Independent Review of Proposed Ammonium Nitrate Plant (Incitec Pivot Ltd, Kooragang Island)

Public Report for: NSW Dept. of Planning and Infrastructure

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Amendment Record

Issue	Date	Author	Change Summary	Approved By
01	5/5/2014	Howard Lister	Initial issue	Howard Lister
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1. Introduction

Incitec Pivot Limited (IPL) is proposing the development of a Nitric Acid (NA) / Technical Grade Ammonium Nitrate (TGAN) facility (the 'Project') on Kooragang Island, Newcastle, adjacent to the existing facility operated by Orica. As part of the development approval process, IPL has submitted an Environmental Impact Assessment (EIS) under the provisions of Part 4 of the *Environmental Planning and Assessment Act 1979*.

The Project is a potentially hazardous development under State Environmental Planning Policy No.33 (Hazardous and Offensive Development). As such the Director General of the Department of Planning and Infrastructure required the EIS to include:

- A Preliminary Hazard Analysis (PHA) prepared in accordance with the Department's Hazardous Industry Planning Advisory Paper No.6 – *Hazard Analysis* (HIPAP6);
- An evaluation of the impacts of the transport of Dangerous Goods to and from the site in the surrounding area.

As part of the evaluation process, the Department commissioned Mr Howard Lister of Scott Lister Pty Ltd to undertake an independent peer review of the documentation presented by the applicant in respect of the Hazard and Risk aspects of the development. This document provides details of that review, including the review methodology and its findings.

Some information relating to the PHA and transport study were submitted in support of the EIS on a confidential basis, due to the security sensitivity of the information. Scott Lister's review included consideration of this confidential information. However because this report is expected to be in the public domain, it does not provide any detail relating to information provided on a confidential basis.

2. Scope

The scope of the Independent Review included the Hazard and Risk aspects of the proposed development as described in the Department's Hazardous Industry Planning Advisory Paper series (in particular HIPAP6 *Hazard Analysis* and Hazardous Industry Planning Advisory Paper No.4 - *Risk Criteria for Land Use Safety Planning* (HIPAP4)).

The objective was to undertake a technical review of the Preliminary Hazard Analysis supporting the EIS and to provide an independent opinion as to whether the Department's risk criteria (as enunciated in HIPAP4) are satisfied.

3. Methodology

The review methodology involved an independent review of Hazard and Risk documentation supporting the EIS for the Project i.e.:

- Section 9 of the EIS Main Report Hazards and Risks;

- EIS Volume 2 Appendix D Confidential Hazard and Risk Assessment which in turn included:
    - D1 Confidential Preliminary Hazard Analysis (PHA) and
    - D2 Transport Risk Assessment (TRA).

The review took place over the period July 2012 to October 2013 and involved a range of document reviews and technical meetings with the applicant, and consideration of IPL responses to comments:

- An initial Adequacy Review conducted in July-August 2012. Consistent with the Department's normal processes, the purpose of this review was to ensure that the (draft) reports submitted by the applicant satisfied the Director General's Requirements, prior to public exhibition.
- Review of the PHA and TRA included in the EIS, including confidential information provided in appendices.
- Review of public submissions, including a confidential submission by the Orica (neigbouring facility) and the formal response by IPL to these submissions.
- Consideration of additional (confidential) information provided by IPL in response to these comments and queries.

The main documents reviewed are detailed in Table 1 below.

Document	Revision / Date
EIS Main Report	September 2012
EIS Appendix D1 Confidential PHA - Main Report	Rev 0, 12 June 2012 Rev 1, 27 August 2012
EIS Appendix D1 Confidential PHA - Appendices	Rev 0, 8 June 2012 Rev 1, 27 August 2012
IPL Response to Submissions	June 2013
Letters from IPL in response to Queries	Various (confidential).

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4. Assessment of PHA

4.1 Overview

The PHA was conducted by Hazard and Risk specialists from Lloyd's Register, IPL's consultant. The individuals undertaking the study are very experienced and competent to perform this type of work. The software analysis tool used (Phast-Risk v6.7) is well recognised internationally and represents best practice.

As part of the review, a number of technical discussions took place with both IPL and Lloyd's Register personnel. A very good understanding was displayed of the hazards involved, the analysis techniques applied and detail of the analysis undertaken. The IPL team was able to respond knowledgeably to the vast majority of issues raised and it was apparent that a great deal of thought had gone into the multitude of assumptions and judgements underlying the analysis. The level of detail in the study is significantly greater than is typical for PHA studies of this type (this is appropriate considering the nature of the proposed development and the degree of community concern).

The study uses classical Quantitative Risk Analysis methodology that is consistent with that espoused in HIPAP6. This involves a large number of inputs, assumptions and calculations. These are generally well presented and justified as necessary in the study report. In some cases further technical clarification was requested of IPL and provided via supplementary confidential information. The interpretation of the PHA's risk analysis results using the Department's risk criteria (HIPAP4) was sound.

The study relies on the following key information and the veracity of this is critical to the integrity of the study and its findings:

- **Ammonium nitrate hazards.** The hazardous properties of ammonium nitrate are complex and the precise circumstances in which explosions can occur are the subject of some uncertainty. This is because accidents are very rare and when explosions occur there is often little evidence remaining upon which to base investigations. The PHA, however, shows evidence of state-of-the-art understanding and references a range of current authoritative studies and research.

- **Explosion frequency analysis.** Whilst the prediction of ammonium nitrate explosion likelihood is an important part of the methodologies supported by the Department, this is subject to a degree of uncertainty due to the very small number of major incidents worldwide. This contrasts with more typical hazard analysis studies for chemical manufacturing facilities where the frequency prediction methods are able to rely on much more commonly occurring incidents and equipment failure data such as fires and process equipment failures. The study necessarily relies on published papers by K.D. Shah which identify and analyse worldwide incidents, and also on the SAFEX Guidelines as below.

- **SAFEX Guidelines**. This is a recently published international document that aims to promote good practice in terms of TGAN storage and handling. It draws on the collective experience of a range of experts and international companies and represents the best guidance available to companies in terms of the safety controls to be applied.

As stated in the PHA report, IPL has committed to comply with the requirements of the SAFEX guidelines

- **Risk modeling software.** Phast-Risk is recognised as one of the most advanced software tools available for quantitative risk modeling.

4.2 Detailed Review Comments

This section summarises the findings of the review of the final PHA report. It does not present in detail all of the issues raised and discussed with IPL, all of which were clarified to the satisfaction of the reviewer, but instead summarises the key issues and highlights any areas where the conclusions are reliant on matters of professional judgement on behalf of the analyst. It is structured according to PHA report structure which is generally in accordance with HIPAP6 requirements.

4.2.1 Scope

The study scope is considered appropriate:

- The facilities scope detailed in the PHA is consistent with that described in the EIS Main Report.
- The analysis scope is appropriate, consistent with that required by HIPAP6, focusing on potential offsite (as opposed to onsite) impacts.
- The scope addresses all of the DG's Requirements.
- The study separately analyses the existing and proposed facilities, as required by the DG's requirements.
- The scope excludes vessels at berth, which is usual for PHA studies and is consistent with DP&I policy

4.2.2 Methodology / Assumptions

The methodology employed is consistent with that required by HIPAP6 and is appropriate.

Key assumptions used in the analysis are presented in Appendix A of the PHA report These were reviewed in detail and some were discussed with IPL where clarification was required. Assumptions of note are:

- No.9 Isolation Time. The assumed times to isolate are considered to be potentially optimistic unless a very robust gas detection system is installed. On discussion with IPL, it was found that the assumed times are consistent with another similar IPL plant. This issue is to be further assessed in the Final Hazard Analysis once plant design is further progressed and this is considered acceptable as it is included as a recommendation of the PHA (#6).
- No.12 Explosion Overpressure Prediction. The Kingery paper presenting blast coefficients is ambiguous as to whether the coefficients are based on hemispherical or spherical models. This was discussed with IPL's risk consultant who acknowledged

the ambiguity but it is noted that the assumption can only result in a conservative result if their interpretation is incorrect i.e. the PHA could potentially overestimate the explosion consequences by a factor 2.

- No.33, 34 Impairment Criteria for Toxic Exposure. The results are sensitive to the selection of these, but IPL's selection rationale was found to be sound.

For the purposes of compliance with the SAFEX guidelines, separation distances were defined using "Medium Density" AN. Required separation distances are greater for lower density AN. Hence the site would need to be reconfigured if lower density product were to be stored. It is recommended that compliance with SAFEX requirements should be explicitly required via conditions of consent.

4.2.3 Facility and Location Description

This was considered to be adequately described in the PHA report.

A clarification question was asked in relation to parts of the site being leased to third parties (Air Liquide, Chemtrans and P&O). It was confirmed that the Departments risk criteria in relation to these operations are satisfied, i.e. the 50 x 10-6 pa fatality risk criterion for industrial uses.

4.2.4 Hazard Identification

The hazard identification was undertaken to an appropriate level of detail and the IPL team displayed a very good understanding of the complex set of hazards presented. Many of the hazards and appropriate control mechanisms are well understood within the industry but explosion mechanisms of ammonium nitrate and toxic combustion products in the event of a fire are more complex and are the subject of ongoing international research. IPL appears to be well informed of the latest thinking, however, and participates in international safety research forums such as SAFEX.

Whilst a wide range of hazards are presented, the hazards of primary concern are those of TGAN explosion (initiated by fire, contamination, or high energy impact) and liquid anhydrous ammonia release which could cause a toxic gas cloud.

As well as providing evidence of a sound understanding of the hazards and the various causal mechanisms that could result in an incident, the study presents considerable detail of individual hazards for each operating section of the plant in a "Hazard Identification Word Diagram" which provides good detail of potential initiating events, consequences and proposed control features (Appendix C of PHA report).

An important output of the Hazard Identification is the "Major Accident Event (MAE) Register" (section C.2) which is a listing of hazardous representative events selected as the basis for ongoing risk analysis. Hazards that do not have potential for offsite impact are screened out as the focus of the study is on potential offsite impacts. The MAE Register is considered to be well constructed.

4.2.5 Consequence Analysis

The consequence analysis is undertaken mostly using the specialist risk analysis software tool, Phast-Risk. Some up-front calculations are required outside of the tool, in particular for the TGAN explosion scenarios, and these are well documented and justified based on well accepted calculation models. The Phast-Risk modeling is state-of-the-art but relies on a range of input parameters. These input parameters are not presented in the report, as they are very detailed and differ for the various hazard scenarios, but were reviewed by sampling and discussion with IPL's consultant and found to be soundly based.

The consequence analysis calculations are dependent on the veracity of the technical assumptions presented in Appendix A. These were reviewed and were found to be mostly well justified, with the exception of these previously mentioned in section 4.2.2.

The consequence analysis includes a detailed assessment of the possibility of a TGAN explosion escalating to involve a major toxic gas release, with the anhydrous ammonia tank being of particular concern. The escalation analysis undertaken is more thorough than would typically be undertaken in PHA studies of this type and uses appropriate methodology. The key output from the escalation analysis is the identification of process plant items whose integrity could be compromised by a TGAN explosion elsewhere on the site, along with a predicted loss of containment frequency that is added to the 'normal' frequency for these events.

Extensive consequence analysis results are provided in detail in Appendix D of the IPL report (confidential). Consequence results are generally consistent with what the reviewer would expect.

Toxic Gas "Impact Criteria"

In this context "Impact criteria" are the concentration-time doses of toxic gases that are modeled as causing a defined level of effect (i.e. fatality / injury / irritation). The values utilised were reviewed in detail with IPL's risk consultant and were found to be sound: based on well documented research and well justified.

4.2.6 Likelihood Analysis

The estimation of the frequencies of the various accident scenarios was conducted in a generally robust manner using appropriate data sources and methodologies.

Key items clarified with IPL include the following:

AN explosion frequency

The frequency analysis for process plant events is relatively straightforward and uses well accepted methodologies based on a large set of historical failure data. The prediction of explosion frequencies for the various TGAN storages is less straightforward, however, as there is no accepted 'norm' for how these are to be calculated. The study applies the methodology in the SAFEX guideline, which represents good practice, but the recommended

calculation methods in the guideline suffer from lack of clarity in certain respects, requiring interpretation by the analyst.

A substantial amount of clarification discussion was required with IPL's risk consultant. The conclusion was that the frequencies utilised can be considered acceptable and the justifications for the values used are reasonable.

Frequency of explosion damage to ammonia tank

It is possible that an explosion, either involving AN or a process plant explosion, could compromise the integrity of the ammonia storage tank, with the potential for offsite effects in the form of a toxic gas cloud. This could be caused either by the blast effect or by flying fragments. It was queried whether the likelihood of this had been considered in determining the loss of containment frequency for the ammonia tank. IPL was able to demonstrate that significant background effort had gone into this using a sophisticated software modeling tool (IMESAFR - Institute of Makers of Explosives Safety Analysis for Risk) developed by the US Dept. of Defense. The conclusion of this work was that the major loss of containment frequency due to secondary events was not significant compared to the frequency from other primary causes.

Frequencies used in the Fault Tree Analysis

IPL's analysis is supported by a number of fault trees and a number of the frequencies and probabilities therein were queried via clarifications. IPL responded to all of these satisfactorily, although it should be noted that some of the detail must be confirmed via the Final Hazard Analysis once detailed design information is available. This is consistent with the Department's normal processes.

4.2.7 Risk Analysis and Assessment

The PHA study concludes that the proposed development satisfies all of the Department's risk criteria and this conclusion is supported.

The Director General's Requirements included the requirement for cumulative risk to be assessed. This is not a specific requirement of HIPAP6 or HIPAP4, but was appropriate given the nature of neighbouring facilities. The report presents detailed fatality risk results, which are shown to be acceptable.

4.2.8 Findings and Recommendations

In addition to the finding that the Department's risk criteria are satisfied, the study also concludes that the recommendations of the 1992 Newcastle and Kooragang Island Area Risk Assessment Study were found to be 'not relevant'. This is supported.

The report makes a number of recommendations pertinent to detailed design and future operations. These all represent good practice and it would be appropriate to enforce them via conditions of development consent

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5. Assessment of TRA

The Transport Risk Assessment (TRA) was conducted using a number of risk analysis techniques:

- Hazard identification, including consideration of the generic hazards posed by the materials handled, and the definition of Major Accident Events (MAE) representative of the range of potential incident scenarios
- Bow-tie analysis. This involved the definition of potential causes and controls (both preventative and mitigation) for each MAE. This enabled a qualitative evaluation to be undertaken of the adequacy of the controls, based on comparison against good practice and cognizant of the inherent risk.
- Semi-Quantitative Risk Assessment. The risk imposed on land uses along the main transport routes and for a ship at berth was quantified and assessed against the Department's risk criteria for fixed facilities.

The methodologies employed are appropriate for this type of assessment, and go beyond the norm for potentially hazardous developments (i.e. the approach is more sophisticated and detailed than would normally be expected).

The study concluded that:

- The proposed practices and risk controls are generally in line with good practice; and
- The risk to populated areas along transport routes is below the risk criteria for fixed facilities.

These conclusions are considered valid and no significant concerns were identified with respect to the TRA.

It should be noted that the Department has not defined quantitative risk acceptability criteria for transport risks. At the Development Application stage, it expects that:

- Potential risk impacts related to Dangerous Goods transportation are identified and qualitatively evaluated with a view to ensure that the risk imposed on surrounding land uses do not significantly add to the background risk and
- Risks from Dangerous Goods transport are minimised as far as practicable.

This is consistent with the approach that the Department applies to fixed facilities, but the Department has not been as prescriptive in terms of assessment methods because transport risks are inherently more complex to assess (due to such factors as the uncontrolled nature of movements, unpredictable volumes and seasonal variations).

The IPL Transport Risk Assessment adequately addresses these expectations by a) performing a quantitative risk assessment that demonstrates that the risks are below the fixed

facility criteria (and hence are low compared to background risk) and b) undertaking a detailed evaluation of the proposed risk controls to be applied.

A number of recommendations were made for the management of transport risks and these are supported as they represent good practice.

Overall the TRA is considered to provide an adequate demonstration of the acceptability of the proposed transport activities, subject to implementation of the recommendations and the future conduct of a Route Selection Study which is usually required as a condition of consent.

6. Assessment of Response to Submissions

As part of the development application process, the applicant must respond to submissions made by the public and other stakeholders following exhibition of the EIS. Numerous submissions were made. In terms of hazards, the submissions included concerns about the acceptability of the risk, the cumulative nature of the risk, site security, transport risk, emergency response plans, compliance with the Department's Newcastle and Kooragang Island Area Risk Assessment Study and comparisons with standards applied by other states. The neighbouring facility, Orica, made a confidential submission including detailed technical queries.

IPL's response to submissions was reviewed in detail with IPL and its consultants. IPL's "Response to Submissions" document is considered to represent a reasonable position. No major concerns were identified with the way that IPL responded to submissions, including the Orica confidential submission.

7. Conclusions

It is concluded that the IPL Preliminary Hazard Analysis and Transport Risk Assessment, along with its response to submissions:

- Adequately address the DG's Requirements in respect of hazards/risk aspects; and
- Provides a robust demonstration that the Department's risk criteria for potentially hazardous development are satisfied.

A number of recommendations are made within the PHA / TRA, as well as in this report, that should be considered to be imposed as conditions of consent should conditional approval be granted.

APPENDIX H – INDEPENDENT REVIEW OF AIR QUALITY

TODOROSKI AIR SCIENCES

REVIEW OF AIR QUALITY ISSUES INCITEC PIVOT LIMITED AMMONIUM NITRATE FACILITY, KOORAGANG ISLAND

NSW Department of Planning & Infrastructure

16 July 2013

Job Number 12080117

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1 SUMMARY

Our review found that the Air Quality Impact Assessment (AQIA) provides a generally suitable assessment of the potential air quality impacts associated with the project. It is noted that the NSW EPA made similar conclusions in its review of the project.

As with most assessments, there are some aspects of the AQIA that in hindsight could have been improved on. These include a more detailed examination of ammonia effects and potential cumulative impacts and the mitigation measures required. (It is noted that in July 2014, the neighbouring operation, Orica put forward a proposal to improve its performance in this regard. This is well after the AQIA was completed.) Overall however, the indication is that the modelling methodology is generally conservative, and perhaps would overestimate the likely impacts in many receptor areas. The nature of the consultant's preferred approach for meteorological modelling is likely to be the influencing factor however the approach is adequate when applied in this situation.

The approach taken to consider potential upset and non-routine emissions is considered appropriate and it has been applied to reasonably and conservatively address the likely impacts that may arise.

The Greenhouse Gas Assessment (GHGA) provides a reasonable estimation of the potential greenhouse gas emissions for the project with inclusion of N_2O abatement measures and energy efficiency opportunities which will be utilised at the facility.

The submissions relating to the Project have been addressed comprehensively and in detail.

Overall the modelling and assessment approach is suitable, and predicted air quality impacts are below the relevant criteria for each of the modelled pollutants. Predicted cumulative impacts associated with the Project are also predicted to be below the relevant criteria.

The proposed implementation of best available control technology is detailed in the report and is compared with other similar technologies based on a literature review of similar facilities. The evaluation shows a high level of control for the chosen option, and it is considered that the Project proposes controls that would be consistent with best practice.

The estimated greenhouse gas emissions for the Project are sensible and the proposed abatement measures result in a substantial reduction in greenhouse gas emissions associated with the Project.

Table 1-1 presents a summary of specific review comments for both assessments.

Table 1-1: Summary of key review aspects

Aspect	Comments
Description of project and process	The report provides an adequate description of the process and material flows through the process.
Description of emissions and emissions inventory	Emissions are well presented and cover the key pollutants of interest. Source parameters are clearly documented. The variable emissions profile for the operations and scenarios modelled are well defined.
Air quality assessment criteria	The impact assessment criteria for pollutants have been correctly applied in the Project.
Existing environment	The existing environment in reference to air quality and climatic conditions is well presented.
Meteorological data and approach to modelling	The model settings can be improved to enhance the accuracy of the predicted results. Nevertheless, it is considered that the applied settings provide a conservative result and are suitable for this assessment.

Aspect	Comments
	Various scenarios have been modelled which provide a range of potential impacts associated with the Project.
Predicted air quality impacts	Results adequately present impacts at discrete receptors locations and across the modelling domain as isopleth plots. There is no consideration of potential air quality impacts at industrial receptors.
Compliance with regulatory stack concentration limits	The proposal would comply with the Clean Air Regulation limits at all stack emission points assessed.
Assessment of air quality impacts	Air quality impacts have been assessed appropriately. Air quality impacts arising from NO_2 have been conservatively assessed as NO_X. Cumulative air quality impacts have been assessed using the maximum background level. The Project would meet air quality impact assessment criteria at all off-site receptors.
Management of potential operational impacts	Not enough detail is provided regarding an operational Environmental Management Plan or key actions that would be undertaken to mitigate impacts under various operating scenarios.
Greenhouse gas assessment	The assessment has not utilised the most recent National Greenhouse Accounts Factors document to estimate emissions. We note however that this does not have a significant bearing on the outcomes of the assessment. There is no assessment of indirect Scope 3 emissions associated with the Project. We note that these emissions cannot be entirely accounted for by the Project and would be considered in the Scope 1 and 2 emissions of the associated industries and activities.
Response to submissions	Each submission has been suitably addressed

2 INTRODUCTION

Todoroski Air Sciences has been engaged by the NSW Department of Planning & Infrastructure (DP&I) to provide independent advice in relation to air quality matters associated with the proposed Incitec Pivot Limited Ammonium Nitrate Facility (the Project), located at Kooragang Island, Newcastle.

In summary, Todoroski Air Sciences has conducted the following:

- A review of the Air Quality Impact Assessment (AQIA) and the Greenhouse Gas Assessment (GHGA) prepared by URS Australia Pty Limited (URS) for Incitec Pivot Limited (Incitec) (**URS, 2012a & b**);
- A review of the Response to Submissions (**URS, 2013**) received during the assessment process; and
- Suggestions for DP&I consideration for specific approval conditions necessary for the management of air quality.

This report provides an overall assessment of the air quality issues associated with the Project and suggestions for ongoing management of air quality.

3 PROJECT OVERVIEW

Incitec Pivot Limited proposes to construct and operate an ammonium nitrate facility located at Kooragang Island, Newcastle (see **Figure 3-1**). An Air Quality Impact Assessment and Greenhouse Gas Assessment for the proposed operation was conducted by URS Australia Pty Ltd.

The air quality assessment identified that the primary source of air emissions from the site would be from processes associated with the production of Nitric Acid and Technical Grade Ammonium Nitrate, with the key air pollutants identified as oxides of nitrogen (NO_X), particulate matter (PM) and ammonia (NH_3).

The facility would incorporate various control technologies and best available techniques to ensure air emissions from the operations would be minimised. These controls and associated emissions were found to be comparable to best available techniques and would comply with relevant regulatory limits.

To assess the potential air quality impacts associated with the operation, air dispersion modelling using the CALPUFF model was utilised. Meteorological data were sourced from various sites surrounding the facility and incorporated into the air dispersion model using a combination of TAPM and CALMET.

The predicted impacts of air emissions from the operation of the facility indicate that air pollutant levels would be below the respective criteria at receptor locations and cumulative impacts would also be below the relevant criteria.

Source: **URS, 2012a**

Figure 3-1: Project location

4 GREENHOUSE GAS EMISSIONS

A greenhouse gas (GHG) assessment was undertaken as part of the Environmental Impact Statement (EIS) for the Project. The assessment quantified the Scope 1 and 2 (direct and indirect) emissions from the operations of the Project, calculated in accordance with the *National Greenhouse Accounts (NGA) Factors* (Department of Climate Change and Energy Efficiency, 2011).

The primary greenhouse gas emissions from the project include nitrous oxide (N_2O) and carbon dioxide (CO_2) from process reactions and burning of fuels during production of ammonia and nitric acid and through the use of electrical energy. The N_2O emissions are the most significant given the global warming potential of N_2O is 310 times higher than that of CO_2. A summary of estimated emissions from the project are shown in **Table 4-1**.

Table 4-1: Annual Greenhouse Gas Emissions from the project (t CO_2-e)

Sources	Overall site
N_2O from Nitric Acid Production	42,186
CO_2 from on-site natural gas use	31,720
Emissions due to liquid fuel combustion	526
CO_2 from on-site electricity use	11,609
Total emissions	**86,041**

Given the global warming potential of N_2O emissions and the potential emissions associated with the Project, Incitec proposes to incorporate various energy efficiency opportunities and GHG abatement measures including the use of heat recovery and process optimisation and abatement of N_2O emissions using primary and secondary control technologies in the process reactions.

The heat generated from the exothermic reactions in the processes of the plant would allow the facility to produce steam which is captured for heat recovery and the generation of electricity. This reduces the facility's reliance on electricity from the grid and is estimated to have a potential reduction of approximately 51,660 t CO_2-e emissions.

The primary and secondary control technologies proposed will attempt to maximise the efficiency of the process catalyst and minimise the risk of reduced conversion efficiency and formation of N_2O. The technology proposed is estimated to result in a 93% reduction in the N_2O produced in the process relative to a similar uncontrolled facility.

The comparison of the estimated emissions associated with the facility against literature values for similar facilities within Australia and globally demonstrate that the project would be consistent with best practice.

The project demonstrates that the implementation of the proposed energy efficiency measures and N_2O abatement technology would have a large positive effect in reducing the potential greenhouse gas emissions generated compared with an uncontrolled facility.

The impacts associated with the greenhouse gas emissions from the overall site, were considered in the context of annual Australian emissions. Total emissions of 0.86 million t/CO_2-e per year represent:

- 0.02% of Australia's total emissions of 546.3 million t/CO_2-e per year (in 2009) and would be insignificant in the global context;
- 0.06% of NSW's total emissions of 152.5 million t/CO_2-e per year (in 2009); and
- 0.26% of Australia's emissions from industrial processes of 32.6 million t/CO_2-e per year.

The direct GHG emissions of the Project are considered to be minor both in the NSW, national and global context, and Incitec have proposed to implement suitable reasonable and feasible measures to minimise these emissions as outlined in the EIS.

Scope 3 indirect emissions associated from the facility activities have not been included in the greenhouse gas assessment for the project.

The indirect Scope 3 emissions of the Project, generated by the upstream consumed materials and downstream use of the product material, would be much greater than the direct emissions of the project. However it is not required that Incitec should account for these emissions, principally because:

- these emissions are the Scope 1 and 2 emissions of other industries/activities, and should be considered in the assessment of these industries/activities rather than Incitec's activities;
- Incitec, as a supplier and distributor of ammonium nitrate, has limited power to influence the generation of these downstream emissions; and,
- these emissions should be regulated by means of economic such as a national carbon trading scheme or direct action, rather than through the conditions of approval for individual projects.

Finally, Incitec should also implement an Energy Savings Action Plan (ESAP) and provide annual reports to the NSW EPA on their progress to ensure suitable effort is being taken to further mitigate greenhouse gas emissions.

Based on our review, we are generally satisfied that the estimated greenhouse gas impacts of the project will be appropriately monitored and managed via the ESAP and the future National Greenhouse and Energy Reporting System, and that the appropriate steps would be taken to minimise greenhouse gas emissions from the Project.

5 AIR QUALITY

5.1 Existing air quality

Background air quality in the Newcastle area is typically dominated by emissions from anthropogenic sources including domestic wood heaters in winter and emissions from major industries at Kooragang Island, Mayfield and Tomago. Significant heavy industry that would contribute to air emissions in the area include coal handling, fertiliser and pesticide manufacturing and metal manufacturing. Natural sources of emissions, include sea salt and particulates originating from storms and bushfires.

The EIS provides background air emissions data from monitoring stations located at Stockton, Newcastle, Wallsend and Beresfield. A summary of available data from 1993-2011 indicated that particulate matter less than or equal to 10 microns in diameter (PM_{10}) and nitrogen dioxide (NO_2) generally meet the relevant NSW EPA air quality impact assessment criteria. This is also the case in recent monitoring conducted by industry and EPA in the Lower Hunter as reported by Todoroski Air Sciences (**TAS, 2013**).

5.2 Meteorology

Meteorological data used in the modelling assessment were generated with the CALMET model by utilising TAPM prognostic data and surface observation data from a number of stations located in the general vicinity. The meteorological modelling appears to have been conducted appropriately with the resulting outputs showing typically expected atmospheric conditions of the area.

We note that the approach taken in the meteorological modelling includes some setting preferences which are likely to result in more conservative predictions (i.e. may lead to overestimating potential air quality impacts). This is unlikely to change the outcome of the report and the modelling approach is considered to be suitable.

5.3 Emissions

Primary emissions from the project that may have potential to impact the surrounding environment include particulate matter (as PM_{10}), ammonia (NH_3) and oxides of nitrogen (NO_x) from various sources at the site.

The EIS used the CALPUFF dispersion modelling system to predict air emissions from the project and the modelling incorporated a number of factors to ensure a conservative assessment.

5.4 Predicted impacts

The assessment concluded that the air quality impact assessment criteria for PM_{10}, NH_3 and NO_2 would be met for the facility. A summary of the predicted impacts, for the various scenarios assessed is outlined in **Table 5-1**.

The results show the predicted incremental level (due to only the Project) and the cumulative level including background and all other sources would be within the EPA criteria.

Table 5-1: Predicted maximum impacts at most affected receptor location (µg/m³)

Source / Scenario	Category	NO_2 (all NOx as NO_2)		PM_{10}		NH_3
		1-hour average (µg/m³)	Annual average (µg/m³)	24-hour average (µg/m³)	Annual average (µg/m³)	1-hour average (µg/m³)

		Air quality impact criteria				
		246	62	50	30	330
	Background level	**84**	**18.7**	**31.7**	**21.7**	**N/A**
Plant Operation	Increment	25	0.4	2	0.2	1.2
	Cumulative	109	19.1	33.7	21.9	-
NA Startup (non Routine)	Increment	40	-	-	-	-
	Cumulative	124	-	-	-	-
Flaring (non Routine)	Increment	47	-	-	-	52
	Cumulative	131	-	-	-	-
NA Startup (Orica and IPL KI)	Increment	41	-	-	-	-
	Cumulative	125	-	-	-	-
Plant Operation (Orica and IPL KI)	Increment	41	0.7	-	-	-
	Cumulative	125	19.4	-	-	-

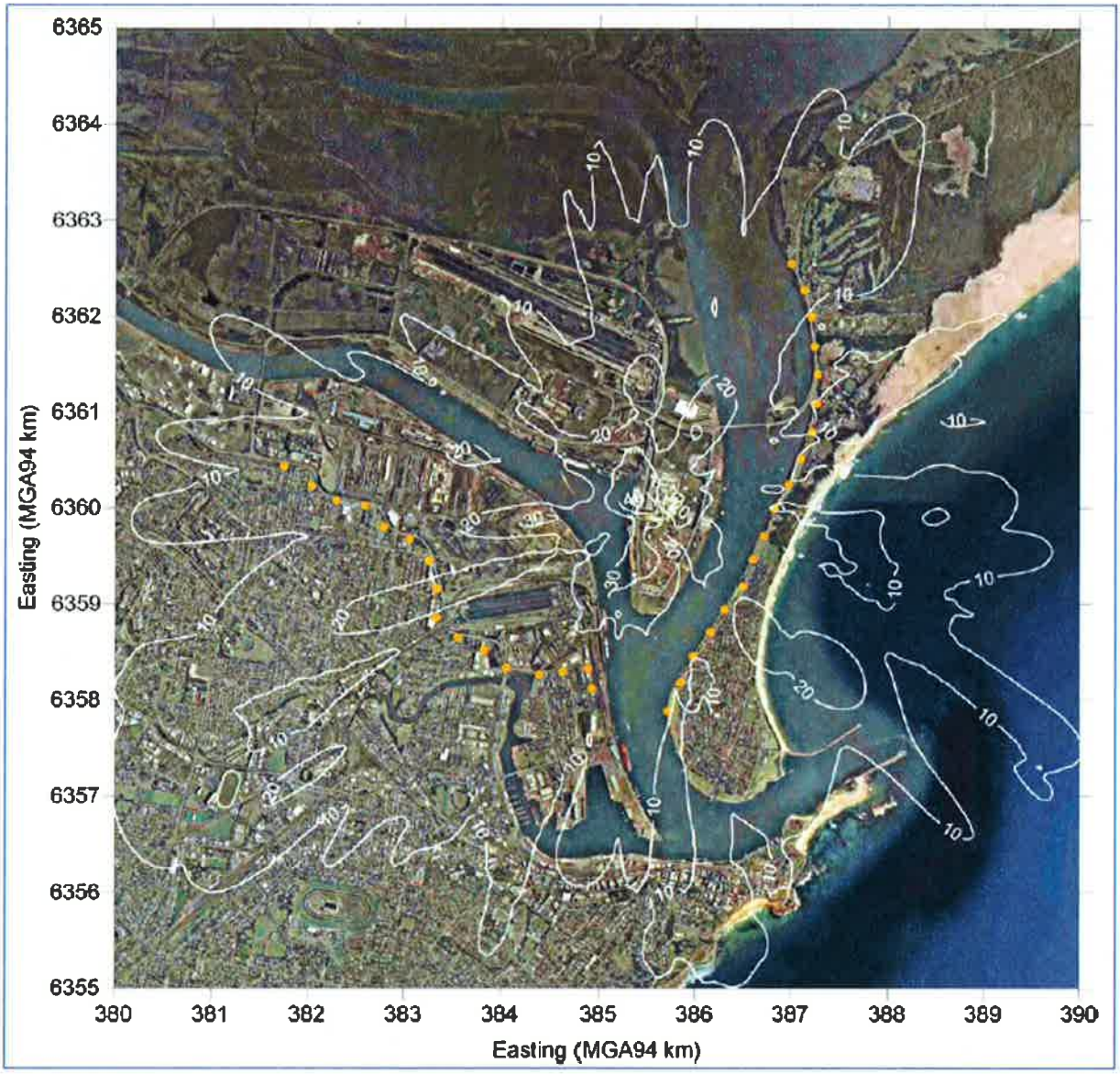
Source: **URS, 2012c**

This potential spatial extent of the predicted effects is examined further below.

5.4.1 Nitrogen dioxide

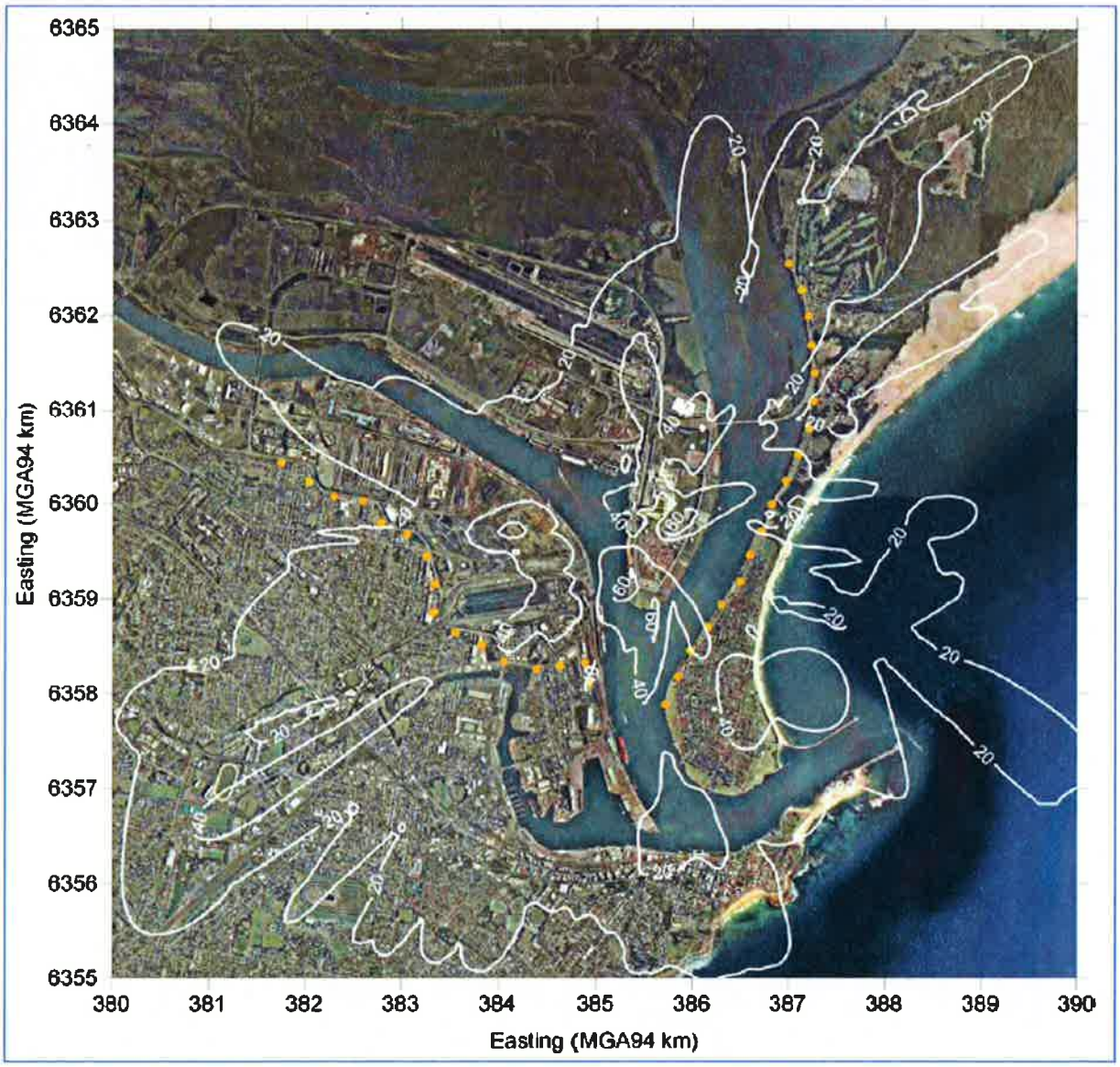
The primary emissions from the Project, being NO_2, would comply with the relevant criteria. We note the conservative approach of assuming all NO_X as NO_2 and in reality would result in much lower levels.

As illustrated in **Figure 5-1**, and **Figure 5-2** cumulative NO_2 impacts have considered emissions from the Orica facility located adjacent to the Project with a predicted maximum cumulative concentration of 125ug/m^3 at discrete receptor locations and would meet the relevant NSW EPA criteria of 246ug/m^3.



Source: **URS, 2012c**

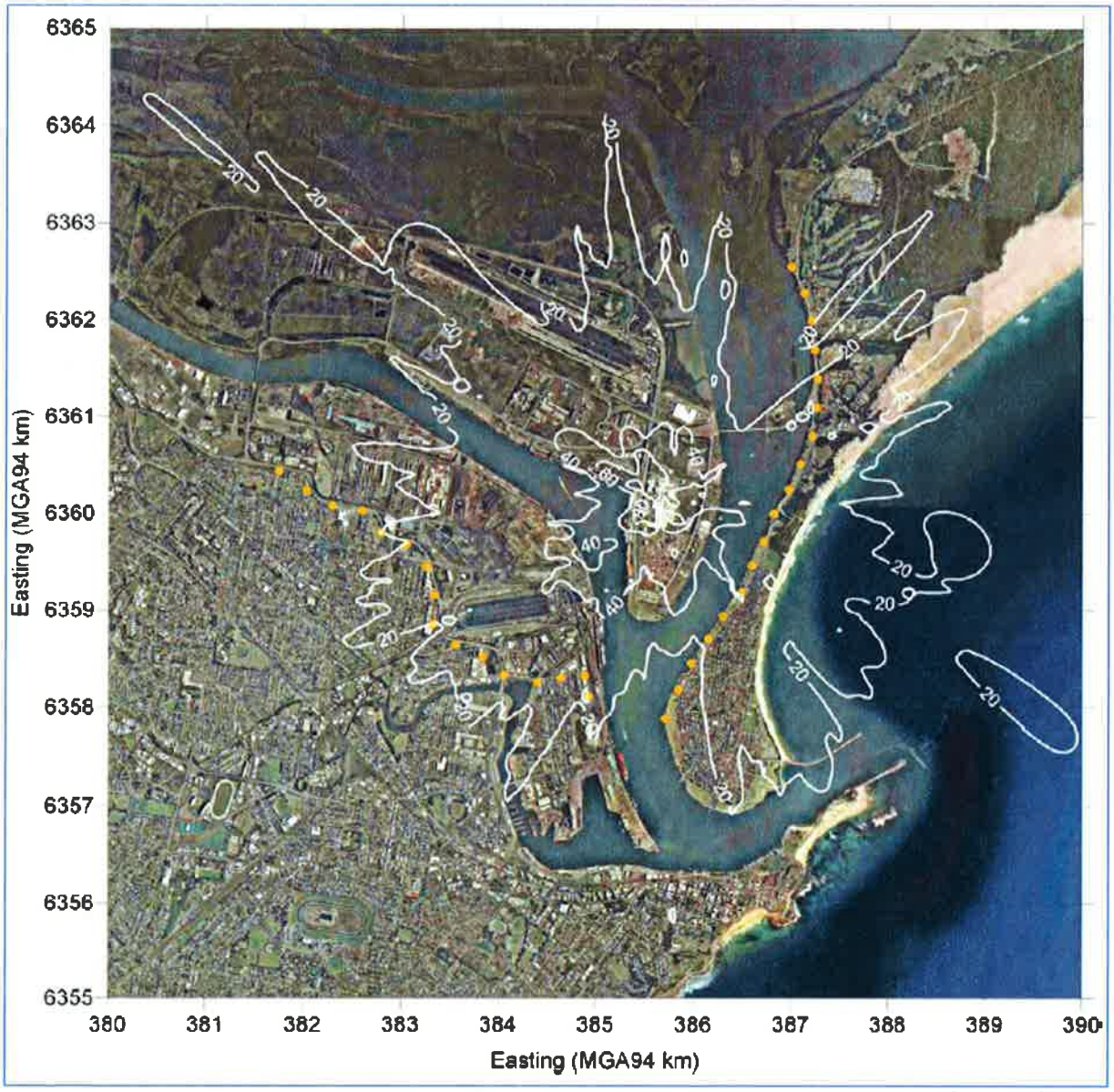
Figure 5-1: Predicted maximum incremental 1-hour average NO_2 (all NO_X as NO_2) (µg/m³)



Source: **URS, 2012c**

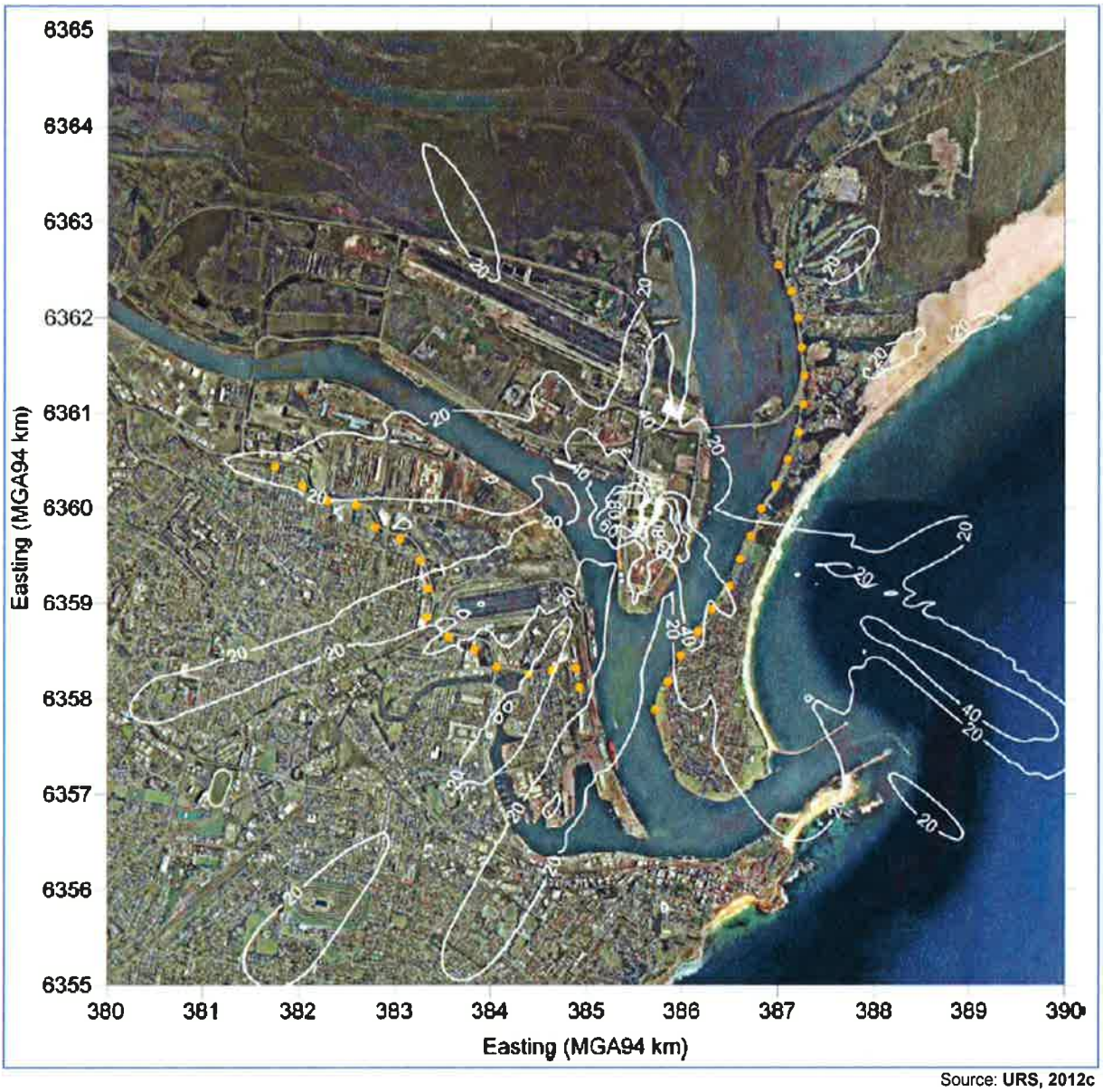
Figure 5-2: Predicted cumulative 1-hour average NO_2 (all NOX as NO_2) ($\mu g/m^3$)

Non-routine emissions associated with the plant start-up and ammonia flare operations were also considered in the assessment. Predicted impacts as illustrated in **Figure 5-3** and **Figure 5-4** show that no impacts would be likely to arise due to non-routine emissions with predicted maximum cumulative concentrations of 124ug/m^3 and 131ug/m^3 at the discrete receptors for the plant start-up and ammonia flare operations respectively.



Source: **URS, 2012c**

Figure 5-3: Predicted maximum incremental 1-hour average NO_2 from plant start-up (Non Routine)



Source: **URS, 2012c**

Figure 5-4: Predicted maximum incremental 1-hour average NO_2 from ammonia flare (non Routine)

5.4.2 Particulate matter

The assessment also indicates that predicted particulate matter (as PM_{10}) concentrations would meet the relevant NSW EPA criteria with the predicted incremental maximum 24-hour average and annual average PM_{10} concentrations of 2µg/m³ and 0.2µg/m³ respectively. These are low levels relative to the respectively applicable criteria of 50 and 30µg/m^3.

It is noted that more recent assessments have considered potential $PM_{2.5}$ impacts in comparison to advisory reporting levels. Advisory reporting levels are not suitable for project impact assessment purposes, and it is noted that there are no directly applicable $PM_{2.5}$ criteria in NSW. $PM_{2.5}$ is not specifically addressed in the AQIA, however because $PM_{2.5}$ is a subset of PM_{10}, and as the incremental PM_{10} predictions are low it is clear that the $PM_{2.5}$ impacts would also be low.

5.4.3 Ammonia

The assessment also considered odorous emissions from the facility by considering emissions of ammonia (NH_3) and concluded that emissions would meet the NSW EPA criteria at identified sensitive receivers, therefore odour impacts are unlikely to occur.

5.5 Air quality control measures

A number of design measures would be incorporated into the facility, aimed at minimising emissions and ensuring compliance with air quality criteria. These measures include:

- Optimisation of the absorption stage of the process such that initial NO_X concentrations in the tail gas are reduced;
- Treatment of the tail gas through Selective Catalytic Reduction (SCR) to reduce NO_X;
- Installation of a tail gas heater such that the SCR is at operation temperature during start-up of the NA plant;
- The NA tank vent would be fitted with a gravity fed water column scrubber;
- Recycling of air to minimise the quantity of the waste stream;
- Wet scrubbing of the waste stream;
- Low NO_X combustion boiler;
- Capture and filtration of emissions from bagging plant; and
- Ammonia storage flare.

As air emissions from the project would be dependent on the installation and efficient operation of the proposed design measures, it is recommended that site specific monitoring and the existing ambient air quality monitoring being conducted in the area is continued to verify that actual emissions and predicted impacts meet the relevant criteria and to confirm that the implemented emission controls remain effective during the operation of the Project.

It is recommended that development of a suitable joint risk management strategy be formulated with the neighbouring Orica facility to ensure that all reasonable measures are being taken to minimise cumulative air quality effects from the two operations. Whilst the assessment shows that potential cumulative air quality impacts would be below relevant criteria, it is noted that a recent review of the ambient air quality monitoring data for the lower Hunter Valley shows that some potential exists for occasional short term elevated air pollutant levels downwind of the two operations. Formulation of a joint risk management strategy should aim to identify the potential sources at each operation that may on occasion contribute to the recorded elevated levels of pollutants, and reasonable and practical measures that could be taken to reduce and prevent the likelihood of these events occurring due to normal operations.

6 PROJECT SUBMISSIONS

6.1 Government

The NSW EPA in its submission raised no issues with the assessment and indicated that the proposed operation and emission controls are consistent with best practice and suitably predict compliance with the relevant impact assessment criteria. The NSW EPA have recommended regular stack monitoring of sources on-site and ambient air quality monitoring in representative locations in the Stockton and Mayfield areas.

6.2 Public

Public submissions on the Project regarding air quality focused on the anticipated deterioration of local air quality, potential cumulative impacts and worst case scenarios such as with a massive release of ammonia.

The submissions clearly outline the community concerns in regard to air quality. The Project has responded to each submission in detail.

Based on our review of the Project's response to the submissions and undertakings with regard to managing air quality, it is considered that the responses are satisfactory and are commensurate with the likely risk of impact that may arise due to the operation of the Project. The response provides a detailed response to each of the submissions received.

Based on our review of the Project, government and public submissions and proponents response to the submissions, we are satisfied that air emissions from the facility could be adequately managed to meet relevant air quality criteria and avoid detrimental impacts on the surrounding community. To ensure this remains the case during the operation of the Project we have made suggestions for DP&I to consider in regard to its approval conditions.

7 SUGGESTIONS FOR CONDITIONS OF APPROVAL

Recommended considerations for conditions of approval for the Project are summarised below.

The conditions aim to achieve three key outcomes:

1. Provide assurance to the community that what was assumed in the EIS will be delivered by Incitec;
2. Prompt better planning between Incitec (the Applicant) and the neighbouring Orica site in regard to minimising potential cumulative effects; and,
3. Enhance EPA's regulatory basis to pursue any action needed for Incitec to achieve what was assumed in the EIS (if not already achieved).

Verification

The Applicant shall carry out an Air Quality Verification Study for the Project to the satisfaction of the Secretary. The study shall:

(a) be prepared by a suitably qualified expert whose appointment has been agreed to in writing by the Secretary;

(b) be based on a minimum of 12 months of monitoring data and be completed during the initial 18 months of operation or as otherwise agreed to in writing by the Secretary;

(c) include a verification of actual monitored emissions performance against the assumptions adopted within the EIS, including:

i. point source pollutant concentrations;

ii. point source pollutant mass emission rates; and

iii. point source emission parameters as relevant to plume dispersion.

(d) confirm, through direct measurement, that applicable EPL requirements are being complied with; and

(e) confirm, using reasonable means, the effectiveness of the implemented emission controls in minimising air quality impacts.

Should the Air Quality Verification Study indicate that the development has not complied with applicable EPL requirements, or where the verification indicates that greater impacts than predicted in the EIS may arise, a detailed investigation and an outline of any management measures necessary to prevent exceedances must be submitted to the Department and the EPA, as part of the study.

Better management of potential cumulative effects

The Applicant shall consult with the operators of the adjacent Orica facility, with the objective of developing an Air Quality Risk Management Strategy suitable for incorporation into the Air Quality Management Plan. The objective this strategy is to minimise the potential for cumulative air quality impacts from any air emissions from the development and the adjacent Orica facility.

This strategy is expected to include protocols for the communication and planning of planned non-routine operations such as plant startup, shutdown and commissioning events between the development and the adjacent Orica facility.

8 CONCLUSIONS

Dispersion modelling of air quality emissions from the Project indicates that overall there is a relatively low risk of significant impact on the community arising from the Project.

To provide an additional level of confidence in the modelling results, the predicted impacts from the Project could be appropriately validated though monitoring post commissioning.

9 REFERENCES

Department of Climate Change and Energy Efficiency (2011)
"National Greenhouse Accounts Factors", prepared by the Department of Climate Change and Energy Efficiency, July 2011.

TAS (2013)
"Lower Hunter Air Quality Review of Ambient Air Quality Data – August 2013", prepared by Todoroski Air Sciences for NSW Environmental Protection Authority, November 2013

URS (2012a)
"Air Quality Impact Assessment for Proposed Ammonium Nitrate Facility, Kooragang Island", prepared by URS Australia Pty Limited for Incitec Pivot Limited, June 2012

URS (2012b)
"Greenhouse Gas Assessment for Proposed Ammonium Nitrate Facility, Kooragang Island", prepared by URS Australia Pty Limited for Incitec Pivot Limited, August 2012

URS (2012c)
"Air Quality Impact Assessment for Proposed Ammonium Nitrate Facility, Kooragang Island", prepared by URS Australia Pty Limited for Incitec Pivot Limited, August 2012

URS (2013)
"Proposed Ammonium Nitrate Facility Heron Road, Kooragang Island - Response to Submissions" prepared by URS Australia Pty Ltd, October 2013