of Karratha Planning Scheme No.8) | 1,200 m to the closest occupied buildings west of the Ammonia Plant |
| Industrial receptor – Pluto LNG Project<br>(zoned strategic industry City of Karratha Planning Scheme No.8) | 1,300 m to the north west (measured from the boundary the Ammonia Plant) |
| Industrial receptor – Karratha Gas Plant<br>(zoned strategic industry City of Karratha Planning Scheme No.8) | 2,600 m to the north west (measured from the north-west corner of the TAN Plant) |
| Industrial receptor – Parker Point Iron Ore Port<br>(zoned strategic industry City of Karratha Planning Scheme No.8) | 4,500 m to the south west (measured from the boundary the Ammonia Plant) |
| Residential Premises – Dampier townsite | 6.9 km to the south west (measured from the boundary of the Ammonia Plant) |
| Residential Premises – Karratha townsite | 11.5 km to the south-south east (measured from the boundary of the Ammonia Plant) |

## 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 8. Table 8 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

## Table 18: Environmental values

| **Specified ecosystems** | **Distance from the Premises** |
|---|---|
| Parks and Wildlife Managed Lands and Waters | Murujuga National Park - Borders Lot 3017 to the east, 500 m from the boundary of the Ammonia Plant to the north and 900 m to the south.<br>Deep Gorge, a popular site frequented by tourists containing rock art, is located 1,100 m south (measured from the Contaminated Water Ponds to the Deep Gorge car park). |
| 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 of the Ammonia Plant.<br>Priority 1 ecological communities exist within 5,00 0m of the TAN Plant including 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 | Priority 3 flora has 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. 24 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 | Supratidal flat located directly adjacent to the Premises boundary to the south.<br>Mangrove community located 1,000 m east of Lot 564.<br>The waters of King Bay are afforded a high level of ecological protection with the exception of a one hectare area surrounding the 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 2006b). |
| Hearson Cove – marine tidal ecosystem | 800 m to the east (measured from the eastern wall of the bulk storage shed). |
| 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.<br>Nearest rock art to the Premises is 400 m. |

## 8.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 9.

**Table 19: 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 TAN Plant including areas such as the clean and contaminated water pond are elevated to 5.5 mAHD. | 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 ranges from a maximum of 11 mbgl in the northern, more elevated areas to a minimum of 0.2mbgl in the southern part of the Premises near the supra-tidal flat area). Variation is driven by tidal variation and rainfall.<br>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) (based on information within works approval W4701/2010/1 and groundwater reports).<br>The Premises is located within the Pilbara Groundwater Area and Pilbara Surface Water Area (proclaimed under the *Rights in Water Irrigation Act 1914*). | Water is not used for potable or industrial use.<br>Groundwater flows to the south-east, towards the supra-tidal flats which connect to King Bay. Mangrove community located 1,000 m east of the boundary of the Ammonia Plant. |

## 8.5 Soil type

The Premises are partially located in 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 TAN Plant is located on colluvium of sand, silt and gravel in outwash fans of the supra-tidal flats between Kings Bay and Hearson Cove. This supra-tidal flat indicates a soil profile associated with a low energy marine depositional environment.Table 20 details soil types and characteristics relevant to the assessment.

**Table 20: 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 2 shows the annual wind rose based on the five year average annual wind direction and strength.

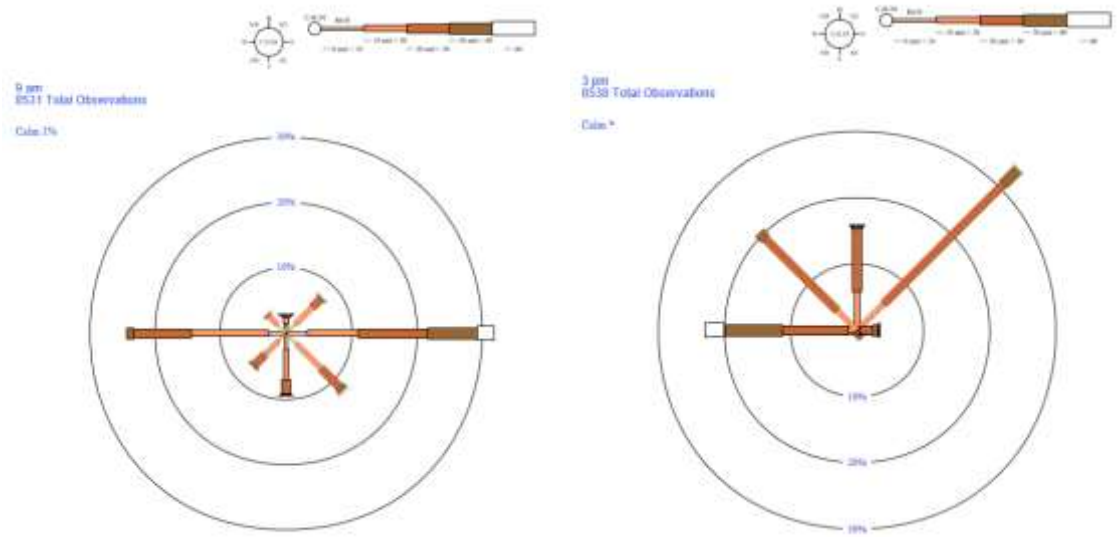


**Figure 2. Wind Rose, Karratha Airport based annual average**

*(Sourced from www.bom.gov.au on 30 April 2018)*

As shown in Figure 2, 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 °C in January to 26.2 °C in July and mean minimum temperatures range from 26.7 °C in January to 13.7 °C in July. Mean monthly rainfalls vary from 0.5 mm in October to 74.2 mm in February. Mean annual rainfall is 298.6 mm (BOM 2016a). Annual evaporation is approximately 3,200 mm (BOM 2016b).

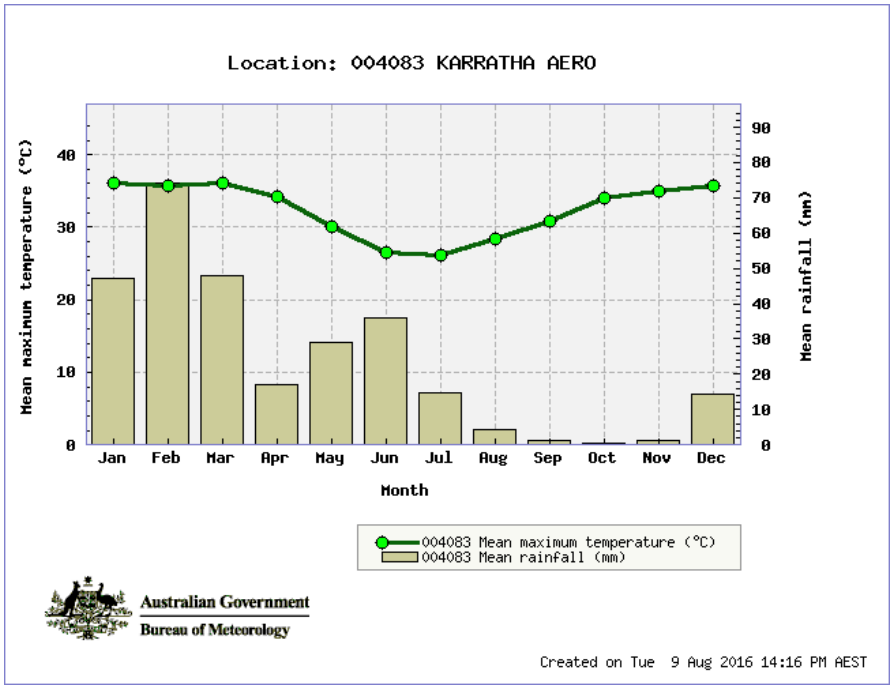



**Figure 3. Mean temperature and rainfall at Karratha airport**

# 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 the risk assessment set out in Tables 22-27.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Tables 22-27 below.

**Table 21: Identification of emissions, pathway and receptors - Ammonia Plant (normal operations)**

| Risk Events: Ammonia Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Point source emissions to Air | NOx, $PM_{10}$, CO | Primary reformer furnace | Hearson Cove and Cowrie Cove (beach recreation)<br>Residential areas at Dampier and Karratha<br>Industrial workforce at Mermaid Marine, Dampier Port Authority and Woodside facilities | Air/ wind dispersion | Health and amenity impacts | Yes | See sections 9.4, 9.5 |
| | NOx, $SO_2$, $PM_{10}$, CO | Package boiler<br>(operates at 25% load during normal operations) | | | | | |
| | $CO_2$, CO | $CO_2$ stripper stack | | Air/ wind dispersion | Potential impacts associated with climate change | No | 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 in MS.586.<br>On 5 August 2015, the Ministerial Statement was amended which noted that *The National Greenhouse and Energy Reporting Act 2007* is the appropriate regulatory mechanism for $CO_2$ emissions from the process. |
| | -- | Power Generation (Internal Generation).<br>1 x 22MW captive steam turbine generator operating at 100% capacity.<br>1 x 22MW captive steam turbine generator operated at 25% capacity. | | Air/ wind dispersion | Health and amenity impacts | 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. |

| Risk Events: Ammonia Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Emissions to land | Total dissolved solids (TDS), total suspended solids (TSS), hydrocarbons<br>See Appendix 3 for details of other contaminants expected | **Wastewater effluent sump** which collects following streams prior to disposal via seawater outfall:<br>• Process condensate<br>• $CO_2$ removal purge<br>• Boiler blowdown<br>• Outflow from the oil interceptor which collects following streams:<br>  ○ Gland condenser steam condensate<br>  ○ Intercoolers<br>  ○ Wastewater from curbed potentially oil contaminated areas | Groundwater (<3mBGL) and dependent ecosystems | Direct discharge/ infiltration | Groundwater contamination | Yes | Emissions to land may occur as a result of loss of containment or planned discharges from sedimentation basins to tidal mud flats. See section 9.9 |
| | Hydrocarbons | **Oil containment sump** which collects oil from the oil interceptor outlet | | | | | |
| | TDS, TSS, | **Drains** which collect following wastewater streams:<br>• Laboratory wastewater (neutralized)<br>• Demineraliser drains<br>• Regenerated demineraliser wastewater (neutralized) | | | | | |

| Risk Events: Ammonia Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| | TSS, TDS, hydrocarbons | Planned discharge from the eastern and western sedimentation basins collecting stormwater runoff and cooling tower blowdown from the Ammonia Plant | | | | | |
| | Solid waste | Spent catalysts, resins, filter media, desiccants. See Appendix 3 for details of potential contaminants. | Groundwater (<3 mBGL) | Direct discharge/ leachate | Groundwater contamination | Yes | Impacts may occur as a result of inadequate storage or loss of containment. See section 9.9 |
| | | Stabilised biosolids from wastewater treatment plant onsite | | | | | |
| | | Domestic waste & Commercial Waste comprising recyclable, organic and residual materials | | | | | |
| | Saline water | Leakage from or failure of pipeline carrying seawater for the cooling purposes to be used in the seawater cooling circuit | Vegetation | Direct discharge/ Infiltration | Groundwater contamination | Yes | |
| | Liquid $NH_3$ | Leakage from ammonia storage tanks | Groundwater (<3 mBGL) | | | No | The Delegated Officer considers these risk events were previously assessed, and projects approved, under Part IV of the EP Act. DMIRS is the regulatory authority for Major Hazard Facilities. |
| | Hydrocarbons | Spills of Hydrocarbons/ fuels | | | | | |

| Risk Events: Ammonia Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| | | Spills of hazardous materials including MDEA, sulfuric acid ($H_2SO_4$), caustic, liquid $NH_3$ | Groundwater (<3 mBGL) | Direct discharge/ infiltration | Groundwater contamination | Yes | See section 9.10 |
| Point source emissions to marine waters | Temperature, salinity, nutrients, methanol, anti-scalants and biocides | Seawater outfall via MUBRL operated by Water Corporation:<br>• Cooling tower blowdown<br>• Jacket water blowdown<br>• Outflow from the wastewater effluent sump<br>• Wastewater from wastewater and neutralisation pits<br>• Desalination plant reject water stream | Marine ecosystem | Direct discharge | Degradation of marine water quality<br>Ecological impacts | Yes | See section 9.11, 9.12 |
| | TSS, hydrocarbons, MDEA | Direct Discharge from the western sedimentation basin and eastern sedimentation basin into King Bay Tidal Flats. The sedimentation basins receive:<br>• Stormwater; and<br>• Cooling tower blowdown | | | | | |

| Risk Events: Ammonia Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Noise | Noise | Normal operation of the Ammonia Plant and associated process equipment | Hearson Cove and Cowrie Cove (beach recreation)<br>Residential areas at Dampier and Karratha<br>Industrial workforce at Mermaid Marine, Dampier Port Authority and Woodside facilities | Air/ wind dispersion | Health/ amenity impacts | Yes | See section 9.13 |
| Light | Light spill | | Beach recreation<br>Terrestrial species including reptiles, amphibians, birds and mammals present in surrounding areas | Air | | No | The Delegated Officer has determined that light emissions during operation are not likely to cause significant impacts considering the location and presence of other industrial premises in the vicinity. |

**Table 22: Identification of emissions, pathway and receptors - Ammonia Plant startup, shutdown and upset conditions**

| Risk Events: Ammonia Plant (startup, shutdown and upset conditions) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Point source emissions to air | $NO_x$, $SO_2$, CO, $PM_{10}$ | Startup (cold and Hot):<br>Package boilers | Hearson Cove and Cowrie Cove (beach recreation)<br>Residential areas at Dampier and Karratha<br>Industrial workforce at Mermaid Marine, Dampier Port Authority and Woodside facilities | Air/ wind dispersion | Health and amenity impacts | Yes | See section 9.7 |
| | | Startup (cold and Hot):<br>Primary Reformer Furnace | | | | | |
| | | Startup (cold and hot):<br>Startup heater | | | | | |
| | Gases comprising $H_2$, $N_2$ and $CH_4$ | Startup (cold and hot):<br>Vent A and vent B | | | | | |
| | Gases comprising $H_2$, $N_2$ | Plant trip:<br>Back End Vent - Vent A | | | | | |
| | Gases comprising $H_2$, $N_2$, $CH_4$, CO, $CO_2$ | Plant trip:<br>Front End Vent - Vent B | | | | | |

| Risk Events: Ammonia Plant (startup, shutdown and upset conditions) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| | NOx, $NH_3$, $N_2$, $H_2O$ | Refrigeration Plant Failure:<br>Ammonia storage tank flare | | | | Yes | See section 9.6, 9.7 |
| | Combustion gases | 1.5 MW Emergency Diesel Generator | | | | No | The Delegated Officer considers this emission source is minor and will unlikely have any impact offsite. |
| Fugitive emission to air | $NH_3$ | Leakage from product pipeline carrying refrigerated (volatile) liquid NH3 between the Premises and the Dampier Public Wharf. | Hearson Cove and Cowrie Cove (beach recreation)<br>Residential areas at Dampier and Karratha<br>Industrial workforce at Mermaid Marine, Dampier Port Authority and Woodside facilities | Air/ Wind dispersion | Health impacts | No | A portion of the 4.3km long pipeline falls within Premises boundary. Pipelines was 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. A former 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.<br>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 |

| Risk Events: Ammonia Plant (startup, shutdown and upset conditions) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Odour | $NH_3$ | Failure of refrigeration system for the ammonia storage tanks;<br>Leak/ spill from the ammonia pipeline | Hearson Cove and Cowrie Cove (beach recreation)<br>Residential areas at Dampier and Karratha<br>Industrial workforce at Mermaid Marine, Dampier Port Authority and Woodside facilities | Air/ wind dispersion | Amenity impacts | 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 23: Identification of emissions, pathway and receptors - TAN Plant (normal operations)**

| Risk Events: TAN Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Point source emissions to air | NOx (as $NO_2$), $N_2O$, $NH_3$ | Nitric acid plant tail gas<br>Nitric acid storage tank vents (A and B) | Hearson Cove and Cowrie Cove (beach recreation)<br>Residential areas at Dampier and Karratha<br>Industrial workforce at Mermaid Marine, Dampier Port Authority and Woodside facilities | Air/ wind dispersion | Health and amenity impacts | Yes | See section 9.4<br>Note: $SO_2$ emissions will occur; however these are not expected to be significant when compared to assessment criteria. Therefore emissions of $SO_2$ have not been considered further.<br>Ammonia venting from Unit 32 and Unit 12 vents is minimal, therefore unlikely to have an offsite impact. |
| | $NH_3$, PM | Ammonium nitrate solution plant (common stack) | | | | | |
| | $NH_3$, $PM_{10}$ (ammonium nitrate) | TAN prilling plant (via common stack) | | | | | |
| | $NH_3$ | Unit 32 and Unit 12 vents | | | | | |
| Fugitive Emissions to air | PM | Handling of TAN product | | | | | Refer to section 9.8 |
| Noise emissions | Noise | Normal operation of the TAN Plant and associated process equipment | | Air/ wind dispersion | Health/ amenity impacts | Yes | Refer to section 9.13 |
| Light emissions | Light | | | | | No | The Delegated Officer has determined that light emissions during operation are not likely to cause significant impacts considering the location and presence of other industrial premises in the vicinity. |

| Risk Events: TAN Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Emissions to land | TSS, hydrocarbons, nutrient rich water | Discharge/ seepage from contaminated stormwater ponds 4 and 5<br>The contaminated stormwater ponds receive:<br>• Contaminated water from process areas;<br>• Flushing water;<br>• Air condensate for instrument air;<br>• Reverse ssmosis cleaning and flushing water;<br>• Rejected reverse osmosis condensate waste;<br>• Mixed bed regeneration; and<br>• Rejected clean process condensates. | Groundwater (<11 mBGL) | Direct discharge/ infiltration | Groundwater contamination | Yes | Refer to section 9.9 |
| | TAN<br><br>Heavy metals, Hydrocarbons | Solid waste/ special waste:<br>Components of off-spec prills (specifically organic matter) which can't be recycled in the process (120kg/day)<br>Catalysts from the nitric acid plant<br>Heat exchanger sludge and sludge from nitric acid process equipment<br>Oil residue and sludge from ammonia stripper<br>Sludge from contaminated stormwater ponds | | | | | |

| Risk Events: TAN Plant (normal operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| **Emissions to land: storage of chemicals** | Nitric acid | Two nitric acid storage tanks with a total capacity of 3000 m3 | | | | Yes | Refer to section 9.9 |
| | Ammonium nitrate solution | Ammonium nitrate solution tank (500 tonnes) | | | | | |
| | Hydrocarbons | Diesel storage (approximately 70 $m^3$) | | | | | |
| **Discharge to marine waters** | Nitrogen (from ammonia and ammonium nitrate 15ppm each) | Seawater outfall via MUBRL operated by Water Corporation:<br>• Blowdown from sea water cooling tower<br>• Purified process condensate<br>• Chiller condensate<br>• Boiler blowdown | Marine waters<br>Marine ecosystem | Direct discharge | Degradation of surface water quality and associated impacts | Yes | Refer to section 9.11 |

**Table 24: Identification of emissions, pathway and receptors - TAN Plant (non-routine operations)**

| Risk Events: TAN Plant (non-routine operations) | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Point source emissions to air | $NO_x$, $NH_3$, $PM_{10}$ | Nitric acid plant<br>TAN prilling plant and ammonium nitrate solution plant via (Common stack) | Hearson Cove and Cowrie Cove (beach recreation)<br>Residential areas at Dampier and Karratha<br>Industrial workforce at Mermaid Marine, Dampier Port Authority and Woodside facilities | Air/ Wind dispersion | Health impacts | Yes | Refer to section 9.4, 9.5<br>The PER document notes that continuous venting sources were eliminated during the concept design stage of the TAN Plant; the closed-loop design of the process only provides for discharges of major emissions through controlled emission points. Accordingly, venting/ flaring of emissions at the TAN Plant are not considered further in this assessment. |
| | $NH_3$ | Unit 12 vent | | | | No | The Delegated Officer considers ammonia venting from Unit 32 and Unit 12 vents is minimal, therefore unlikely to have an offsite impact. |
| Fugitive emissions to air | $NH_3$ | Non-mitigated release of ammonia associated with:<br>• Leak in the above-ground pipeline carrying liquid ammonia from the Ammonia Plant to TAN Plant;<br>• Leaks from chillers, vaporisers | | | | Yes | Refer to section 9.7 |

**Table 25: Identification of emissions, pathway and receptors - WWTPs servicing the TAN Plant and Ammonia Plant**

| Risk Events: WWTPs servicing the TAN Plant and Ammonia Plant | | | | | | Continue to detailed risk assessment | Reasoning |
|---|---|---|---|---|---|---|---|
| **Emission Type** | **Emission** | **Source/ Activities** | **Potential receptors** | **Potential pathway** | **Potential adverse impacts (cumulative)** | | |
| Emissions to land | Nutrients, TDS, biochemical and chemical oxygen demand (BOD, COD) | Discharge of treated domestic wastewater from Ammonia Plant WWTP to infiltration basins | Groundwater | Direct discharge/ infiltration | Groundwater contamination | Yes | Refer to section 9.110 |
| | | Discharge of treated domestic wastewater from the TAN Plant ATUs to clean surface water pond | | | | | |
| Emissions to Air | Odour | Operation of the sewage treatment plants servicing the Ammonia Plant and the TAN Plant | Residential receptors<br>Recreation (Hearson Cove) | Air/ wind dispersion | Amenity impacts | 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.<br>The Delegated Officer considers that the separation distance between the WWTPs and potential receptors is sufficient to prevent the Risk Event from occurring. |

## 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 26 below.

**Table 26: 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 27 below.

**Table 27: 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<br>• **offsite impacts local scale**: high level or above<br>• **offsite impacts wider scale:** mid-level or above<br>• Mid to long-term or permanent impact to an area of high conservation value or special significance^<br>• Specific Consequence Criteria (for environment) are significantly exceeded | • Loss of life<br>• **Adverse health effects:** high level or ongoing medical treatment<br>• Specific Consequence Criteria (for public health) are significantly exceeded<br>• **Local scale impacts:** permanent loss of amenity |
| Likely | The risk event will probably occur in most circumstances | Major | • **onsite impacts**: high level<br>• **offsite impacts local scale**: mid-level<br>• **offsite impacts wider scale**: low level<br>• Short-term impact to an area of high conservation value or special significance^<br>• Specific Consequence Criteria (for environment) are exceeded | • **Adverse health effects:** mid-level or frequent medical treatment<br>• Specific Consequence Criteria (for public health) are exceeded<br>• **Local scale impacts**: high level impact to amenity |
| Possible | The risk event could occur at some time | Moderate | • **onsite impacts**: mid-level<br>• **offsite impacts local scale**: low level<br>• **offsite impacts wider scale**: minimal<br>• Specific Consequence Criteria (for environment) are at risk of not being met | • **Adverse health effects:** low level or occasional medical treatment<br>• Specific Consequence Criteria (for public health) are at risk of not being met<br>• **Local scale impacts:** mid-level impact to amenity |
| Unlikely | The risk event will probably not occur in most circumstances | Minor | • **onsite impacts**: low level<br>• **offsite impacts local scale**: minimal<br>• **offsite impacts wider scale**: not detectable<br>• Specific Consequence Criteria (for environment) likely to be met | • Specific Consequence Criteria (for public health) are likely to be met<br>• **Local scale impacts:** low level impact to amenity |
| Rare | The risk event may only occur in exceptional circumstances | Slight | • **onsite impact**: minimal<br>• Specific Consequence Criteria (for environment) met | • **Local scale**: minimal to amenity<br>• 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 28 below:

**Table 28: 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.<br>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 (Ammonia Plant and TAN Plant: normal operations)

### 9.4.1 Description of risk of point source emissions to air causing environmental or public health impacts

Key point source air emission sources of NOx, $SO_2$ and CO from the Ammonia Plant include the primary reformer stack and the package boiler stack. Key emissions from the nitric acid plant stack in the TAN Plant include $NO_X$ (as $NO_2$), $N_2O$ and $NH_3$. Key emissions from the common stack in the TAN Plant are PM and $NH_3$.

### 9.4.2 Identification and general characterisation of emission

Refer to section 6.1 of this Decision Report for details on the estimated emission rates of various contaminants in emissions to air as reported in the PER documents for the Part IV assessment.

Table 24 below includes a summary of the stack emission concentrations as reported in the AERs for the Ammonia Plant. Prior to the licence amendment granted in 2016, Yara was only required to undertake annual stack sampling. The values for 2016 are the averages of the two stack sampling events undertaken in that reporting year as per the amended licence conditions. The amended licence in 2016 only specified stack monitoring requirements for NOx; accordingly stack monitoring results for other parameters have not been reported in the AER. Yara have advised that the $SO_2$ and NOx results obtained for the $CO_2$ Stripper are likely to be the result of analyser interference rather than actual emissions.

Monitoring results from CEMS installed on the Ammonia Plant stack have not been considered in this assessment. The CEMS are known to be non-compliant with the CEMS Code and the recorded values are not reliable when compared with the extractive sampling results reported.

The works approval for the TAN Plant specified that stack sampling must be conducted for each month during commissioning. The data, as reported in the Commissioning Report dated 29 September 2017, is included in Table 30 below.

**Table 29 Identification and general characterisation of emission - Ammonia Plant**

| Source | Primary reformer (mg/m3) | | | | $CO_2$ stripper (mg/m3) | | | | Package boiler (mg/m3) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 2014 | 2015 | 2016 | 2017 | 2014 | 2015 | 2016 | 2017 | 2014 | 2015 | 2016 | 2017 |
| NOx | 160 | 94 | 29 | 32 | n/a | 4 | n/a | | 56 | 63 | 52.5 | 51 |
| SO2 | <4.7 | <4.9 | n/a | n/a | n/a | 47 | n/a | | <3.1 | <3.6 | n/a | n/a |
| PM10 | 1.7 | <1 | n/a | n/a | n/a | n/a | n/a | | 1.4 | n/a | n/a | n/a |
| CO | 11 | <2.2 | n/a | n/a | n/a | 330 | n/a | | 79 | 39.48 | n/a | n/a |

**Table 30 Identification and general characterisation of emissions - TAN Plant**

| Source | Common stack | | | | | Nitric acid plant stack | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Apr-17 | May-17 | Jun-17 | Jul-17 | Aug-17 | Apr-17 | May-17 | Jun-17 | Jul-17 | Aug-17 |
| PM | 2.4 | 3.7 | 3.6 | Not sampled | 3 | Sampling not required under W4701 | | | | |
| mg/Nm$^3$ | 0.087 | 0.12 | 0.12 | | 0.11 | | | | | |
| g/s | | | | | | | | | | |
| $NH_3$ | <0.6 | 3.3 | 3.1 | Not sampled | 3.6 | <0.1 | <0.2 | <0.3 | Not sampled | 0.68 |
| mg/Nm$^3$ | <0.021 | 0.11 | 0.105 | | 0.13 | <0.003 | <0.005 | <0.007 | | 0.02 |
| g/s | | | | | | | | | | |
| NOx | Sampling not required under W4701 | | | | | 50 | 88 | 92 | Not sampled | 80 |
| mg/Nm$^3$ | | | | | | 1.2 | 2.1 | 2.2 | | 1.9 |
| g/s | | | | | | | | | | |
| $N_2O$ ppmv | | | | | | 21 | 25 | 15 | Not sampled | 18 |
| g/s | | | | | | 1 | 1.1 | 0.67 | | 0.84 |

**Table 31: GLCs (µg/m$^3$) from combined emissions at Ammonia and TAN Plant - normal operating conditions**

| 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 | 82 | 45 | 100 |
| | 61 | Annual | 0.97 | 0.42 | 0.11 | 2.51 | 21 | 6.3 | 32 |
| **$SO_2$** | 520 | 1-hour | 1.56 | 1.25 | 0.62 | 4.37 | 2.1 | 0.4 | 2.2 |
| | 226 | 24-hour | 0.31 | 0.12 | 0.06 | 0.94 | 1.8 | 0.3 | 1.9 |
| | 56 | Annual | 0.03 | 0.01 | 0.002 | 0.08 | 0.9 | 0.2 | 1.3 |
| **CO** | 10300 | 8-hour | 49 | 17 | 9.4 | 99 | 3.9 | N/R | 3.9 |
| **$NH_3$** | 330 | 1-hour | 14 | 3.2 | 1.06 | 27 | 20 | 0.9 | 20 |
| | 180 | Annual | 0.37 | 0.07 | 0.01 | 1.48 | 1.0 | N/R | 1.0 |
| **TSP** | 90 | 24-hour | 1.21 | 0.76 | 0.36 | 2.85 | 12 | 18.9 | 33 |
| **$PM_{10}$** | 50 | 24-hour | 0.60 | 0.38 | 0.18 | 1.42 | 11 | 23.8 | 58 |

Note 1: Background figures are determined in 2012 updated modelling (TAN Plant).

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

A modelling assessment which considers the cumulative impact of both the Ammonia Plant and TAN Plant has not been completed. Yara have used an approach which assumes that the maximum GLCs from each plant will occur simultaneously at the receptors, which is highly unlikely to occur. In particular, the emissions sources from each plant are separated by at least 390 m (Package Boiler stack to Nitric Acid Plant stack), which means that even for times of winds blow along the axis of those stacks, the emissions from the stack nearest to the wind will already be significantly diluted before the emissions from the next stack interact with the plume. A similar situation will occur for the alignments of the other stacks with various wind directions.

Maximum predicted GLCs from concurrent normal operations of the Ammonia and TAN Plants are shown in Table 31. These are derived from the actual emissions data from the Ammonia Plant from 2015-2017 (Table 29) and emissions from the TAN Plant commissioning (Table 30). Emissions data from the Ammonia Plant prior to 2015 are not representative of emissions from current operations of have been excluded from this assessment.

From the information provided It is not clear where each of the maximum GLCs occur and under what meteorological conditions. 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 this information provides a conservative estimate of potential air quality and the contribution from Yara's operations (Ammonia and TAN Plant).

### 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 and the TAN Plant to impact on ambient air quality and to cause environmental and public health impacts through dispersion in air.

#### Nitrogen oxides

Nitrogen oxides are a respiratory irritant which may contribute to bronchitis in infants, children and susceptible adults. Nitrogen oxides along with hydrocarbons are the basis of formation of photochemical smog. Nitrogen dioxide has an odour and is an acidic gas which can contribute to acid rain.

The cumulative air quality assessment (See Table 31) indicates that, amongst the receptors considered, the highest 1-hr and annual GLC of $NO_2$ is likely to be experienced at Hearson Cove (54% and 14% of the assessment criteria, respectively). These GLCs include background concentrations which were 18% of the 1-hr criterion and 10% of the annual criterion. Maximum impacts from the Ammonia and TAN Plants at the nearest receptor Hearson Cove, were 35% of the 1-hr criteria and 4% of the annual criteria.

#### Sulfur dioxide

$SO_2$ is an acidic gas which has a sharp smell. It can irritate the nose, throat, and airways, and can cause coughing, wheezing, and shortness of breath. Cumulative modelling results, presented in Table 31, indicate that GLCs of $SO_2$ can reach 0.8% of the assessment criteria (1-hr) (at Hearson Cove) during normal operations.

#### 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.

CO was not included in the contaminants modelled to assess potential GLCs during normal operation of the Ammonia Plant and the TAN Plant.

The PER document for the Ammonia Plant had predicted CO emissions from the $CO_2$ stripper stack to be negligible (see Table 10). However, the 2015 stack monitoring data submitted shows a CO concentration of 330 mg/m$^3$ from the $CO_2$ stripper stack. CO emissions from the primary

reformer and package boiler stacks are also noted to be higher than those estimated at the time of modelling (3.1 mg/m$^3$ and 0.31 mg/m$^3$ respectively).

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

### Ammonia

Ammonia gas has an intense and irritating odour, and is corrosive. Potential health impacts associated with exposure include irritation to eyes, the throat and nose. Higher concentrations may cause breathing difficulty and chest pain etc., and overexposure can cause death.

Cumulative modelling results, presented in Table 31, indicate that GLCs of $NH_3$ can reach approximately 8% of the adopted short term (1-hour) assessment criteria at Hearson Cove during normal operations.

Predicted nitric acid concentrations at Hearson Cove from the TAN Plant (there are no emissions from the Ammonia Plant) were shown to be below 4.5% of assessment criteria and 10% of assessment criteria at Deep Gorge (see Table 15).

### Particulates (ammonium nitrate):

Particulate matter emitted from the TAN Plant process is assumed to mainly comprise of ammonium nitrate particulates and some coating materials. Elevated concentrations of ammonium nitrate can cause impacts including headache, dizziness, and eye and skin irritation. Maximum predicted cumulative concentrations of TSP at sensitive receptors is 24% of the assessment criteria, with the background contributing to the majority of the criteria at 21%.

## 9.4.4 Criteria for assessment

Ambient air quality goals set in the *National Environmental Protection (Ambient Air Quality) Measure* (NEPM), as amended on 4 February 2016 are considered appropriate, refer to Table 32.

**Table 32: Assessment criteria - gaseous and particulate emissions**

| Parameter | Ambient criteria | Averaging period | Guideline |
|---|---|---|---|
| CO | 9 ppm | 8-hour | NEPM |
| NOx | 0.12 ppm | 1-hour | |
| | 0.03 ppm | Annual | |
| $SO_2$ | 0.2 ppm | 1-hour | |
| | 0.08 ppm | 24-hour | |
| | 0.02 ppm | Annual | |
| $PM_{10}$ | 50 µg/m$^3$ | 24-hour | |
| | 25 µg/m$^3$ | Annual | |
| $PM_{2.5}$ | 25 µg/m$^3$ | 24-hour | |
| | 8 µg/m$^3$ | Annual | |

| Parameter | Ambient criteria | Averaging period | Guideline |
|---|---|---|---|
| $NH_3$ | 330 µg/$m^3$ | 1-hour | Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales |

### 9.4.5 Licence Holder controls

Specific engineering and management controls adopted are summarised in Table 33 below.

**Table 33: Engineering and management controls**

| Plant component | Engineering/ Management controls |
|---|---|
| Ammonia Plant | Design features and operational practices including:<br>• Process controls for plant reliability;<br>• Adoption of excess air process;<br>• Installation of low NOx burners on primary reformer and startup heater;<br>• Use of low sulfur gas from the North-West Shelf;<br>• Minimal venting and flaring from the plant during normal operations;<br>• Installation of CEMS on primary reformer and package boiler stacks<br>• Stack verification testing on 6 monthly basis. |
| Nitric acid plant | Dual pressure process plant design to:<br>• lower operational energy consumption rates from increased combustion efficiency<br>• lower $NH_3$ consumption during operation<br>• reduce concentration of $N_2O$ in tail gas; and<br>• provide longer equipment life. |
| | Use of catalytic abatement system to achieve lower NOx concentration in tail gas |
| | Designed to recover waste heat from the exothermic process which is recycled through the steam system which reuses steam to generate electric power. |
| Ammonium nitrate solution plant | Uses pressure reactor technology and is designed to produce no emissions to the atmosphere. |

<table>
<tr><th>Plant component</th><th>Engineering/ Management controls</th></tr>
<tr><td>Tan prilling plant</td><td>Wet scrubbers are used to control $NH_3$ and ammonium nitrate ($PM_{10}$) particulate emissions from the ammonium nitrate prilling plant common stack. The following configuration of scrubbers is used in the TAN Plant:<ul><li>Stage 1- Prilling air from each prill tower is directed through its own independent scrubber. The prill air is washed with a chilled 5% ammonium nitrate solution. 80-90% of the air is then recycled back through the prill tower.</li><li>Stage 2- The bleed air from each prill air scrubbing system is sent to a pair of rotary brush scrubbers (four in total). The rotary brush scrubbers contain wetted spinning brush fibers (polypropylene) in which any dust is captured. Wash water solution is continuously sprayed on the brush and volute casing.</li><li>Stage 3- From the rotary brush scrubbers, the air streams are combined and directed to the final scrubber. This scrubber operates like a large “knock-out” vessel. Air enters the bottom of a large diameter vessel and is drawn upwards. The large diameter reduces the air flow velocity allowing gravity to drop out moisture in the air. The air then passes through a demister pad before exiting the scrubber and going to the common stack.</li></ul></td></tr>
<tr><td>TAN Plant-General</td><td>The Burrup Technical Ammonium Nitrate Production Facility Air Quality Management Plan 2013 includes the following commitments:<ul><li>The TAN Plant management will maintain a site record for the following during the operational period:<ul><li>Any operational upsets (for process units/ pollution control equipment) and routine maintenance work that have an effect on air emissions;</li><li>Management measures applied, date and time;</li><li>Complaints relating to air emissions/ air quality impacts;</li><li>Any visual observations; and</li><li>Exceedance of monitoring trigger thresholds.</li></ul></li><li>NOx and $NH_3$ stack emissions from the nitric acid plant stack will be monitored using CEMS and annual verification testing;</li><li>$NH_3$ and PM ($NH_4NO_3$) emissions from the ammonium nitrate plant stack will be monitored annually;</li><li>NOx (as $NO_2$) emissions from nitric acid storage tanks will be monitored using headspace testing and evaluation of air losses.</li><li>Manufacturer guarantees specified in the table below will be used as Trigger Thresholds:<table><tr><th>Stack ID</th><th>Species Emitted</th><th>Manufacturer's Guarantee</th></tr><tr><td rowspan="2">Nitric Acid Plant stack</td><td>$NO_X$ as $NO_2$[1]</td><td>102.6 mg/Nm³</td></tr><tr><td>$NH_3$</td><td>0.75 mg/Nm³</td></tr><tr><td rowspan="2">Ammonium Nitrate Plant stack</td><td>$NH_3$</td><td>10 mg/Nm³</td></tr><tr><td>Particles (as Ammonium Nitrate particles)</td><td>15 mg/Nm³</td></tr><tr><td>Nitric Acid Storage Tanks stacks ( x 2)</td><td>$NO_X$ as $NO_2$[1]</td><td>339 mg/Nm³</td></tr><tr><td colspan="3">[1] Not normalized for oxygen content, i.e. oxygen content at stack conditions</td></tr></table></li></ul></td></tr>
</table>

9.4.6

### 9.4.7 Key findings

Key findings: The Delegated Officer has considered information relating to point source emissions to air and has found:

1. Consistent with the requirements of the Part IV approval and Works Approval W4701, the TAN Plant has been designed to comply with best practice emission concentrations as listed in the:
    - *European Fertilizer Manufacturers Association (EFMA) Best Available Techniques for Pollution Prevention and Control in the European Fertilizer Industry Booklet No. 2: Production of Nitric Acid (EFMA Booklet No. 2)*; and
    - *European Commission Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers (European Commission, 2007)*.
2. The assessment of the data from the Commissioning Report of the TAN Plant has confirmed that modelling inputs used in the cumulative air quality assessment are appropriate;
3. Ground level concentrations of key contaminants during normal operation of the TAN Plant and normal operation of the Ammonia Plant are considered significant when compared with relevant assessment criteria (NOx ($NO_2$, $N_2O$) and $NH_3$)
4. Yara's controls are appropriate to mitigate risks associated with point source emissions to air during normal operations.

### 9.4.8 Consequence

Considering the information above, the Delegated Officer considers the consequence of point source emissions to air as below:

- Nitrogen oxides: When background concentrations of NOx are considered, NEPM criteria is at risk of not being met. There is the potential for mid-level amenity impacts on a local scale or low level health impacts. The Delegated Officer considers the consequence to be ***moderate***.
- Particulates: NEPM criteria is met, although given the chemical characteristics of particulates, emissions may have potential adverse amenity impacts. The Delegated Officer considers the consequence to be ***minor*** considering high background levels.
- CO: Criteria are met and there is unlikely to be an impact on amenity. The Delegated Officer considers the consequence to be ***slight***. Sulfur dioxide: Criteria are met and there is unlikely to be an impact on amenity. The Delegated Officer considers the consequence to be ***slight***.
- Ammonia: Criteria are likely to be met and emissions may have a low level impact on amenity. The Delegated Officer considers the consequence to be ***minor***.

### 9.4.9 Likelihood of the risk event

The likelihood of an impact occurring 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 each point source emissions to air under normal operations to be:

- Nitrogen oxides: *Possible*
- Particulates: *Unlikely*

- CO: *Rare*
- Sulfur dioxide: *Rare*
- Ammonia: *Unlikely*

### 9.4.10 Overall rating of risk of point source emissions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) 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: *Medium* Risk
- CO: *Low* Risk
- Sulfur dioxide: *Low* Risk
- Ammonia: *Medium* Risk

The potential for impacts resulting from NOx and Ammonia emissions increases during start-up, shutdown or plant trips. This is further assessed in section 9.6.

## 9.5 Risk assessment - point source emissions to air (TAN Plant: non routine operations)

### 9.5.1 Identification and general characterisation of emission

Non-routine operations of the TAN Plant, include start-up, planned shutdowns and emergency shutdowns. These situations result in potential increases of NOx, particulate and ammonia emissions from the nitric acid plant stack. Emissions from these operating scenarios are characterized in Table 14. The resulting GLC's at receptors, as predicted in the 2012 updated model, are detailed in Table 16.

Upset conditions which result from plant failure result in emergency shutdown and are therefore captured in this section. It is noted that upset conditions which lead to emergency shutdown may result in increased ammonia, particulate and NO2 emissions from the nitric acid stack and common stack but are likely to be of very short duration.

### 9.5.2 Description of potential adverse impact from the emission

Potential health and environmental impacts associated with various contaminants are described in section 9.4.

Cumulative air quality modelling results (See Table 16) which consider emissions from the TAN Plant in non-routine operation (start-up, shutdown and emergency shutdown events) including background indicate that, amongst the receptors considered, the highest 1-hour GLC of $NO_2$ is likely to be experienced at Hearson Cove (approximately 62% of the assessment criteria). The Highest 1-hour GLC of Ammonia at Hearson Cove is predicted to be approximately 4% of the assessment criteria. The Highest 1-hour GLC of Nitric Acid at Deep Gorge is predicted to be 12% of the assessment criteria.

Emissions resulting from non-routine operations, specifically those that occurred during commissioning of the TAN Plant have been independently reviewed in relation to potential health impacts, see section 6.1.6. The findings of this review indicated that the emissions that occurred during these events are unlikely to impact on human health and do not exceed relevant exposure criteria.

### 9.5.3 Licence Holder controls

The engineering and management controls adopted are summarised in Table 33.

### 9.5.4 Consequence

Considering the information above, the Delegated Officer has determined that the consequence ratings for the various contaminants as discussed in section 9.4 of this Decision Report are applicable to the scenario where the TAN Plant under non-routine operations.

Nitrogen oxides: *Moderate* consequence

Particulates: *Minor* consequence

Ammonia: *Slight* consequence

### 9.5.5 Likelihood or risk event

The Delegated Officer considers that during non-routine operations of the TAN Plant and normal operation of Ammonia Plant, impacts at receptors or exceedance of relevant criteria is *Possible.*

### 9.5.6 Overall rating of risk of point source emissions to air

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the risk rating of point source emissions to air for non-routine operations of the TAN Plant is *Medium*.

## 9.6 Risk assessment - point source emissions to air (Ammonia Plant: start-up, shutdown and plant trips)

### 9.6.1 Identification and general characterisation of emission

Emission characteristics change when the Ammonia Plant is in start-up, shutdown or experiences a plant trip. Yara has provided details of these events from January 2017 to present (end May 2018) that includes information on frequency, duration and emission characteristics. These components are integral in understanding potential impacts and assessing the likelihood of these impacts. An assessment of duration and emissions characteristics during start-up, shutdown and plant trips are detailed in Table 12. Yara have advised that any one of these scenarios has only occurred on one or two occasions since January 2017.

These events result in venting of process gases via the Back and/or Front end vents. Gases from the respective vents include:

Front end vent (Vent B): $H_2$, $N_2$, $CH_4$, CO, $CO_2$, $H_2O$

Back end vent (Vent A): $H_2$, $N_2$, Ar

During these events, venting from the Front End Vent (Vent B) will result in elevated CO and NOx emissions. Other emissions are not expected to have an impact. In addition to venting, increased NOx emissions occur from the Package Boiler and Primary Reformer Furnace stacks from natural gas combustion. Inefficient flaring may also lead to odour impacts which result from the release of Ammonia.

Emissions resulting from venting events was considered in the 2015 Updated Model for the Ammonia Plant (detailed in section 6.1.1). This assessment considered emissions from the primary reformer, package boiler, start-up heater and front end vent during start-up. Model inputs were based on mass balance calculations and supported by stack testing data where available. The assessment considered start-up emissions occurred for the entire modelling period, therefore resulting GLCs are considered conservative. The resulting GLC's for worst-case scenarios and comparison against relevant criteria are at Table 34.

**Table 34: GLCs (µg/m$^3$) resulting from worst-case Ammonia start-up (considering venting) and assessment against ambient criteria**

| Emission | Criteria (µg/m$^3$) | Averaging period | Deep Gorge | Karratha | Hearson Cove | Maximum at any location | Maximum of criteria at receptors (%) |
|---|---|---|---|---|---|---|---|
| **NOx (as $NO_2$)** | 246 | 1-hour | 39 | 16 | 97 | 364 | 39 |
| | 61 | Annual | 1.0 | 0.08 | 2.8 | 16 | 4.6 |
| **$SO_2$** | 520 | 1-hour | 1.9 | 0.4 | 2.8 | 8.5 | 0.54 |
| | 226 | 24-hour | 0.3 | 0.03 | 0.7 | 2.7 | 0.31 |
| | 56 | Annual | 0.03 | 0.002 | 0.08 | 0.5 | 0.14 |
| **CO** | 10300 | 8-hour | 4250 | 837 | 6719 | 20256 | 65 |
| **$NH_3$** | 330 | 1-hour | $9.72E^{-06}$ | $2.86\text{-}E^{-06}$ | $3.12E^{-05}$ | $8.10E^{-05}$ | <1 |
| | 180 | Annual | $1.5E^{-07}$ | $1.6E^{-08}$ | $8.6E^{-07}$ | $7.2E^{-06}$ | <1 |
| **$PM_{10}$** | 50 | 24-hour | 0.5 | 0.08 | 1.4 | 5.1 | 2.8 |

### 9.6.2 Description of potential adverse impact from the emission

Potential health and environmental impacts associated with various contaminants are described in section 9.4.

Maximum GLCs of $NO_2$, $SO_2$ and $PM_{10}$ predicted in the 2015 updated model for the Ammonia Plant occur on or close to the premises boundary. These modelling results indicate emissions during start-up events are within relevant assessment criteria at receptors, as detailed in Table 34. Given the short duration of these events, the emissions are not likely to cause significant environmental or health impacts at receptors.

Air emissions modelling undertaken in the 2015 updated model for the Ammonia Plant does not consider flaring events. Modelling undertaken for the PER in 2001 notes the following in relation to the flaring of ammonia:

- Maximum 1-hour NOx concentrations from flaring could 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 concentrations were predicted to be 59 µg/m$^3$.
- Maximum concentrations were predicted to occur 700 m to the north of the Ammonia Plant with only a small area to the north and south expected to exceed the assessment criteria. Concentrations at identified receptors are within relevant the assessment criteria.
- A maximum 3-minute ammonia concentration of 1500 µg/m$^3$ (2.5 times the 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).

As detailed in section 6.1.1, the original model predictions are superseded by the actual flaring that occurs at the Ammonia Plant which varies from that predicted in the PER and considered in the 2001 modelling.

### 9.6.3 Licence Holder controls

Specific engineering and management controls adopted are summarised below:

- Flaring of Storage Tank ammonia vapours can occur in the event of refrigeration compressor failure which is anticipated to occur only in a total blackout scenario. Built-in redundancy in the system (power and refrigeration) makes this unlikely.
- Should flaring be required by the Storage Flare, boil-off gas from the storage tanks will be directed to the flare. Ammonia will be combusted upon flaring, releasing combustion products including water vapour, $CO_2$, N2, NOx and small amounts of unburnt ammonia.
- Flaring of waste process gases from the Production Flare will occur as required during normal operations
- 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 (20ppm).
- Handheld gas detectors are used to conduct perimeter checks should a complaint be received or issue identified.

### 9.6.4 Consequence

Considering the information above, the Delegated Officer has determined following consequence ratings for the various contaminants resulting from venting or flaring during startup.

Nitrogen oxides, sulfur dioxide and Particulates: *Minor* consequence

Ammonia: *Moderate* consequence

### 9.6.5 Likelihood of risk event

The Delegated Officer considers that impact to receptors could occur during flaring if ammonia is not completely combusted. Considering the predicted low frequency of flaring from the storage flare and low probability that flaring activities will be inefficient, the likelihood of the risk event is considered *Unlikely*.

The Delegated Officer considers that the likelihood of elevated emissions resulting from startups (considering venting) will impact on the amenity of nearby receptors or exceed assessment criteria is *Unlikely*.

### 9.6.6 Overall rating of risk of point source emissions to air

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 27) and determined that the risk rating of point source emissions of ammonia to air during flaring/ venting operations of the ammonia plant is *Medium risk*.

## 9.7 Risk assessment - fugitive emissions to air – ammonia

### 9.7.1 Description of risk of fugitive Ammonia emissions to air

Releases of ammonia can occur from a leak or rupture in the Ammonia Plant, leaks in the refrigerated ammonia storage tanks or ammonia export pump, leaking/ruptured vales on the liquid ammonia storage tanks, and the pipeline carrying liquid ammonia from the Ammonia Plant to the TAN Plant or Port.

Catastrophic failure of the ammonia storage tanks is considered to be the event with the highest risk which was considered at the Part IV assessment stage for the Ammonia Plant in EPA 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 required to meet the requirements administered by the Department of Mines, Industry Regulation and Safety. Ammonia leaks associated with the operation of the TAN Plant are limited to pipeline ruptures which have been addressed by the Part IV assessment of the Ammonia Plant.

In addition to catastrophic risks and major incidents, minor ammonia releases may occur from storage tanks via pressure safety valves etc. The risk of these incidents are considered in this assessment.

### 9.7.2 Identification and general characterisation of emission

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

Table 35 includes a summary of incidents notified to the DWER by Yara over the past two years which involved releases of ammonia to the atmosphere.

**Table 35: 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. Under investigation by DWER. |
| 18/4/17 | Controlled release of ammonia during TAN Plant commissioning. 14 Kg ammonia released. Gas monitoring detected 0ppm across the Premise. No complaints |
| 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. |
| 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. |

### 9.7.3 Description of potential adverse impact from the emission

Ammonia gas has intensely irritating odour, and is corrosive. Potential health impacts associated with exposure include irritation to the eyes, throat and nose. Higher concentrations may cause breathing difficulty, chest pain etc. and overexposure can cause death.

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

### 9.7.4 Licence Holder controls

The Premises has gas detectors which trigger an alarm if ammonia is detected (20ppm). Handheld gas detectors are available onsite and are used to conduct perimeter 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.
- 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; and
    - Emergency power system.

### 9.7.5 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 reasons identified by Yara as causing release of ammonia from storage tanks.
2. Yara undertook a detailed investigation in 2016 in response to the premature activation of a storage tank PSV and identified a number of contributory and significant non-contributory factors. Corrective actions based on investigation report recommendations were completed.
3. Yara has ambient ammonia detectors which can detect potentially harmful concentrations of ammonia.
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. Both the Ammonia Plant and TAN Plant are classified as a Major Hazard Facilities and subject to regulation by the Department of Mines, Industry Regulation and Safety.

### 9.7.6 Consequence

Considering the information above, the Delegated Officer has determined that ammonia releases may result in high level adverse health impacts, therefore the consequence of fugitive ammonia emissions is *Severe*.

### 9.7.7 Likelihood of risk event

With consideration afforded to the Licence Holder's controls and distance to nearby receptors, the Delegated Officer considers that the likelihood an ammonia release will have an adverse impact on receptors is *Unlikely.*

### 9.7.8 Overall rating of risk of point source emissions to air

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the risk rating of fugitive emissions of ammonia to air causing public health impacts during operation is *High*.

## 9.8 Risk assessment - fugitive emissions to air (particulates)

### 9.8.1 Description of risk of fugitive emissions to air

Fugitive emissions of ammonium nitrate particulates can occur from the operation of the TAN prilling plant associated with storage, handling, bagging of product, and handling of material in the off-spec area.

### 9.8.2 Description of potential adverse impact from the emission

Ammonium nitrate is an oxidising agent and exposure to its dust may cause serious irritation to the eyes. Inhalation of the dust may also result in respiratory irritation. Absorption of ammonium nitrate by inhalation, ingestion or through burnt or broken skin may cause dilation of blood vessels, dizziness, drowsiness, nausea and headache.

### 9.8.3 Criteria for assessment

No specific criteria for acceptable environmental exposure to ammonium nitrate particles has been endorsed. The 1-hour NEPM criteria applicable to $PM_{10}$ emissions is considered appropriate.

### 9.8.4 Licence Holder controls

Specific engineering and management controls adopted are summarised below:

- The bulk storage shed operates at a positive pressure to maintain the humidity and temperature in the storage area (TAN prill degrades with moisture). The building is sealed and entrances have fan blowers which create an air curtain to keep air inside.
- Fines are screened out in the bulk storage shed prior to product being transferred via conveyor to the loading areas. Fines drop out into a storage bay. A front end loader is used to collect fines and transfer them to the off-spec hopper (outside the shed) for reprocessing. Loader buckets are quarter filled to minimise dust during transfer.
- Retractable loading arms with shrouds on the ends are installed at the truck loading area. Fines are screened out prior to transfer to the loading area, as they are not part of product specification, which reduces potential dust. Excess air goes back through the transfer chute to the prilling tower.
- When bagging, the opening between the bag and the loading arm is sealed and no air escapes. Bags are clamped closed when filling is complete.
- Material is directed to the off-spec area if is there is a problem or if the product does not meet the required specification. Material is directed to two undercover storage bays on concrete hardstand. Once the issue with the plant is rectified, material in the off-spec area is removed from the storage bays using loaders and transferred to a hopper for reprocessing.

### 9.8.5 Consequence

Considering the information above, the Delegated Officer has determined the consequence of fugitive emissions of ammonium nitrate *is Minor.*

### 9.8.6 Likelihood of risk event

The Delegated Officer considers that minor impact to receptors is unlikely to occur. Therefore, the likelihood is *Rare*.

### 9.8.7 Overall rating of risk of fugitive emissions to air

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of fugitive emissions of ammonium nitrate particulate causing environmental or health impacts during normal operations is ***Low****.*

## 9.9 Risk assessment - emissions to land (TAN Plant and Ammonia Plant)

### 9.9.1 Description of risk of emissions to land

Emissions to land may occur from breached containment infrastructure, namely:

- potentially contaminated storm water and process wastewater in the contaminated surface water ponds at the TAN Plant;

- potentially contaminated storm water in the eastern and western sedimentation basins at the Ammonia Plant;
- pipeline carrying saline water in the seawater cooling circuit in the Ammonia Plant
- Process wastewater collected from various streams at the Ammonia Plant in the wastewater and neutralisation pits prior to disposal via the MUBRL;
- Waste oil in the containment sumps which collects oil from the oil interceptor outlets on both the Ammonia & TAN Plant sites; and
- Hydrocarbons, including diesel and hydrocarbon wastes, i.e. waste oil on both the Ammonia & TAN Plant sites.

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. Key contaminants associated with spent catalysts include variety of heavy metals. On average spent catalysts from various stages in the ammonia production process need to be disposed of every three to ten years.

### 9.9.2 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), cooling tower blowdown, and reverse osmosis reject streams, which can have higher solids concentration (electrical conductivity).

Table 36 characterises the various wastewater streams discharged offsite as described in the PER document for the Ammonia Plant. The Licence Holder is not currently required to monitor the volume of wastewater discharged to basins and sumps offsite. Accordingly, the volume of discharge included in the table below is indicative only.

**Table 36: Waste streams generated during normal operation of the Ammonia Plant and TAN Plant**

| Waste stream | Approximate volume of discharge | Location of Discharge |
|---|---|---|
| Demineraliser drains | NA | Drain |
| Raw water filter backwash | | |
| Steam condensate | | |
| Laboratory wastewater (neutralised) | | |
| Process condensate | Normally no flow | Wastewater effluent sump[1] |
| $CO_2$ removal purge | | |
| Boiler blowdown | NA | |
| Process condensate | Normally no flow | Oil containment sump and wastewater effluent sump[1] via the oil interceptor.<br>Oil is transferred to a vacuum truck for offsite disposal. |
| Gland condensate/ steam condensate | 300 kg/hr | |
| Intercoolers | 3153 kg/hr | |
| Curbed potentially oil contaminated areas | n/a | Wastewater effluent sump[1] via oil interceptor |

| Waste stream | Approximate volume of discharge | Location of Discharge |
|---|---|---|
| Stormwater | n/a | Eastern and western sedimentation basins (Ammonia Plant) |
| Cooling tower blowdown | | |
| Contaminated water from process areas | n/a | Contaminated surface water ponds (TAN Plant) |
| Flushing water | | |
| Air condensates for instrument air | | |
| Reverse osmosis cleaning and flushing water | | |
| Rejected osmosis condensate waste | | |
| Mixed bed regeneration | | |
| Rejected clean process condensate | | |
| Spent catalysts, resins, filter media, desiccants associated with ammonia production process | See Appendix 3 | Disposed offsite |
| Solid waste/ special waste associated with TAN production process:<br>Solid waste/ special waste:<br>Components of off-spec prills (specifically organic matter) which can't be recycled in the process (120kg/day)<br>Catalysts from the nitric acid plant<br>Heat exchanger sludge and sludge from nitric acid process equipment<br>Oil residue and sludge from ammonia stripper<br>Sludge from Contaminated SWPs | | |

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

Nitric acid, ammonium nitrate solution, and hydrocarbons are stored on the premises in large quantities. During commissioning of the TAN Plant, emissions of significant quantities of chemicals to land occurred on two occasions. On the first occasion (6 March 2017), approximately 2.18 tonnes of ammonium nitrate solution was released to ground. On the second occasion (30 June 2017), an unknown quantity of water containing ammonium nitrate leaked from contaminated surface water pond 2. Both incidents are currently under investigation by the DWER and Yara. Other chemicals that could potentially be released offsite include hydrocarbons.

### 9.9.3 Description of potential adverse impact from the emission

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 seepage of wastewater from the Premises to degrade local groundwater quality. Groundwater flows in a south-easterly to east-south-easterly direction. The hydraulic gradient is steeper to the north and north-west of

the Ammonia Plant and TAN Plant, respectively 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 both plants 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.

The AER for the Ammonia Plant for the period 1 January 2016 to 31 December 2016 notes that a review of groundwater data obtained since 2011 had been completed and the following trends were identified:

- Arsenic at monitoring bore location BFC continues to exceed the trigger level;
- Copper at monitoring bore location BFE exceeded the trigger at the beginning of 2016; however, there is an overall decreasing trend since 2011;
- Nickel at monitoring bore location BFE continues to exceed the trigger level;
- Total nitrogen at monitoring bore location BFE continues to exceed trigger level;
- Phosphorous at monitoring bore location BFF initially exceeded the trigger level but has have reduced significantly since 2015; and
- Zinc levels at monitoring bore locations BFF and BFC have exceeded trigger levels, spikes in zinc concentrations appear to be common throughout all groundwater wells with a return to normal levels decreasing by the next monitoring event.

The TAN Plant Commissioning Report notes that monitoring bore location MW4 indicated a spike in total nitrogen and nitrate-nitrogen concentrations subsequent to the unplanned release of ammonium nitrate solution, which was in the vicinity of the bore.

Seawater cooling circuit in the Ammonia Plant consists of plate 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.

Improper storage/ disposal of spent catalysts, resins and other solid waste streams can cause soil contamination and indirectly impact groundwater quality.

### 9.9.4 Criteria for assessment

The *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.

MS 870 for the TAN Plant required the development of site-specific trigger levels for contaminants based on hydrogeological studies and monitoring. A similar requirement was not included in the Part IV approval for the Ammonia Plant. Yara has proposed trigger levels for individual groundwater monitoring bores for the Ammonia Plant and the TAN Plant.

Trigger levels for individual contaminants of concern are required to develop assessment criteria to determine environmental impacts associated with ongoing operations. Baseline concentrations can be established using the groundwater monitoring data collected by Yara in 2003 and 2004.

Yara have advised that baseline groundwater monitoring conducted quarterly from April 2003 to September 2005 (prior to construction of the Ammonia Plant) in bores BFB to BFF identified

that naturally occurring concentrations for copper and nickel were above ANZECC & ARMCANZ trigger levels.

### 9.9.5 Licence Holder controls

Specific engineering and management controls adopted are summarised below:

- The contaminated storm water collection system includes sealed bunded collection areas and lined sedimentation basins.
- 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.
- Contaminated storm water ponds and eastern and western sedimentation basins are lined with 1.5 mm thick HDPE to achieve a permeability of less than 1 x $10^{-9}$ m/s.

### 9.9.6 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. The TAN Plant has not been classified under the CS Act. However, given the land use, there is potential to cause contamination.
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).*
3. Yara is required to develop site-specific trigger levels to effectively manage impacts from ongoing operations. The trigger levels should include both the Ammonia Plant and the TAN Plant for each contaminant of concern. The trigger levels should be developed using baseline data collected in 2003 and 2004.
4. Potential for spent catalysts, resins, desiccants etc. on the premises to impact on groundwater quality is considered to be low given the low frequency (every three to ten years).
5. Any unreasonable emissions associated with onsite temporary storage, handling, transfer of solid waste stream can be managed under General provisions of the EP Act. Disposal of spent catalysts/ resins/ desiccants/ special wastes offsite will be subject to requirements under the EP (Controlled Waste) Regulations.

### 9.9.7 Consequence

Considering the information above, the Delegated Officer has determined that emissions to land associated with operation of the TAN Plant and the Ammonia Plant can cause low level offsite impacts. Therefore, the Delegated Officer considers the consequence of emissions to land to be *Moderate*.

### 9.9.8 Likelihood of risk event

The Delegated Officer considers that impacts on the receiving environment has occurred, although the long term impacts are not clear, therefore, the likelihood is *Likely*.

### 9.9.9 Overall rating of risk of emissions to land

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of emissions to land causing environmental or ecological impacts is *High.*

## 9.10 Risk assessment - emissions to land (WWTP)

### 9.10.1 Description of risk of emissions to land

During normal operation of the WWTP, emissions to land occur associated with the discharge of treated domestic wastewater. A new sewage treatment plant servicing the Ammonia Plant was installed by Yara, through Works Approval W5920/2015/1. Treated wastewater from this plant discharges into infiltration basins onsite.

Five ATUs, with a capacity to service an operational workforce of up to 38 people (each unit has a maximum capacity of 1800 L/day), have been installed to treat domestic wastewater associated with TAN Plant operations. Treated wastewater is discharged to clean water ponds 3 and 6.

### 9.10.2 Identification and general characterisation of emission

The WWTP servicing the Ammonia Plant is a rotating biological reactor unit with a design capacity of 36 kL/day. During normal operations, the throughput is expected to be less than 6 kL/day.

The Existing Licence specifies discharge water quality limits for the wastewater being discharged to the infiltration basins onsite. These limits applied to the new system servicing the Ammonia Plant. During the 2016 reporting period, the sewage treatment plant servicing the Ammonia Plant exceeded the specified limits on 11 occasions. The Licence Holder has advised that:

- The new WWTP has been unable to meet the manufacturer's performance criteria;
- Initially, exceedances were thought to be due to the immaturity of the WWTP and a lack of biological activity, and that with time, these would decrease. This has not been the case and it appears that the WWTP is not capable of reducing total nitrogen and total phosphorus to a level that would be comply with the licence limits without the addition of chemicals;
- The Licence Holder continues to undertake weekly monitoring to understand how the WWTP is performing and have discussed the additional treatment options with the WWTP service provider. However, this would most likely include the addition of chemicals (to reduce nitrogen and phosphorus levels).

The ATUs servicing the TAN Plant are expected to discharge up to 6.84 $m^3$/day of wastewater to the clean surface water pond.

Table 37 below summarises wastewater quality limits which currently apply to the Ammonia Plant and the design performance criteria for the ATUs servicing the TAN Plant.

**Table 37: Wastewater quality limits and actual performance for the WWTP servicing the Ammonia Plant and design performance specifications for the ATUs servicing the TAN Plant**

| Emission point | Parameter | Limit (including units) | WWTP actual performance (average since July 2016) |
|---|---|---|---|
| Discharge point to infiltration basin | Total nitrogen | 25 mg/L | 62 mg/L |
| | Total phosphorus | 5 mg/L | 8.7 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 | |
| Design performance specification for ATUs servicing the TAN Plant | Total nitrogen | <30 mg/L | NA |
| | Total phosphorus | <20 mg/L | |
| | Biochemical oxygen demand | 20 mg/L | |
| | pH | - | |
| | Total suspended solids | 30 mg/L | |
| | *Thermotolerant coliforms* | 10cfu/100ml | |

### 9.10.3 Description of potential adverse impact from the emission

Secondary treated domestic wastewater can have elevated nutrient, BOD and *E.coli* concentrations compared to background water quality. 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 seepage of wastewater from the Premises to degrade local groundwater quality. Groundwater flows in a south-easterly to east-south-easterly direction. The hydraulic gradient is steeper to the north and north-west of the Ammonia Plant and TAN Plant, respectively 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 both plants 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.

### 9.10.4 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.

### 9.10.5 Licence Holder controls

Yara has been undertaking weekly wastewater quality monitoring for the WWTP servicing the Ammonia Plant as it has unable to comply with the design performance criteria. Existing ambient

groundwater monitoring undertaken by Yara can serve as an indicator of potential contamination associated with discharge of domestic treated wastewater to land.

### 9.10.6 Key findings

**Key findings:** The Delegated Officer has considered information relating to emissions to land on account of discharge of domestic treated wastewater and has found:

1. The WWTP servicing the Ammonia Plant, installed through Works Approval W5920, has been unable to meet design performance criteria. This unit discharges to infiltration basins offsite. Specifically, the average TN concentration (62 mg/L) is well above the design criteria.
2. The ATUs servicing the TAN Plant discharges to the clean surface water ponds. The clean surface water ponds also receives surface water from non-process areas, storage areas, building roofs, surplus purified water, non-contaminated wash water, and any non-contact process water..
3. Yara has requested that the emission limits specified in Table 2.4.2 of the Existing Licence which apply to the discharge to infiltration basins offsite are reviewed, and requested that load based limits are considered consistent with Department of Water (now DWER) *Water Quality Protection Note 22: Irrigation with nutrient-rich wastewater* (WQPN22). The Licence Holder has also requested that the wastewater quality monitoring frequency is reduced to quarterly instead of monthly.

   The Delegated Officer has determined that load based limits specified in WQPN22 are not relevant to the activities as the treated wastewater is discharged to infiltration basins rather than being irrigated. It is also noted that the risk assessment is based on the design capacity rather than the actual throughput, which can be variable.
4. The Licence Holder has submitted that the wastewater treatment plant servicing the Ammonia Plant should not be required to treat the wastewater to remove nutrients in accordance with Treatment Process Category D specified in the *National Water Quality Management Strategy Australian Guidelines for Sewerage Systems Effluent Management 1997*.

   It is noted that the groundwater levels at the Premises are shallow and local groundwater flows towards the King Bay Tidal Flats. If groundwater levels have elevated nutrient concentrations, it has the potential to affect local surface water dependant ecosystems.

   Given the shallow groundwater levels at the Premises and the direction of local groundwater flows, there is potential for discharge into infiltration basins to cause some impact on local groundwater quality.

   The Licence Holder's submission is also at variance with the performance criteria that was originally proposed and subsequently approved through Works Approval W5920.

### 9.10.7 Consequence

Considering the information above, the Delegated Officer has determined that emissions to land associated with operation of the wastewater treatment plants could cause minimal offsite impacts. Therefore, the Delegated Officer considers the consequence to be *Minor*.

### 9.10.8 Likelihood of risk event

Considering the Key Findings, the Delegated Officer considers that minor impact to receptors could occur at some time. Therefore, the likelihood is *Possible*.

### 9.10.9 Overall rating of risk of emissions to surface water

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of emissions to land, from operation of the WWTPs, causing environmental or ecological impacts during normal operations is ***Moderate*.**

## 9.11 Risk assessment - emissions to marine waters (discharge via MUBRL)

### 9.11.1 Description of risk of emissions to marine waters

During normal operations, the following wastewater streams are discharged from the Premises into Water Corporation's MUBRL for final discharge into surface waters at King Bay.

**Table 38: Wastewater streams discharged to MUBRL**

| Plant | Wastewater stream | Volume of discharge |
|---|---|---|
| Ammonia Plant | Cooling tower blowdown, which includes:<br>• discharge from the desalination plant (300 $m^3$/hour)<br>• wastewater from air compressor intercoolers (4 $m^3$/hour),<br>• reformer jacket water blowdown (4 $m^3$/hour but only when tripping on high conductivity),<br>• reformer steam drum boiler blowdown (2.5 $m^3$/hour) recycled into jacket water pit and recovered unless tripping on high conductivity.<br>• Package boiler blowdown (2 $m^3$/hour) recycled into jacket water pit and recovered unless tripping on high conductivity. | 1860 $m^3$/hour |
| TAN Plant | Blowdown from cooling water system | 3095.9 ML/year |
| | Purified process condensate | 106.9 ML/year |
| | Chiller condensate | 15.7 ML/year |
| | Boiler blowdown | 4.16 ML/year |

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

### 9.11.2 Identification and general characterisation of emission

Table 39 below summarises the monitoring results for discharge from the Ammonia Plant into the MUBRL as reported in the Annual Environmental Report covering the reporting periods ending 31 December 2016 and 31 December 2017.

**Table 39: 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 2016 AER) |
|---|---|---|
| pH | - | 7.8-8.1 |
| Conductivity | µS/cm | -40435-103262[1] |
| Ammonia | µg/L | 63-780 |
| Total Phosphorus | µg/L | Reporting not required |
| Arsenic | µg/L | All results below limit of detection (As-III);<br>1-6 (As- V) |
| Cadmium | µg/L | All results below limit of detection |
| Chromium | µg/L | All results below limit of detection (Cr-III)<br>2 - 3 (Cr-VI) |
| Copper | µg/L | 1 - 5 |
| Lead | µg/L | All results below limit of detection |
| Mercury | µg/L | All results below limit of detection |
| Nickel | µg/L | All results below limit of detection |
| Zinc | µg/L | 2-26 |

Note 1: The 2016 and 2017 AER identified that despite monthly calibrations the continuous online EC analyser read on average 19% higher than laboratory results. An alternative calibration method was identified that achieved improved EC accuracy. This calibration method was first utilised on 16 March 2018.

Wastewater was discharged into the MUBRL during commissioning of the TAN Plant and continuous monitoring of flow rate, turbidity, conductivity, TDS, pH, and temperature differential was undertaken by Yara. The Commissioning Report notes that:

- The TAN Plant was substantially compliant with the Commissioning Environmental Management Plan (CEMP) temperature discharge requirements and deviations from the target occurred for less than 2% of the operational time. The deviation was partly attributed to issues with the reliability of Water Corporation's temperature compliance point;
- Ammoniacal nitrogen concentrations from wastewater streams were below the commissioning plan target of 1.7 mg/L except on five occasions. However all results were still below the Existing Licence limit;
- Cadmium and chromium concentrations were below the CEMP target with the majority of results being below the analytical method detection limits. Lead, mercury, and nickel concentrations were below detection limits;
- Copper concentrations exceeded the CEMP target of 0.008 mg/L on two occasions; however, these values were still below the Existing Licence limit; and
- The monthly rolling average for zinc concentrations was below the target of 0.043 mg/L

during commissioning, except for one weekly sample which recorded an exceedance.

### 9.11.3 Description of potential adverse impact from the emission

The nutrients and toxic heavy metals in wastewater discharged from MUBRL can degrade surface 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 surface water affecting the marine environment. MDEA is also toxic to aquatic animals.

### 9.11.4 Criteria for assessment

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

The specified ecological are environmental objectives are based on the EPA's *Pilbara Coastal Water Quality Consultation Outcomes (2006)* report which recommended 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.

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 40: Trigger levels for discharges via the MUBRL**

| Parameter | Units | Water Corp OMEMP Triggers |
|---|---|---|
| pH | µS/cm | 6.3 - 8.33 |
| Conductivity | µg/L | 75,000 |
| Ammonia | µg/L | 32,141 |
| Total Phosphorus | µg/L | 179 |
| Arsenic | µg/L | 140- As(III)<br>275- As(V) |
| Cadmium | µg/L | 36 |
| Chromium | µg/L | 459-Cr(III)<br>8.5-Cr(VI) |
| Copper | µg/L | 11 |
| Iron | µg/L | NA |
| Lead | µg/L | 134 |
| Mercury | µg/L | 1.4 |

| Parameter | Units | Water Corp OMEMP Triggers |
|---|---|---|
| Nickel | µg/L | 427 |
| Zinc | µg/L | 419 |

### 9.11.5 Licence Holder controls

Specific engineering and management controls adopted 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; and
- Demineralisation and recycle of blowdowns from the package boilers and primary reformer.

### 9.11.6 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. Amendments to MS 870 dated 9 July 2013 removed the reference to wastewater from the key characteristics table for the Ammonia Plant and recommended regulation under the licence.
3. EPA Report 1379 for the TAN Plant recommends following the 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 (antiscalant) concentration of up to 1.2 ppm (~1.2 mg/L);
    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 and the TAN Plant Commissioning Report demonstrates that the quality of wastewater discharged into the MUBRL can meet the water quality criteria specified by Water Corporation.

### 9.11.7 Consequence

Considering the information above, the Delegated Officer has determined that emissions to the marine environment associated with operation of the TAN Plant and the Ammonia Plant 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*.

### 9.11.8 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*.

### 9.11.9 Overall rating of risk of emissions to surface water

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of emissions to surface water causing environmental or ecological impacts during normal operations is *Medium*.

## 9.12 Risk assessment - emissions to marine waters (discharge from eastern and western sedimentation basins)

### 9.12.1 Description of risk of emissions to surface water

The western and eastern sedimentation basins receive contaminated storm water and cooling tower blowdown associated with Ammonia Plant operations. The basins are designed to withstand rainfall from a 1 in 100 year event and discharge into King Bay tidal flats via dedicated pipelines.

The AER covering the reporting the period 1 January 2017 to 31 December 2017 notes that there were eight releases of wastewater from the sedimentation basins into King Bay tidal flats during the reporting period (Table 39). Three discharge events from the sedimentation basins were reported in the previous annual reporting period. Identification and general characterisation of emission

Wastewater discharged from sedimentation basins can have elevated concentrations of suspended solids and hydrocarbons. There is potential for water to be contaminated with MDEA (due to any spills, leaks of MDEA).

**Table 41 Sedimentation Basin Releases**

| Emission point | Date | Approximate Volume |
|---|---|---|
| Western sedimentation basin (W2) | 9-10 February 2017 | 13,750kL |
| | 8-9 March 2017 | 12,600kL |
| | 11 September2017 | 11,000kL |
| | 14-16 September 2017 | 33,500kL |
| | 4-6 October 2017 | 29,600kL |
| | 22 December 2017 | 9,500kL |

| | | |
|---|---|---|
| Eastern sedimentation basin (W3) | 8 February 2017 | 6,000kL |
| | 10 February 2017 | 6,000kL |

Water samples were taken prior to each release and the results are shown in Table 42.

**Table 42 Water quality analysis results for wastewater discharged from eastern and western sedimentation basins**

| Emission point | Date released | Monitoring Results (Parameter, Limit) | | | |
|---|---|---|---|---|---|
| | | Total Suspended Solids | pH | Total Recoverable Hydrocarbons | MDEA |
| **Licence Limit** | | **80 mg/L** | **6 - 9** | **15 mg/L** | **1 mg/L** |
| W2 | 9-10 February 2017 | 8 | 7.40 | <0.25[1] | <0.1 |
| | 8-9 March 2017 | 42 | 8.40 | <0.28 | <0.1 |
| | 11 September2017 | 11 | 8.40 | <0.28 | <0.1 |
| | 14-16 September 2017 | 6 | 8.40 | <0.28 | <0.1 |
| | 4-6 October 2017 | 11 | 8.40 | <0.28 | <0.1 |
| | 22 December 2017 | 23 | NA | <0.28 | <0.1 |
| W3 | 8 February 2017 | 2 | 8.40 | <0.25[1] | <0.1 |
| | 10 February 2017 | 2 | 8.40 | <0.25[1] | <0.1 |

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

With the exception of the discharge of MDEA on 11 August 2016, all the monitoring values are below the Existing Licence limits. The MDEA value of 41 mg/L exceeded the licence limit of 1 mg/L. An investigation was completed to assess the environmental impact. The release of MDEA was deemed to have not caused environmental harm, and therefore was not considered a pollution event by Yara.

### 9.12.2 Description of potential adverse impact from the emission

There is potential for degradation of marine water quality and potential impacts to marine ecology. MDEA is toxic to aquatic organisms.

### 9.12.3 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 EPA's *Pilbara Coastal Water Quality Consultation Outcomes (2006)* report are appropriate guidelines. The point source emission limits to surface water set under the Existing Licence, as indicated in Table 42above, are appropriate criteria for the assessment of potential impacts.

### 9.12.4 Licence Holder controls

Specific engineering and management controls adopted are summarised 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, Yara undertook a corrective action, and sealed the MDEA bund. Rainwater collected in the bund is now removed and disposed offsite to limit the risk for further potential contamination.

### 9.12.5 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 contaminants exceeding the Existing Licence limits.
2. Potential environmental impacts associated with the discharge will depend on the volume of the discharge, the duration, and the concentration of contaminants.
3. Prior to discharging, wastewater sampling is conducted; however, analytical results are not always available prior to discharge. Any investigation of exceedances and corrective actions are likely to be retrospective in most instances.

### 9.12.6 Consequence

Considering the information above, the Delegated Officer has determined that emissions to surface water can cause limited offsite impacts and that there is risk of specified environmental criteria not being met. Therefore, the Delegated Officer considers the consequence to be ***Moderate***.

### 9.12.7 Likelihood of risk event

The Delegated Officer considers that moderate impact to receptors could occur at some time. Therefore, the likelihood is ***Possible***.

### 9.12.8 Overall rating of risk of emissions to surface water

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of emissions to surface water causing environmental or ecological impacts during abnormal operations is ***Medium***.

## 9.13 Risk assessment- noise emissions

### 9.13.1 Description of risk of noise emissions

Noise emissions can arise from normal operation of the TAN Plant and 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.

### 9.13.2 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.

Hearson Cove is the nearest beach located 800 m to the east of the Premises. Deep Gorge is another area accessed by members of the public, located 1000 m south of the Premises boundary. Noise emissions may impact the amenity of these receptors.

### 9.13.3 Criteria for assessment

Works Approval W4701 required Yara to comply with the aspirational goal of an ambient noise level of 45 dB(A) set under EPA Bulletin 1077. However, more recent advice confirms that this target is now considered obsolete.

Based on the requirements specified in the EP (Noise) Regulations, and consistent with the advice received regarding the above target, the following assessment criteria has been used. The criteria applies at Premises boundary.

**Table 43: 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 Incident and Complaints Management System (ICMS) did not identify any noise related complaints from the community during commissioning of the TAN Plant or during normal operation of the Ammonia Plant.

### 9.13.4 Licence Holder 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.

During commissioning of the TAN Plant, the nitric acid plant compressor was identified as the primary source of noise that may impact Hearson Cove. To mitigate the impact of noise from the compressor, Yara installed external acoustic insulation to the compressor air inlet duct in August 2017. There has not been any subsequent monitoring to determine the effectiveness of this control measure.

As part of the Commissioning Report for the TAN Plant, the Licence Holder has committed to develop and conduct revised noise monitoring program which identifies the representative noise emitted at Hearson Cove.

### 9.13.5 Key findings

**Key findings:** The Delegated Officer has considered the results of ambient noise emissions monitoring as presented in the Commissioning Report for the TAN Plant and the advice received and has found:

1. The TAN Plant and the Ammonia Plant are major contributors to noise levels at Hearson Cove. The TAN Plant is likely to be a bigger contributor of the two; however, the ambient noise monitoring results from the commissioning of the TAN Plant does not confirm this.
2. Ambient noise monitoring methodology adopted by the Licence Holder during commissioning of the TAN Plant is appropriate;
3. Noise monitoring data indicates that, barring a few occasions, ambient noise levels at Hearson Cove during the TAN Plant commissioning process remained below the specified level of 65 dB(A). Noise levels measured at the SE boundary of the TAN Plant exceeded the 65 dB(A) level on one occasion (19 October 2016).
4. The nitric acid plant compressor in the TAN Plant was identified as a significant noise source of noise. Subsequently, Yara installed external acoustic insulation to the compressor air inlet duct. Yara advises that the acoustic insulation material chosen is compliant with requirements of the relevant International Standard (ISO 15665) for noise attenuation materials and is expected to generate a 15 dB(A) reduction from the compressor building. It is noted that the Commissioning Report does not include data to demonstrate this.
5. The EP (Noise) Regulations contain relevant standards that can be used to regulate noise emissions from the Premises.
6. Yara has committed to develop and conduct revised noise monitoring program which identifies the representative noise emitted at Hearson Cove. Details of the proposed monitoring methodology have not been provided. However, any such monitoring programme should include several monitoring locations in the area between the Premises and Hearson Cove, audio-recording, detailed post monitoring analysis, and directional noise monitoring.

### 9.13.6 Consequence

Considering the results of ambient noise monitoring conducted during commissioning of the TAN Plant, the Delegated Officer has determined that noise emissions associated with operation of the TAN Plant and the Ammonia Plant may cause low level offsite impacts. Therefore, the Delegated Officer considers the consequence of noise emissions to impact receptors to be *Moderate*.

### 9.13.7 Likelihood of risk event

The Delegated Officer considers that noise emissions from the Premises could impact receptors at some time. Therefore, the likelihood is *Possible*.

### 9.13.8 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 26) and determined that the overall rating for the risk of noise emissions impacting amenity of receptors during normal operations is *Medium*.

## 9.14 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 **44** below. Controls are described further in section 10.

**Table 44: 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 | Ammonia Plant (primary reformer stack, package boiler stacks)<br><br>TAN Plant<br>(Common stack, Nitric Acid Plant Stack) | Air<br>Environmental/ Public Health impacts | See section 9.4.5 | Nitrogen oxides and Particulates: **Medium risk**<br>CO: **Low risk**<br>Sulfur dioxide: **Low Risk**<br>Ammonia: **Medium Risk** | Acceptable subject to regulatory controls |
| | | Ammonia Plant – start-up and shutdown | Air<br>Environmental/ Public Health impacts | | **Medium Risk** | Acceptable subject to regulatory controls |
| | | TAN Plant – non-routine operations | Air<br>Environmental/ Public Health impacts | | **Medium Risk** | Acceptable subject to regulatory controls |
| 2. | Fugitive emissions to Air (Ammonia) | Ammonia Plant, pipeline, liq. NH3 storage tanks, pumps | Air<br>Public Health impacts | See section 9.7.4 | **High Risk** | Acceptable subject to regulatory controls |
| 3. | Fugitive emissions to Air (Ammonium nitrates articulates) | Prilling plant, product handling including bagging | Air<br>Public Health impacts | See section 9.8.4 | **Low Risk** | No regulatory controls required |
| 4. | Emissions to Land | Discharge to the Contaminated Stormwater Pond (TAN Plant), Discharge to the Eastern and Western Sedimentation Basins (Ammonia Plant) | Direct Discharge/ seepage<br>Degradation of local groundwater quality<br>Potential impact on surface water quality due to local groundwater flow direction | See section 9.9.5 | **High Risk** | Acceptable subject to regulatory controls |

| | Description of Risk Event | | | Applicant controls | Risk rating | Acceptability with controls (conditions on instrument) |
|---|---|---|---|---|---|---|
| | **Emission** | **Source** | **Pathway/ Receptor (Impact)** | | | |
| 5. | Emissions to Land (WWTP) | WWTP servicing the Ammonia Plant and the TAN Plant | Direct discharge | See section 9.10.5 | **Medium Risk** | Acceptable subject to regulatory controls |
| 6. | Emissions to Marine Waters (MUBRL) | Wastewater streams, discharged into MUBRL | Direct discharge | See section 9.11.5 | **Medium Risk** | Acceptable subject to Licence Holder controls conditioned |
| 7. | Emissions to Marine Waters | Discharge from Western and Eastern sedimentation Basins into King Bay tidal flats | Direct discharge | See section 9.12.5 | **Medium Risk** | Acceptable subject to regulatory controls |
| 8. | Noise Emissions | Operations of the Ammonia Plant and the TAN Plant | Air/ Wind dispersion | See section 9.13.4 | **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 45. The risks are set out in the assessment in section 9 and the controls are detailed in this section. DWER will determine controls having regard to the adequacy of controls proposed by the Licence Holder. The conditions of the Licence will be set to give effect to the determined regulatory controls.

**Table 45: Summary of regulatory controls to be applied**

| | | **Controls (references are to sections below, setting out details of controls)** | | | |
|---|---|---|---|---|---|
| | | Infrastructure and equipment (10.1.1, 10.2.1, 10.4.2, 10.5.1, 10.6.1, 10.7.1) | Specified actions (10.1.4 | Monitoring and Reporting Requirements (10.1.3-5, 10.3.1, 10.5.3,-4, 10.6.2-3, 10.7.2-3, 10.8.2-3) | Limit (10.1.2, 10.5.2, 10.7.1, 10.8.1) |
| **Risk Items (see risk analysis in section 9)** | Point Source emissions to air – Normal Operations | ● | ● | ● | ● |
| | Point Source emissions to air- Abnormal operations | ● | ● | ● | ● |
| | Point Source emissions to Air- Abnormal operation- abnormal conditions requiring flaring | ● | | | |
| | Emissions to land- Normal operations | ● | | ● | |
| | Emissions to land (WWTP) | ● | | ● | ● |
| | Emissions to surface water- (MUBRL) | ● | | ● | ● |
| | Emissions to surface water (Basins) | ● | | ● | ● |
| | Noise emissions | | | ● | ● |

## 10.1 Licence controls - point source emissions to air

### 10.1.1 Infrastructure and equipment

The following requirements will be included in the Amended Licence:

- Significant emission points will be specified. These include the primary reformer stack, package boiler stack and $CO_2$ stripper stack, start up heater stack, vents A and B, the production flare and storage flare on the Ammonia Plant; and the nitric acid plant stack and the common stack on the TAN Plant;
- The Licence Holder will be required to ensure that the following end of pipe control measures are active and operational when the Ammonia Plant and the TAN Plant are in operation:
    - the wet scrubbers used to control PM and $NH_3$ emissions from the TAN Plant prilling plant;
    - the catalytic abatement system installed on nitric acid plant; and
    - Low NOx burners on the primary reformer and startup heater.

**Grounds:** Emissions of NOx have been assessed as medium risk during normal operation. Particulate emissions from the TAN Plant have been assessed as medium risk under normal operations. Height of an emission point is one of the tools to aid in dispersion of contaminant plume and to minimise ground level impacts. Stack heights have been sourced from the design specifications provided by the Licence Holder and specified in the Amended Licence.

Engineering design measures incorporated in plant design are intrinsic to emission control. Accordingly, emission control technology as assessed in the Part IV approval stage and corresponding works approval/ licence assessments will be specified under infrastructure requirements.

### 10.1.2 Limits

Point source emission limits will be specified as per Table 46

**Table 46: Proposed emission limits – normal operations**

| Stack reference | Parameter | Recommended Limit (mg/m$^3$) | Justification for the limit value proposed |
|---|---|---|---|
| Primary reformer stack (Ammonia Plant)- A1 | NOx | 180 | Emission limits from the existing licence have been modified to reflect emissions proportionate with current operations, without increasing the combined emission concentration. Previous limits for the Ammonia plant were 130mg/m$^3$ and 350mg/m$^3$ for the primary reformer stack and package boiler stack respectively. There are no expected changes to the overall impact from the Ammonia Plant at ambient level. These limits are in line with best practice emission concentrations, as described in *Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers*, European Commission 2007, and consistent with Part IV assessments.<br><br>Emissions are to be corrected to 3% $O_2$ at STP. This correction factor is reflective of design capabilities for equipment of this |
| Package Boiler Stack (Ammonia Plant)- A2 | NOx | 300 | |

| Stack reference | Parameter | Recommended Limit (mg/m$^3$) | Justification for the limit value proposed |
|---|---|---|---|
| | | | nature and in line with best practice. Concentrations corrected to 3% will provide standardized data and prevents dilution of emission concentrations. |
| Nitric Acid Plant Stack- A3 | NOx (as $NO_2$) | 103 | Limits for TAN Plant emission sources are derived from the targets specified in W4701. These are in line with best practice emission concentrations and consistent with Part IV assessments. |
| | $N_2O$ | 196 | |
| | $NH_3$ | 0.75 | |
| Common Stack- A4 | PM | 15 | |
| | $NH_3$ | 10 | |

Additional licence limits are applicable to air emissions during startup conditions as per Table 47.

**Table 47: Proposed licence limits - startup**

| Discharge point | Emission | Limit (mg/m$^3$) | Justification for the limit value proposed |
|---|---|---|---|
| Nitric acid plant stack | NOx (as $NO_2$) | 1540 | The limits applicable to the Nitric acid plant stack only apply for a maximum of 2 hours. This prohibits the Licence Holder from operating in start-up for prolonged periods and minimises the potential for offsite impacts. |
| | $NH_3$ | 11.5 | |

**Grounds:** Emissions of nitrogen oxides and particulates from the Ammonia and TAN Plant have been assessed as medium risk. Limiting point source emissions to air is key to ensuring that ground level concentration of key contaminants at the receptors remain within specified criteria to protect environment and public health.

MS 870 for the TAN Plant requires the Licence Holder to implement best practice pollution control technology to minimise relevant emissions from the TAN Plant ammonium nitrate prilling plant. The key characteristics specified in MS 870 (TAN Plant) and MS 560 (Ammonia Plant) specify load based limits for key contaminants.

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 CEMS have been upgraded (see section 10.1.6). This will enable additional limits to be imposed on the Ammonia plant during start-up if warranted by risk.

### 10.1.3 Monitoring requirements

Monitoring of discharges to air will be included in the Amended Licence:

- Quarterly stack emissions monitoring of the Common Stack (TAN Plant) for particulates and ammonia. Flow monitoring is also required to ensure emission rates are accurately calculated from concentration data;
- Quarterly stack emissions monitoring of the primary reformer stack and package boiler stack for NOx (as $NO_2$) emissions. Flow monitoring is also required to ensure emission rates are accurately calculated from concentration data;
- Continuous monitoring of NOx (as $NO_2$) emissions and flow rate from the primary reformer stack and package boiler stack following the installation of CEMS (see section

10.1.6);

- CEMS monitoring for NOx (as $NO_2$), nitrous oxide ($N_2O$), ammonia and flow rate from the nitric acid plant stack (TAN Plant);
- 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.

Refer to Map of monitoring points, Appendix 4, for monitoring locations.

**Grounds:** Emissions of nitrogen oxides, particulates and ammonia have been assessed as medium risk.

The Existing Licence requires the Licence Holder to undertake stack sampling bi-annually for the Ammonia Plant. The Licence Holder had existing CEMS installed on the primary reformer and package boiler stacks, because of which the extractive stack sampling frequency specified on Existing Licence was considered appropriate.

However, in response to improvement requirement specified in the Existing Licence, the Licence Holder advised that the CEMS installed on the Package Boiler and Primary Reformer stacks on the Ammonia Plant do not comply with the CEMS Code. Given the outcomes of the risk assessment, it is considered appropriate that extractive stack sampling be undertaken more frequently to ensure that Ammonia Plant emissions comply with the specified limits. This is likely to be an interim measure until the Licence Holder upgrades the CEMS on the Ammonia Plant (see section 10.1.6).

The Licence Holder has requested approval to use a PEMS instead of CEMS for regulatory reporting and compliance purpose. As discussed under the Key Findings in section 6.1.5of this Decision Report, a key factor in determining whether a PEMS can be used as an alternative monitoring methodology for regulatory reporting and compliance measurement purposes is whether the PEMS will have the same or better precision and reliability than a CEMS. The use of PEMS for regulatory compliance purposes is not supported at this stage as the Licence Holder has not provided sufficient data to demonstrate the suitability of PEMS.

The nitric acid plant stack on the TAN Plant has a CEMS compliant with CEMS Code.

Ongoing compliance requirements to demonstrate continued acceptability and accuracy of the CEMS in accordance with the CEMS Code are specified accordingly.

### 10.1.4 Monitoring reports

The following requirements will be included in the Amended Licence:

- Requirement for submission of laboratory analysis reports for any monitoring event specified in the licence;
- Requirement to submit CEMS data in a readable electronic format;
- Requirement to report on CEMS availability;
- Requirement to submit an Annual Environmental Report to include analysis on any trends in emissions and reasons for the same, and a comparison against any limits specified in the licence;

- Requirement to include in the AER a summary of all Ammonia Plant startup and shutdown events including dates, times, durations, reasons for each event, characterisation and quantification of gases vented during each event, and commentary on how the emissions compared with inputs used to asses venting in air emissions modelling for the Ammonia Plant; and
- Requirement to submit an Annual Audit Compliance Report to enable the Licence Holder to report on their compliance or non-compliance(s) with licence conditions.

**Grounds:** Reporting requirements are necessary for the administration of the licence and for validating ongoing acceptability of the Premises operation.

Venting of gases including ammonia is part of standard operations for the Ammonia Plant at each startup and shutdown event. Reporting on quantification of emissions during venting will help the ongoing review of risk for the Premises.

### 10.1.5 Notification

The Licence Holder will be required to notify the DWER of any exceedances of the limits specified in the Amended Licence. Notification requirements will include:

a) The time and date when the non-compliance occurred;

b) Details of any environmental impact occurred as a result of the non-compliance and if so what that impact was and where the impact occurred;

c) The details and result of any investigation undertaken into the cause of the non-compliance;

d) Details of any action taken and the date on which it was taken to prevent the non-compliance occurring again; and

e) Details of any action taken and the date by which it will be taken to prevent the non-compliance occurring again.

**Grounds**: Notification of limit exceedances is required for effective administration of the licence.

### 10.1.6 Specified actions

The following requirements will be included in the Amended Licence:

- Requirement to upgrade the CEMS on the Primary reformer stack and Package boiler stack to be compatible with the CEMS Code by 30 September 2019;

**Grounds:** The risk assessment is currently based on modelling of mass emission data and stack monitoring completed during normal operations of the Ammonia Plant. Due to the lack of actual data during shutdown, startup and plant trips, CEMS monitoring is considered a priority to confirm the ongoing risk of emissions under all operating scenarios.

## 10.2 Licence controls - point source emissions to air (flaring/venting from Ammonia Plant)

### 10.2.1 Infrastructure and equipment

The following requirements will be included in the Amended Licence:

- The production and storage flare tips will be specified as authorised emission points (see Map of discharge locations, Appendix 4), including the requirements for the pilot light to be lit at all times during plant operation and for ammonia directed to the flares to be combusted (i.e. not vented).

Additional controls are not warranted given the inherent safety requirements for flare

operation. Inefficient flare operations are covered by reporting requirements under section 72 of the EP Act.

## 10.3 Fugitive emissions to air (ammonia)

### 10.3.1 Monitoring

Under section 72 of the EP Act, the Licence Holder is required to notify the Department as soon as practicable of an event causing a release of ammonia into the atmosphere that has caused or is likely to cause pollution, material environmental harm or serious environmental harm.

The Licence Holder will be required to continuously monitor ambient air for ammonia at the Premises boundary which may be released from venting or inefficient flaring. The location of ammonia ambient monitors are detailed in the map of monitoring point, Attachment 5. This monitoring requirement requires continuous monitoring and that alarms 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 9.7.

**Grounds:** Fugitive releases of ammonia are considered high risk, predominantly due to the severe consequence. 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. The inclusions of ambient monitoring requirements will assist in informing any s72 notifications required under section 72 of the EP Act.

## 10.4 Emissions to land

The *Draft Yara Pilbara Groundwater Procedure* submitted by the Licence Holder in response to an improvement requirement (IR2) specified on the Existing Licence has been reviewed by the Department's technical experts. Recommendations for licence conditions included in this section are based on the findings of this review. Key considerations include:

- The groundwater monitoring bore network has been expanded;
- Screened intervals for the groundwater monitoring wells (MW1-MW5) associated with the TAN Plant are consistent across the Premises and typically intersect the top of the aquifer. Monitoring wells MW1 and MW4, which were reinstalled in 2014, are screened at deeper depths within the granophyre layer, which may lead to variation in groundwater chemistry;
- Baseline assessment for the TAN Plant (2011 and 2012) shows the inferred groundwater flow direction is to the southeast;
- Monitoring well BFF was installed during the baseline assessment (SKM, 2006) as an up-hydraulic gradient monitoring well. However, a wastewater infiltration basin construction up-gradient of this monitoring well appears to have impacted groundwater. As a consequence, groundwater beneath this part of the Premise is unlikely to represent background groundwater quality;
- Monitoring well BFA was also installed during the baseline assessment as an up hydraulic gradient monitoring well. However this well was dry during the initial baseline sampling and as a consequence background groundwater quality at this location has not been established. This well has been replaced with a new well US1;
- There is inconsistency in the approaches used for deriving and applying trigger levels at the TAN Plant and the Ammonia Plant; and

- The trigger levels for the TAN Plant are based on the requirements of Condition 8.4 of MS 870 and a site-wide trigger level has been determined for each analyte based on the average baseline concentration plus 10%. Trigger levels proposed for the Ammonia Plant are based on maximum baseline concentrations plus 10% and are currently set on an individual basis for each well. A consistent approach needs to be established across both sites.

### 10.4.1 Ambient groundwater monitoring, analysis and reporting

Groundwater sampling requirements specified in Schedule B2 of the NEPM 2013 will guide the licence conditions.

Specifically, the following requirements will be added to the Amended Licence:

- Groundwater sampling and analysis program to include:
    - Updated monitoring network, see Map of monitoring locations, Appendix 4;
    - 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; and
    - Hydrocarbons.
- Option for in-situ groundwater physiochemical parameters (electrical conductivity, redox potential, pH, temperature and dissolved oxygen) to be measured in the field;
- Field parameters and groundwater samples should be collected 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.
- Analysis should be completed by a NATA accredited laboratory for the required methodology, with the exception of in-field analysis; and
- Given the possible matrix interference with saline groundwater samples and consequential increase of the limits of reporting, 'ultra-trace' analysis should be used where possible.

**Grounds:** Premises operations have been assessed as high risk and likely to impact local groundwater. Given the location of the Premises and proximity of a sensitive marine environment, ambient groundwater quality monitoring is considered a key operational control tool to assess ongoing impacts from Premises operations. Once sufficient groundwater monitoring results are available from the upgraded monitoring program and following the completion of groundwater improvement requirements, the Delegated Officer considers it appropriate to review trigger levels established by the Licence Holder and consider these for inclusion as licence limits.

### 10.4.2 Infrastructure

The following requirements will be specified:

- Use of the contaminated surface water ponds for storage of process effluent including

contaminated surface water;

- Use of eastern and western sedimentation basins for storage of storm water flows and cooling tower blowdown; and
- Liner specifications of the contaminated surface water pond, and eastern and western sedimentation basins;

**Grounds:** Groundwater depth at the Premises is shallow. Contaminated stormwater or process water storage in ponds can impact groundwater quality if appropriate storage is not maintained.

## 10.5 Emissions to land – (WWTP)

### 10.5.1 Infrastructure

The following requirements will be specified:

- Use of infiltration basins for the discharge of treated wastewater from the WWTP servicing the Ammonia Plant if it meets the water quality criteria specified in the licence; and
- Use of the contaminated surface water pond, including permeability specifications, for the disposal of treated domestic wastewater from the ATUs servicing the TAN Plant.

See Map of Discharge points, Appendix 4 for location details.

### 10.5.2 Emission limits

Emission limits will be specified for the discharge of treated wastewater to the infiltration basins. Limits will be specified for nutrients, biochemical oxygen demand, pH, total suspended solids, and pathogens in line with the Existing Licence limits.

Noting that the WWTP cannot achieve the specified limit for Total nitrogen and phosphorus, an improvement program will be required to demonstrate that discharges to the infiltration basins are environmentally acceptable or, options for alternative disposal are investigated. Outcomes from this investigation are expected to ensure discharges to land satisfy the licence limits, as such the limits for Total nitrogen and total phosphorus will apply 3 months following the completion of the improvement requirement.

### 10.5.3 Monitoring and reporting

The following requirements will be specified:

- The Licence Holder should monitor the quality of domestic treated wastewater from the WWTP servicing the Ammonia Plant prior to discharge via infiltration basins offsite;
- The quarterly monitoring frequency as specified on the Existing Licence is considered appropriate until such time that performance issues with the WWTP are resolved; and
- Reporting of treated wastewater quality monitoring results through Annual Environmental Reports.

See Map of monitoring locations, Appendix 4 for location details.

**Grounds:** The new WWTP servicing the Ammonia Plant has been unable to meet the manufacturer's design specifications originally assessed under Works Approval W5920. The Licence Holder was previously approved to discharge treated wastewater via infiltration offsite and has continued using the same wastewater disposal method after installing the new unit. The risk of a discharge of inadequately treated wastewater to land impacting groundwater quality has been assessed as moderate. Until such time that performance issues with the WWTP are resolved, or the Licence Holder ceases discharging this wastewater via infiltration, quarterly monitoring of wastewater quality discharged is considered appropriate. The frequency or the need for monitoring can be reviewed in future subject to the Licence Holder's actions as

recommended in the section 11.6.3 of this Decision Report.

Treated wastewater from the ATUs servicing the TAN Plant is disposed to the Contaminated Surface Water Ponds for evaporation offsite. Wastewater from the ponds can be disposed into MUBRL in the event of intense rainfall. Any wastewater discharged into the MUBRL will have to comply with the relevant licence requirements. The ATUs are also subject to regulation by the Department of Health. As part of the TAN Plant Commissioning Report, the Licence Holder has committed to implement an ATU maintenance strategy in line with the *Code of Practice for the Design, Manufacture, Installation and Operation of ATUs serving Single Dwellings*, published by the Department of Health, Western Australia 2001.

### 10.5.4 Notification

Notification requirements regarding exceedances of emission limits will be specified as described for emissions to air.

### 10.5.5 Improvements

- The development of a local conceptual model (CSM) of the existing infiltration system, based on the CSM developed for the Ammonia Plant, to identify the expected pathway and receptors for infiltrated nutrients;
- A review of groundwater quality based on available groundwater monitoring data to identify any evidence of nutrient contamination in the vicinity of the infiltration system;
- Contaminant fate and transport modelling based on a range of aquifer parameters to address the uncertainty in site conditions;
- Review of expected nutrient concentrations at sensitive receptors and the associated ecological risk;
- Identification of improvements in the wastewater treatment system;
- Consideration of alternative effluent disposal options including, but not necessarily limited to reuse, discharge to the MUBRL or irrigation.
- Schedule for implementation of identified improvements, upgrades or alternative disposal options, resulting from the review

**Grounds:** WWTP servicing the Ammonia Plant has been unable to perform to the design specifications. Disposal of inadequately treated wastewater into infiltration basins can impact groundwater quality at the Premises.

A wastewater balance undertaken by the Licence Holder for the Part IV assessments of the TAN Plant and Ammonia Plant looked at wastewater generation volumes and containment capacities of infrastructure associated with each operation separately. With the proposed change in Premises boundary, it is necessary for the Licence Holder to review wastewater flows and containment/ disposal options for domestic treated wastewater from the Ammonia Plant. This is covered by the improvement requirement.

## 10.6 Emissions to marine waters (MUBRL)

### 10.6.1 Infrastructure and Limits

The following requirements will be specified:

- Emission points for discharging into the MUBRL will be authorised in the licence and wastewater streams that can be discharged into MUBRL through these emissions points will be specified.

See Map of discharge points, Appendix 4, for discharge locations to the MUBRL

**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.

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

- Ecological Quality Objectives set for King Bay as recommended in the Pilbara Coastal Water Quality Consultation Outcomes 2006 report;
- Appropriateness of limits specified in the Existing Licence;
- Requirements of MS 586 and the OMEMP; and
- Commitments given by the Licence Holder when undertaking commissioning of the TAN Plant
- 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 NH3 and to not contain greater than 15 ppm nitrogen from NH4NO3;
    - 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 (antiscalant) concentration of up to 1.2 ppm (~1.2 mg/L).

**Grounds:** Discharge of wastewater through the MUBRL operated by Water Corporation is subject to requirements specified in MS 594. The OMEMP developed by Water Corporation sets triggers established with the objective of meeting. The risk assessment in this Decision Report has not recommended any changes to the Water Quality Objectives set.

The OMEMP sets a framework for managing cumulative discharge from the MUBRL. EPA Bulletin 1044 and the OMEMP recommend that management of the discharge from each operator should be managed under respective licence conditions. The section 45C amendment to MS 586 specified that wastewater discharges from the Premises should be regulated under Part V of the EP Act.

### 10.6.2 Monitoring and reporting

The following requirements have been specified:

- 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
- Monitoring/ sampling frequency.
- Reporting requirements relating to submission of monitoring and analysis results.

See Map of monitoring locations, Appendix 4, for location details.

**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 are the key contributor of discharges of wastewater into the MUBRL and emissions from the Premises are likely to impact surface water quality at the discharge location in Kings Bay. 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.

### 10.6.3 Notification

Notification requirements regarding exceedances of emission limits will be specified as described for emissions to air.

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

### 10.7.1 Infrastructure and Limits

Infrastructure requirements relating to the discharge and licence limits have been retained from the current licence. As there have been no changes to the process of these events since the previous assessment, these regulatory requirements remain valid.

### 10.7.2 Monitoring and reporting

Following each discharge event, the Licence Holder will be required to undertake monitoring of water for potential contaminants prior to discharge and every 24-hours during the discharge. The purpose of this monitoring is to ensure compliance with prescribed limits and minimize the potential for offsite impacts. Other monitoring and reporting requirements are as described in section 10.6.2.

Refer to Map of monitoring points, Appendix 4, for monitoring locations.

### 10.7.1 Notification

Notification requirements regarding exceedances of emission limits will be specified as described for emissions to air.

**Grounds:** The risk of emissions from discharges from sedimentation basins was considered Medium. There is potential for wastewater discharged from sedimentation basins to have elevated contaminants concentration exceeding the emissions limits specified. Potential environmental impacts associated with the discharge will depend on the volume of discharge, duration and concentration of contaminants.

## 10.8 Noise emissions

### 10.8.1 Limit

A noise limit of 65dB(A) will be specified in the licence at the Premises boundary.

**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 (as stipulated in the EP (Noise) Regulations). The limit specified is consisted with the Part IV assessment of the proposal.

### 10.8.2 Monitoring and reporting

Quarterly boundary noise monitoring will be specified on the Amended Licence using the methods described in the EP (Noise) Regulations. The location of noise monitors are as depicted in the Map of monitoring points, Appendix 4. Results of the monitoring will be reported in the Annual Environmental Reports

A complaints management condition will be included in the Amended Licence requiring the Licence Holder to record details of complaints received, the root cause identified and corrective/

preventive actions implemented. A summary of complaints will be required to be reported through the Annual Environmental Reports.

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

### 10.8.3 Notification

Notification requirements regarding exceedances of the emission limit will be specified as described for emissions to air.

# 11. Determination of Amended Licence conditions

The conditions in the Amended Licence have been determined in accordance with the *Guidance Statement: Setting Conditions*.

Table 48 provides a summary of the conditions to be applied to the Amended Licence and how they relate to conditions of the Existing Licence.

**Table 48: Summary of conditions to be applied**

| Condition Reference | Grounds | Existing Licence condition |
|---|---|---|
| Emissions<br>Condition 1 | The general and authorised emissions condition is a valid, risk-based condition to ensure appropriate extent of authorised emissions. | Condition 2.2.1, previously authorised emissions.<br><br>New condition has been expanded to provide further details and include TAN plant operation. |
| Infrastructure and equipment<br>Condition 2 | The condition is valid, risk-based and contain appropriate controls on infrastructure requirements. | Conditions 1.2.1 and 1.2.2 previously specified infrastructure conditions.<br><br>New condition includes TAN plant operation. |
| Discharges to air<br>Condition 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 | These conditions are valid, risk-based and consistent with the EP Act. | Conditions 2.2.2, 2.2.3 have been reviewed to reconsider the Oxygen correction and limits. Conditions 3.2.1, 3.2.2 have been updated to quarterly monitoring and will reflect CEMS data in future.<br><br>New conditions include TAN plant operation. |
| Discharges to marine waters<br>Condition 13, 14, 15, 16 | These conditions are valid, risk-based and consistent with the EP Act. | Conditions 2.3.1, 2.3.2 and 3.3.1 have been reviewed.<br><br>New conditions consider TAN plant operation. |
| Discharges to land<br>Condition 17, 18, 19, 29 | These conditions are valid, risk-based and consistent with the EP Act. | Conditions 2.4.1, 2.4.2 and 3.4.1 have been reviewed.<br><br>New conditions consider TAN plant operation. |
| Ambient groundwater Monitoring<br>Condition 21 | These conditions are valid, risk-based and consistent with the EP Act. | Condition 3.5.1 has been reviewed.<br><br>New condition consider TAN plant operation. |
| Noise emissions<br>Condition 22, 23, 24 | These conditions are valid, risk-based and consistent with the EP Act. | New conditions have been included to consider the operation of both Ammonia and TAN plant operation. |
| Improvements<br>Condition 25, 26 | These conditions are valid, risk-based and consistent with the EP Act. | N/A |

| Condition Reference | Grounds | Existing Licence condition |
|---|---|---|
| Records and reporting Condition 27, 28, 29, 30, 31 | Reporting conditions are valid, risk-based and consistent with the EP Act. | Conditions 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.2.1, 5.2.2, 5.2.3, 5.3.1, have been reviewed.<br><br>New conditions consider TAN plant operation. |

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. Licence Holder's comments

The Licence Holder was provided with the draft Decision Report and draft Licence on 26 June 2018. The Licence Holder provided a response on 27 June 2018. This response included comments regarding the groundwater monitoring condition requiring monitoring of total nitramines and total nitrosoamines which are products of MDEA degradation. The Licence Holder advised that consultation with laboratories in Australia indicated that analysis of these compounds as totals was not possible. During discussions with the Licence Holder, DWER provided four specific compounds within the nitramine and nitrosoamine groups which are to be analysed. The Licence Holder requested Table 19 of the draft licence be updated to reflect this requirement.

In addition to the specification of nitramine and nitrosoamine analytes, the Licence Holder requested that the sampling requirement for these four parameters be standardised with the requirements to monitor and analyse MDEA.

The Licence Holder waived the 21 comment period, providing a satisfactory outcome of the matter could be determined.

The Delegated Officer accepted the Licence Holder's request and amended the licence accordingly.

# 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 continuous operation of the TAN Plant and reviewed emissions and discharges from the Ammonia Plant. The assessment has resulted in a consolidated licence with risk based regulatory controls.

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

**Ed Schuller**

**Acting Director**
**Regulatory Services (Environment)**
Delegated Officer under section 20 of the *Environmental Protection Act 1986*

## Appendix 1: Key documents

| | Document title | Availability |
|---|---|---|
| 1 | ANZECC Guidelines for Fresh and Marine Water Quality | http://www.agriculture.gov.au/SiteCollectionDocuments/water/nwqms-guidelines-4-vol1.pdf |
| 2 | *Burrup Technical Ammonium Nitrate Production Facility Air Quality Management Plan 2013* | DWER records |
| *3* | *Burrup Peninsula Desalinated Water and Seawater Supplies Project: Operational Marine Environmental Management Plan (OMEMP)* | http://www.epa.wa.gov.au/policies-guidance/pilbara-coastal-water-quality-consultation-outcomes |
| | Consolidated Baseline Groundwater Report – Burrup Fertilisers Pty Ltd, Burrup Ammonia Plant, 15 February 2006, authorised by SKM | DWER records |
| 4 | Contaminated Sites Act 2003 | https://www.slp.wa.gov.au/Index.html |
| 5 | Dangerous Good Safety (Major Hazard Facilities) Regulations 2007 | https://www.slp.wa.gov.au/Index.html |
| *6* | *Draft Burrup Rock Art Strategy* | https://www.der.wa.gov.au/our-work/consultation |
| 7 | Environment Protection and Biodiversity Conservation Act 1999 | http://www.environment.gov.au/epbc |
| 8 | Environmental Protection Act 1986 | https://www.slp.wa.gov.au/Index.html |
| 9 | Environmental Protection Regulations 1987 | |
| 10 | Environmental Protection (Noise) Regulations 1997 | |
| 11 | Guidance Statement: Regulatory Principles (July 2015) | https://www.der.wa.gov.au/our-work/regulatory-framework |
| 12 | Guidance Statement: Decision Making (February 2017) | |
| 13 | Guidance Statement: Risk Assessments (February 2017) | |
| 14 | Guidance Statement: Environmental Siting (November 2016) | |
| 15 | Guidance Statement: Setting Conditions (October 2015) | |
| 16 | Guidance Statement: Land Use Planning (February 2017) | |
| 17 | Guidance Statement: Licence Duration (August 2016) | |
| 18 | Guideline: Continuous Emission Monitoring System Code for Stationary Source Air Emissions | https://www.der.wa.gov.au/our-work/licences-and-works-approvals/publications |
| 19 | Ministerial Statement 870 | https://www.dwer.wa.gov.au/environmental-protection-authority |
| 20 | Ministerial statement 586 | |

| | Document title | Availability |
|---|---|---|
| 21 | EPA Report 1379 | |
| 22 | EPA Bulletin 1077 | |
| 23 | National Environmental Protection (Assessment of Site Contamination) Measure 1999 | https://www.legislation.gov.au/Details/F2013C00288 |
| 24 | European Fertilizer Manufacturers Association (EFMA) Best Available Techniques for Pollution Prevention and Control in the European Fertilizer Industry Booklet No. 2: Production of Nitric Acid (EFMA Booklet No. 2) | http://fertilizerseurope.com/fileadmin/user_upload/publications/tecnical_publications/BATs/ |
| 25 | European Commission Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers (European Commission, 2007). | http://eippcb.jrc.ec.europa.eu/reference/BREF/lvic_aaf.pdf |
| 26 | EFMA Best Available Techniques for Pollution Prevention and Control in the European Fertilizer Industry Booklet No. 6: Production of Ammonium Nitrate and Calcium Ammonium Nitrate (EFMA Booklet No. 6) | http://fertilizerseurope.com/fileadmin/user_upload/publications/tecnical_publications/BATs/ |
| 27 | Works Approval W4701/2010/1 | DWER records |
| 28 | Works Approval W4701/2010/1 Commissioning Report Technical Ammonium Nitrate Plant | DWER records |

## Appendix 2: Summary of stakeholder comments on application

| Comments Received | Key concerns raised | DWER Consideration or reference to the relevant section in this Decision Report |
|---|---|---|
| **Public Authorities including the then Department of Parks and Wildlife (now Department of Biodiversity, Conservation and Attractions), the Water Corporation** | • Licence should be amended to be consistent with the OMEMP- Revision 4 and Ministerial Statement 594<br>• Potential impact on shells and reproductive capacity of land and aquatic snails has not been considered in the proposal. Increased acidity within waterbodies and subsequent erosion of cement forming tufa may result in porous rock pools and subsequent loss of aquatic habitat.<br>• Emission targets and emission profile should be reviewed if DBCA (DPaW) initiated monitoring of water quality and aquatic biodiversity demonstrates adverse impacts. | • Wastewater emission limits have been reviewed to be consistent with the OMEMP and Ministerial Statement 594.<br>• DBCA has not advised DWER if monitoring of water quality and aquatic biodiversity, initiated by DBCA, has identified adverse impacts on biodiversity or water quality on the Burrup Peninsula.<br>• The air emission limits in the Licence have been reviewed in accordance with the findings of this Decision Report and to be consistent with the requirements of the Ministerial Statements No. 586 and 870 and outcome of the Independent Health Risk Assessment initiated by DWER in 2018. |
| **Murujuga Aboriginal Corporation** | • Impact on rock art<br>• Lack of understanding of what the licence amendment application specifically relates to.<br>• Progress made by Yara in complying with current environmental and cultural heritage obligations pursuant to requirements specified in the Common Wealth approval. | • See Section 5.3 of the Decision Report for details on current legislative framework to manage potential impacts on the rock art.<br>• The Licence Amendment Application was advertised consistent with the requirements in the EP Act. The extent of the licence amendment sought by the Applicant is noted in the Application and Supporting Documentation.<br>• Updates on Yara's extent of compliance with the requirements specified in Commonwealth Approval granted under the EPBC Act are reported on the Company's website. Assessment and review of compliance with the EPBC Approval conditions is out of scope of this Decision Report. |
| **Community Groups** | • Impact on rock art<br>• Lack of sufficient documentation to support the Application for licence amendment<br>• Concerns with stakeholder engagement process followed raising that Public and Traditional Owners were not provided with due process to understand and comment on the proposal | • See Section 5.3 of the Decision Report for details on current legislative framework to manage potential impacts on the rock art.<br>• The Application Document and supporting information submitted by the Applicant was reviewed by DWER for the purpose of this assessment. Additional information and clarification was sought from Yara as appropriate where any information gaps were identified. The Delegated Officer did not consider the Application to be so deficient to warrant refusal of the amendment application. |

| Comments Received | Key concerns raised | DWER Consideration or reference to the relevant section in this Decision Report |
|---|---|---|
| | | • The Licence Amendment Application was advertised consistent with the requirements in the EP Act.<br>• Murujuga Aboriginal Corporation was notified of the proposal as a Direct Interest Stakeholder and comments considered. |
| **Individual submissions** | A total of 57 individual submissions were received. 15 submissions requested that the amended licence should not be granted. 16 submissions requested that the amended licence should be granted only with strict limits or if the emissions are zero. 3 submissions requested that the Applicant should be required to resubmit the application for licence amendment.<br>Key concerns raised include:<br>• Impact on rock art<br>• Plans for ongoing monitoring at rock art subsequent to disbanding of the BRATWG.<br>• Impact on environment and public health<br>• Cumulative impacts of emissions<br>• Credibility/ reliability of environmental measurements submitted by Yara<br>• Yara's ability to manage operations safely given multiple incidents of gas and acid leaks<br>• Validity of Original Approval by WA Government which was based on CSIRO studies which had inadequate scientific evidence and no statistical analysis<br>• Risk from potential explosion of the stored ammonium nitrate | • See Section 5.3 of the Decision Report for details on current legislative framework to manage potential impacts on the rock art. The Governance Framework being developed by DWER under the Burrup Rock Art Strategy will provide monitoring and reporting mechanisms to assess potential adverse impacts on the rock art.<br>• Cumulative impact of emissions and potential environmental and public health impacts of premises operations have been considered in this assessment. See Risk Assessment detailed in section 9 and corresponding regulatory controls specified in section 10 of this Decision Report.<br>• Licence Conditions on the previous licence (L7997) for the Ammonia Plant, conditions of works approval W4701 for the TAN Plant specified monitoring methods, frequency and reporting requirements. Any non-continuous monitoring, sampling and analysis is required to be undertaken by a holder of NATA accreditation.<br>Yara is required to submit Annual Audit Compliance Report and to declare the extent of compliance with conditions of the Licence. It is an offence under the EP Act to provide false or misleading information. DWER's regularly reviews compliance with licence condition by undertaking premises inspections and by assessing the Annual Environmental Report submitted by the Licence Holder.<br>• Past incidents of fugitive emissions of ammonia and leaks/ spills of chemicals on the premises are under investigation by DWER. Regulatory controls are determined based on emissions risk, licence holder controls and operator competency.<br>The licence conditions are subject to ongoing review. Outcome of DWER investigation will inform future review as appropriate.<br>• The original approval by the WA State Government was based on scientific |

| Comments Received | Key concerns raised | DWER Consideration or reference to the relevant section in this Decision Report |
|---|---|---|
| | | evidence available at the time. Subsequent deficiencies identified in the CSIRO approach for monitoring impacts on rock art will be dealt with through the Burrup Rock Art Strategy.<br>• The Department of Mines, Industry Regulation and Safety (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. |

# Appendix 3: List of contaminants

## Process Liquid waste streams

| Contaminants Expected in Process Liquid Waste Streams- Ammonia Production | | | | | |
|---|---|---|---|---|---|
| **Source** | **Contaminants & Composition** | | **Source** | **Contaminants & Composition** | |
| Package boiler blowdown | Ca: 15 ppm | $SO_4$: 5 ppm | Reformer jacket water blowdown | $CO_2$: 300 ppm | $NH_3$:100 ppm |
| | Mg: 15 ppm | $PO_4$: 15ppm | | Methanol: 100 ppm | PH: 6-9 |
| | Na: 160 ppm | Fe: 2.5ppm | | Fe: trace | TDS:500 ppm |
| | K: 12.5 ppm | $SiO_2$: 2.5ppm | Air compressor intercoolers | $CO_2$: 100 ppm | Fe: trace |
| | $HCO_3$: 2.5 ppm | pH: 7-9 | | pH:6-9 | |
| | $CO_3$: trace | TDS: 500ppm | | $HCO_3$: 100 ppm | |
| | Cl:260 ppm | | | TDS: 200 ppm | |
| Cooling tower blowdown | TDS: 53,000mg/L (concentrated seawater) pH:6-9 | | Process condensate | $CO_2$: 3000 ppm | Methanol: 1000 ppm |
| | | | | $NH_3$: 1000 ppm | TDS: 100 ppm |
| | | | | pH: 6-9 | |
| Neutralised demineraliser regenerant wastewater | Ca: 250 ppm | $HCO_3$: 5 ppm | Reformer steam drum boiler blowdown | Ca: 2.5 ppm | HCO3: 0.5 ppm |
| | SO4: 8500 ppm | pH: 6-9 | | $SO_4$: 1 ppm | pH: 7-9 |
| | Mg: 250 ppm | $CO_3$: trace | | Mg: 2.5 ppm | CO3: trace |
| | $PO_4$: trace | TDS: 15,00ppm | | $PO_4$: 10ppm | TDS: 100ppm |
| | Na: 5000 ppm | Cl: 5000 ppm | | Fe: 0.5ppm | Cl:50 ppm |
| | Fe: 5ppm | $SiO_2$: 5ppm | | K: 2.5 ppm | Na: 30 ppm |
| | K: 250 ppm | | | $SiO_2$: 0.5ppm | |

## Solid waste streams

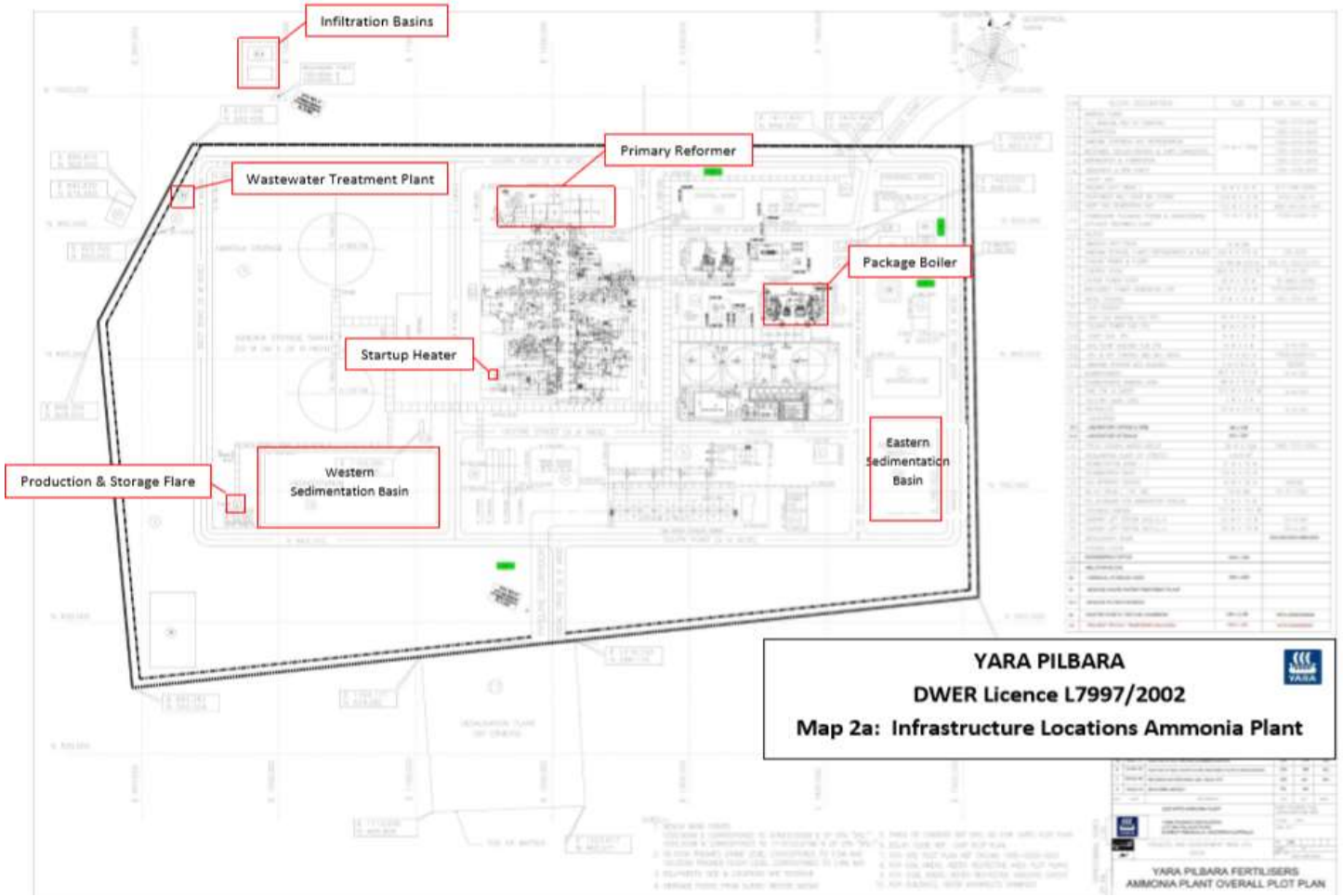
| Source (Ammonia Production) | Quantity ($m^3$/ period) | Contaminants |
|---|---|---|
| Demineraliser Spent Cation/ Anion Resin | 27000$m^3$/ every 3 years | Di-vinyl Benzene Polystyrene Resin |
| Primary Reformer Spent Catalyst | 35$m^3$/ every 3 years | Nickel/ Aluminium oxides |
| Secondary reformer Spent catalyst | 45$m^3$/ Every 3 to 5 years | Ni/ Mg/ Al Oxides |
| High Temperature Shift Spent catalyst | 69$m^3$/ Every 3 to 5 years | Fe/ Cu Oxides |
| Low Temperature Shift Spent catalyst | 87$m^3$/ Every 3 years | Cu/Al/Zn Oxides |
| Synthesis Converter Spent Catalyst | 115$m^3$/ Every 5 to 10 years | Promoted Iron Oxides |
| Methanator Spent catalyst | 39$m^3$/ every 3 years | Ni/ Alumina oxides |
| Desulfuriser Spent catalyst | 33,200$m^3$/ Every 3 years | Zinc oxides |
| Desulfuriser Spent catalyst | 15700$m^3$/Every 6 years | Co/Mb Oxides |
| Molecular sieve spent desiccant | 12.5$m^3$/every 5 years | Sodium alumino silicates |
| MDEA solution spent filter media | 2$m^3$/ every 3 years | Activated carbon |

# Appendix 4: Figures

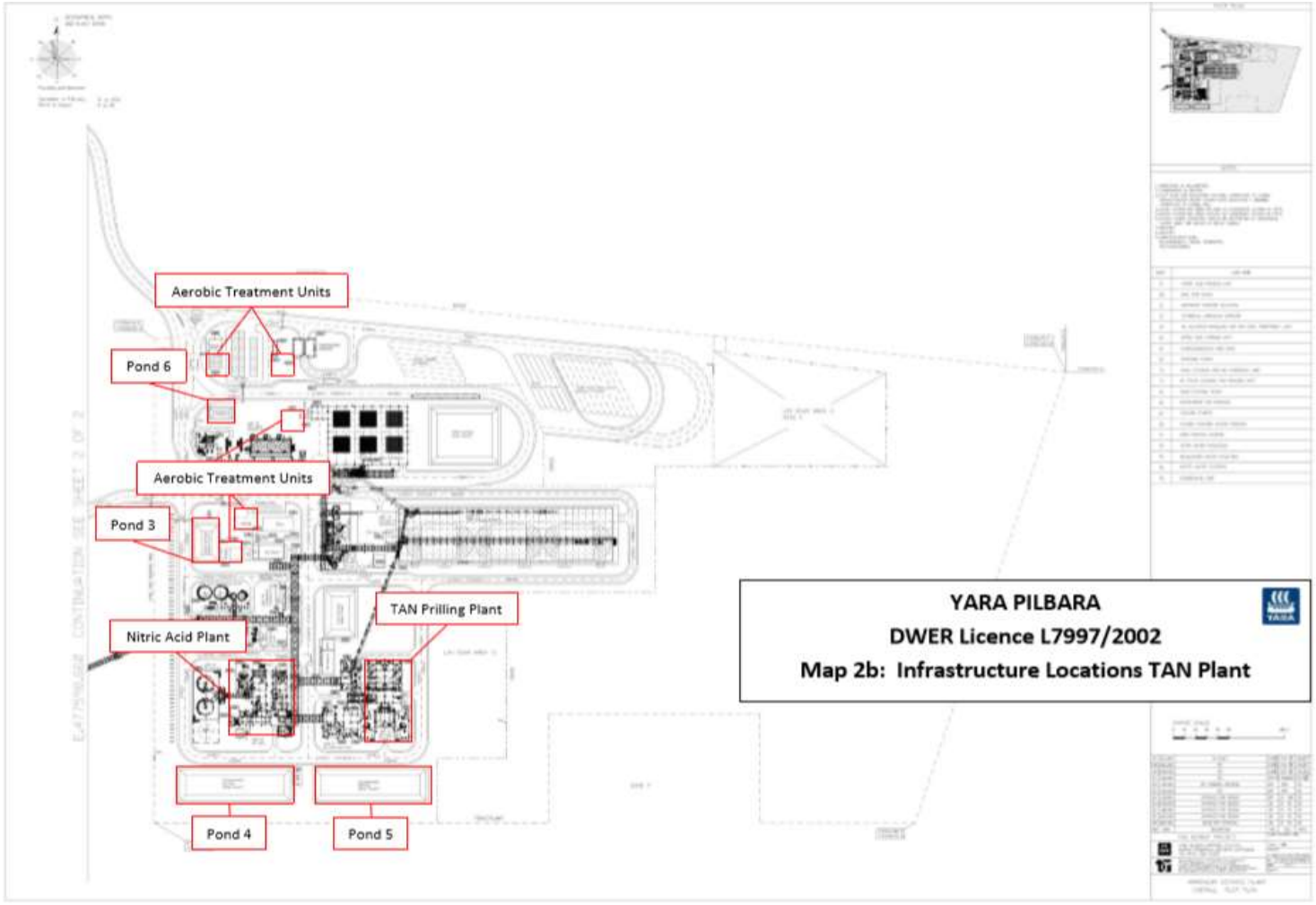
## Premises location

## Site Plan Reference

### Ammonia Plant



## TAN Plant


Aerobic Treatment Units
Pond 6
Aerobic Treatment Units
Pond 3
TAN Prilling Plant
Nitric Acid Plant
Pond 4
Pond 5
YARA PILBARA
DWER Licence L7997/2002
Map 2b: Infrastructure Locations TAN Plant

## Map of discharge point locations

## Map of monitoring locations

# Appendix 5: Benchmark Toxicology Services Report

# BenchMark Toxicology Services

As Trustee for the P & K family Trust ABN 72 217 434 679

*Empowering Through Knowledge*

## Peer review of documents for an application of licence of an existing industrial premises currently being assessed by the Department of Water and Environmental Regulation (under Part V of the EP Act a Ministerial Statement (under Part IV of the EP Act)

BTS File Number: BTS 2018 04 12 C0013 DWER R01 DRAFT Rev3

Prepared for:

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Date: 22 June 2018

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## ABBREVIATIONS

| | |
|---|---|
| AAQG | Ambient air quality guideline(s) |
| ADD | Aerodynamic diameter |
| AEGL | Acute Exposure Guideline Level(s) |
| AESH | Adelaide Exposure Science and Health |
| BTS | Benchmark Toxicology Services Pty Ltd |
| Cf. | Latin *confer*; compare |
| d | Day(s) |
| DEH | Department of the Environment and Heritage -Currently Department of Environment and Energy (DEE) |
| DWER | Department of Water and Environmental Regulation |
| e.g. | For example - Latin *exempli gratia* |
| EP | Environment Protection |
| g | Gram(s) |
| GLC | Ground level concentration |
| h | Hour(s) |
| i.e. | That is – Latin *id est* |
| JLBC | John L Black Consulting |
| Kg | Kilogram(s) |
| µg | Microgram; one thousandth of a mg ($10^{-3}$ mg); one millionth of a gram ($10^{-6}$ g) |
| mg | Milligram(s); one thousandth of a gram |
| min | Minute(s) |
| NAS | National Academies of Science USA |
| NEPC | National Environmental Protection Council |
| NEPM | National Environmental Protection (Ambient Air Quality) Measure |
| NOAEL | No observable adverse effect level |
| NRC | National Research Council of NAS |
| PM | Particulate matter |
| $PM_{10}$ | Particulate matter with aerodynamic diameter ≤ 10 µm |
| $PM_{2.5}$ | Particulate matter with aerodynamic diameter ≤ 2.5 µm |
| SE | Strategen Environmental |
| STL | Short-term exposure limits - usually 15-min averages |
| TANP | Technical Ammonium Nitrate Plant |
| TANPF | Technical Ammonium Nitrate Production Facility |
| TSP | Total suspended particulate(s) |
| TWA | Time weighted average |
| US EPA | United States Environmental Protection Authority |
| USA | United states of America |

| | |
|---|---|
| vs | Versus |
| WACR | Works Approval Commissioning Report (Yara) |
| WES | Worker exposure standards |
| WHO | World Health Organisation |
| YPN | Yara Pilbara Nitrates |
| yr | Year(s) |
| yr | Year(s) |

# EXECUTIVE SUMMARY

## Context

Benchmark Toxicology Services (BTS) has been engaged by the Department of Water and Environmental Regulation (DWER) to undertake an independent peer review of documents submitted to DWER by Yara Pilbara Nitrates Pty Ltd (YPN) for licence renewal to operate an industrial plant in the Burrup Peninsula to produce fertiliser ammonium nitrate.

Comments

BTS uses *italics* and indented paragraphs for complete quotes used in this review to separate clearly the quoted text. BTS also uses ambient air quality guidelines (AAQG) generically to avoid confusion with the different nomenclature used by regulatory jurisdictions.

The information provided by DWER includes the following documents for review:

1. Works Approval Commissioning Report (WACR) by YNP dated 22 September 2017, particularly Appendix 5.
2. The review of the WACR by John L Black Consulting (JLBC) dated March 2018 in which JLBC states that Appendix 5 of the WACR was provided to the Adelaide Exposure Science and Health (AESH; formerly OEH Consulting), University of Adelaide, *for analysis in relation to danger to human health*;
3. A letter report by AESH to Friends of Australian Rock Arts described by the authors as a *brief qualitative opinion* of the potential human health risks associated with ammonium nitrate plant emissions at the Burrup plant, dated 5 February 2018.
4. A response to a review of the WACR submitted by JLBC undertaken by Strategen Environmental (SE) dated 4 April 2018, including a cover letter and summary of the review by YNP.
5. Ambient air quality assessment (modelling of stack emissions) undertaken by Environmental Resources Management Australia (ERM, 2012).

YPN provides 40,010 fifteen-minutes (15-min) average concentrations of stack emissions from the nitric acid stack plant (Appendix 5 of the WACR) for oxides of nitrogen, ammonia and nitrous oxide from 24 May 2016 to 15 September 2017. Of these, 9,202 samples reflected continuous measurement during operations conditions.

The emissions were reported as volumetric flow rate ($m^3/s$), concentration of oxides of nitrogen as nitrogen dioxide and ammonia ($mg/Nm^3$ and g/s), and nitrous oxide (ppmv and g/s).

JLBC raised concerns in the review about health risks posed by nitrogen dioxide from the plant to people on or visiting the Burrup Peninsula stating in the first paragraph of its review:

> *Results provided in the Yara Pilbara Nitrates Pty Ltd (YPN) Commissioning Report (29/09/2017) and Appendix 5 for the new ammonium nitrate plant show that a large number of emissions of the toxic gas, nitrogen dioxide, have occurred and threaten the health of people travelling to Hearson's Cove or Deep Gorge. The emissions have produced gas concentrations in the vicinity of the road to Hearson's Cove up to 23 times higher than stated in the Australian health standard guidelines*.

This conclusion was based on:

- a *photograph taken by a Karratha resident on 29 April 2017, showing a yellow cloud of nitrogen dioxide emitted from the plant and crossing the road to Hearson's Cove*,
- concurrent stack emission data (15-min averages) reported in Appendix 5 of WACR,
- an estimate of the concentration of nitrogen dioxide of 0.47 ppm (0.99 mg/$m^3$) in the yellow cloud based on its colour,
- Based on the ratio of this concentration and the 15-min average concentration of the concurrent interval stack emission at the stack when the cloud was photographed JLBC estimated the ambient air concentration of the highest stack emission concentration and the two concentrations were considered to exceed by about four and 23 times, respectively, the 1-h average national AAQG of 0.12 ppm or 246 µg/$m^3$,
- an assertion that nitrogen dioxide will concentrate closer to the ground because its molecular mass is higher than air, and
- an incomplete quote of the conclusion in the executive summary of the letter report by AESH.

## Scope of works

The scope of works required by DWER included:

1. Analyse the Technical Ammonium Nitrate Production Facility (TANPF) emission data in the commissioning report submitted by Yara to DWER on 29 September 2017 (Appendix 5 in *document 1*)
    - Oxides of nitrogen (as $NO_2$)
    - Nitrous Oxide ($N_2O$)
    - Ammonia ($NH_3$)
    - Ammonium nitrate - as pariculates at at the Common Stack

(A1)

2. Undertake a peer review of the documents produced by Dr John Black and the University of Adelaide (*documents 2 and 3, respectively*);
3. Undertake a peer review of the documents produced by consultants (SE, 2018) on behalf of Yara (*document 4*); and
4. Review modelled ground level concentrations (GLC by Environmental Resources Management Australia, ERM) for the following pollutants:
    - Oxides of nitrogen (as $NO_2$)
    - *Sulfur Dioxide ($SO_2$)*
    - *Nitrous Oxide ($N_2O$)*
    - Ammonia ($NH_3$)
    - Particulate matter ($PM_{10}$, $PM_{2.5}$) and Total Suspended Particulates (TSP);
    - Nitric Acid ($HNO_3$)

    against relevant ambient air quality criteria (short term and long term) such as
    - the National Environmental Protection (Ambient Air Quality) Measure (NEPM) – 1-h, 24-h and annual averages and
    - short-term exposure limits (STEL), e.g. 15-min averages where available, e.g. occupational exposure standards

    to confirm specified emission limits are suitable for the protection of human health in the surrounding area (*document 5*).

## Review summary

This summary of the review of each document is sequentially consistent with the numbering in the scope of works.

### Review of Works Approval Commissioning Report

BTS was requested to analyse the 15-min average data for oxides of nitrogen (measured as nitrogen dioxide), ammonia and nitrous oxide emissions at point source at the Nitric Acid Plant stack (A2), monthly point source emission monitoring at the Common Stack (A1), and compliance with emission limits at the stacks for these gases and for ammonium nitrate (as particles).

Results of monthly testing at Stack (A2) for April 2017 to August 2017 were all below the designated targets or limits for nitrogen dioxide. ammonia and nitrous oxide for stack emission concentrations. Limit emission for mass and volume rates were not available.

For continuous measurement during various periods of routine operations (9,202 samples), exceedances were high at the beginning of the commissioning period for nitrogen dioxide and ammonia but decreased over time as processes were improved and in August 2017 and September 2017 reached zero exceedances for ammonia and 6 and zero exceedances for august and September, respectively, for nitrogen dioxide. Mass emissions during August/September were around 3 g/s except for emission concentration during tests at regular times each day which were higher.

BTS agrees with the analyses and conclusions reached by YPN in the WACR. Relevant aspects of this document will be raised in the following sections as required.

Undertake a peer review of the documents produced by consultants on behalf of Yara

BTS concurs with the critique by SE (2018) and the covering letter by YNP about the JLBC report. Some additional comments are included in the review summaries by BTS that follow.

Undertake a peer review of the documents produced by Dr John Black and the University of Adelaide

Given the dates of these two documents and their content, BTS concludes that JLBC retained AESH to assess the health risks. Consequently, the review of the letter report by AESH will be summarised and assessed first.

Letter report by AESH

AESH has undertaken brief literature searches to identify the hazardous properties and the ambient air quality guidelines for ammonium nitrate particulates, ammonia, nitrogen dioxide, sulfur dioxide and nitric acid (as nitrates).

AESH also presents a table of AAQG for nitrogen dioxide (Acute Exposure Guideline Levels – AEGL) from the National Research Council (NRC) of the US National Academies of Sciences (NAS, 2012) which classify exposure guidelines in three levels - AEGL1, AEGL2 and AEGL3, with effects of increasing severity and the concentrations at which they occur as the tier rank increases.

BTS has accessed the publication by NAS (2012) in which the AEGL1 of 0.5 ppm (1.049 $mg/m^3$ at 0 °C and standard pressure of 1 atm) is considered the no observable adverse effect level (NOAEL) in humans based on controlled exposure chamber studies with asthmatics for exposure durations ranging from 10 min to 8 h.

The conclusions of AESH are based on emission information provided by JLBC by telephone and email stating:

> *The health impacts associated with these emission substances result from very short-term exposures (e.g. ten minutes). If of sufficient intensity, as suggested from the emissions data, the pollutants would result in severe health outcomes for people exposed, particularly for people with asthmatic or other respiratory conditions*

BTS infers that AESH refers to the exceedances of the emission target during the routine operations towards the end of the commissioning programme in particular as well exceedances reported prior to August 2017.

Whilst the conclusion is generally valid for ambient air, the 10-min to 8 h average AEGL1 by NAS suggests that the exposure concentrations of nitrogen dioxide in the cloud provided by JLBC were not of *sufficient intensity* to cause significant adverse effects even in asthmatics. For non-susceptible individuals, the tolerated concentration of nitrogen dioxide is in excess of 1 ppm for periods longer than 15-min (WHO, 2005; NAS, 2012).

This is also supported by a recent review of worker exposure standards (WES) by WorkSafe NZ (2018). WorkSafe NZ reviewed WES from 25 sources world-wide, including Australia and New Zealand. The WES ranged from 0.5 ppm to 3 ppm for 8-h time weighted average (TWA) and 0.5 ppm to 6 ppm for short term limits (STL) of 15-min averages. Seven (7) jurisdictions had published WES ≤ 2 ppm; all from Europe.

AESH considered that a worst-case scenario had not been examined based on the inadequate siting of monitoring stations based on a figure provided by JLBC. The conclusion by AESH assumes that the high stack emission concentrations to which AESH refers occurred during the routine operations of the plant. This is not the case and the conclusion is not necessarily relevant for compliant emissions during routine operations.

Review by JLBC

JLBC states that Appendix 5 of the WACR was sent to AESH for assessment of likely risks to human health. It is apparent the opinions provided by AESH have been included in the document by JLBC and these have been considered above. BTS could not clearly ascertain whether censored data was also provided to AESH. However, the unidentified source of Figure 1 in the AESH letter report strongly suggests that some data provided by JLBC to AESH may have been censored.

The report by SE 2018 and the cover letter by Yara have adequately addressed the limitation of and lack of scientific rigour of the JLBC and AESH documents with respect to emissions, reasons for high emissions and appropriate measurement of exposures for comparison with national AAQG. BTS supports the explanations and conclusion by their submission and adds the following to the review.

JLBC relied on the yellow colour of the nitrogen dioxide cloud photograph taken by a Karratha resident at 16:06 on 29 April 2017 to estimate the concentration of nitrogen dioxide in the cloud as being 0.47 ppm from an extinction coefficient of 0.47 $ppm^{-1}$ × $mile^{-1}$ corresponding to the yellow colour sourced from a table referenced to a book published by Philip A Leighton in 1961. However, JLBC did not consider the concerns by Maga (1965) and Eyring (1962) about the additional complexities in the atmosphere that might affect the colours and chemistry of gases.

With respect to assessing the concentration of nitrogen dioxide based on the colour of the cloud of gas, BTS considers that, while scientifically justifiable by the referenced

table, it is of limited value in the absence of other measures to provide an ambient air concentration that can be used meaningfully for assessing health risks.

JLBC used the ratio of the concurrent 15-min average concentration of emission at the stack and the estimated concentration in the nitrogen dioxide cloud (unknown averaging time) to estimate the ambient air concentration for the highest stack emission concentration of 5.6 mg/m$^3$ to conclude that the exceedances were up to ~ 23 times higher than the AAQG for nitrogen dioxide. This conclusion is alarmist not scientifically justifiable.

In the executive summary, JLBC quotes AESH (2018) as follows:

> *An independent review of the data in the Commissioning Report by the University of Adelaide Exposure Science and Health Centre concluded* 'The pollutants would result in severe health outcomes for people exposed, particularly for people with asthmatic or other respiratory conditions. Due to the nature of these inorganic pollutants, the consequences of such high-level exposure are severe and should not be underestimated by industry or government.'

The most important aspect of the conclusion by AESH is the qualifying statement at the beginning of the first sentence which was omitted by JLBC, i.e.

> *If of sufficient intensity, as suggested from the emission data, the pollutants.*

BTS infers that AESH included this qualification to stress the importance of the dose or concentration of the pollutant and the reliability and accuracy of the measured or estimated doses in question. In addition, BTS believes that AESH was referring to the high stack emission concentrations observed towards the end of the commissioning period that JLBC selected for the assessment.

At this time, there were no exceedances of the target stack emission limit for nitrogen dioxide (102.6 mg/Nm$^3$) during routine operations. The exceedances quoted by JLBC in this period occurred as a result of daily recorded high emissions levels from calibration and drift span checks. at 18:15 each day, i.e. not routine operational conditions.

However, ASEH failed to point out to JLBC that comparing the estimated, unknown average concentration of nitrogen dioxide cloud with the national 1-h average AAQG for assessing health risks is scientifically inappropriate and the outcomes are misleading.

This and the calculated exceedances by JLBC are not scientifically justifiable.

Review of modelled ground level concentration (ERM)

This draft report by ERM (2012) is an update of the original air quality assessment undertaken as part of the Public Environmental Review (PER) for the TANPF in 2009 which has not been considered by BTS.

ERM modelled ground level concentrations (GLC) for oxides of nitrogen, sulfur dioxide, particles (TSP, $PM_{10}$, $PM_{2.5}$), ammonia, nitric acid and dust deposition. The number of

species considered to be particulates (including TSP) were $PM_n$ = $PM_n$ + ammonium nitrate TSP + $SO_4$ + $NO_3$.

Assessment criteria for oxides of nitrogen, sulfur dioxide and particulates were sourced from the national ambient air quality NEPM. Assessment criteria for dust deposition, ammonia and nitric acid were sourced from the NSW Department of Environment and Conservation (DEC NSW)[1] published in 2005.

Background concentration of the substances monitored were used in the modelling and summarised in Table 3.5 of the ERM report. The modelling used a standard approach of *1-hour average output to 99.9 percentile (ninth highest value).* Maximum modelled concentrations where human receptors had been identified were identified by using aerial photographs after applying contouring to the results.

Five receptor locations were identified[2]: 3 human and 2 rock receptors. Two modelling scenarios were considered: normal and non-routine operations, with non-routine operations expected to occur once per year. ERM notes that modelling for non-routine operations *have been modelled as occurring continuously.* (page 29 of ERM report)

With respect to non-routine operations, ERM states:

Emission rates in g/sec for the substances modelled are listed in Table 5.2 and table 5.3 of the ERM report. The nitrogen dioxide concentrations used in the modelling GLC using stack emissions was reported as 2.85 g/s during normal operations and 38 g/s during non-routine operations. The 15-min average concentration of emissions at the stack reported in the WACR were about 3 g/s during the end period of normal operation. Therefore, the concentration used for the model may be considered adequate.

ERM concluded that the GLC of the substances modelled during normal operations[3] comply with the AAQG guidelines used as reference values. The GLC were modelled using both emission data and background concentrations.

Background concentrations were the major contributing source of nitrogen dioxide for the air shed on the Burrup Peninsula Cf. the various industrial facilities.

Regarding the GLC for nitrogen dioxide, the maximum 1-h average concentration modelled was 141.1 µg/$m^3$ (Cf. AAQG of 246 µg/$m^3$); the GLC at the receptor locations were < 50 µg/$m^3$.

BTS concurs with the conclusion by ERM. This is based on review of the information presented in tables in the ERM report for the indicated receptors and the isopleth figures provided in Appendix A which indicated GLC well below AAQG used as reference standards for all time averages and substances described above.

[2] Table 5.1, page 29 of the ERM report.
[3] Table 6.1 of the ERM report

The maximum 1-h average concentration modelled for nitrogen dioxide for the non-operational scenario was 254.9 µg/m$^3$ (Cf. AAQG of 246 µg/m$^3$); the GLC at the receptor locations were < 110 µg/m$^3$.

The GLC reported in the current report were 20% to 50% lower than the 2009 report (Ausplume model used Cf. CALPUFF in the current report).

Conclusions

BTS appreciates the concerns raised by JLBC and AESH about adverse health effects of nitrogen dioxide that may be associated with high ambient air concentrations of the gas. The concentrations of nitrogen dioxide for which concerns were raised were based on the assumptions by JLBC about the estimated concentration in the cloud recorded in the photograph and the concurrent 15-min average stack emission, without considering the duration of exposure.

However, their concerns are not scientifically justifiable for several reasons.

- The photographed yellow cloud is only a snapshot in time of a few milliseconds that will change over time as it disperses in air – it's concentration is most unlikely to increase in ambient air but will decrease with time. However, under the circumstances, the 1-h average cannot be determined. Consequently, the estimated dose in the cloud, although scientifically supported, is inadequate to assess the health risks for people who may have been present in the area at the time it occurred.
- A reliable assessment of the dose or concentration of toxic substance is critical in assessing risks to health. The photographic evidence may be concerning for some observers but is insufficient to satisfy this requirement.
- The scientific principles of risk assessment - and the State, National and International guidelines for risk assessment of pollutants in ambient air based on those scientific principles - require that assessment of risk is based on the hazard quotient which is the ratio of the concentrations in ambient air and AAQG for the same averaging times, e.g. 15-min average concentration vs 15-min average AAQG, annual average concentration vs annual average AAQG, etc. Therefore, it is inadequate to compare the estimated concentration of 0.47 ppm (millisecond average) with the 1-h average AAQG for nitrogen dioxide of 0.12 ppm as it is for comparing it with ambient air concentrations estimated from a 15-min average of the emissions from the stack.
- The exceedances identified by JLBC at the stack emissions towards the end of the commissioning process are a compliance tool to manage ambient air concentrations. While it is linked to health guidelines in terms of its contribution to ambient air concentrations, it is not a health risk measure.
- The NOAEL for nitrogen dioxide in humans is 0.5 ppm (AEGL1) based on controlled chamber studies with asthmatics for exposure durations ranging from

10-min averages to 8-h averages. The NOAEL is higher for healthy people in similar short-term chamber studies.

- A limited exceedance of a guideline level does not mean imminent and certain danger. Higher concentrations of nitrogen dioxide are tolerated by some asthmatics. The 10-min average AEGL2 is 20 ppm.
- International, occupational exposure standards from 25 worldwide jurisdictions range from 0.5 ppm to 3 ppm for 8-h average exposure and 0.5 ppm to 6 ppm for 15-min average exposure.
- Given the two preceding dot points, the cloud of nitrogen dioxide was unlikely to be a health risk even if the concentration of 0.47 was an accurately measured 15-min average concentration.

BTS believes that neither the cloud of nitrogen dioxide gas nor the ambient air concentration resulting from other 15-min average stack emission was likely to have caused adverse health effects for people who might have been in the area at the time given that the NOAEL in humans from chamber studies and the 15-min average STL for occupational exposure ranges up to 6 ppm.

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## INTRODUCTION

Mr Jonathan Bailes from the Department of Water and Environmental Regulation (DWER) contacted Benchmark Toxicology Services Pty Ltd (BTS) by email on 5 April and 12 April 2018 and subsequent telephone calls to Dr Peter Di Marco requesting a peer review of information submitted by Yara Pilbara Nitrates Pty Ltd (YPN or Yara) for an application of licence of an existing industrial premises currently being assessed by the Department of Water and Environmental Regulation (DWER) (under Part V of the EP Act) and a Ministerial Statement (under Part IV of the EP Act).

BTS received a number of documents from DWER as outlined in the following section as well as a draft scope of works and a summary of the relevant background of the licence application and other documents provided (*cf* page 2). BTS submitted the proposal (File number *BTS 2018 04 12 C0013 DW&ER PO1 DRAFT REV0*) for the peer review of the information provided to BTS on 30 April 2018.

***Comment***

BTS uses *italics* and indented paragraphs for direct quotes used in this review to separate clearly the quoted text from BTS text. BTS also uses ambient air quality guidelines (AAQG) generically to avoid confusion with the different nomenclature used by regulatory jurisdictions.

### Information Provided by DWER

DWER provided the following documents:

1. Black J L and Box I (2018). Review of Yara Pilbara Nitrates Pty Ltd Commissioning Report (September 2017) for the Technical Ammonium Nitrate Plant in Relation to Human Health. John L Black Consulting (JLBC). Dated March 2018. (*10 pages of which 6 are text.*)

   BTS will refer to this document as JLBC (2018)

2. Environmental Resources Management Australia (ERM; 2012). Burrup Peninsula Technical Ammonium Nitrate Production Facility Air Quality Assessment Update. Environmental Resources Management Australia. Draft Report 17 Augst 2012. (*75 pages of which 45 are text*)

3. Environmental Resources Management Australia (ERM; 2013). Burrup Technical Ammonium Nitrate Production Facility. Yara Pilbara Nitrates Pty Ltd. February 2013. Air Quality Management Plan. Environmental Resources Management Australia Pty Ltd. (*51 pages of which 44 are text*)

4. Ministerial Statement No. 870. Published 11 July 2011. (*16 pages)*

5. Pisaniello D and Turczynowicz L (2018). Burrup Peninsula Rock Art and local

health concerns. Adelaide Exposure Science and Health (AESH; Formerly OEH Consulting), Adelaide University. Dated 5 February 2018. (*16 pages including figures*)

BTS will refer to this document as AESH (2018)

6. Foster P (2018). Alleged health risk from TAN Plant $NO_2$ emissions - Technical Review of Paper from Black and Box. Strategen Environmental (SE). Dated 4 April 2018). (*6 pages and a cover note by Yara)*

   BTS will refer to this document as SE (2018)

7. Works Approval W4701/2010/1. Issued 25 July 2013. (*9 pages*)

8. Yara (2017). Yara Works Approval W4701/2010/1. Commissioning Report. Technical Ammonium Nitrate Plant. Yara Pilbara Nitrates Pty Ltd. Perth, Western Australia (*185 pages including Appendices other than Appendix 5 (Appendix 5 - Point Source Air Emissions CEMS; 590 pages of emission data*).

## Background

In an email of 12 April 2018, DWER provided the following explanation about the project and preliminary health risk assessment undertaken.

> *Yara Pilbara Fertilisers Pty Ltd holds Licence L7997/2002/11 granted on 25 April 2005 under Part V of the Environmental Protection Act 1986 (EP Act), for the operation of the ammonia manufacturing plant (Fertiliser Plant) on the Burrup Peninsula. The plant is authorised to produce 950,000 tonnes of ammonia per year.*
>
> *A Works Approval (W4701/2010/1) was granted by the then Department of Environment Regulation on 25 July 2013 to Yara Pilbara Nitrates Pty Ltd for the construction of a Technical Ammonium Nitrate Production Facility (TAN Plant). The TAN Plant is located adjacent to the Fertiliser Plant and will process ammonia from the Fertiliser Plant to produce 350,000 tonnes per year of solid ammonium nitrate prills.*
>
> *Both Yara premises were assessed under Part IV of the EP Act and are subject to conditions in Ministerial Statements (Ministerial Statement 586 relating to the Fertiliser Plant and Ministerial Statement 870 relating to the TAN Plant).*
>
> *A licence amendment application was received from Yara on 30 March 2016 to amend the Licence to include the operation of the TAN Plant.*
>
> *Yara notified the Department on 19 September 2017 that practical completion of commissioning of the TAN Plant was completed on 15 September 2017. On 29 September 2017, Yara provided the Department*

*with the commissioning report required by the Works Approval. The Department is currently assessing the licence amendment application and the information provided in the commissioning report.*

*During the commissioning of the TAN Plant, there were occurrences when the plant was not operating under normal conditions, which resulted in elevated emissions. Because of these events, the community has concerns whether the level of emissions from the TAN Plant are sufficiently low to continuously and reliably protect human health in surrounding areas.*

*As part of these concerns, Dr John Black provided a submission to the DWER and Minister for Environment containing a review of the commissioning report. In response to these concerns, the DWER has agreed to address these specific concerns in the licence amendment process by commissioning an independent health risk assessment by an air quality specialist.*

## Scope of works

The following documents were specifically identified by DWER for review:

1. Yara (2017) Works Approval Commissioning Report (WACR) by YNP, particularly Appendix 5.
2. SE (2018) response to the review of the WACR by JLBC.
3. AESH (2018) letter report to Friends of Australian Rock Arts
4. JLBC (2018) review of the WACR in which it's acknowledged that AESH was retained *for analysis in relation to danger to human health* of the WACR.
5. ERM (2012) modelling point sources report of ground level concentrations for a number of air pollutants.

BTS was requested to:

1. Analyse the TANPF emission data in the commissioning report submitted by Yara to DWER on 29 September 2017 (Appendix 5 in *document 1*)
    - Oxides of nitrogen (as $NO_2$)
    - Nitrous Oxide ($N_2O$)
    - Ammonia ($NH_3$)
2. Undertake a peer review of the documents produced by consultants on behalf of Yara (*document 4*);
3. Undertake a peer review of the documents produced by Dr John Black and the University of Adelaide (*documents 3 and 2, respectively*); and
4. Review modelled ground level concentrations (Environmental Resources Management Australia, ERM) of the following pollutants:
    - Oxides of nitrogen (as $NO_2$)

- Sulfur Dioxide ($SO_2$)
- Nitrous Oxide ($N_2O$)
- Ammonia ($NH_3$)
- Particulate matter ($PM_{10}$, $PM_{2.5}$) and Total Suspended Particulates (TSP);
- Nitric Acid ($HNO_3$)

against relevant ambient air quality criteria (short term and long term) such as

- the National Environmental Protection (ambient Air Quality) Measure (NEPM) – 1 h, 24 h and annual averages - and
- short-term exposure limits (STEL), e.g. 15-min averages where available, e.g. occupational exposure standards.

to confirm specified emission limits are suitable for the protection of human health in the surrounding area (*document 5*).

## REVIEW

### Context of review by BTS

As described in the background information above provided by DWER, BTS was engaged to undertake an independent peer review of the information submitted to DWER by Yara for licence renewal to operate an industrial plant in the Burrup Peninsula to produce fertiliser ammonium nitrate, reviews of these documents by JLBC (2018) and AESH (2018). JLBC retained AESH to provide a *brief qualitative opinion* …..in *relation to danger to human health* of the information reported in the WACR.

With the support of the qualitative opinion by AESH, JLBC expressed concerns about the risks to health and the environment by elevated emissions of nitrogen dioxide to the environment that were reported in the WACR.

YPN provides 40,010 fifteen-minutes (15-min) average concentrations stack emissions from the nitric acid stack plant (Appendix 5 of the WACR) for each of the three gases monitored - oxides of nitrogen measured as nitrogen dioxide, ammonia and nitrous oxide - from 24 May 2016 to 15 September 2017. Of these, 9202 15-min average samples were collected during various periods of continuous routine operation at the plant.

The emissions were reported as volumetric flow rate ($m^3/s$), concentration of oxides of nitrogen as nitrogen dioxide and ammonia ($mg/Nm^3$ and g/s), and nitrous oxide (ppmv and g/s).

JLBC raised concerns in the review about health risks posed by nitrogen dioxide from the plant to people on or visiting the Burrup Peninsula stating in the first paragraph of its review:

> *Results provided in the Yara Pilbara Nitrates Pty Ltd (YPN) Commissioning Report (29/09/2017) and Appendix 5 for the new ammonium nitrate plant show that a large number of emissions of the toxic gas, nitrogen dioxide, have occurred and threaten the health of people travelling to Hearson's Cove or Deep Gorge. The emissions have produced gas concentrations in the vicinity of the road to Hearson's Cove up to 23 times higher than stated in the Australian health standard guidelines*.

This conclusion was based on:

- a *photograph taken by a Karratha resident on 29 April 2017, showing a yellow cloud of nitrogen dioxide emitted from the plant and crossing the road to Hearson's Cove*,
- concurrent stack emission data (15-min average) reported in Appendix 5 of WACR,

- an estimate of the concentration of nitrogen dioxide of 0.47 ppm (0.99 mg/m$^3$) in the yellow cloud based on its colour,
- the ratio of this concentration and the concentration of the concurrent 15 min average stack emission when the cloud was photographed were used to calculate the ambient air concentration that would result for the highest stack emission and the two estimated concentrations were considered to exceed by about four and 23 times, respectively, the 1-h average national AAQG of 0.12 ppm or 246 µg/m$^3$,
- an assertion that nitrogen dioxide will concentrate closer to the ground because its molecular mass is higher than air, and
- an incomplete quote of the conclusion in the executive summary of the letter report by AESH, i.e.:

> *An independent review of the data in the Commissioning Report by the University of Adelaide Exposure Science and Health Centre concluded* 'The pollutants would result in severe health outcomes for people exposed, particularly for people with asthmatic or other respiratory conditions. Due to the nature of these inorganic pollutants, the consequences of such high-level exposure are severe and should not be underestimated by industry or government. (page 1 second paragraph)

Given these concerns, DWER requested the independent peer review of WACR, the critiques by JLBC and AESH, and the ground level concentration (GLC) modelling by ERM which was referenced by AESH.

## BTS Approach

BTS will initially review the relevant documents provided by DWER in the rank order of the Scope of Works and assess the degree of data analysed, the soundness of the arguments presented, and veracity of the conclusions drawn by the authors of the document and the reviewers of the document.

Given the dates of the documents by JLBC and AESH and their content, BTS understands that JLBC retained AESH to assess the health risks of the emissions reported in the WACR. Consequently, the review of the letter report by AESH will be summarised and assessed before the report by JLBC.

## Review summary and comments

This summary of the review of each document is sequentially consistent with the numbering in the scope of works.

### Review of Works Approval Commissioning Report

BTS was requested to analyse the 15-min average data for oxides of nitrogen (measured as nitrogen dioxide), ammonia and nitrous oxide emissions at point source at the Nitric Acid Plant stack (A2) as well as monthly testing for the chemicals, monthly point source emission testing for ammonium nitrate (as particles) at the Common Stack (A1), and

compliance with emission limits at the stacks for these gases and for ammonium nitrate (as particles). These are briefly summarised below.

Table 8 on page 23 of the WACR (2017) that provides the results and emission limits for the monthly testing at the Common Stack (A1) is reproduced below.

| Emission Point source Referenc | Parameter | Method | Units | Target | Average Detected Values | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Apr-17 | May-17 | Jun-17 | Jul-17 | Aug-17 |
| A1 - Commo n Stack | Particulates | Modified USEPA Method 17 | $mg/Nm^3$ | **15** | 2.4 | 3.7 | 3.6 | NS | 3 |
| | | | g/s | N/A | 0.087 | 0.12 | 0.12 | | 0.11 |
| | Ammonia | USEPA CTM 027 | $mg/Nm^3$ | **10** | <0.6 | 3.3 | 3.1 | | 3.6 |
| | | | g/s | N/A | <0.021 | 0.11 | 0.105 | | 0.13 |
| | Volumetric Flow Rate | USEPA Method 2 | $m^3/s$ | N/A | 43.3 | 40 | 33.3 | | 36.7 |

Emissions concentrations were compliant with the supplied emission limits. Emission limits for mass and volume rates were not available. Stack testing was not done in July because of a forced shut down at the time the stack testing was scheduled.

Table 12 on page 28 of the WACR (2017) that provides the results and emission limits for the monthly testing at the Nitric Acid Plant Stack (A2) is reproduced below.

| Emission Point source Reference | Parameter | Method | Units | Target | Average Detected Values | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Apr-17 | May-17 | Jun-17 | Jul-17 | Aug-17 |
| A2 - Nitric Acid Stack | Nitrogen oxides | USEPA Method 7E | $mg/Nm^3$ | **102.6** | 50 | 88 | 92 | NS | 80 |
| | | | g/s | N/A | 1.2 | 2.1 | 2.2 | | 1.9 |
| | Ammonia | USEPA CTM 027 | $mg/Nm^3$ | **0.75** | <0.1 | <0.2 | <0.3 | | 0.68 |
| | | | g/s | N/A | <0.003 | <0.005 | <0.007 | | 0.02 |
| | Nitrous oxide | USEPA CTM 038 | ppmV | **100** | 21 | 25 | 15 | | 18 |
| | | | g/s | N/A | 1 | 1.1 | 0.67 | | 0.84 |
| | Volumetric Flow Rate (dry) | USEPA Method 2 | $m^3/s$ | N/A | 35 | 35 | 23.3 | | 23.3 |

Emissions concentrations for nitrogen dioxide, ammonia and nitrous oxide were compliant with the supplied emission limits. Emission limits for mass and volume rates were not available.

Yara provides 40,010 fifteen-minutes (15-min) average concentrations for stack emissions of oxides of nitrogen (as nitrogen dioxide) ammonia and nitrous oxide from the nitric acid stack plant (Appendix 5 of the WACR), from 24 May 2016 to 15 September 2017.

The emissions were reported as volumetric flow rate ($m^3/s$), concentration ($mg/Nm^3$) and mass flow (g/s) of oxides of nitrogen as nitrogen dioxide and ammonia, and nitrous oxide (ppmv and g/s).

For continuous measurement during various periods of routine operations, 9,202 15-min average samples were collected. Exceedances were high at the beginning of the commissioning period for nitrogen dioxide and ammonia but decreased over time as processes were improved.

In August 2017 and September 2017 there were zero exceedances for ammonia and 6 and zero exceedances for August and September, respectively, for nitrogen dioxide. For nitrous oxide, 6/9,202 exceedances were reported throughout the periods of routine operations.

Mass emissions and concentrations for nitrogen dioxide during August/September were around 3 g/s and about 80% or less of the emission limit of 102.6 $mg/Nm^3$, respectively, except for emission concentration during tests at regular times each day (18:15) which were higher (an estimated 7-10 times the compliant emission concentrations).

The WACR provides adequate summaries and explanations about the stack emission data reported in Appendix 5 and the periods of routine and non-routine operations. BTS is satisfied with the analyses and conclusions reached by Yara in the WACR. Relevant aspects of this document will be raised in the following sections as appropriate.

## Undertake a peer review of the documents produced by consultants on behalf of Yara

BTS concurs with the report by SE (2018) and the covering letter by YNP about the review by JLBC. BTS will include some additional comments and discussion in the review summary that follows to expand on the information provided by SE and some aspects of human health risk assessment.

## Undertake a peer review of the documents produced by Dr John Black and the University of Adelaide

### Letter report by AESH

AESH has undertaken brief literature searches to identify the hazardous properties and the AAQG for ammonium nitrate particulates, ammonia, nitrogen dioxide, sulfur dioxide and nitric acid (as nitrates). The AAQG, in units of $\mu g/m^3$ and $mg/m^3$, but not ppm, are generally consistent with AAQG used by ERM (2012), except for an ~ 10% difference in the AAQG for sulfur dioxide and minor rounding differences in the other AAQG.

Although three sources were referenced, i.e. the Victorian Government Gazette (2001), DEH (2005) and NEPC (2015), the specific source of each AAQG was not provided.

AESH also presents a table of AAQG for nitrogen dioxide (Acute Exposure Guideline Levels – AEGL) from the National Research Council (NRC) of the United States (US) National Academies of Sciences (NAS, 2012) which classify exposure guidelines in three levels - AEGL1, AEGL2 and AEGL3, with effects of increasing severity and the concentrations at which they occur in the higher tiers.

BTS has accessed the publication by the US NAS (2012) in which it concludes that the AEGL1 of 0.5 ppm (1.049 mg/m$^3$ at 0 °C and standard pressure of 1 atm) is the no observable adverse effect level (NOAEL) in humans based on chamber studies with asthmatics for exposure durations ranging from 10 min to 8 h.

The following conclusions of AESH are based on emission information provided by JLBC by telephone and email, i.e. estimated concentration in the cloud of nitrogen dioxide (0.47 ppm) and the concurrent emission at the stack (579.4 mg/Nm$^3$ and 13.8 g/s) stating:

> *The health impacts associated with these emission substances result from very short-term exposures (e.g. ten minutes). If of sufficient intensity, as suggested from the emissions data, the pollutants would result in severe health outcomes for people exposed, particularly for people with asthmatic or other respiratory conditions*

Whilst this conclusion is valid if the concentrations of nitrogen dioxide in ambient air are *of sufficient intensity*, the 10-min to 8 h average AEGL1 by the US NAS suggests that the exposure concentrations of nitrogen dioxide in the cloud provided by JLBC were not of *sufficient intensity* to cause significant adverse effects even in asthmatics. For non-susceptible individuals, the tolerated concentration of nitrogen dioxide is in excess of 1 ppm for periods longer than 15-min (WHO, 2005; US NAS, 2012).

WorkSafe NZ (2018) has recently published review of worker exposure standards (WES) provides a list or WES published by IFA (2017) from 25 sources world-wide, including Australia and New Zealand. The WES ranged from 0.5 ppm to 3 ppm for 8-h time weighted average (TWA) and 0.5 ppm to 6 ppm for STL of 15-min averages. Seven (7) jurisdictions had published WES ≤ 2 ppm; all from Europe.

A small exceedance of the NOAEL does not mean that there is an imminent and certain risk of adverse health effects. Both WHO (2005) and the US NAS (2012) reviewed chamber studies in which some asthmatic subjects tolerated higher concentrations than the NOAEL. In addition, the 10-min average AEGL2 by the US NAS was 20 ppm and tapered down to 6.7 ppm for exposures of 8-h averages. AGL2 is described as:

> "*AEGL-2 is the airborne concentration (expressed as ppm or mg/m$^3$) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.*"

AESH considered that a worst-case scenario had not been examined based on the inadequate siting of monitoring stations based on a figure provided by JLBC[4]. BTS could not identify the original source for the figure.

[4] Figure 1 in the AESH report.

AESH also quotes a baseline monitoring report released Yara (2017) [5]. This may be the source of the location of the monitors. However, BTS has not reviewed Yara (2017).

BTS infers that AESH has assumed that a worst-case emission event such as the assumed exceedances to be part of the operational performance of the plant during August/September. This conclusion is not necessarily relevant for compliant emissions during routine operations.

Comments

The conclusion by AESH is based on the assumption that the high stack emission concentrations to which AESH refers occurred during the routine operations of the plant. This assumption is not substantiated because:

- During routine operations of the plant in the later stages of the commissioning, emissions were compliant with emission target and the apparent exceedances were the result of daily tests.
- The analyses and explanations for the exceedances provided in the WACR and the assessment of the JLBC report by SE (2018). This may be inferred to suggest that the WACR may not have been reviewed by AESH.
- The stack emission concentration of the three air pollutants monitored were lower than the target emission limits during the monthly tests in 2017 as well as the 15-min monitoring emissions during the last 4 weeks of the monitoring when the plant was in routine operational conditions.
- The updated ambient air modelling undertaken by ERM (2012)[6] indicates that the concentrations of nitrogen dioxide modelled for routine operational conditions were a fraction of the national AAQG, with the 99.9$^{th}$ percentile 1-h average concentration of 141.1 µg/m$^3$ Cf. the AAQG of 246 µg/m$^3$.

BTS is not in a position to comment on the location of the monitors. Notwithstanding, DWER may wish to reassess the location of these monitors.

### Review by JLBC

JLBC states that Appendix 5 of the WACR was sent to AESH for assessment of likely risks to human health. It is apparent the opinions provided by AESH have been included in the document by JLBC and these have been considered above (Review by AESH). BTS could not ascertain conclusively whether or not censored emission data was also provided to AESH. However, the anonymous original source of the monitoring sites provided by JLBC and the figures and charts in the two reports suggest that may have been the case.

[5] Referenced as Yara (2017b) by AESH.

[6] See summary below of the review for this report

JLBC relied on the yellow colour of the nitrogen dioxide cloud photograph taken by a Karratha resident at 16:06 on 29 April 2017 to estimate the concentration of nitrogen dioxide in the cloud. This was estimated using information from a table of extinction coefficients of nitrogen dioxide in relation to colour and wave length reproduced by Maga (1965) from what appears to be a text book by Philip A. Leighton entitled *Photochemistry of air pollution* published by Academic Press in 1961. The yellow colour of nitrogen dioxide was associated with an extinction coefficient of 0.47 $ppm^{-1} \times mile^{-1}$. Maga commented that aerosols in the atmosphere would also influence the visibility and colour of the nitrogen dioxide cloud because the aerosol would also scatter the light.

BTS accessed the publication by Maga; but could not access the textbook by Leighton on the web. BTS identified another publication by Henry Eyring (1962) from University of Utah that published a review of the textbook by Leighton. While he was quite supportive of the value of the text book publication, after pointing out that *Leighton treats the elementary nature of photochemical reactions* in an introductory chapter (pp 427-428) he made the following comment which may be pertinent to this review, i.e.:

> *The author draws on a wealth of experience with photochemical reactions in simple systems. This information is indispensable, but without the careful appraisal that was made of the peculiar situation existing in the atmosphere itself it would not suffice.*

BTS infers that Eyring was pointing out that without a thorough analysis of the atmosphere estimates of concentration and chemical reactions may not be accurate.

JLBC used the ratio of the concurrent 15-min average concentration of emission at the stack and the estimated concentration in the nitrogen dioxide cloud (unknown averaging time) to estimate the ambient air concentration for the highest stack emission concentration of 5.6 $mg/m^3$ to conclude that the exceedances were up to ~ 23 times higher than the 1-h average AAQG for nitrogen dioxide. This conclusion is not scientifically justifiable.

The report by SE (2018) and the cover letter by Yara have additionally and adequately addressed the limitation of and lack of scientific rigour of the JLBC and AESH documents with respect to emissions, reasons for high emissions and appropriate measurement of exposures for comparison with national AAQG. BTS supports the explanations and conclusion of their submission.

Comments

With respect to assessing the concentration of nitrogen dioxide based on the colour of the cloud of gas, BTS considers that, while scientifically justifiable in simple systems, it is of limited value in the absence of other measures to provide an ambient air concentration that can be used meaningfully for assessing health risks.

The photograph provides a record of the event which reflects a snapshot of a fraction of a second, more likely milliseconds given the location and the relatively clear sky on the day and time it was taken.

In addition, the estimation of the concentration in air is not only dependent on colour, but also distance from the cloud and the meteorological conditions.

BTS has not discerned that these other factors were taken into account in estimating the concentration of nitrogen dioxide used in the two reports.

Moreover, the concentration in the cloud as photographed does not reflect the concentration in the breathing zone of people who might happen to be on the ground at the time which is also where monitoring of air pollutants in conducted.

JLBC argues that nitrogen dioxide is denser than air and will be present in a higher concentration close to the ground. This is most unlikely to occur in ambient air where there is air movement as pointed out by SE (2018).

Overall, the uncertainties associated with the estimated concentrations are extremely high for assessing risks to health.

More importantly, it is scientifically inappropriate to compare a 15-min or less average concentrations and measurement which are not at ground level with a 1-h AAQG to assess risks to human health.

JLBC appear to be selectively quoting passages from the AESH report. In the executive summary, JLBC quote AESH as follows:

> *An independent review of the data in the Commissioning Report by the University of Adelaide Exposure Science and Health Centre concluded* 'The pollutants would result in severe health outcomes for people exposed, particularly for people with asthmatic or other respiratory conditions. Due to the nature of these inorganic pollutants, the consequences of such high-level exposure are severe and should not be underestimated by industry or government.'

The most important aspect of the conclusion by AESH is the qualifying statement at the beginning of the first sentence which was omitted by JLBC, i.e.:

> *If of sufficient intensity (*concentration*), as suggested from the emission data, the pollutants…….*

BTS infers that AESH included this qualification to stress the importance of the dose or concentration of the pollutant and the reliability and accuracy of the measured or estimated doses in question. In addition, BTS believes that AESH was referring to the high stack emission concentrations observed towards the end of the commissioning period that JLBC selected for the assessment (i.e., the concentrations associated with the daily testing).

At that time, there were no exceedances of the target stack emission limit for nitrogen dioxide (102.6 mg/Nm$^3$) during operational condition. The exceedances quoted by JLBC in this period occurred as a result of daily recorded high emissions levels from calibration and drift span checks at 18:15 each day, i.e. not routine operational conditions.

JLBC used the ratio of the concurrent 15-min average concentration of emission at the stack and the estimated concentration in the nitrogen dioxide cloud (unknown averaging time) to estimate the ambient air concentration for the highest stack emission concentration of 5.6 mg/m$^3$ to conclude that the exceedances were up to ~ 23 times higher than the AAQG for nitrogen dioxide. This conclusion is not scientifically justifiable.

***Comment***

Although consistent with their client request to *present a brief qualitative opinion on the health risks…*i.e. a hazard assessment, ASEH failed to point out to JLBC the scientific importance of using matching averaging times and units of measurements for assessing the risk of the nitrogen dioxide cloud.

BTS considers that JLBC conclusion is not justified given the source and magnitude to which AESH refer and the consistent compliance towards the end of the commission programme.

## Review of modelled ground level concentration (ERM)

This draft report by ERM (2012) was an update of the original air quality assessment undertaken as part of the Public Environmental Review (PER) for the TANPF in 2009 which has not been considered by BTS.

ERM modelled GLC for oxides of nitrogen, sulfur dioxide, particles (TSP, $PM_{10}$, $PM_{2.5}$), ammonia. nitric acid and dust deposition. The number of species considered to be particulates (including TSP) were $PM_n$ = $PM_n$ + ammonium nitrate TSP + $SO_4$ + $NO_3$.

Three of the assessment criteria used were sourced from the NEPM (oxides of nitrogen, sulfur dioxide and particulates). There are no AAQG in the NEPM documents for dust deposition, ammonia and nitric acid. In addition, BTS was unable to locate AAQG for these substance from other international, competent authorities, including the WHO (2015). ERM sourced the assessment criteria from the NSW Department of Environment and Conservation (DEC NSW) published in 2005. AESH used the same values but referenced the Victorian Government Gazette (2001).

Background concentration of the substances monitored were used in the modelling and summarised in Table 3.5 of the ERM report (p 15). The modelling used a standard approach of *1-hour average output to 99.9 percentile (ninth highest value).* Maximum modelled concentrations where human receptors had been identified were identified by using aerial photographs after applying contouring to the results.

Five receptor locations were identified[7]: 3 human and 2 rock receptors. These were summarised in Table 5.1 of the ERM report and are reproduced below. The original table included location coordinates.

[7] Table 5.1, page 29 of the ERM report.

| Receptor ID | Receptor Name | Receptor |
|---|---|---|
| 1. | Searipple Road, Karratha | Human |
| 2. | Balmoral Road, Nickol | Human |
| 3. | Dampier | Human |
| 4. | Hearson Cove | Rock Art |
| 5. | Deep Gorge | Rock Art |

Two modelling scenarios were considered: normal and non-routine operations, with non-routine operations expected to occur once per year.

With respect to non-routine operations, ERM states:

> *……Non-routine operations are expected to occur once a year for up to six hours during shutdown and start up for maintenance.*
>
> *It should be noted that emissions for non-routine operations have been modelled as occurring continuously. This approach tests emissions for non-routine operations against potential meteorological conditions for averaging periods that are less than the period of non-routine emissions. For longer averaging periods this approach provides a very conservative assessment.* (page 29 of ERM report)

Emission rates in g/sec for the substances modelled are listed in Table 5.2 and table 5.3 of the ERM report. The nitrogen dioxide concentrations used in the modelling GLC using stack emissions was reported as 2.85 g/s during normal operations and 38 g/s during non-routine operations. The 15-min average concentration of emissions at the stack reported in the WACR were about 3 g/s[8] during the end period of normal operation.

ERM concluded that the GLC of the substances modelled during normal operations[9] comply with the AAQG guidelines used as refence values. The GLC were modelled using both emission data and background concentrations.

Predicted GLC at identified sensitive receptors and at the maximum modelled location in comparison to the assessment criteria for normal operation are summarised in Table 6.1 of the ERM report which is reproduced in the split table below.

[8] Not calculated

[9] Table 6.1 of the ERM report

| Location | Nitrogen Dioxide (µg/m$^3$) | | Sulphur dioxide (µg /m3) | | |
|---|---|---|---|---|---|
| **Averaging Period** | **1-h** | **1-yr** | **1-h** | **24- h** | **1-yr** |
| | | | | | |
| Receptor 1 | 15.0 | 0.2 | 1.2 | 0.3 | 0.0 |
| Receptor 2 | 10.4 | 0.2 | 0.8 | 0.3 | 0.0 |
| Receptor 3 | 38.8 | 0.8 | 5.7 | 1.8 | 0.1 |
| Receptor 4 | 43.1 | 2.4 | 4.4 | 1.1 | 0.1 |
| Receptor 5 | 49.2 | 1.3 | 5.1 | 1.4 | 0.1 |
| Maximum Modelled | 141.1 | 3.9 | 12.7 | 3.6 | 0.5 |
| Background | 45.13 | 6.3 | 0.4 | 0.3 | 0.2 |
| Criteria | 246 | 62 | 523 | 209 | 52 |

| Location | GLC (µg/m$^3$) | | | | deposition | GLC (µg/m$^3$) | | (mEq/m$^2$/yr) |
|---|---|---|---|---|---|---|---|---|
| | **TSP** | **PM10** | **PM2.5** | | **Dust** | **NH3** | **$HNO_3$** | **Deposition** |
| **Averaging Period** | **1-yr** | **24-h** | **24-h** | **1-yr** | **1-yr** | **1-h** | **1-yr** | **1-h** |
| | | | | | | | | |
| Receptor 1 | 0.1 | 1.1 | 0.1 | 1.0 | 0.0003 | 0.1 | 0.5 | 6.0 |
| Receptor 2 | 0.0 | 0.8 | 0.0 | 0.8 | 0.001 | 0.2 | 0.3 | 8.0 |
| Receptor 3 | 0.1 | 2.6 | 0.1 | 2.6 | 0.002 | 0.3 | 1.8 | 45.4 |
| Receptor 4 | 0.3 | 3.0 | 0.3 | 3.0 | 0.005 | 2.5 | 3.1 | 68.2 |
| Receptor 5 | 0.2 | 2.8 | 0.2 | 2.7 | 0.002 | 1.3 | 8.1 | 39.5 |
| Maximum Modelled | 0.4 | 6.4 | 0.4 | 6.4 | 1.180 | 6.1 | 21.4 | 12039.5 |
| Background | 18.9 | 23.8 | | | 2.1 | 0.9 | 0.9 | 38.0 |
| Criteria | 90 | 50 | 25 | 8 | 2 | 330 | 90 | 200 |

Background concentrations were the major contributing source of nitrogen dioxide for the air shed on the Burrup Peninsula Cf. the various industrial facilities.

Regarding the GLC for nitrogen dioxide, the maximum 1-h average concentration modelled for was 141.1 µg/m$^3$ (cf AAQG of 246 µg/m$^3$); the GLC at the receptor locations ranged from 10.4 µg/m$^3$ to 49.2 µg/m$^3$, being about five times higher in rock art locations compared with the health locations, except for health location 3 where it was about the same.

BTS could not identify the maximum 1-h average concentration modelled of 141.1 µg/m$^3$ in the isopleths in figure 3 of the ERM report, although there are some unlabelled areas where it may be located[10].

BTS concurs with the conclusion by ERM. This is based on review of the information presented in tables in the ERM report for the indicated receptors and the isopleth figures provided in Appendix A which indicated GLC well below AAQG used as reference standards for all time averages and substances described above.

Some isolated one-hour average GLC for nitrogen dioxide were noted for the non-routine operation scenario with background concentrations to exceed AAQG attributed to effects by topographical and meteorological conditions. BTS was not able to readily discern the frequency of the exceedances. However, this observation may be immaterial given that non-routine operations are only scheduled one day per year.

The maximum 1-h average concentration modelled for nitrogen dioxide for the non-operational scenario was 254.9 µg/m$^3$ (cf AAQG of 246 µg/m$^3$); the GLC at the receptor locations ranged from 18.6 µg/m$^3$ to 109.9 µg/m$^3$, being about twice as high in rock art locations compared with the health locations.

ERM provided a table[11] in which the 1-h average GLC generated by Ausplume model used in the 2009 report for nitrogen dioxide and ammonia are compared with those generated by using the CALPUFF model in the current report. The concentration headings were NOx as $NO_2$ for the Ausplume and the $NO_2$ for the CALPUFF heading as only $NO_2$.

The GLC reported in the current report were 20% to 50% lower than the 2009 report. A difference in the results by the two models is to be expected given the different input criteria for the two models. BTS is not in a position to be able to assess the reasons for the extent of the difference.

ERM listed a number of reasons for using CALPUFF, with the following relevant to the difference in GLC for ammonia and oxides of nitrogen[12]:

> *CALPUFF can account for chemical reactions of ammonia and other nitrogen species following emission to atmosphere allowing a more accurate assessment of acid deposition as a result of emissions*

## Conclusions

BTS appreciates the concerns raised by JLBC and AESH about adverse health effects of nitrogen dioxide that may be associated with high ambient air concentrations of the gas. The concentrations of nitrogen dioxide for which concerns were raised were based on the assumptions by JLBC about the estimated concentration in the cloud recorded in the

[10] Some of the number labelling the isopleths were difficult to read, BTS believes that this would not have affected the conclusions materially.
[11] Table 6.3 of ERM report
[12] Page 42 of ERM report

photograph and the concurrent 15-min average stack emission, without considering the duration of exposure.

However, their concerns are not scientifically justifiable for several reasons.

- The photographed yellow cloud is only a snapshot in time of a few milliseconds that will change over time as it disperses in air – it's concentration is most unlikely to increase in ambient air but will decrease with time. However, under the circumstances, the 1-h average cannot be determined. Consequently, the estimated dose in the cloud, although scientifically supported, is inadequate to assess the health risks for people who may have been present in the area at the time it occurred.
- A reliable assessment of the dose or concentration of toxic substance is critical in assessing risks to health. The photographic evidence may be concerning for some observers but is insufficient to satisfy this requirement.
- The scientific principles of risk assessment - and the State, National and International guidelines for risk assessment of pollutants in ambient air based on those scientific principles - require that assessment of risk is based on the hazard quotient which is the ratio of the concentrations in ambient air and AAQG for the same averaging times, e.g. 15-min average concentration vs 15-min average AAQG, annual average concentration vs annual average AAQG, etc. Therefore, it is inadequate to compare the estimated concentration of 0.47 ppm (millisecond average) with the 1-h average AAQG for nitrogen dioxide of 0.12 ppm as it is for comparing it with ambient air concentrations estimated from a 15-min average of the emissions from the stack.
- The exceedances identified by JLBC at the stack emissions towards the end of the commissioning process are a compliance tool to manage ambient air concentrations. While it is linked to health guidelines in terms of its contribution to ambient air concentrations, it is not a health risk measure.
- The NOAEL for nitrogen dioxide in humans is 0.5 ppm (AEGL1) based on controlled chamber studies with asthmatics for exposure durations ranging from 10-min averages to 8-h averages. The NOAEL is higher for healthy people in similar short-term chamber studies.
- A limited exceedance of a guideline level does not mean imminent and certain danger. Higher concentrations of nitrogen dioxide are tolerated by some asthmatics. The 10-min average AEGL2 is 20 ppm.
- International, occupational exposure standards from 25 worldwide jurisdictions range from 0.5 ppm to 3 ppm for 8-h average exposure and 0.5 ppm to 6 ppm for 15-min average exposure.
- Given the two preceding dot points, the cloud of nitrogen dioxide was unlikely to be a health risk even if the concentration of 0.47 was an accurately measured 15-min average concentration.

BTS believes that neither the cloud of nitrogen dioxide gas nor the ambient air concentration resulting from other 15-min average stack emission was likely to have caused adverse health effects for people who might have been in the area at the time given that the NOAEL in humans from chamber studies and the 15-min average STL for occupational exposure ranges up to 6 ppm.

## REFERENCES

***Comment***

References to the documents provided by SWER are listed at the beginning of the report and are not reproduced here

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