Appendix 4

Preliminary Hazard Analysis Completed for the Werris Creek Coal Mine Precursor Storage Facility (Advitech, 2008)

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Preliminary Hazard Analysis

Werris Creek Precursor Facility

Orica Mining Services

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Preliminary Hazard Analysis

Werris Creek Precursor Facility

Orica Mining Services

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1. INTRODUCTION

Advitech Pty Limited have been engaged by Orica Mining Services (Orica) to prepare a Preliminary Hazard Analysis (PHA). This document supports the construction and operation of a precursor facility to be located at Werris Creek Coal Mine (Werris Creek Mine). During operation the facility will supply 5 000 tonne of bulk explosives for use in Werris Creek Mine. The PHA should be read in conjunction with the Statement of Environmental Effects for the Werris Creek Precursor Facility.

It should be noted that this report was prepared by Advitech Pty Limited for Orica ("the customer") in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

1.1 Proposed Location and Surrounding Land Uses

Werris Creek Mine is a 679 ha mining lease approximately 4km south of Werris Creek and 11km north of Quirindi NSW (**Figure 1**).

In order to service the Werris Creek Mine, Orica propose to establish a precursor storage facility to provide blasting services to the mine. The pre-cursor facility will be located adjacent to the western boundary of the mine site, approximately 750 metres from the site office (**Figure 2**).

The proposed pre-cursor facility is located 1,030 metres from the nearest residence 'Old Colliery' and approximately 1,500 metres to Werris Creek Road and the Main Northern Railway.

Figure 1: Site Location

2. FACILITY DESCRIPTION

2.1 Process Description

At the completion of the development, Orica will have constructed and commissioned a precursor storage facility that will store and distribute explosive precursors to service the blasting requirements of Werris Creek Mine.

The development will include:

- 35 tonne silo for ammonium nitrate prill (AN) storage;
- Relocatable vertical 80 tonne ammonium nitrate emulsion (ANE) storage tank and electric drive pump;
- Gasser tank with 400 litre (L) maximum capacity;
- Companion Solution (Comsol) tank with a 400 L maximum capacity;
- Workshop and storage container with cover between; and
- A 65 KVA diesel generator for use within the plant.

Concrete slabs will be installed under loading and delivery points, the silo and pump, the gasser and companion solution storage tank and under the main electrical distribution board.

Operating hours will be between 0700 and 1600 on a five day roster.

The location of the proposed facility in relation to other mining activities is shown in **Figure 2**.

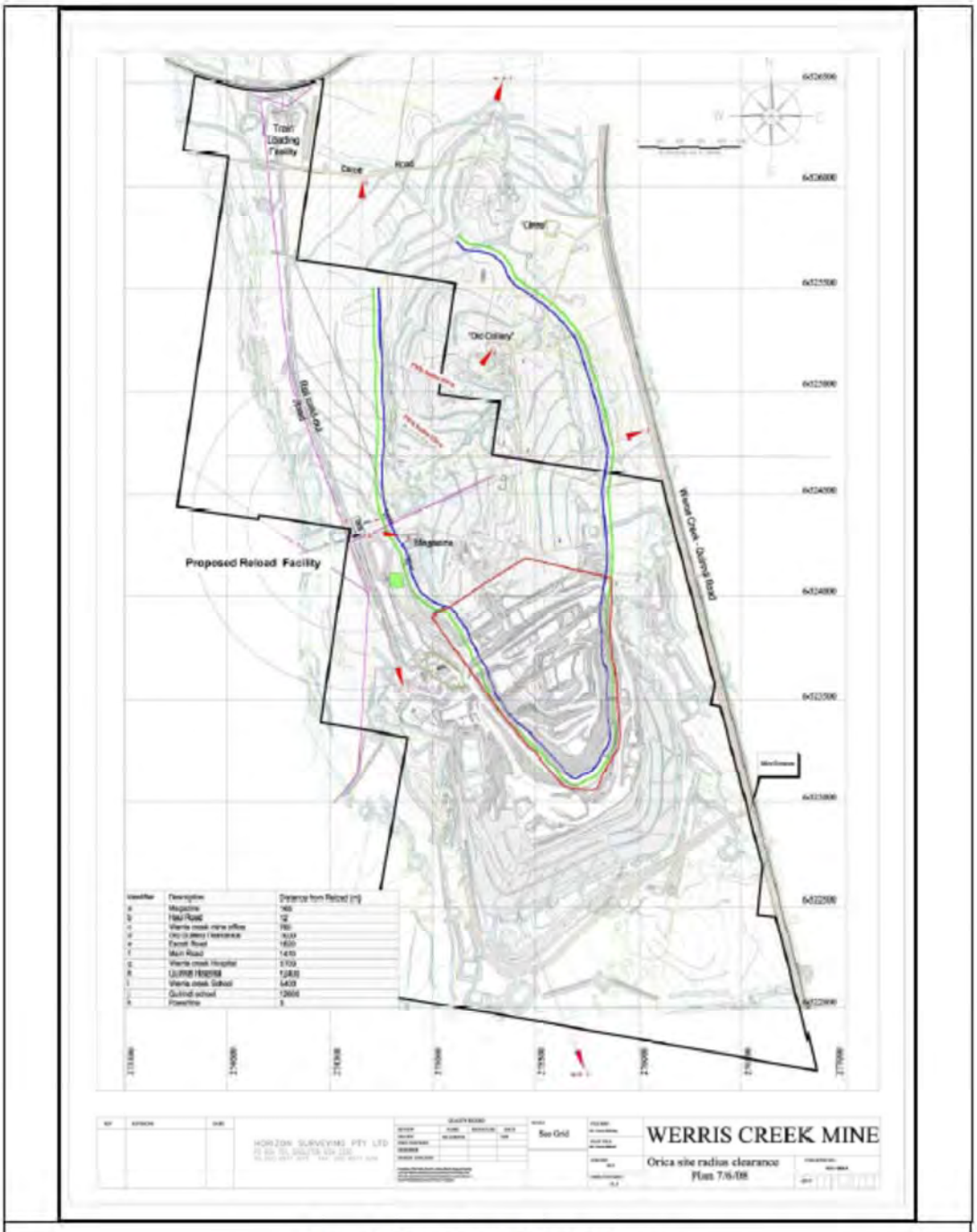


Figure 2: Werris Creek Mine Site Layout

Source: Horizon Surveying Pty Ltd

2.2 Dangerous Goods Storage and Handling

2.2.1 Ammonium Nitrate Emulsion Storage (ANE)

ANE is classified as a Class 5.1 dangerous good. It is manufactured in Newcastle by Orica through a semi-continuous blending process using fuel oil and dissolved ammonium nitrate. Deliveries of ANE will be made after normal working hours if required by authorised contractors in single tankers.

ANE will be stored in an 80 tonne relocatable storage tank and set up adjacent to the loading platform for mobile manufacturing units (MMUs). Orica consider bunding of the ANE storage tanks unnecessary due to the high viscosity of ANE. Previous experience has shown that ANE does not tend to disperse widely following a loss of containment and that it can be readily recovered. A concrete load out/in area will be provided. The requirement not to bund the tank is also necessary from a safety perspective and to reduce the potential fire risks.

Removal of ANE from the tanker to the storage tank will occur through a gear pump and flexible transfer hoses. A remote start and stop button will be located at the high level MMU load out position to allow control of the pump once the flow is initiated. The high level MMU load out position will include a lockable top access manhole, adequate venting, caged access ladder and railed top platform painted yellow to Australian Standards.

Suitable lighting will be supplied surrounding the loading area and control panel allowing deliveries to occur in the early morning and at night as required by the operation.

2.2.2 Ammonium Nitrate (AN) Storage and Delivery

Prilled AN is classified as a Class 5.1 dangerous good and as security sensitive ammonium nitrate (SSAN). SSAN is defined as ammonium nitrate, ammonium nitrate emulsions and ammonium nitrate mixtures containing greater than 45% ammonium nitrate, excluding solutions. The storage and handling of SSAN will be compliant with COAG requirements, the *Explosives Act, 2003* and the *Explosives Regulation, 2005.*

AN will arrive on site during normal working hours and be trucked in as bulk product (i.e. no bags). A 35 tonne silo will receive product via an unloading hopper and auger with a floveyor. The floveyor fluidises dry powders and aids in the conveying of AN to the silo. This will be a manually controlled operation. The loading of the MMUs will be via the auger with a floveyor.

The operation of the AN load-in/load-out will be controlled by an electrical control panel to enable level monitoring of the bin and loading operation of the MMU.

Concrete slabs will be positioned at AN load-in and MMU load out areas allowing the clean-up of spills by dry sweeping.

2.2.3 Companion Solution and Gasser Solution

Companion solution and gasser containers will be mounted on concrete pads adjacent to the ANE loading system. The containers will also include bunding, weather covering and standard fittings.

3. STATUTORY REQUIREMENTS

Preliminary risk screening of the proposed development is required under NSW State Environmental Planning Policy No 33 Hazardous and Offensive Development (SEPP 33). *Applying SEPP 33* requires potentially hazardous developments to undertake a PHA to determine the risk to people, property and the environment at the proposed location and in the presence of controls. Should such risk exceed the criteria of acceptability, the development is classified as 'hazardous industry' and may not be permissible within most industrial zones in NSW.

A development may also be considered potentially hazardous with respect to the transport of dangerous goods. A proposed development may be potentially hazardous if the number of generated traffic movements (for significant quantities of hazardous materials entering or leaving the site) is above the cumulative annual or peak weekly vehicle movements. Table 2 in the document *Applying SEPP 33* outlines the screening thresholds for transportation. If the development's transportation of dangerous goods exceeds the thresholds a route evaluation study should be completed in accordance with the route selection guidelines prepared by the Department of Planning.

In addition to SEPP 33, this PHA was prepared generally in accordance with the Department of Planning (formerly Department of Urban Affairs and Planning) publications *Hazardous Industry Planning Advisory Paper No. 6 - Guidelines for Hazard Analysis* (1992) and *Multi-level Risk Assessment* (1997). An assessment of the proposed development with respect to the recommended fatality, injury and irritation risk criteria presented in the publication *Hazardous Industry Planning Advisory Paper No. 4 - Risk Criteria for Land Use Safety Planning* (1990) has been undertaken.

In summary the purpose of a PHA is to:

- Identify all potential hazards associated with the proposal;
- Analyse both their consequences (effects) for people, property and the environment, and their probability (likelihood or frequency) of occurrence;
- Estimate the resultant risk to the surrounding land uses and environment; and
- Ensure that the proposed safeguards are adequate, and thus demonstrate that the operation will not impose a level of risk that is intolerable with respect to its surroundings.

3.1 Legislation for the Handling of Security Sensitive Ammonium Nitrate

The Council of Australian Governments (COAG) agreed during a meeting held on 25 June 2004 that a national approach was needed to control the manufacture and use of SSAN that is, ammonium nitrate products containing more than 45 percent ammonium nitrate. The aim of the agreement was to establish a licensing regime for the use, manufacture, storage, transport, supply, import and export of SSAN.

Legislation was introduced in NSW in September 2005. The *Dangerous Goods Act* 1975 was repealed and the following legislation commenced:

- *Explosives Act* 2003 and supporting Explosives Regulation 2005;
- *OHS Amendment (Dangerous Goods) Act* 2003; and the supporting
- *OHS Amendment (Dangerous Goods) Regulation* 2005.

The new legislation established a complete supply chain licensing regime for security sensitive substances. A person must not handle SSAN unless authorised to do so by a WorkCover approved licence. The new licences cover activities such as manufacture, importation, supply, transport by vehicle or vessel, storage, blasting, pyrotechnics, fireworks, usage and unsupervised handling. Suppliers must record the particulars of all sales and must only supply security sensitive substances to licensed users.

COAG also discussed the safety of vulnerable facilities and the issue of separation distances with the intention of protecting public infrastructure from sabotage events. Vulnerable facilities include:

- Multistorey buildings of four storey or higher;
- Large glass fronted buildings of high population;
- Health care facilities, child care facilities and schools;
- Public buildings or structures of major historical value;
- Major public utilities, e.g. gas, water, electricity works;
- Residential areas;
- Sports stadium; and
- Critical infrastructure.

The *National Guidance Note 4 - Siting of New Facilities* was written as a guide to regulatory authorities to ensure adequate separation distances for new security sensitive ammonium nitrate (SSAN) facilities. No vulnerable facilities surround the proposed development and as such the guidance note is not applicable.

4. METHODOLOGY

4.1 General

A PHA aims to provide sufficient information and assessment of risks to demonstrate that a project satisfies the risk management requirements of the proponent company and the relevant public authorities. Within this context the primary role of the PHA is to demonstrate that the residual risk levels are acceptable in relation to the surrounding land use and that risk will be appropriately managed.

This is done by systematically:

- Identifying hazards and abnormal process conditions that could lead to hazards;
- Identifying inherent and existing safeguards;
- Assessing the risks by determining the probability (likelihood) and consequence (effects) of hazardous events for people and the surrounding land uses and environment; and
- Identifying opportunities to reduce the risks by elimination, minimisation and/or incorporation of additional protective measures. This will demonstrate that the operation will not impose a level of risk that is intolerable with respect to its surroundings.

The PHA should be carefully and clearly documented with the assumptions and uncertainties of the final design and operation defined.

4.2 Preliminary Risk Screening

Preliminary risk screening of the proposed development is required under SEPP 33 to determine the need for a PHA. The preliminary screening assesses the storage of specific dangerous goods classes that have the potential for significant off-site effects. Specifically, the assessment involves the identification of classes and quantities of all dangerous goods to be used, stored or produced on site with respect to storage depot locations.

4.3 Risk Classification and Prioritisation

The Department of Planning's document *Multi-Level Risk Assessment* suggests the use of a preliminary analysis of the risks related to a proposed development to enable the selection of the most appropriate level of risk assessment in the PHA. This preliminary analysis includes risk classification and prioritisation based on a Hazard and Operability (HAZOP) risk assessment undertaken during review of the design for the proposed installation.

4.4 HAZOP Risk Assessment

The HAZOP risk assessment uses guide words and descriptive scales to determine the likelihood of each identified hazard and its consequences. This provides an estimate of the likely rate of occurrence of hazardous events and their severity, from which a measure of the risk may be obtained through application of the equation:

Risk = Likelihood x Consequence

The risk associated with a proposed development is determined by combining the likelihood of the potentially hazardous events and their consequences using **Table 1, Table 2, Table 3** and **Table 4** below, which are adapted from Australian/New Zealand Standard 4360:1999 *Risk Management*. The process of combining consequences and frequencies gives appropriate weight to the range between small consequence events (which are relatively frequent) and events of major consequence (which are very infrequent).

Table 1: Qualitative Measures of Consequence, Impact or Severity

Category		Personnel	Financial	Environment	Community, Compliance, Reputation
1	Catastrophic	Fatality	Huge loss > $_____ . (e.g. > $10m) (e.g. > $1m)	Short and long term impacts; alteration to biological or biochemical systems; toxicological effects; shutdown during investigation. E.g. Ok Tedi (PNG), fish kills.	Inter/national public/media outrage; shutdown order; public enquiry; major prosecution and fines.
2	Major	Extensive injury or illness, permanent disability	Major loss $_____ to _____ . (e.g. $1m - 10m) (e.g. $100k - 1m)	Offsite release; long-term impact (>1 reporting period); fine, investigation or prosecution. E.g. Significant discharge of pollutant into air or water.	Widespread public/media concern; major breach; significant fines; investigation.
3	Moderate	Injury or illness requiring hospital admission, LTI, restricted work	High loss $_____ to _____ . (e.g. $100k - 1m) (e.g. $10 - 100k)	Offsite release; transient impact (<1 reporting period); reportable breach of license conditions; fine or prosecution. E.g. Persistent noise or odour complaints.	Public/media attention outside local area; regulation breach; reportable; fines likely.
4	Minor	Reversible injury or illness requiring offsite medical treatment	Medium loss $_____ to _____ . (e.g. $10 - 100k) (e.g. $1k - 10k)	Contained onsite; clean-up may require outside assistance; reportable to authorities (e.g. EPA). E.g. large chemical spill (i.e. IBC, pallet of drums) into bund.	Local public/media attention; minor regulation breach; reportable to authorities.
5	Insignificant	Negligible injuries requiring first aid treatment (onsite) or less	Low loss < $_____ . (e.g. < $10k) (e.g. < $1k)	Contained onsite; transient impact; not reportable. E.g. small chemical spill into bund.	Not noticeable to public/media, not reportable.

Table 2: Qualitative Measures of Likelihood

Category		Description	Indicative Frequency
A	Common	Expected to occur, happens often	1 a year or more frequent
B	Likely	Has occurred, heard of it happening here or somewhere similar	1 in 10 yrs or so
C	Possible	Could occur, unusual but possible, may happen within working lifetime	1 in 40 yrs or so
D	Unlikely	Not expected to occur, remotely possible	1 in 100 yrs or so
E	Rare	Conceivable only in exceptional circumstances, practically impossible	1 in 1000 yrs or less frequent

Table 3: Qualitative Risk Analysis Matrix

CONSEQUENCE	LIKELIHOOD A	B	C	D	E
1	25	24	22	19	15
2	23	21	18	14	10
3	20	17	13	9	6
4	16	12	8	5	3
5	11	7	4	2	1

Table 4: Risk Ranking Priorities

Ranking	Range	Priority
Extreme	20 - 25	Requires urgent and immediate attention, senior management response needed.
High	12 - 19	Requires proactive management, senior management attention needed.
Moderate	6 - 11	Requires active monitoring, management responsibility must be assigned.
Low	1 - 5	Does not require active management, manage with routine procedures.

Risk assessment involves comparing the determined level of risk with previously established risk criteria, and deciding whether or not that level of risk can be accepted. Such decisions take into account the wider context of the risk and include consideration of the tolerability of the risks borne by external parties.

Low and acceptable moderate risks can be allowed with minimal further treatment, however, they should be monitored and periodically reviewed to ensure they remain at this level. Higher-level risks should be treated using appropriate safeguards.

4.5 Risk Treatment

Appropriate safeguards should be incorporated into the design and operation of the proposed development as prevention or protection measures for higher-level risks. These measures may include plant design features, organisational safety controls and emergency and counter disaster procedures. Options should be evaluated on the basis of the extent of risk reduction and the extent of benefits or opportunities they create. In general, the cost of managing risks should be commensurate with the benefits obtained.

4.6 Monitoring and Review

Risks and the effectiveness of control measures need to be continually monitored to ensure changing circumstances do not alter risk priorities. Factors that may affect the likelihood and consequences of an outcome may change, as may the factors that affect suitability or cost of various treatment options. Ongoing review is therefore essential to ensure that risk management activities remain relevant.

5. PRELIMINARY RISK SCREENING

5.1 Hazardous Materials Storage

Orica has advised that a range of dangerous goods and hazardous substances will be stored at proposed precursor facility, some of which are defined as dangerous goods (DG) in accordance with the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code). **Table 5** summarises the dangerous goods proposed for storage on the site. **Appendix II** contains the Material Safety Data Sheets for all the dangerous goods to be stored on site.

Table 5: Hazardous Materials Inventory

Substance	ADG Class	Packing Group (PG)	Total Storage Capacity	Screening Threshold
Ammonium nitrate prill (AN)	5.1	III	35 t	5 tonne
Ammonium nitrate emulsion (ANE)	5.1	II	80 t	5 tonne

5.2 Storage Quantity Screening

For the purposes of the SEPP 33 risk screening process ammonium nitrate is treated separately to other Class 5.1 goods. There is a combined storage of 115 tonnes of ammonium nitrate products stored on site in various forms. According to Table 3 of the guidelines, the screening threshold for ammonium nitrate is 5 tonne. Therefore, the ammonium nitrate storage exceeds the threshold quantity and the facility can be considered *potentially hazardous*.

If any of the thresholds are exceeded in aggregate, this is an indication that further risk assessment is warranted. However, it is important to recognise that the screening test is conservative and it should not automatically be assumed that exceeding the threshold means there is a significant risk.

5.3 Transportation Screening

Table 6 shows the vehicle movements to and from the facility with the transportation screening thresholds.

Table 6: Vehicle Movements of Dangerous Goods

Substance	Dangerous Goods Class	Number of Deliveries per Annum	Typical Quantities per Delivery	Screening Threshold	
				Cumulative Annual	Quantity per Load
Ammonium nitrate prill	5.1	365	35 t	-	2 tonne
Ammonium nitrate emulsion	5.1	365	40 t	-	2 tonne
Finished Product[1]	5.1	1095	12t	-	2 tonne
Total	**5.1**	**1 825**	**-**	**500**	**-**

1 A combination of prill and emulsion

The quantity per delivery of each of the Class 5.1 substances exceeds the quantity thresholds and therefore constitutes significant quantities of dangerous goods. The total annual movements also exceed the vehicle movement threshold and therefore the development is considered *potentially hazardous* with respect to transport and a route evaluation study needs to be completed in accordance with the route selection guidelines prepared by the Department of Planning.

5.3.1 Route Evaluation Study

AN and ANE are currently transported by licensed contractors from Orica manufacturing facility at Ravensworth, via the New England Highway to Werris Creek. The proposed development will not alter the transport route currently taken from Ravensworth or the volumes of heavy vehicles using the roads, but will merely provide a centralised depot from which explosive precursors can be more effectively distributed. As the proposed development will not alter the current transport route for raw materials, the route is considered adequate and further evaluation of the route is not required.

MMU's originating from the proposed development will transport explosive precursors to Werris Creek Mine via the haul road. This road is currently used by approximately 40 semi-trailers movements per hour from 7.00am - 5.00pm. The haul road is as utilised for AN and ANE for distribution to Werris Creek Mine. It is therefore considered that the haul road is adequate and further evaluation of the route is not required.

6. HAZARD IDENTIFICATION

6.1 General

Hazard identification represents a Level 1 or qualitative risk assessment and involves documenting all possible events that could lead to a hazardous incident. It is a systematic process listing potential causes and consequences (in qualitative terms). Reference is also made to proposed operational and organisational safeguards that would prevent such hazardous events from occurring, or should they occur, that would protect the plant, its equipment, people and the environment. This process enables the establishment, at least in principle, of the adequacy and relevance of proposed safeguards.

The aim of the hazard identification study process is to highlight risks associated with the interaction of the proposed development (as a whole) with the surrounding environment. A hazard study of the proposed development was conducted by Orica employees in November 2007.

6.2 Hazard Identification Tables

The hazard scenarios identified in the hazard study relevant to the operations at the facility are presented in **Appendix I**. Each hazard scenario has since been evaluated in terms of consequence and likelihood, and a qualitative assessment of the resultant risk was made using **Table 4**. The hazards identified are a result of deviation from normal operations and the qualitative risk assigned to each scenario takes into account the inherent and proposed physical, operational and organisational safeguards designed to reduce the severity and frequency of these hazards.

6.3 Assumptions

When using the information provided in the qualitative risk assessment a number of assumptions were made. These include:

- Preliminary hazard scenarios are based on information gathered from documentation provided by Orica to Advitech and verbal communications between Advitech and Orica;
- All plant and equipment will be operated and installed in accordance with appropriate Australian Standards, codes and guidelines;
- Dangerous goods quantities and locations are as notified by Orica;
- Dangerous goods are stored in accordance with the ADG Code, relevant standards and guidelines even if not of a licensable quantity; and
- All equipment and systems are designed to be inherently safe.

6.4 Level of Risk Assessment

Applying SEPP 33 states:

- *If any of the screening thresholds are exceeded then the proposed developments should be considered hazardous and a PHA is required to be submitted with the development application.*
- *If the quantities are close to the screening values and the development site is near a sensitive receiver then the proposed development is also considered to be potentially hazardous and a PHA is required.*

Based on the above assessment the proposed development exceeds the storage threshold for dangerous goods Class 5.1 and therefore further hazard analysis is required.

Multi-Level Risk Assessment (1997) provides guidance on choosing the level of assessment required based on dangerous goods classes. The guidelines suggest that a qualitative assessment of risk may suffice in instances involving Class 5.1 dangerous goods, but only when the there are no harmful consequences extending significantly beyond the site boundary. If there are significant off-site consequences, a quantification of consequences of all credible accidents is required.

The majority of scenarios during the risk assessment had either no or negligible off-site impact. All high risk scenarios (score of 12 or above) with potential for off-site impacts are summarised in **Table 7**.

Table 7: Risk Scenarios

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
AN storage tank and handling	External explosion	Explosion in magazine, MMU or fire from other various process units that leads to a detonation.	Operator or member of public exposed to overpressure, toxic fumes and damage to buildings occurs.	Magazine and plant are located appropriately from each other, the mine and public infrastructure. Storage vessels are separated within the plant. Provision of a number of fire extinguishes around the site. Designated smoking areas on site, signage on non smoking areas, hot work clearance procedure, site induction	2	D	14	Adequate signage i.e. non- smoking signs on all gate entrances. Re-training clearance issuer Ensure all personnel, employees, visitor, and contractors are properly inducted Hazard reduction activities
AN storage tank and handling	External fire	Fire caused by chemical decomposition of incompatible material leads to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential spill sites.	2	D	14	Establish operating procedures for handling AN Establish site safety management plan
AN storage tank and handling	Internal fire / explosion	Internal fire/heating caused by chemical decomposition of incompatible materials leads to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential spill sites.	2	D	14	Establish operating procedures for handling AN Establish site safety management plan

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
ANE storage tank and handling	External explosion	Explosion in magazine, MMU or fire from other various process units that leads to projectile impacting on the ANE storage tank.	Operator or member of public exposed to overpressure, toxic fumes and damage to buildings occurs. Possible loss of product.	Magazine and plant are located appropriately from each other, the mine and public infrastructure. Storage vessels are separated within the plant. Provision of a number of fire extinguishes around the site. Designated smoking areas on site, signage on non smoking areas, hot work clearance procedure, site induction	2	D	14	Adequate signage i.e. non- smoking signs on all gate entrances. Re-training clearance issuer Ensure all personnel, employees, visitor, and contractors are properly inducted Hazard reduction activities
ANE storage tank and handling	External fire	Human fault results in external fire that engulfs ANE storage tank leading to exposure of ANE to radiant heat causing thermal decomposition of ANE.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures Designated smoking areas outside of precursor site	2	D	14	Separation distances are adequate between the storage tanks.
ANE storage tank and handling	External fire	Fire caused by chemical decomposition of incompatible material leads to exposure of ANE to radiant heat causing thermal decomposition of ANE.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential spill sites.	2	D	14	Establish operating procedures for handling ANE Establish site safety management plan

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
General site interactions	External fire / explosion	Fire from people with unauthorized access. Bush fires	Major fire, and possible human injuries•	Restrict access personnel, security provided to prevent unauthorized access. Establish emergency and evacuation plans. Maintain 10-metre firebreak around perimeter fence.	2	D	14	Access to the plant is restricted, and entry to the operation area is minimised. Site safety management plan addresses the emergency and evacuation procedures specific to the Whitehaven site.

6.4.1 Quantitative Assessment

All high risk scenarios identified in the qualitative risk assessment relate to a fire, explosion or both involving ammonium nitrate at the facility. The consequences and potential effects on surrounding land users cannot be adequately assessed by means of a qualitative risk assessment and as such a quantitative analysis of this scenario has been prepared.

Australian Standard 2187.1 -1998 details appropriate separation distances to provide an acceptable level of risk for the storage of explosives. The Standard identifies two categories of protected works; land uses from which explosives (or explosive pre-cursors) should be adequately separated from, these are as follows:

- Class A: Public street, road or thoroughfare, railway, navigable waterway, public recreation or sports ground or other place where the public is accustomed to assemble, open place of work in another occupancy, radio or television transmitter, main electrical substation, private road which is the principal means of access to a church, chapel, college, school, hospital or factory.
- Class B: Dwelling house, public building, church chapel, college, school, hospital, theatre or other building or structure where the public is accustomed to assemble, shop, factory, warehouse, store, building in which any person is employed in any trade or business, depot for the keeping of flammable or dangerous goods, major dam.

The separation distances listed in AS 2187.1 are based on TNT as the donor explosive, however the net explosive quantity (NEQ) can be adjusted for substances with a different output, such as explosive pre-cursors AN and ANE.

For Protected Works Class A:

- $D = 14.8\ Q^{1/3}$ for Q>4500 kg

For Protected Works Class B:

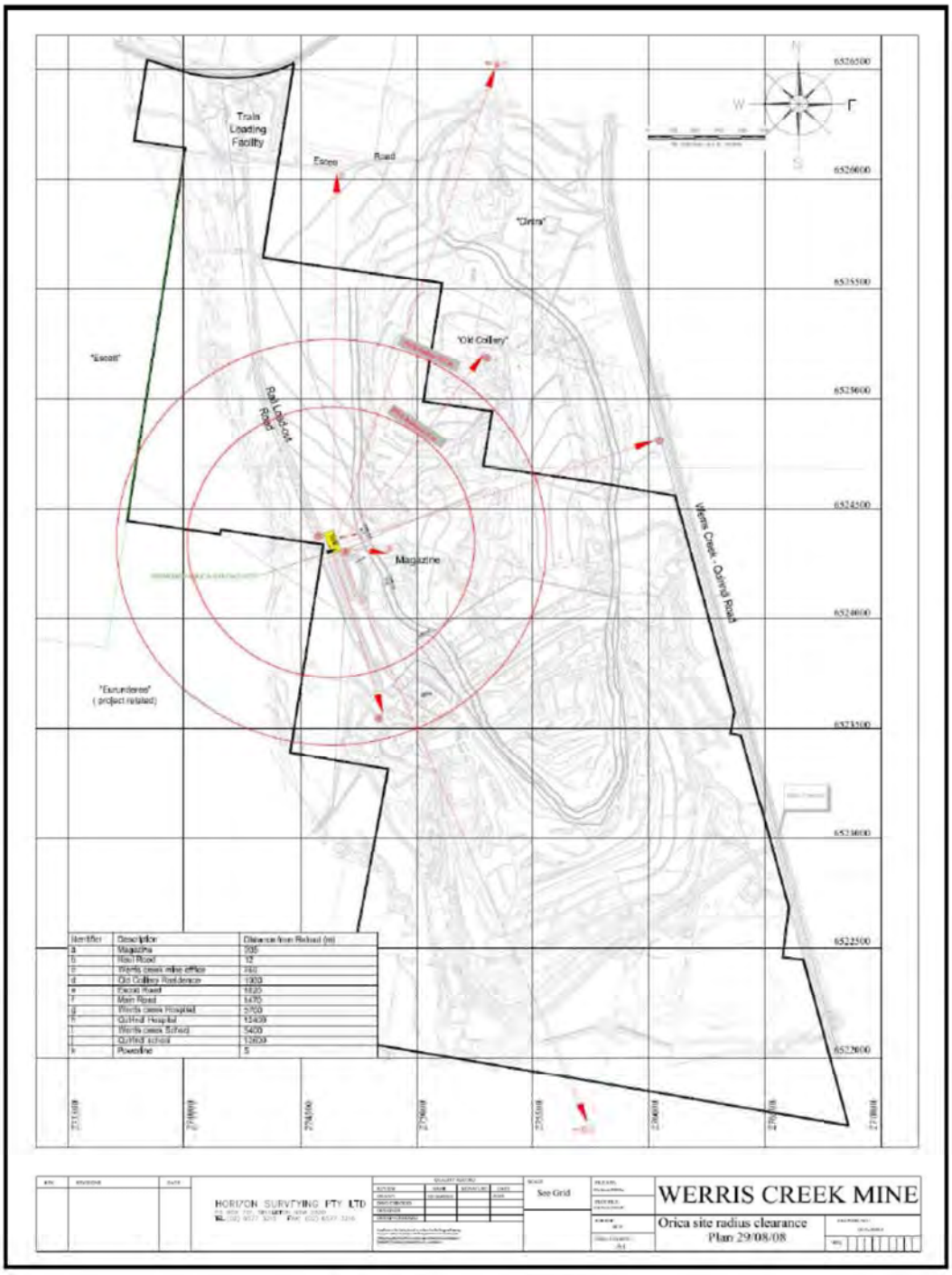
- $D = 22.2\ Q^{1/3}$ for Q>4500 kg

Protected Works calculations are detailed in **Table 8**.

Table 8: Protected Works Area Calculations

	Ammonium Nitrate	Ammonium Nitrate Emulsion	Combined
Storage Capacity	35,000 kg	80, 000 kg	
NEQ (Q)	17,500 kg	54,400 kg	71,900 kg
Protected Works A			615 m
Protected Works B			923 m

The protected works areas are identified in **Figure 3**.



Identifier	Description	Distance from Reload (m)
a	Magazine	235
b	Main Road	12
c	Werris creek mine office	760
d	Old Colliery Residence	1300
e	Excelt Road	1820
f	Main Road	1470
g	Werris creek Hospital	5700
h	Quirindi Hospital	13400
i	Werris creek School	5400
j	Quirindi school	12800
k	Powerline	5

Figure 3: Protected Works Areas

At the distance specified for Protected Works Class A (615 metres), the direct effects of blast, radiant heat and projections are minor, and at the Class B distance (923 metres) any impacts would be further reduced. All residential properties, public roads and rail lines are outside of the identified protected works areas and as such it is reasonable to conclude that an explosion or fire associated with the proposed facility will not result in any significant off site impacts.

6.4.2 Safeguards

In addition to the siting of the facility, Orica have in place all practicable safeguards to ensure that the risk of an explosion or plant fire is minimised. These include:

- Correct plant and equipment design;
- Controlled site access to ensure ignition sources are not introduced;
- Adequate fire fighting equipment;
- Detailed emergency procedures;
- Construction of a bund along the plant fence to separate the plant from the haul road and magazines;
- Magazines are sited in accordance with AS 2187.1;
- No forklifts will be used onsite;
- Hot work clearance procedures;
- Appropriately trained staff; and
- Designated smoking areas will be located outside the plant yard.

Safeguards for identified events have are presented in the respective sections of the tables in **Appendix I**.

7. CONCLUSION

Preliminary risk screening in accordance with SEPP 33 found that the storage of Class 5.1 substances exceeded the threshold of 5 tonne and therefore the development was classified as *potentially hazardous* with regard to the storage of Class 5.1 substances.

A subsequent risk assessment was completed to ascertain the qualitative nature of any hazards present. This assessment showed several high risk scenarios with possible environmental impact resulting from a fire or explosion. The risk of these scenarios to off-site receptors were assessed in accordance with AS 2187.1 - 1998, and found to be negligible. The safeguards proposed by Orica are adequate to ensure that the development poses minimal risk to the neighbouring land users and therefore can be classified as *not hazardous*.

8. REFERENCES

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Appendix I

Risk Assessment Tables

Company: Orica Mining Services

Plant Area/Section: AN STORAGE TANK AND HANDLING SYSTEM

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	External explosion	Explosion in magazine, MMU or fire from other various process units that leads to a detonation.	Operator or member of public exposed to overpressure, toxic fumes and damage to buildings occurs.	Magazine and plant are located appropriately from each other, the mine and public infrastructure. Storage vessels are separated within the plant. Provision of a number of fire extinguishes around the site. Designated smoking areas on site, signage on non smoking areas, hot work clearance procedure, site induction	2	D	14	Adequate signage i.e. non- smoking signs on all gate entrances. Re-training clearance issuer Ensure all personnel, employees, visitor, and contractors are properly inducted Hazard reduction activities
	External fire	Vehicle fire leads to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Storage areas (i.e. ANE tank) to be protected by bollard, high visibility clothing, established site traffic control management plan, licensed driver, approved vehicle.	2	E	10	Place the designated speed limit (10 km/hr) signs at the front of the front gate. Limited access to the plant. Include the site traffic movement/management plan as part of induction process.

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	External fire	External fire engulfs AN storage tank leading to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site.	2	E	10	Separation distances are adequate between the storage tanks.
	External fire	Fire caused by chemical decomposition of incompatible material leads to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential spill sites.	2	D	14	Establish operating procedures for handling AN Establish site safety management plan
	External fire	External fire caused by electrical fault engulfs AN storage tank leading to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures for maintenance of electrical equipment.	2	E	10	Establish operating procedures for handling AN Establish site safety management plan
	Internal fire / explosion	Internal fire/heating caused by chemical decomposition of incompatible materials leads to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential spill sites.	2	D	14	Establish operating procedures for handling AN Establish site safety management plan

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	Explosive Decomposition / detonation	Local or spot heating caused by friction or impact in transfer equipment causes a fire in tank leading to exposure of AN to radiant heat causing thermal decomposition of AN.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site.	2	E	10	Establish operating procedures for handling AN Establish site safety management plan
	Toxic / harmful exposure	Spillage or chemical reaction causes operator to be exposed to toxic fumes when enters the auger pit	Potential for personal injury	Suitable lighting at loading areas.	3	D	9	Establish operating procedures for handling spills Establish site safety management plan Provide spill mgmt kit.
	Violent release of energy	Sudden collapse of bulk material in AN storage tanks causing shock load to equipment	Potential for serious personal injury. Property damage, damage to critical equipment.	Provide an operating procedure/manual to open the container if major AN spills occur inside/during transport.	3	E	6	Establish operating procedures for operating machinery and equipment Provide training for operators
	Exposure to damaging energy	Operator to be exposed to rotating parts of the auger and elevator.	Potential for serious personal injury.	Protective cages and guards surrounding moving parts on machines.	2	E	10	Establish operating procedures for operating machinery and equipment Provide training for operators

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	Environmental pollution	Dust emissions from tipping of AN into the receival hopper and from loading MMU's released to the environment.	Potential for personal injury.	Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential loss of contaminant.	4	C	8	Establish operating procedures for handling spills Establish site safety management plan Provide spill mgmt kit.
	Environmental pollution	Major spill of AN onto the ground during wet weather.	Loss of product. Possible contamination in surrounding environment. Potential for personal injury.	Concrete slabs underneath loading areas. Suitable drive-away protection to reduce likelihood of trucks leaving without disconnecting.	2	E	10	Establish operating procedures for handling AN Establish site safety management plan Provide spill mgmt kit.

COMPANY: Orica Mining Services

Plant Area/Section: ANE STORAGE TANK AND HANDLING SYSTEM

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	External explosion	Explosion in magazine, MMU or fire from other various process units that leads to projectile impacting on the ANE storage tank.	Operator or member of public exposed to overpressure, toxic fumes and damage to buildings occurs. Possible loss of product.	Magazine and plant are located appropriately from each other, the mine and public infrastructure. Storage vessels are separated within the plant. Provision of a number of fire extinguishes around the site. Designated smoking areas on site, signage on non smoking areas, hot work clearance procedure, site induction	2	D	14	Adequate signage i.e. non- smoking signs on all gate entrances. Re-training clearance issuer Ensure all personnel, employees, visitor, and contractors are properly inducted Hazard reduction activities
	External fire	External vehicle fire leads to exposure of ANE to radiant heat causing thermal decomposition of ANE.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Storage areas (i.e. ANE tank) to be protected by bollard, high visibility clothing, established site traffic control management plan, licensed driver, approved vehicle.	2	E	10	Place the designated speed limit (10 km/hr) signs at the front of the front gate. Limited access to the plant. Include the site traffic movement/management plan as part of induction process.

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	External fire	Human fault results in external fire that engulfs ANE storage tank leading to exposure of ANE to radiant heat causing thermal decomposition of ANE.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures Designated smoking areas outside of precursor site	2	D	14	Separation distances are adequate between the storage tanks.
	External fire	Fire caused by chemical decomposition of incompatible material leads to exposure of ANE to radiant heat causing thermal decomposition of ANE.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential spill sites.	2	D	14	Establish operating procedures for handling ANE Establish site safety management plan
	External fire	External fire caused by electrical fault engulfs ANE storage tank and transfer equipment leading to exposure of ANE to radiant heat causing thermal decomposition of ANE.	Property damage, damage to critical equipment. Generation of toxic fumes. Possibility of detonation. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Operating procedures for maintenance of electrical equipment.	2	E	10	Establish operating procedures for handling ANE Establish site safety management plan
Heating decompositions	Explosive decomposition / detonation	Thermal heating caused by dry running or dead heading the gear pump resulting in heating of ANE leading to thermal decomposition.	Potential for personal injury. Potential for loss of product.	The use of NAPCO pump with the appropriate safety devices including: quick heat dissipation and thermofuse pressure gauge. The pump can not generate enough heat to cause deflagration. Design in accordance with Basics of Safety.	3	D	9	Establish operating procedures for handling ANE Establish site safety management plan

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
Toxic / harmful exposure	Damaging Energy	Failure of ANE transfer hose/line under pressure leads to operator being sprayed.	Potential for serious personal injury. Possible loss of product.	Components and hardware assessed for their materials of construction and replaced if not protected or coated. Stainless steel pipework and valving	2	E	10	Establish operating procedures for handling ANE Establish site safety management plan Provide spill mgmt kit.

COMPANY: Orica Mining Services

Plant Area/Section: DWAG COMPANION SOLUTION

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	External fire	Vehicle fire or accident causes external heating of companion storage resulting in ignition of combustible material with consequential fire and combustion products. Creates noxious fume.	Possible loss of product. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Storage areas (i.e. ANE tank) to be protected by bollard, high visibility clothing, established site traffic control management plan, licensed driver, approved vehicle.	2	E	10	Place the designated speed limit (10 km/hr) signs at the front of the front gate. Limited access to the plant. Include the site traffic movement/management plan as part of induction process.
	External fire	Chemical contamination of spilled gasser residue causes thermal decomposition and external fire in proximity of companion solution.	Potential for personal injury. Possibility of violent rupture of container and loss of product.	Concrete slabs for the easy removal of spills. Provision of a number of fire extinguishes around the site.	4	D	5	Separation distances are adequate between the storage tanks.
Heating decompositions	Explosive decompositions/ detonators	Thermal decomposition of companion solution due to chemical contamination or exposure to heat from a fire.	Potential for personal injury. Possibility of violent rupture of container and loss of product.	Bunding and separation distances. Provision of a number of fire extinguishes around the site.	4	D	5	Establish operating procedures for handling DWAG companion solution Establish site safety management plan

COMPANY: Orica Mining Services

Plant Area/Section: GASSER STORAGE

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	External fire	Vehicle fire or accident causes heating of gasser storage resulting in ignition of combustible material with consequential fire	Possible loss of product. Potential for serious personal injury.	Provision of a number of fire extinguishes around the site. Storage areas (i.e. ANE tank) to be protected by bollard, high visibility clothing, established site traffic control management plan, licensed driver, approved vehicle.	2	E	10	Place the designated speed limit (10 km/hr) signs at the front of the front gate. Limited access to the plant. Include the site traffic movement/management plan as part of induction process.
	External fire	Chemical contamination of spilled gasser residue causes thermal decomposition and external fire in proximity of gasser storage.	Potential for personal injury. Possibility of violent rupture of container and loss of product.	Concrete slabs for the easy removal of spills. Provision of a number of fire extinguishes around the site.	4	D	5	Separation distances are adequate between the storage tanks.
Heating decompositions	Explosive decompositions/ detonators	Thermal decomposition of gasser due to chemical contamination or exposure to heat from a fire.	Potential for personal injury. Possibility of violent rupture of container and loss of product.	Labelling of storage tanks Storage tanks located in different areas onsite	3	D	9	Separation distances are adequate between the storage tanks.

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	Exposure to harmful substances	Accidental ingestion of gasser solution.	Potential for serious personal injury.	Operator training and safety with handling gasser solution Appropriate PPE used as per MSDS	2	D	14	Establish operating procedures for handling gasser solution Schedule adequate maintenance on PPE
Plant items	Exposure to damaging energy	MMU or delivery vehicle drives off while still connected to the tank.	Property damage, damage to critical equipment. Potential for serious personal injury. Loss of product.	Bunding around unit. Drive-away protection to prevent loss of product. Level loading bays	3	E	6	Establish operating procedures for handling gasser solution. Supervision of contractors while onsite
	Environmental pollution	Overheating causing the release of gasser solution with potential for offsite contamination or rejection of incompatible materials.	Potential for personal injury. Loss of product. Pollution and contamination of surrounding environment.	Bunding around unit. Temperature gauges installed on storage tanks.	3	D	9	Establish operating procedures for handling gasser solution Establish site safety management plan

Company: Orica Mining Services

Plant Area/Section: GENERATOR

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	Internal fire / explosion	Fuel or electric fault causes the ignition of a fire.	Damage to plant equipment. Potential for personal injury.	Correct plant and equipment design, correct separation distances	2	E	9	Final layout needs to be signed off.
	Damaging Energy	Electrocution via electrical fault, or contact with moving parts due to poor maintenance or removal of protective guards.	Serious personal injury. Loss of production time.	Operator training and safety procedures. Appropriate use of PPE	2	E	10	Establish operating procedures for handling electrical equipment. Establish site safety management plan

Company: Orica Mining Services

Plant Area/Section: SITE IMPACTS

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
General site interactions	External fire / explosion	Fire from people with unauthorized access, Bush fires	Major fire, and possible human injuries•	Restrict access personnel, security provided to prevent unauthorized access. Establish emergency and evacuation plans. Maintain 10-metre firebreak around perimeter fence.	2	D	14	Access to the plant is restricted, and entry to the operation area is minimised. Site safety management plan addresses the emergency and evacuation procedures specific to the Whitehaven site.
General site	External fire	Exposure to AN from radiant heat from an external fire due to natural causes results in thermal decomposition of AN.	Personal injury. Potential for loss of product. Damage to plant equipment.	Correct plant and equipment design, correct separation distances	2	E	10	Final layout needs to be signed off.
Vehicle interactions forklift, MMU, semi-trailer container delivery truck	Vehicle collision	Human fault causing vehicle impact into process storage and handling equipment or pedestrain	Damage to equipment. Possible loss of production. Potential for personal injury.	60km/h speed limit on the haul road. Construction workers will be escorted while onsite. Good visibility either way outside Orica facility. Movement of traffic one way through the facility.	2	E	10	Place the designated speed limit (10 km/hr) signs at the front of the front gate. Limited access to the plant. Include the site traffic movement/management plan as part of induction process.

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
Environmental pollution	Contamination	Loss of product or process chemicals due to spillages from human fault and equipment failure.	Contamination of surrounding soil with AN and associated substances.	Concrete slab covering under loading areas. Correct plant and equipment adequate separation distances Excellent housekeeping and maintenance	2	E	10	Provide waste cages Ensure housekeeping is maintained to high standards.
Environmental pollution	Waste products	Reaction between incompatible waste steams causes a decomposition reaction generating heat and fumes.	Potential for explosion. Possible personal injury. Loss of product.	Adequate separation distances Different couplings installed	2	E	10	Establish operating procedures for handling electrical equipment Establish site safety management plan

COMPANY: Orica Mining Services

Plant Area/Section: GASSER COMSOL STORAGE

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	High flow	Pump over speed due to failed air regulator or piping failure.	Damage to plant equipment. Loss of product. Potential for personal injury.	Existing safeguards adequate. Operator observations i.e noise of pump during operation Circuit breakers, fuses, earthing	3	E	6	Establish operating procedures for handling high flow scenarios Establish site safety management plan Regular maintenance of electrical equipment
AN loading into silo	High flow	Wheat door on delivery tipper opened too much. Auger is faster than bucket elevator. Auger is running without bucket elevator. Bin is full	Major LOC, overflow and spill from auger hopper, Bogging of bucket elevator Bogging of bucket elevator, trip out of motor.	Establish site operating procedures and training especially for contractors. Sight glass on side of bin is provided.	4	D	5	Develop and enforce site-operating procedures. Ensure that the auger is synchronized to the bucket elevator via interlocking mechanism.
	Low flow	Tanker empty, valve partially shut or closed, pipe block from impurities (dye residue), line blockage or hose kinked.	Major LOC, heat generation, mechanical and electrical damage, production downtime. Affect product quality control. Bogging of material	Speed sensor installed on the bucket elevator. Electric motor overloads safety system. Operator observations i.e. view of the prills condition going in, screen remains in place.	3	D	9	Conduct periodic inspection of equipment Equipment maintenance in accordance with manufacture specifications and red book. Set up the red book

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	Zero flow	Tanker empty, valve partially shut or closed, pipe block from impurities (dye residue), line blockage or hose kinked.	Major LOC, heat generation, mechanical and electrical damage, production downtime. Affecting product quality control. Bogging of material.	Speed sensor installed on the bucket elevator. Electric motor overloads safety system. Operator observations	3	D	9	Ensure no blockage on the central bearings/auger Schedule regular maintenance and set up the red book
	Reverse flow	Not considered possible		Existing safeguards adequate.				
	High pressure	Line blockage or overpressure in tank.	Sudden release of pressure causing damage to plant equipment. Possible personal injury.	Existing safeguards adequate. Operator observations Installation of mesh grants and guards	3	D	9	Ensure adequate line sensors installed. Establish operating procedures for handling line blockages and over pressure
	Low pressure	Air failure	Loss of production time while problem is fixed.	Existing safeguards adequate. Operator observation	2	D	14	Conduct periodic inspection of equipment Equipment maintenance in accordance with manufacture specifications and red book.

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	High temperature	Auger rubbing against the metal (friction) Electric motor burning	Generated heat, possible fire/explosion under right condition	Auger is designed to high standards Orica design with speed limitation, flight clearance, stand off/ offset bearings, overload in motor, motor to IP65, poly auger casing Noise observation by standby operator Included in training, and procedures Scheduled periodic inspection and maintenance of equipment	3	D	9	Ensure inspection of equipment is carried out on regular basis (include in the red book checks) Ensure training matrix is followed
	Impurities	Out of specification product or wrong product.	Loss of sellable product.	Existing safeguards adequate. Regular testing of product	2	D	14	Ensure procedures are followed; adequate training, appropriate signage in place.
	Materials	Wrong materials used in production.	Loss of sellable product.	Existing safeguards adequate.	2	D	14	
	Operator health	Human fault of equipment failure resulting in exposure to chemicals.	Potential for personal injury.	Existing safeguards adequate. Appropriate PPE used.	3	D	9	Conduct periodic inspection of PPE Conduct operator equipment training and safety training.
	Waste	Cross contamination of waste spillages.	Potential off-site contamination	Operating procedures, secondary containment. Concrete load in/load out areas. Stormwater isolation in potential spill sites.	3	E	6	Establish operating procedures for handling AN Establish site safety management plan Provide spill mgmt kit.

Component	Guideword	Cause	Consequence	Current Barriers	C	L	R	Actions
	Fire and explosion	Mixing of incompatible materials.	Fire: property damage/ personnel injury	Provide designated gasser solution area, segregated from AN based solution tanks	3	E	6	Separation distances are adequate between the AN and gasser solution storage. (>5 metres)

Appendix II

Dangerous Goods Material Safety Data Sheets

Material Safety Data Sheet

Based on available information, not classified as hazardous according to criteria of NOHSC.
Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail.

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name: **AMMONIUM NITRATE**

Synonyms: Nitric acid ammonium salt; Nitram; Nitropril; CPAN; Chemically Pure Ammonium Nitrate; Security Sensitive Ammonium Nitrate; SSAN.
Supplier: Orica Australia Pty Ltd
ABN: 004 117 828
Street Address: 1 Nicholson Street,
Melbourne 3000
Australia
Telephone Number: +61 3 9665 7111
Facsimile: +61 3 9665 7937

Emergency Telephone: **1 800 033 111 (ALL HOURS)**

2. COMPOSITION/INFORMATION ON INGREDIENTS

Product Description: General chemical; explosives manufacture; fertilizer.
White crystalline solid / prills.

Various government controls may apply to this material.

Components / CAS Number	Proportion	Risk Phrases
Ammonium nitrate 6484-52-2	100%	-

3. HAZARDS IDENTIFICATION

Poisons Schedule: None allocated.

4. FIRST AID MEASURES

Inhalation: Remove victim from area of exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. If patient finds breathing difficult and develops a bluish discolouration of the skin (which suggests a lack of oxygen in the blood - cyanosis), ensure airways are clear of any obstruction and have a qualified person give oxygen through a face mask. Apply artificial respiration if patient is not breathing. Seek immediate medical advice.

Skin Contact: If skin contact occurs, remove contaminated clothing and wash skin with running water. If irritation occurs seek medical advice.

Eye Contact: If in eyes, wash out immediately with water. In all cases of eye contamination it is a sensible

Material Safety Data Sheet

precaution to seek medical advice.

Ingestion: Rinse mouth with water. If swallowed, do NOT induce vomiting. Give a glass of water. Seek medical advice.

Notes to physician: Clinical findings: The smooth muscle relaxant effect of nitrate salts may lead to headache, dizziness and marked hypotension.
Cyanosis is clinically detectable when approximately 15% of the haemoglobin has been converted to methaemoglobin (ie. ferric iron).
Symptoms such as headache, dizziness, weakness and dyspnoea occur when methaemoglobin concentrations are 30% to 40%; at levels of about 60%, stupor, convulsions, coma and respiratory paralysis occur and the blood is a chocolate brown colour. At higher levels death may result.
Spectrophotometric analysis can determine the presense and concentration of methaemoglobin in blood.
Treatment:
1. Give 100% oxygen.
2. In cases of (a) ingestion: use gastric lavage, (b) contamination of skin (unburnt or burnt): continue washing to remove salts.
3. Observe blood pressure and treat hypotension if necessary.
4. When methaemoglobin concentrations exceed 40% or when symptoms are present, give methylene blue 1 to 2 mg/kg body weight in a 1% solution by slow intravenous injection. If cyanosis has not resolved within one hour a second dose of 2 mg/kg body weight may be given. The total dose should not exceed 7 mg/kg body weight as unwanted effects such as dyspnoea, chest pain, vomiting, diarrhoea, mental confusion and cyanosis may occur. Without treatment methaemoglobin levels of 20-30% revert to normal within 3 days.
5. Bed rest is required for methaemoglobin levels in excess of 40%.
6. Continue to monitor and give oxygen for at least two hours after treatment with methylene blue.
7. Consider transfer to centre where haemoperfusion can be performed to remove the nitrates from the blood if the condition of the patient is unstable.
8. Following inhalation of oxides of nitrogen the patient should be observed in hospital for 24 hours for delayed onset of pulmonary oedema.
Further observation for 2-3 weeks may be required to detect the onset of the inflammatory changes of bronchiolitis fibrosa obliterans.

5. FIRE FIGHTING MEASURES

Specific Hazards: Oxidizing substance.

Fire-fighting advice: Nitrate salts on their own are not combustible, however they will support the combustion of other materials. Decomposes on heating emitting irritating white fumes. Brown fumes indicate the presence of toxic oxides of nitrogen. On detection of fire the compartment(s) should be opened up to provide maximum ventilation. Fire-fighters to wear self-contained breathing apparatus and suitable protective clothing if there is a risk of exposure to products of combustion/decomposition. Fires should be fought from a protected location. Keep containers and adjacent areas cool with water spray. If safe to do so, remove containers from path of fire. A major fire may involve a risk of explosion. An adjacent detonation may also involve the risk of explosion.

Suitable Extinguishing Media: Water spray (large quantities).

6. ACCIDENTAL RELEASE MEASURES

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Shut off all possible sources of ignition. Clear area of all unprotected personnel. Wear protective equipment to prevent skin and eye contact. Avoid breathing in dust. Work up wind or increase ventilation. Cover with damp absorbent (inert material, sand or soil). Sweep or vacuum up, but avoid generating dust. Collect and seal in properly labelled containers, bags or drums for disposal or re-use.

7. HANDLING AND STORAGE

Handling advice: Avoid skin and eye contact and breathing in dust.

Storage advice: Store in a cool, dry, well ventilated place and out of direct sunlight. Store away from sources of heat or ignition. Ammonium Nitrate is incompatible with, and must be stored away from, tetranitromethane, dichloroisocyanuric acid, trichloroisocyanuric acid, any bromate, chlorate, chlorite, hypochlorite or chloroisocyanurate or any inorganic nitrite. If using wooden pallets, these must be hardwood and periodically washed down with large amounts of water to remove all traces of the material. Keep containers closed when not in use - check regularly for spills.
This product when stored in a confined, unventilated space/hold can give off ammonia or other odour and lead to the depletion of oxygen within this space and other confined spaces. It is therefore essential that ventilation is carried out prior to entry to all ship holds.

Ensure ammonium nitrate is stored securely and in accordance with regulations/controls issued by relevant authoritiy. Secure storage may involve locking the facility/container or constant surveillance.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits:
No value assigned for this specific material by the National Occupational Health and Safety Commission. However, Exposure Standard(s) for particulates:

Nuisance dust: 8hr TWA = 10 mg/m3

As published by the National Occupational Health and Safety Commission.

TWA - The time-weighted average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life.

These Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Engineering Control Measures:
Ensure ventilation is adequate to maintain air concentrations below Exposure Standards. Avoid generating and breathing in dusts. Use with local exhaust ventilation or while wearing dust mask. Keep containers closed when not in use.

Personal Protective Equipment:
Orica Personal Protection Guide No. 1, 1998: E - OVERALLS, SAFETY SHOES, SAFETY GLASSES, GLOVES, DUST MASK.

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Wear overalls, safety glasses and impervious gloves. Avoid generating and inhaling dusts. If dust exists, wear dust mask/respirator meeting the requirements of AS/NZS 1715 and AS/NZS 1716. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Crystalline Solid / Prills
Colour:	White
Odour:	Mild Ammoniacal
Molecular Formula:	NH4NO3
Solubility:	Soluble in water.
Specific Gravity:	1.72 @20°C
Relative Vapour Density (air=1):	Not available
Vapour Pressure (20 °C):	Negligible
Flash Point (°C):	Not applicable
Flammability Limits (%):	Not applicable
Autoignition Temperature (°C):	Not available
Melting Point/Range (°C):	170
Boiling Point/Range (°C):	Decomposes
Decomposition Point (°C):	210
pH:	5.4 (0.1M aq. solution)

10. STABILITY AND REACTIVITY

Stability: Ammonium nitrate is a powerful oxidising agent. It is incompatible with tetranitromethane, dichloroisocyanuric acid, trichloroisocyanuric acid, any bromate, chlorate, chlorite, hypochlorite or chloroisocyanurate, any inorganic nitrite and metal powders. When heated to decomposition (unconfined) it produces nitrous oxide, white ammonium nitrate fumes and water. When mixed with strong acids, and occasionally during blasting, it produces an irritating toxic brown gas, mostly of nitrogen dioxide. When molten may decompose violently due to shock or pressure.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Ingestion: Swallowing can result in nausea, vomiting, diarrhoea, and abdominal pain. Swallowing large amounts may result in headaches, dizziness and a reduction in blood pressure (hypotension).
Eye contact: May be an eye irritant.
Skin contact: Repeated or prolonged skin contact may lead to irritation. Contact with molten material may cause skin burns.
Inhalation: Breathing in dust may result in respiratory irritation.

Long Term Effects:
No information available for the product.

Toxicological Data:

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Oral LD50 (rat): 2,217 mg/kg.
Following the ingestion of nitrates in humans and animals methaemoglobinaemia has occured.

12. ECOTOXICOLOGICAL INFORMATION

Avoid contaminating waterways.

Aquatic toxicity:
Ammonium nitrate was evaluated at 5, 10, 25 and 50 mg (NH4+)/L.
The fertility of Daphnia magna was decreased at 50 mg/L. Post embryonic growth of crustacea was impaired at 10, 25 and 50 mg/L.

13. DISPOSAL CONSIDERATIONS

Refer to Waste Management Authority. Dispose of material through a licensed waste contractor. Disposal of material needs to be appropriately documented and material accurately accounted for.

14. TRANSPORT INFORMATION

Road and Rail Transport
Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail.

UN No: 1942
Class-primary 5.1 Oxidizing Agent
Packing Group: III
Proper Shipping Name: AMMONIUM NITRATE

Hazchem Code: 1[Y]

Marine Transport
Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea.

UN No: 1942
Class-primary: 5.1 Oxidizing Agent
Packing Group: III
Proper Shipping Name: AMMONIUM NITRATE

Air Transport
Classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods

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Regulations for transport by air.

UN No: 1942
Class-primary: 5.1 Oxidizing Agent
Packing Group: III
Proper Shipping Name: AMMONIUM NITRATE

15. REGULATORY INFORMATION

Classification: Based on available information, not classified as hazardous according to criteria of NOHSC.
Poisons Schedule: None allocated.

This material is listed on the Australian Inventory of Chemical Substances (AICS).

Various regulations/controls/authorisations/licences may apply governing the manufacture, importation, exportation, use, handling, storage, sale/supply, transport and disposal of ammonium nitrate. Ammonium nitrate may be considered a security sensitive material and loss, theft, attempted theft and unexplained discrepencies may need to be reported to authorities. Record keeping and/or licensing of individuals may be required.

16. OTHER INFORMATION

`Registry of Toxic Effects of Chemical Substances'. Ed. D. Sweet, US Dept. of Health & Human Services: Cincinatti, 2003.
Material Safety Data Sheet - Orica Australia Pty Ltd; 08/ 2002.
In: 'The Dictionary of Substances and their Effects'. Ed.Gangolli S. Royal Society of Chemistry, 1999.

This material safety data sheet has been prepared by SH&E Shared Services, Orica.

Reason(s) for Issue:
Addition/Change of synonymous name(s)
Change in Handling & Storage Requirements

This MSDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Orica Limited cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact their Orica representative or Orica Limited at the contact details on page 1.

Orica Limited's responsibility for the material as sold is subject to the terms and conditions of sale, a copy of which is available upon request.

Material Safety Data Sheet

This material is hazardous according to criteria of NOHSC.
Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail.

1. Identification of the substance/preparation and of the company/undertaking

Product Name: **MBU601 EMULSION PHASE**

Supplier: Orica Australia Pty Ltd
ABN: 004 117 828
Street Address: 1 Nicholson Street
Melbourne 3000
Australia
Telephone Number: +61 3 9665 7111
Facsimile: +61 3 9665 7937

Emergency Telephone: **1 800 033 111 (ALL HOURS)**

2. Composition/information on ingredients

Product Description: Emulsion phase ingredient for explosives. Creamy emulsion. Material may be warm to hot (60 - 80°C). Negligible odour.

Components / CAS Number	Proportion	Risk Phrases
Non hazardous component(s) -	< 20%	-
Water 7732-18-5	10 - 30%	Non hazardous
Fuels, diesel 68334-30-5	< 10%	R40 Carc. Cat. 3, R65, R66, R51/53
Mineral oil 8012-95-1	< 10%	-
Ammonium nitrate 6484-52-2	> 60%	-

3. Hazards identification

Risk Phrases: Limited evidence of a carcinogenic effect.

Poisons Schedule: None allocated.

4. First-aid measures

For advice, contact a Poisons Information Centre (Phone eg. Australia 131 126; New Zealand 0 800 764766) or a doctor.

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Inhalation: Remove victim from area of exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. If patient finds breathing difficult and develops a bluish discolouration of the skin (which suggests a lack of oxygen in the blood - cyanosis), ensure airways are clear of any obstruction and have a qualified person give oxygen through a face mask. Apply artificial respiration if patient is not breathing. Seek immediate medical advice.

Skin Contact: If skin contact occurs, remove contaminated clothing and wash skin with running water. If irritation occurs seek medical advice. Nitrates can be absorbed through cut, burnt or broken skin. Launder clothing before reuse. For skin burns, cover with a clean, dry dressing until medical help is available.

Eye Contact: If in eyes, wash out immediately with water. In all cases of eye contamination it is a sensible precaution to seek medical advice.

Ingestion: Rinse mouth with water. If swallowed, do NOT induce vomiting. Give a glass of water. Seek medical advice.

Notes to physician: Treat symptomatically. May cause methemoglobinemia. Clinical findings: The smooth muscle relaxant effect of nitrate salts may lead to headache, dizziness and marked hypotension.
Cyanosis is clinically detectable when approximately 15% of the haemoglobin has been converted to methaemoglobin (ie. ferric iron).
Symptoms such as headache, dizziness, weakness and dyspnoea occur when methaemoglobin concentrations are 30% to 40%; at levels of about 60%, stupor, convulsions, coma and respiratory paralysis occur and the blood is a chocolate brown colour. At higher levels death may result.
Spectrophotometric analysis can determine the presense and concentration of methaemoglobin in blood.
Treatment:
1. Give 100% oxygen.
2. In cases of (a) ingestion: use gastric lavage, (b) contamination of skin (unburnt or burnt): continue washing to remove salts.
3. Observe blood pressure and treat hypotension if necessary.
4. When methaemoglobin concentrations exceed 40% or when symptoms are present, give methylene blue 1 to 2 mg/kg body weight in a 1% solution by slow intravenous injection. If cyanosis has not resolved within one hour a second dose of 2 mg/kg body weight may be given. The total dose should not exceed 7 mg/kg body weight as unwanted effects such as dyspnoea, chest pain, vomiting, diarrhoea, mental confusion and cyanosis may occur. Without treatment methaemoglobin levels of 20-30% revert to normal within 3 days.
5. Bed rest is required for methaemoglobin levels in excess of 40%.
6. Continue to monitor and give oxygen for at least two hours after treatment with methylene blue.
7. Consider transfer to centre where haemoperfusion can be performed to remove the nitrates from the blood if the condition of the patient is unstable.
8. Following inhalation of oxides of nitrogen the patient should be observed in hospital for 24 hours for delayed onset of pulmonary oedema.
Further observation for 2-3 weeks may be required to detect the onset of the inflammatory changes of bronchiolitis fibrosa obliterans.

5. Fire-fighting measures

Specific Hazards: Oxidizing substance. Will support combustion of other materials. Non-combustible material.

Fire-fighting advice: Nitrate salts on their own are not combustible, however they will support the combustion of other materials. Decomposes on heating emitting irritating white fumes. Brown fumes indicate the presence of toxic oxides of nitrogen. On detection of fire the

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compartment(s) should be opened up to provide maximum ventilation. Fire-fighters to wear self-contained breathing apparatus and suitable protective clothing if there is a risk of exposure to products of combustion/decomposition. Fires should be fought from a protected location. Keep containers and adjacent areas cool with water spray. If safe to do so, remove containers from path of fire. A major fire may involve a risk of explosion. An adjacent detonation may also involve the risk of explosion. Heating can cause expansion or decomposition of the material, which can lead to the containers exploding. If safe to do so, remove containers from the path of fire.

Suitable Extinguishing Media: Not combustible, however, if material is involved in a fire use: Water jets.

6. Accidental release measures

Shut off all possible sources of ignition. Clear area of all unprotected personnel. Wear protective equipment to prevent skin and eye contact and breathing in vapours/dust. Slippery when spilt. Avoid accidents, clean up immediately. Contain - prevent run off into drains and waterways. Use absorbent - inert material such as vermiculite, perlite or clean sand - NOT combustible absorbents such as sawdust. Addition of water is recommended. Collect in properly labelled containers, with loose fitting lids, for disposal. If contamination of sewers or waterways has occurred advise local emergency services. In the case of a transport accident notify the Police, Explosives Inspector and Orica Australia Pty Ltd (Telephone: 1800 033 111 -- 24 hour service) and/or Orica New Zealand Pty Ltd (Telephone: 0800 734 607 -- 24 hour service).

7. Handling and storage

Handling advice: Avoid skin and eye contact and breathing in vapour. Do NOT subject the material to impact, friction between hard surfaces nor to any form of heating. Avoid all contact with other chemicals.

Storage advice: Ammonium Nitrate is incompatible with, and must be stored away from, tetranitromethane, dichloroisocyanuric acid, trichloroisocyanuric acid, any bromate, chlorate, chlorite, hypochlorite or chloroisocyanurate or any inorganic nitrite. Store away from strong acids, strong alkalis, nitrites, chlorates, chlorides and permanganates. Store in cool place and out of direct sunlight. Keep containers closed when not in use - check regularly for leaks.
Product Deterioration: The process of deterioration is a gradual crystallisation of the ammonium nitrate and a thickening of the emulsion. If heated for long periods the emulsion may segregate. Product which has deteriorated badly is unsuitable for use.

8. Exposure controls/personal protection

Occupational Exposure Limits:
No value assigned for this specific material by the National Occupational Health and Safety Commission. However, Exposure Standard(s) for constituent(s):

Oil mist, refined mineral: 8hr TWA = 5 mg/m3

As published by the National Occupational Health and Safety Commission.

TWA - The time-weighted average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life.

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These Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Supplier recommended Exposure Standard: Diesel Oil: 500 mg/m3 total vapour (approx 100 ppm) or 5 mg/m3 stable aerosols for 8 hour time-weighted average (TWA). (1)

Engineering Control Measures:
Ensure ventilation is adequate and that air concentrations of components are controlled below quoted Exposure Standards.

Personal Protective Equipment:
Orica Personal Protection Guide No. 1, 1998: C - OVERALLS, SAFETY SHOES, CHEMICAL GOGGLES, GLOVES.

Wear overalls, chemical goggles and impervious gloves. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

9. Physical and chemical properties

Physical state:	Creamy emulsion. Material may be warm to hot (60-80°C).
Odour:	Negligible
Solubility:	Insoluble in water.
Specific Gravity:	1.35 @ 20°C
Flash Point (°C):	Not applicable
Solubility in water (g/L):	Negligible

10. Stability and reactivity

Stability: Incompatible with nitrites , chlorates chlorides and permanganates . Incompatible with strong acids and alkalis. Ammonium nitrate is a powerful oxidising agent. It is incompatible with tetranitromethane, dichloroisocyanuric acid, trichloroisocyanuric acid, any bromate, chlorate, chlorite, hypochlorite or chloroisocyanurate, any inorganic nitrite and metal powders. When heated to decomposition (unconfined) it produces nitrous oxide, white ammonium nitrate fumes and water. When mixed with strong acids, and occasionally during blasting, it produces an irritating toxic brown gas, mostly of nitrogen dioxide. When molten may decompose violently due to shock or pressure. Detonation may occur from heavy impact or excessive heating, particularly under confinement.

11. Toxicological information

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Ingestion: Swallowing can result in nausea, vomiting, diarrhoea, and abdominal pain. Other symptoms include headaches and dizziness.
Eye contact: May be an eye irritant.
Skin contact: Contact with skin may result in irritation. Will have a degreasing action on the skin. Repeated or prolonged skin contact may lead to irritant contact dermatitis. Can be absorbed through cut, broken, or

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burnt skin with resultant adverse effects. Contact with hot material may cause skin burns.

Inhalation: Material may be irritant to the mucous membranes of the respiratory tract (airways). Breathing in vapour can result in headaches, dizziness, drowsiness, and possible nausea.

Long Term Effects:
No information available for the product. Available evidence from animal studies indicate that repeated or prolonged exposure to a component of this material could result in effects on the skin. This material contains within the diesel oil component of this formulation polycyclic aromatic hydrocarbons (PAHs). Some PAHs have been implicated as potential skin carcinogens in humans under conditions of poor personal hygiene, prolonged or repeated skin contact and exposure to sunlight. Toxic effects are unlikely to occur if good personal hygiene is practised. (1)

Toxicological Data:
No LD50 data available for the product. For the constituent AMMONIUM NITRATE: (2):

Oral LD50 (rat): 2217 mg/kg
In humans and animals methaemoglobinaemia has occurred under untreated circumstances following the ingestion of nitrates. (2)

12. Ecotoxicological information

Avoid contaminating waterways.

13. Disposal considerations

Refer to Waste Management Authority. Dispose of material through a licensed waste contractor. This emulsion can be destroyed by dispersion in a detergent solution. Small quantities of damaged or deteriorated explosives may be destroyed by inclusion in a blast hole containing good explosive(s). For large quantities of damaged or deteriorated explosives notify Orica Australia Pty Ltd and/or Orica New Zealand Pty Ltd.

14. Transport information

Road and Rail Transport
Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail.

UN No:	3375
Class-primary	5.1 Oxidizing Agent
Packing Group:	II
Proper Shipping Name:	AMMONIUM NITRATE EMULSION
Hazchem Code:	1[Y]E

Marine Transport
Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for

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transport by sea.

UN No:	3375
Class-primary:	5.1 Oxidizing Agent
Packing Group:	II
Proper Shipping Name:	AMMONIUM NITRATE EMULSION

Air Transport
TRANSPORT PROHIBITED under the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air in passenger aircraft and cargo aircraft.

15. Regulatory information

Classification: This material is hazardous according to criteria of NOHSC.
Xn: Harmful

Risk Phrase(s): R40: Limited evidence of a carcinogenic effect.

Safety Phrase(s): S24: Avoid contact with skin.

Poisons Schedule: None allocated.

All the constituents of this material are listed on the Australian Inventory of Chemical Substances (AICS).

16. Other information

(1) Supplier Material Safety Data Sheet; 12/ 2002.
(2) Material Safety Data Sheet - Orica Australia Pty Ltd; 08/ 2004.

This material safety data sheet has been prepared by SH&E Shared Services, Orica.

This material, as an ammonium nitrate emulsion, was formerly classified with UN No 3139, OXIDIZING LIQUID, N.O.S. (AMMONIUM NITRATE EMULSION). This UN No has now been replaced by UN No 3375.

Reason(s) for Issue:
Change to Transport Information
Revised Primary MSDS
Change in Hazardous Substance Classification

This MSDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Orica Limited cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

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