

Date of Report 5 Dec 2023

Explosives Holding Site – Impact Investigation Report

REPORT FOR DARRABY PTY LTD ON STAGE 3 RESIDENTIAL DEVELOPMENT
PROPOSAL NEAR EXPLOSIVES FACILITY AT 94 WILSON DRIVE, MARULAN,NSW

Prepared by Noel Erichsen, Member, Institute of Explosives Engineers
under CXC Contract with Darraby Pty Ltd

Disclaimer

Professional Liability Disclaimer (General) Noel Erichsen of Erichsen Contracting Pty Ltd

1. This disclaimer should be reviewed in line with the assumptions in the report as it will detail limitations.
2. The consultant assumes that information that has been requested from the client and other parties to meet the scope of work agreement is provided and that any operating procedures and protocols are conducted in a safe and reasonable manner.
3. The client parties involved have a good understanding of the activities to be managed and have an appropriate level of competence to ensure the management of the activity will meet safety and security requirements.
4. A report provided by the consultant in relation to explosives activities is to be regarded as advice and the liability to adopt or reject parts of the report are at the complete discretion of the client.
5. The report advice is based on the known statement of knowledge that exists in relation to the activity at the time the report is written. Additional knowledge such as advanced research not available or considered known to professionals in the field should not be used to judge the quality of the advice given.
6. Data provided from any modelling is not directly applicable to different circumstances.
7. The site plans provided are indicative only and should not be relied upon for construction or detailed planning.
8. Report conclusions and recommendations to be taken by a client are done so at the clients discretion.

This Report has been prepared solely for the client. While every effort has been made to ensure the accuracy of this document and any attachments, the variation in data inputs, information provided by client and other persons, analysis assumptions mean that Erichsen Contracting is unable to make any warranties in relation to the information contained herein. Erichsen Contracting Pty Ltd, its employees and agents disclaim liability for any loss or damage that may arise because of any person relying on the information contained in this document and any attachments.

© Erichsen Contracting. All rights reserved.

This work is copyright. The Copyright Act 1968 permits fair dealing for study, research, news reporting, criticism, or review. Selected passages, tables or diagrams may be reproduced for such purposes provided acknowledgment of the source is included. Permission for any more extensive reproduction must be obtained from Erichsen Contracting Pty Ltd through the contact officer listed for this report.

Contents

Explosives Holding Site – Impact Investigation Report.....	1
REPORT FOR DARRABY PTY LTD ON STAGE 3 RESIDENTIAL DEVELOPMENT PROPOSAL NEAR EXPLOSIVES FACILITY AT 94 WILSON DRIVE, MARULAN,NSW	1
Disclaimer	2
Glossary of terms.....	5
Executive Summary.....	7
Report Objective	7
Assumptions and limitations	7
Explosives Facility	7
Potential Explosion Sites (PES) and Exposed Sites (ES)	7
Determination of Safeguard Lines	8
<i>Map 5 – Summary Safeguard indicating yellow hatch for no dwellings</i>	8
<i>and purple hatch for no vulnerable facilities</i>	8
Conclusions	8
Main Report.....	10
Background	10
<i>Map 1 – SIXMAPS view of proposed Stage 3 development and Explosives Facility</i>	10
Report Objective	11
Scope of the report	11
Limitations and Assumptions.....	11
Legislation and References	12
Basis of the review.....	12
Potential Explosives Sites.....	13
<i>Table 1 – Energetic materials to be analysed</i>	13
Identify potential explosives sites (Silo and magazine).....	13
<i>Map 2 – Indicative map showing PES and Developmental Area</i>	13
Exposed Sites (ES).....	14
Regulatory Requirements.....	14
Establish regulatory safeguarding lines from the operator to the development area.....	14
Use of Safeguard Lines to indicate tolerable risk from PES to relevant ES type	14
Inside Quantity Distances (IQD).....	15
Outside Quantity Distances OQD.....	15
ANE.....	15
With warning or No warning Event	16
<i>Table 2 – OQD Distances for 40000kg ANE No warning</i>	16
Safeguard Map for ANE	16

<i>Map 3 – Indicating the Safeguard lines for ANE and yellow hatch area not for dwellings, purple hatch not for vulnerable facilities Red line is 400m min to protect against projections for significant person exposure.</i>	17
Impact on development site ES from ANE PES.....	17
HE.....	17
<i>Table 3 – OQD Distances for 40000kg HE.....</i>	18
Safeguard Map for HE.....	18
<i>Map 4 – Indicating the Safeguard lines for HE with PW B intolerable zone and VF intolerable zone over development site</i>	18
Impact on development site ES from HE Site PES 2/3.....	18
Combined Safeguard Map for Explosives Facility	19
<i>Map 5 – Summary Safeguard indicating yellow hatch for no dwellings.....</i>	19
<i>and purple hatch for no vulnerable facilities. Red line 400m minimum to minimise debris to the development</i>	19
Impact Summary of PES.....	19
Conclusions.....	19
Annex A Proposed Lot for Development	20
Annex B - Legislation, Standards and codes to be met	21
Annex C – Assumed quantities and locations for energetic materials on Orica site	22
Resulting Table of Distances.....	22
Annex D – Descriptors for Safeguarding Lines (informative)	23
Annex E ALL Layer Reference Map.....	25

Glossary of terms

Abbreviation	Term	Description
ANE	Ammonium Nitrate Emulsion	Emulsion form of Ammonium Nitrate
ANP	Ammonium Nitrate Prill	Prill form of ammonium nitrate
AW	Associated works	Other magazines, process buildings and storages of energetic materials, e.g. ammonium nitrate or other dangerous goods
Code	Code	The code referred to in this report is the AEISG Code of Practice STORAGE AND HANDLING OF UN3375
Developer	Darraby Pty Ltd	Reference to Darraby Pty Ltd
Development	Development	Refers to the Stage 3 property development at Marulan
ES	Exposed Site	A Vulnerable Facility, Protected Work or ANE Associated Work that may be affected by an explosion of the PES under consideration. (As defined in AS2187.0)
HCC	Hazard Compatibility Code	The hazard division and compatibility code of a substance under the UN requirements
HD	Hazard Division	A numeric designator within a hazard class indicating the character, predominance of associated hazards, and potential for causing personnel casualties and property damage.
HE	High Explosives	Category of explosives that has a detonation effect faster than speed of sound.
HIPAP 4	Hazardous Industry Planning Advisory Paper No 4	Risk Criteria for Land Use Safety Planning
IBD	Inhabited Building Distance	Safe Distance required to an inhabited building Similar to term Protected Works B
NEQ	Net Explosives Quantity	The amount in KG of explosives
Operator	Operator of Explosives Facility	Orica Pty Ltd
PES	Potential Explosion Site	A location that could be the source of an explosion.
PTR	Public Traffic Route Distance	Safe distance required to a traffic route. Similar to term Protected Works A.
PW (A)	Protected works Class A	Public street, road or thoroughfare, railway, navigable waterway, dock, wharf, pier or jetty, marketplace, public recreation and sports ground or other open place where the public is accustomed to assemble, open place of work in another occupancy, river-wall, seawall, reservoir, water main (above ground), radio or television transmitter, main electrical

		substation, private road which is a principal means of access to a church, chapel, college, school, hospital or factory
PW (B)	Protected works Class B	Dwelling house, public building, church, chapel, college, school, hospital, theatre, cinema or other building or structure where the public is accustomed to assembling, 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.
regulator	Regulatory Authority	Safework NSW
SSDS	Security Sensitive Dangerous Substance	Security sensitive dangerous substances (SSDS) you might need a licence for can include types of ammonium nitrate generally used in fertilizer for agriculture, horticulture or other primary production bio-manufacturing education and research.
Standard	Standard	The standard referred to in this report is Australian Standard AS 2187 Explosives storage, transport and use
UN	United Nations	World body that includes specific requirements for explosives
VF	Vulnerable facility.	A category of facility that includes, but is not restricted to, the following: <ul style="list-style-type: none"> i. Multistorey buildings, e.g., above 4 storeys. ii. Large glass fronted buildings of high population. iii. Health care facilities, childcare facilities, schools. iv. Public buildings or structures of major historical value. v. Major traffic terminals, e.g., railway stations, airports. vi. Major public utilities, e.g., gas, water, electricity works

Executive Summary

1. This report was requested by Darraby Pty Ltd (the developer) to consider the impact of an existing explosives facility (the operator) on its Stage 3 residential development proposal near Marulan, NSW. The developer has provided advice that the two main energetic materials at the explosives facility are ammonium nitrate emulsion (ANE) and high explosives (HE) boosters in two potential explosives sites (PES). This report has been compiled on state planning mapping without precise storage locations and the type and quantity of energetic materials.

Report Objective

2. This report considers the impact of the explosives facility storage on the Stage 3 proposed development site (the development).

Assumptions and limitations

3. Assumptions and limitations are outlined in the main report at page 11.

Explosives Facility

4. The current explosives operation conducted by the operator (Orica) is licensed by the regulator. The operator would not provide a copy of the existing licence to the developer. This report has therefore been completed based on verbal advice from the local operations manager to the developer. A newspaper report from 2003 when approved indicates that ammonium nitrate emulsion, ammonium nitrate prill as well as high explosives boosters and detonators could be on the site.

5. The developer has advised that the report should be based on the following information provided by the local site manager. These items represent the worst case in the unlikely event of an explosion of the explosives mentioned above.

- a. 40000 kg of ammonium nitrate emulsion (Hazard Division (HD) 5.1, United Nations Number (UN) 3375) are stored on the site.
- b. 40000 kg of high explosives (HE) (HD 1.1, UN 1942) are stored on the site.
- c. No manufacturing is conducted on the site.
- d. The location of the storages are shown as Potential Explosives Site (PES), PES 1 and PES 2/3 on the map in the executive summary.

6. The proposed layout of the proposed Stage 3 development indicates the layout of the proposed lots. These dwellings will be exposed sites (ES) to the identified PES. The following references are applicable for the two energetic materials:

- a. Ammonium Nitrate Emulsion (ANE) – (Australian Explosives Industry Safety Code (AEISG) Code for use of UN 3375. (the code)
- b. High Explosives (HE) –Australian Standard (AS) 2178 Storage use and transport. (the standard)

Potential Explosion Sites (PES) and Exposed Sites (ES)

7. The two storages used are PES 1 for the ammonium nitrate emulsion storage and PES 2/3 for the high explosives boosters. The HE PES in two buildings have been treated as a single PES due to their proximity. The precise mapped locations are not verified but will provide adequate guidance.

8. The proposed Stage 3 development is shown in the map below. There are 125 lots proposed. The proposal also includes the construction of new roads including the installation/extension of services. The advice is that the development site will not include any vulnerable facilities.

9. There are other ES to the operator PES such as roads, railway lines, other dwellings and places of work. However, this report is focused only on the ES that will be on the proposed Stage 3 development. Individual ES would include every dwelling proposed for the Stage 3 development site.

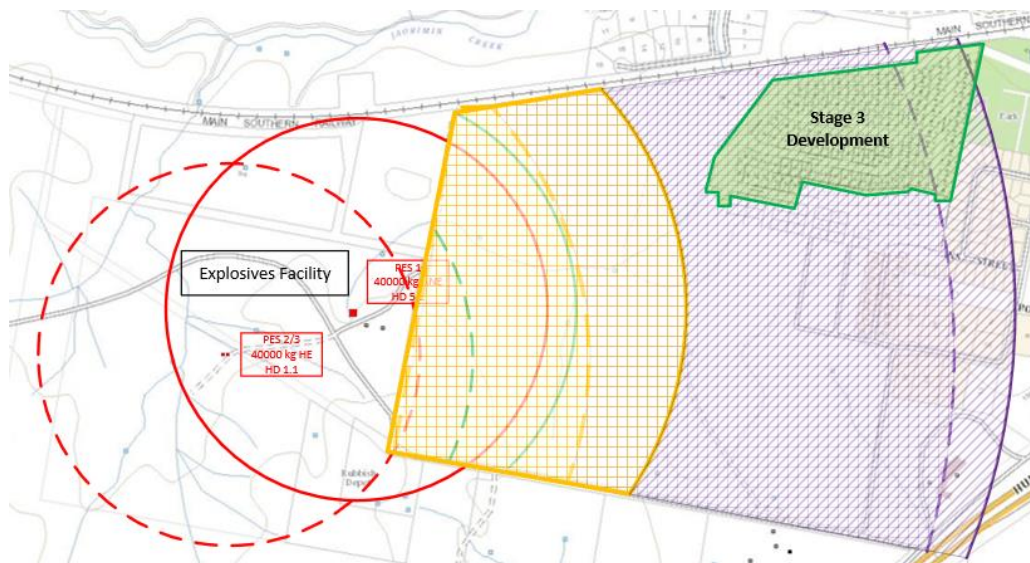
Determination of Safeguard Lines

10. Safeguard¹ lines are provided for the three categories of outside quantity distances (OQD) i.e., distances from PES to ES necessary for the protection of property and persons at ES outside the explosives facility property. These categories are:

- a. Protected Works Class A (PW A): Roads, open areas, sports grounds and open place of work where people may assemble. (Number of persons usually low and infrequent)
- b. Protected Works Class B (PW B): Dwelling house or other building (trade or business) where persons may assemble plus infrastructure like dams, major sub stations and major flammable storages.(Persons frequently present and inside buildings or minor infrastructure)
- c. Vulnerable Facilities (VF). a category of facility that includes, high population buildings, schools, major terminals major utilities. (Number of persons high, frequent and inside buildings)

11. The maps in this report use three colour lines to indicate the tolerable risk criteria for PW A (Green), PW B (Yellow)and VF (Purple). These lines drawn from a PES show the effect at the line for overpressure and to a lesser extent projection hazard. The tables in the code and standard assume that the magazine will detonate (probability of 1) with the maximum amount of explosives allowed to be stored and that the explosion is complete. This is a very conservative approach befitting a hazardous good. The descriptors for each of the safeguard lines are detailed in Annex D.

12. The safeguard map below shows that the driver for the greatest distance from a PES is ANE (solid lines). Subsequently safeguard lines are not necessary to be shown for HE as the HE safeguard lines are within the area of the ANE safeguard lines. PES 1 storing ANE is the most significant driver of the safeguard lines as it is equivalent to 30000 kg of HE and closer to the development lot than the HE at PES 2/3.



Map 5 – Summary Safeguard indicating yellow hatch for no dwellings and purple hatch for no vulnerable facilities

Conclusions

13. The ammonium nitrate storage (PES 1) does not impact on the proposed Stage 3 development proposal. An examination of the map indicates all of the Stage 3 lots are not inside the yellow shaded

¹ Safeguard does not imply absolute safety rather it is a measure where the risk is regarded by the regulator as being tolerable or acceptable.

area which is an area where the risk is considered unacceptable. All the proposed lots are beyond the code requirements for PW B/inhabited buildings. In fact, there is additional distance available which would lower the risk.

14. Regarding impact on the Stage 3 development:

a. Stage 3 is not impacted with any PWA /PTRD or PWB/IBD line.

b. Stage 3 is impacted by the VF line. The developer has advised there will be no VF in the proposed development therefore there is no impact .

15. Explosives facility and the proposed Stage 3 development are considered compatible as all proposed lots are outside the PW B/inhabited building distance.

16. The HE PES impacts nearly all of the Stage 3 development lots for the VF category but to a lightly lesser extent to the ANE PES VF arc. There is no issue in this regard as there are no VF in the Stage 3 development to consider.

17. The HE PES has no impact on the lots proposed under the Stage 3 development.

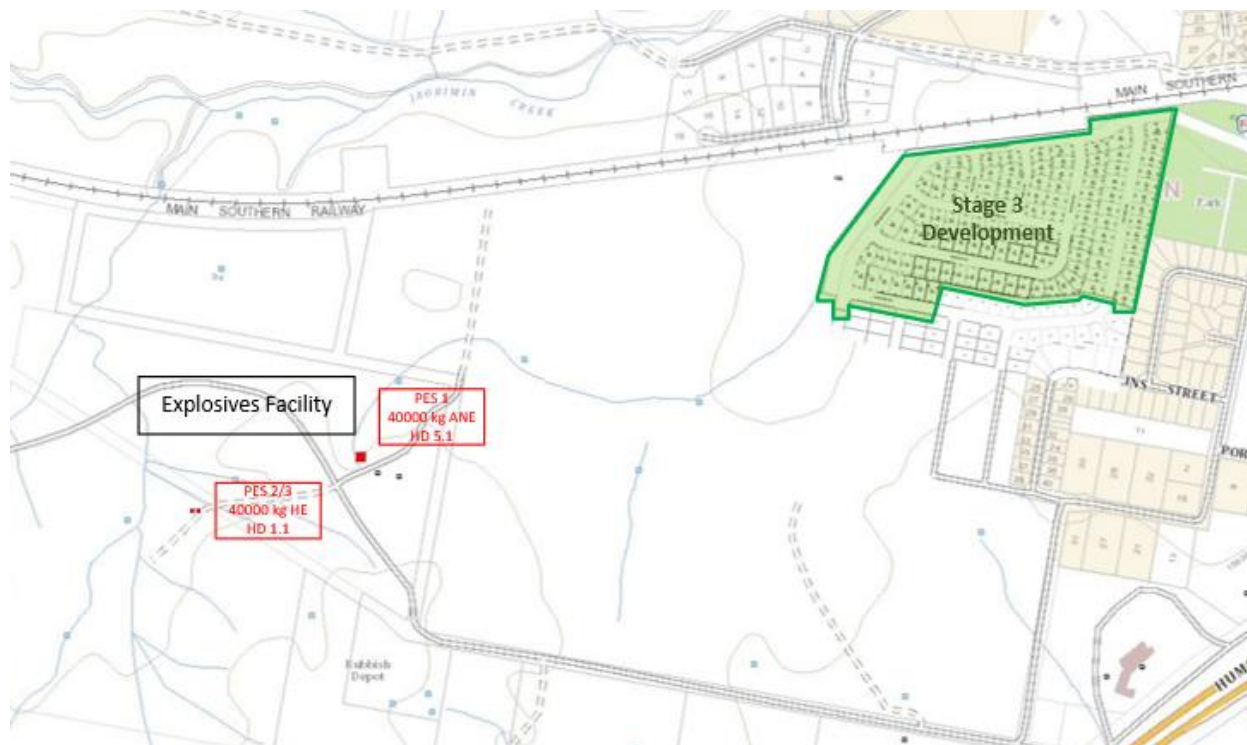
18. The proposed Stage 3 development does not impact the explosives operator as there are adequate OQD as laid down in the code and the standard. There is an ongoing obligation for the explosives operator to ensure that adequate safety distances as stipulated in the code and standard are maintained.

19. The construction of dwellings in the zoned area appears consistent with the town planning scheme (Willowtree Report)

Main Report

Background

1. Darraby Pty Ltd (the developer) is proposing to develop Stage 3 lots within Lot 23 DP 1256090 and Lot 2 DP1136538 zoned R1 General Residential zone under Goulburn Mulwarree Local Environmental Plan 2009, NSW for residential housing. The lot is located east of an Explosives Facility operated by Orica Pty Ltd (the operator). The intention of the proposed Stage 3 development is to provide residential lots for dwellings.



Map 1 – SIXMAPS view of proposed Stage 3 development and Explosives Facility

2. The operator has several storages of energetic material including ammonium nitrate emulsion and high explosives.
3. The developer has provided energetic material² amounts to be used for this report and the local operator has confirmed with the developer they will not supply details of the explosives licence but did confirm 40000kg of ammonium nitrate emulsion in a silo and 40000kg of high explosive primers/boosters in two magazines. A Government Information Public Access (GIPA) request by the developer to Goulburn Council to obtain explosives licences for the explosives operation has gone unanswered.
4. A Goulburn Post article from May 2002 indicated that the site would have 40000kg of mixture known as emulsion phase (ANE) and high explosives (HE). This is consistent with the verbal advice in regard to ANE and HE which is more recent. That article also mentioned ammonium nitrate prill (ANP) and detonators. Both are unlikely to present a greater risk than the two energetic materials advised recently.

² Energetic materials cover HD Class 1 explosives and other energetic materials not in Class 1 e.g. Ammonium Nitrate Class 5.1 but has explosives properties under some conditions.

5. Several assumptions have been made to provide a report without the key data of the operator's licence. In this regard the report provides a reasonable estimate of the impact of the identified energetic materials at the operators site on the proposed Stage 3 residential development.

Report Objective

6. The objective of this report is to demonstrate the impacts of the existing Orica explosives facility on the proposed Stage 3 residential development.

Scope of the report

7. This report is to address the following matters:

- Identify limitations and assumptions in this report.
- Determine regulatory requirements for the advised energetic material on the explosives facility.
- Identify explosives storages, manufacturing and park up (Potential Explosives Sites PES) in terms of location, explosives type and net explosives quantity (NEQ) to support calculation of relevant safety distances.³
- Identify ES on the development site.
- Establish required explosives safety distances to exposed sites in the proposed Stage 3 development
- The explosives safety distances will be provided for the categories Protected Works A (PW A), Protected Works B (PW B) and Vulnerable facilities (VF) for the two categories of energetic material and clearly indicated on a map. An explanation of the category and the relevant risk will be provided in the risk study.
- The study will only consider the two energetic materials provided by the developer.
- Provide maps, schematics and tables to support the explosives report.

Limitations and Assumptions

8. All analysis has inherent limitations due to the quality of the data. This report is no exception. The identified limitations are:

- a. A full current survey map has not been used. Google Earth Pro and Six Map have been used as a basis for the report. The mapping used is approximate and the PES sites are best estimates.
- b. A site visit was not conducted at either the explosives facility or the development site.
- c. The exact location, nature of potential explosive site(PES) and the exact type and quantities of energetic material were not available for analysis.
- d. The Exposed Sites (ES) to the Orica explosives facility are the multiple dwellings being built across the Stage 3 development site. (See Annex A that shows the density of lots for the proposed Stage 3 Development.)
- e. The numbers of exposed personnel in dwellings are not known. The Stage 3 development will include 111 lots. The total number of people on the Stage 3 developed site will be significant.
- f. It is assumed that the explosives (HE) and precursor (ANE)(energetic materials) locations are as indicated on Map 2 showing PES.

³ A copy of the licence has not been obtained; the developer has provided figures to use for the report regarded as worst case.

- g. The two buildings PES 2 and 3 holding boosters are treated as a single PES due to their proximity which would not meet Internal Quantity Distances from AS 2187 Storage Use and Transport of Explosives (referred to as the standard).
- h. It is assumed that there are no issues with the internal separation distances (IQD) for storages of ANE and HE and the amounts provided can be treated individually so that an explosive event in one site would not communicate to another site.
- i. It is assumed there is no manufacturing taking place on the operators site.
- j. There is no advice of other dangerous goods on the operator site that would impact the development area.

9. To cater for these limitations criteria used have been chosen to ensure a more conservative outcome e.g., minor additions to mapped safety distances. Note: detailed planning and construction should not take place from the drawings provided in this report. The distances in the table are suitable for consideration of planning but not construction as the finer details of energetic products and locations are not available.

Legislation and References

10. The legislation and references used in this report are listed in Annex B. An explosives licence would be required by the operator for the explosives facility. That Explosives License issued by Safework NSW is required to meet the requirements of the Explosives Act 2003 as of 14 December 2022, and Explosive Regulation 2013 as of 22 October 2022. The operator has decided not to supply a copy of the licence to the developer.

11. Conformance to legislation or a code or a standard in the legislation is regarded as achieving tolerable risk. An operator is required to be compliant with the legislation.

Basis of the review

12. This report is based on the advice from the developer that there are two large energetic storages containing ammonium nitrate emulsion and high explosives. The specific regulatory requirements for each product will be used to determine the required compliance. The regulations indicate that compliance with the legislation and associated codes and standards is regarded as meeting tolerable risk requirements. An ES not within compliance is regarded as having an intolerable risk.

13. The codes and standards specify separation distances for specific quantities of energetic materials in certain constructions (PES) to achieve a tolerable amount of risk at the relevant ES. In an explosives event a blast wave and projections (debris) will travel from the PES to an ES. The safe distance provided in the code and standards is not absolute but provides tolerable protection from blasts and projections if the ES is at the distance or further specified in the relevant code or standard.

14. It is important to note that the code and standards assume that an event will occur (probability of 1), the magazine or storage to full to the licence limit and the explosion is complete. These explosions are unlikely in the context of well-regulated Australian explosives operations. But the events though low risk would be high consequence. Hence the need for appropriate distances to be in place in the unlikely event of a mass explosion.

15. The use of the tables is designed to place ES at an appropriate distance such that deaths, injuries and property damage are at a tolerable level of risk. In this regard the categories of ES are broadly described as public roads (PW A), dwellings/inhabited buildings (PW B) and vulnerable facilities (VF) such as hospitals.

16. The distances required for each of the energetic materials will be used to demonstrate the impact on the development site by safeguard maps for each product. The development comes into the category of dwellings under Protective Works Class B (PW B) or inhabited building distance (IBD). Comments will be made in the report about consideration of requiring extra protection due to the density of the dwellings and number of exposed persons that could be affected in the unlikely event of a mass explosion.

Potential Explosives Sites

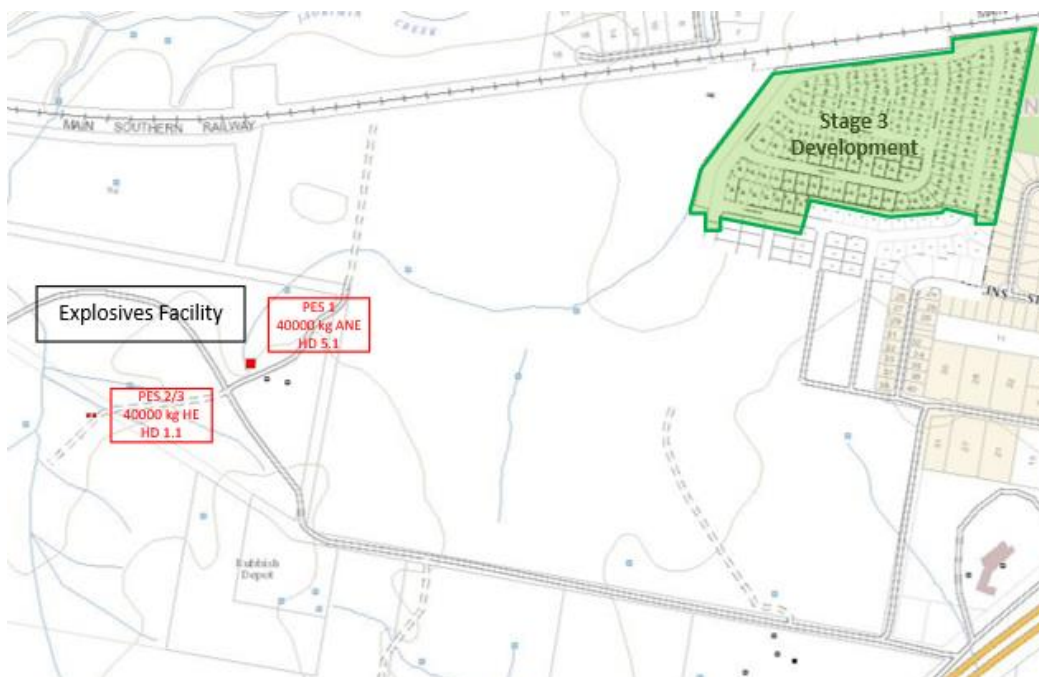
17. The developer has requested that the report be based on the following table which is regarded as the most accurate information available (supplied by the local operations manager of the facility). (Email dated 11 Sep 2023 from Darraby Pty Ltd and subsequent teleconference of 28 Sep 2023 between the developer and the contractor).

PES No	Item	UN Number	HD	Qty kg
PES 1	Ammonium Nitrate Emulsion Storage in silo)	3375	5.1	40000
PES 2 & 3	High Explosives (Boosters Magazines)	1942	1.1	40000

Table 1 – Energetic materials to be analysed

Identify potential explosives sites (Silo and magazine)

18. The identified potential explosives sites with ANE and high explosives are shown on MAP 2 at PES 1 and PES2/3 respectively. These storage locations will be used in this report.



Map 2 – Indicative map showing PES and Developmental Area

19. The two explosives magazines, said to be holding the high explosives boosters, are located close to each other. The distance is not adequate to meet the relevant Internal Quantity Distance from the standard and are treated as a single PES holding 40000kg HE.⁴

⁴ This amount appears high for a typical operation but represents worst case.

20. There were no instances of explosives accidents at the explosives facility found in a search of relevant databases, newspaper information and the internet.

Exposed Sites (ES)

21. There are many exposed sites outside the operators facility which include public roads, a railway line, dwellings and other facilities such as a waste facility. In this report it is not necessary to consider anything other than the impacts of the explosives operations on the proposed Stage 3 development. lot.

Regulatory Requirements

22. The report is based on the current Safework NSW regulatory requirements in relation to the ammonium nitrate emulsion and high explosives advised to be held on the site.

23. The operator is licensed by Safework NSW for the explosives operations to be conducted on site. However, this is not visible to the author. The report will only focus on the two energetic materials (ANE and HE) advised by the developer in Table 1 above. While there may be ANP on site it would be located near the ANE and has a lesser effect than ANE. The site might also have detonators but the impact from detonators compared to HE is negligible. So, in fact the report addresses the two most energetic materials advised on the site i.e., worst case in the event of an explosives event occurring.

24. The ES affected on the Stage 3 development development lot will be dwellings. Therefore, the relevant category to consider is Protected Works (B), which covers dwellings/inhabited buildings. To be regarded as tolerable risk the dwellings should be at the minimum PW (B) distance or IBD for the quantity of explosive/precursor from the table in the code or standard.

25. The density of the dwellings is such that a reasonable larger number of persons are exposed to explosives risk. The regulator and planning authorities may wish to consider a higher level of protection by ensuring the distance from a PES is at a minimum of 400m. This is more conservative and in the unlikely event of an explosion would present a lower risk to dwelling occupants. It transpires that the required distance for the NEQ PW B distance in the table is greater than this 400m (690m for ANE and 760m for HE) so this extra protection is in place.

Establish regulatory safeguarding lines from the operator to the development area

26. In determining an acceptable level of risk, the legislation requires safety distances from PES that are required to give exposed sites a tolerable/acceptable level of risk. There are two broad categories of safety distances. These are referred to as Internal Quantity Distances (IQD) and Outside Quantity distances (OQD).

27. As IQD have been assumed to be adequate the report will focus on the OQD which will affect the Stage 3 development site from the impact of the ANE and the high explosives making two assessments in total. For the two HE magazines they are treated as a single PES as their separation distances does not appear to meet IQD. There is a possibility that PES 2/3 is for detonators with very small NEQ and that the HE boosters (40000kg or less) are stored further to the southwest. If this is the case the impact would be marginally less on the Stage 3 development block

Use of Safeguard Lines to indicate tolerable risk from PES to relevant ES type

28. The maps in this report use three colour lines to indicate the acceptable risk criteria for PW A (Green), PW B (Yellow) and VF (Purple). These lines drawn from a PES show the effect at the line for overpressure and to a lesser extent projection hazard. The tables assume that the magazine will

detonate (probability of 1) with the maximum amount of explosives allowed to be stored and that the explosion is complete. This is a conservative approach befitting a hazardous good. The descriptors provided for each of the distances for the lines are the worst case. The descriptors for each line are detailed in Annex D. These descriptors are useful in assessing the type of building and standards used around explosives areas.

29. The summary is that there are unlikely to be serious injuries or death and no significant property damage at the relevant line if the exposed areas conform to the standard. This is because the distances nominated in the standard and codes provide sufficient distance to mitigate the effects of blast and projection hazards.

30. These lines ensure the adequate distance and hence protection is always in place and evacuation is not essential. There is no warning for HE events and while ANE incidents usually take some 30-45 minutes to explode. The ability to evacuate large residential areas is not feasible so distance protection is critical in the event of an explosion.

Inside Quantity Distances (IQD)

31. IQD are used to provide a safe distance between sites (buildings, magazines, process buildings) inside a facility that have explosives activities at PES and ES. If the safe distance as illustrated in the tables from AS 2178 are in place then an explosion in one site will not cause the other site to explode. If a PES has less than the table distance to another PES, it is likely to explode – in this instance the total amount of explosives in the two sites would be considered as a single site. This has been adopted for the two magazines containing HE boosters.

Outside Quantity Distances OQD

32. OQD are related to the protection of persons and property outside the explosives area. The distances required for OQD are therefore more stringent than the IQD distances. The OQD are considered in three categories as follows:

- a. *Protected Works Class A (PW A) Public Traffic route distance*: Roads, open areas sports grounds open place of work where people may assemble. (Number of persons usually low and infrequent)
- b. *Protected Works Class B (PW B) Inhabited Building Distance*: Dwelling house or other building (trade or business) where persons may assemble plus dams major flammable storages. (Persons frequently present and inside buildings)
- c. *Vulnerable Facilities (VF)*. a category of facility that includes, high population buildings, schools, major terminals major utilities. (Number of persons high and frequent and inside buildings)

33. In this report the proposed Stage 3 development for dwellings is categorized as PW B or inhabited building distance. The dwellings should not be inside the safeguarding distance PW B (yellow line) prescribed for a PES.

ANE

34. ANE PES is up to 40000kg of HD 5.1 Ammonium Nitrate Emulsion UN 3375. The regulatory requirement for ANE is based on a general condition of licence issued by the NSW regulator in 2014. The general condition 85 (shown below) calls up the Australian Explosives Industry Safety Group (AEISG) Code of Practice STORAGE AND HANDLING OF UN3375 Edition 4 May 2017 (referred to as the code)

Condition 85: AEISG Code of Practice for ANEs

It is a condition of licence to store that a person storing explosive precursors must comply with the AEISG Code of Practice for Ammonium nitrate emulsions, suspensions or gels – ANEs (UN3375).

This condition does not commence until 1 March 2014.

35. ANE and ANP both require significant shock, sustained fire, or contamination (or combinations thereof) to explode. ANE explosives events in storage have a low likelihood however if an explosion does occur it can have catastrophic results (a low risk - high consequence event). A safe distance from a PES containing ANE enables tolerable risk to be achieved. The code stipulates safety distances based on PW B that indicates at the line there is exposure to five kilopascals (5 kPa) and there would be some projection hazard but tolerable if greater than 400m from the PES.

With warning or No warning Event

36. Warning and Without Warning Scenario. The code for ANE includes a concept of “with warning” events or “without warning” events. It is considered that if exposed sites within the perceived explosives hazardous area can be evacuated than that would be acceptable. This usually only applies where the people involved are under the direct control of the facility operator. Dwellings would not normally be considered in such evacuation plans.

37. Therefore, the calculations are based on a “Without Warning Scenario”. That is, there is no ability to effectively evacuate a residential area and greater distances are applied to achieve a tolerable level of risk to the dwelling occupants. PES 1, the ANE storage site is designated a “No Warning Site”. ANE is regarded in the code as having a 75% equivalence to high explosives so that the amount is reduced to 75% before checking the distance in the code. The following table gives the OQD distances for PW (A), PW (B) and vulnerable facilities for the 40000kg storage of ANE HD 5.1. The distance is measured from the corner of the PES nearest to the ES. Note: This level of accuracy is not available for this report as size of silo precise location into known.

OQD	Site ID	Type	NEQ
	PES 1 ANE	3375	40000kg@75% ⁵
	VF Site	VF	1380m
	PWB Site	PWB	690m
	PWA Site	PWA	460m

Table 2 – OQD Distances for 40000kg ANE No warning

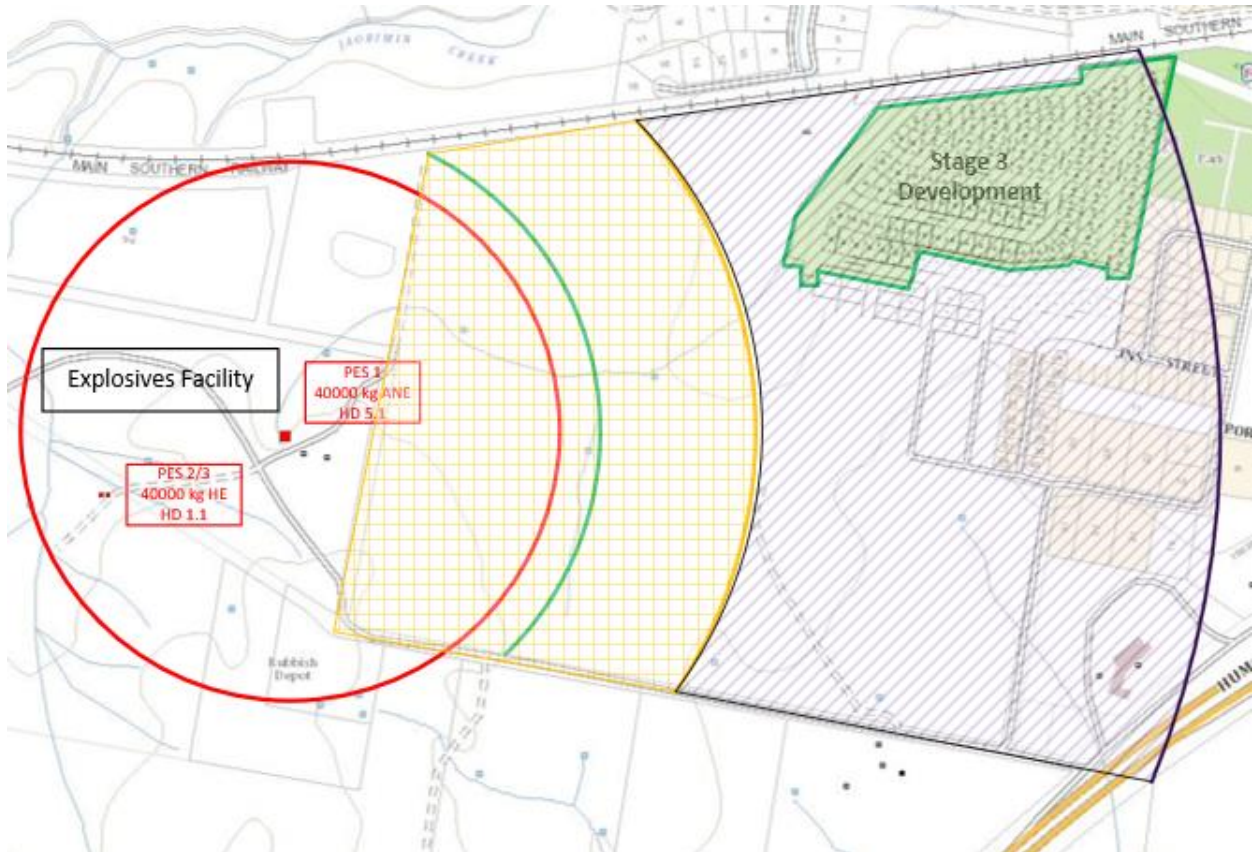
Safeguard Map for ANE

38. The safeguard distances for ANE are drawn from the code and shown on MAP 3 below. The PW B yellow line should not have dwellings inside as they would not be compliant with the code. The hatched yellow area is not suitable for dwellings. None of the Stage 3 development lots are inside the yellow line and therefore the distance is compliant.

39. It should be noted that the explosives facility was established in 2002 when the current code was not called up as a condition of licence. At that time this site would have required a lesser distance. This may be evident on the original licence issued by Safework NSW.

40. The fact that the lot was devoid of dwellings meant that Orica were able to meet their duty of care as nobody was exposed to the risk of an explosion.

⁵ The equivalency factor used in the code is 75%



Map 3 – Indicating the Safeguard lines for ANE and yellow hatch area not for dwellings, purple hatch not for vulnerable facilities Red line is 400m min to protect against projections for significant person exposure.

Impact on development site ES from ANE PES

41. The impacts on the proposed development site are:
 - a. None of the Stage 3 development lots are in the yellow hatch area (no dwellings/inhabited buildings).
 - b. Nearly all the proposed Stage 3 lots are in the vulnerable facility zone. As the advice is that no VF are proposed for the zone it is of no consequence.
 - c. The green PW A line (also called the public transport route distance PTRD) does not affect any of the Stage 3 development.

HE

42. HE storage appears to be in two magazines with a total of 40000kg HD 1.1. The regulatory requirement for Class 1 explosives is AS 2187 Explosives – Storage, Transport and Use 1998 (referred to as the standard). This is called up in the Explosives Regulation NSW reg 65 shown below:

65 Duty to comply with certain standards or codes

A person who carries out an activity to which any of the following standards or codes applies must ensure the activity is carried out in compliance with that standard or code—

- (a) in relation to explosives—
 - (i) AS 2187, and
 - (ii) the Australian Explosives Code,

- (b) in relation to explosive precursors—
 - (i) the ADG Code, and
 - (ii) the Australian Standard AS 4326 *The storage and handling of oxidizing agents*, as in force from time to time.
- Maximum penalty—250 penalty units.

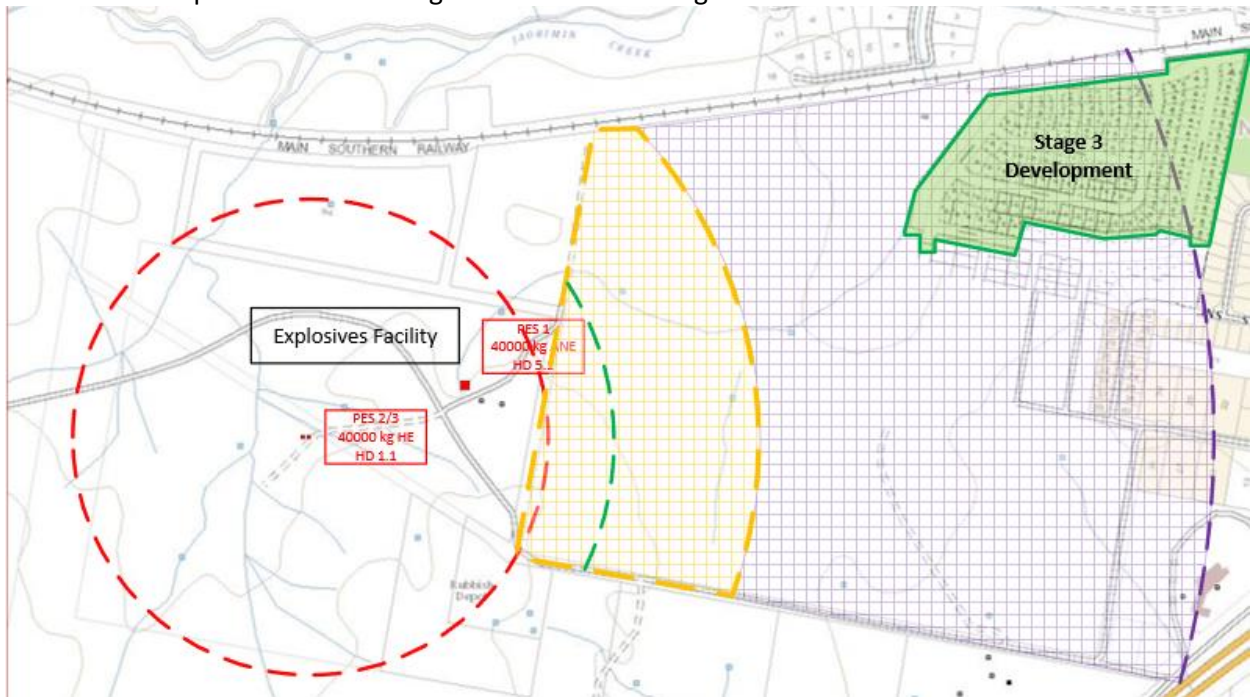
43. The following table gives the OQD distances from AS 2187 for 40000kg storage of HE HD 1.1.

OQD	Site ID	Type	NEQ
	PES 2/3 HE	0042	40000kg
	VF Site	VF	1520m
	PWB Site	PWB	760m
	PWA Site	PWA	510m

Table 3 – OQD Distances for 40000kg HE

Safeguard Map for HE

44. This map indicates the safeguard lines for 40000kg HE.



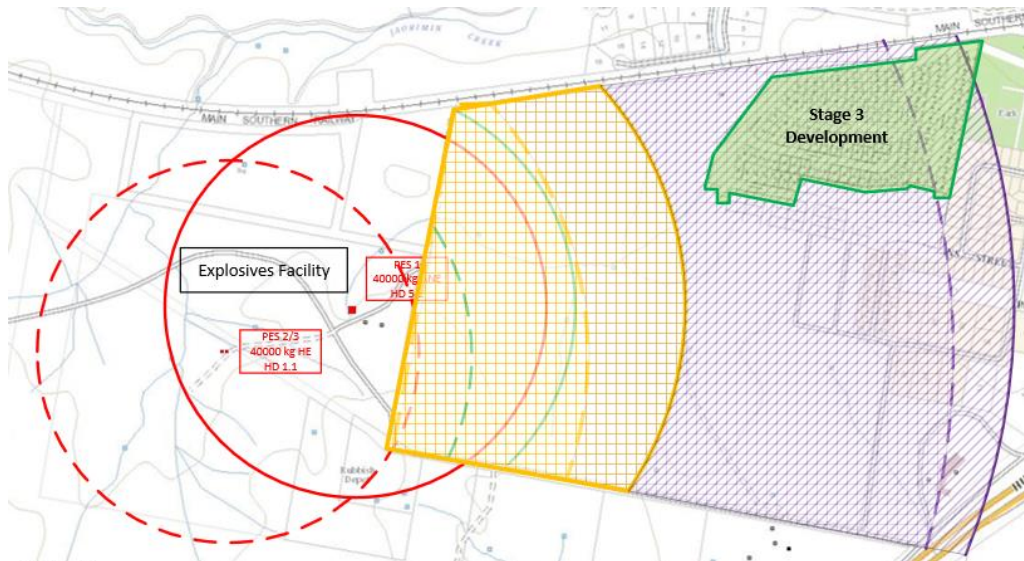
Map 4 – Indicating the Safeguard lines for HE with PW B intolerable zone and VF intolerable zone over development site

Impact on development site ES from HE Site PES 2/3.

45. The impacts on the proposed Stage 3 development site are:
- a. None of the Stage 3 development lots are in the yellow hatch area (no dwellings/inhabited buildings).
 - b. Nearly all the proposed Stage 3 lots are in the vulnerable facility zone. As the advice is that no VF are proposed for the zone it is of no consequence.
 - c. The green PW A line (also called the public transport route distance PTRD) does not affect any of the Stage 3 development.
 - d. The HE impact is less than ANE due to the HE PES being located further west.

Combined Safeguard Map for Explosives Facility

46. Usually safeguard maps for PES are combined but in this instance the ANE safeguard map is the main driver and all safeguard lines for HE are contained in the ANE safeguard lines in relation to the proposed Stage 3 development.



Map 5 – Summary Safeguard indicating yellow hatch for no dwellings and purple hatch for no vulnerable facilities. Red line 400m minimum to minimise debris to the development

Impact Summary of PES

47. All stages of the Stage 3 development are impacted by the VF purple line which indicates that no VF should be placed on the development area.
48. The Stage 3 development is outside the required safety distances for PW B / inhabited buildings.
49. The explosives operator is not affected by the Stage 3 development proposal.

Conclusions

50. The ANE PES has no impact on the proposed development.
51. The HE PES has no impact on the proposed development.
52. As the Stage 3 development is outside the required safety distances the development has no impact on the explosives operator.
53. The construction of dwellings in the zoned area appears consistent with the town planning scheme (Willowtree Report)

Annexes

Annex A – Proposed Development Outline

Annex B – Legislation standards and codes

Annex C – Assumed energetic materials.

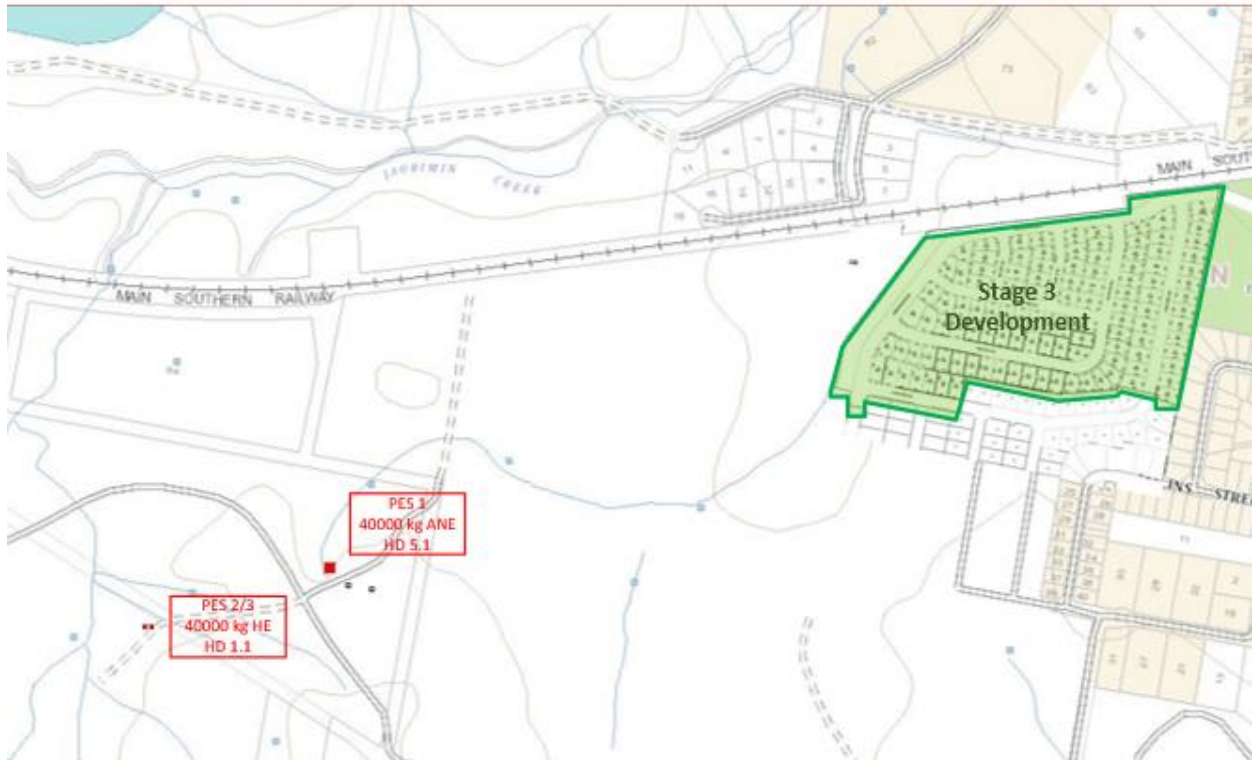
Annex D – Description of Safeguarding Lines

Annex E – Master Map showing all relevant distances with legend.

Annex A Proposed Lot for Development

Further preliminary Planning Data (provided by Darraby Pty Ltd 2023)

Darraby Pty Ltd advised that the Stage 3 development proposal is as detailed in the map below.



This indicates that the number of dwellings (125) proposed in the area may be significant. This increases the number of persons exposed in the event of an explosion. This will be considered in the report.

Annex B - Legislation, Standards and codes to be met

1. The Explosives License issued by Safework NSW is required to meet the requirements of the Explosives Act 2003 as of 14 December 2022, and Explosive Regulation 2013 As of 26 October 2022. The specific requirements for this report are highlighted. The Act and Regulation refer to the following:
 - Australian Standard AS 2187 Explosives storage, transport and use.
 - Australian Standard AS 4326 The storage and handling of oxidizing agents.
 - Australian Standard AS 4145 Locksets and hardware for doors and windows.
 - Australian code for the transport of explosives by road and rail (Australian Explosives Code).
 - Australian code for the transport of dangerous goods by road and rail (Australian Dangerous Goods Code).
 - SafeWork NSW – General explosive licence and security clearance conditions under the NSW Explosives Act and Regulation. This calls up the AEISG Code of Practice STORAGE AND HANDLING OF UN3375 _introduced in 2014
 - SafeWork NSW – Guide for secure and safe handling of explosives and security sensitive dangerous substances (catalogue no. SW08441).
 - Separation Distances for Solid Ammonium Nitrate in NSW Discussion Paper – October 2022.
Note that Safework NSW is proposing to implement mandatory safety distances for the storage of ammonium nitrate, a legislated security sensitive dangerous substance.

ANNEX C -ASSUMED ENERGETIC MATERIALS
TO REPORT
DATED 5 DEC 2023

Annex C – Assumed quantities and locations for energetic materials on Orica site

PES No	Item	UN Number	HD	Qty kg
PES 1	Ammonium Nitrate Emulsion Storage	3375	5.1	40000
PES 2 & 3	High Explosives in Boosters Magazines	1942	1.1	40000

Table 1 PES of Explosives at two locations only

The PES are shown on the maps in this report.

The ANE analysis is based on the code.

The HE analysis is based on the standard

Resulting Table of Distances

OQD			PES 2&3 HE	PES 1 ANE 3375
			Reqd Dist	Reqd Dist
	Site ID / NEQ	Type	40000	40000
	VF Site	VF	1520	1380
	PWB Site	PWB	760	690
	PWA Site	PWA	510	460

Annex D – Descriptors for Safeguarding Lines (informative)

1. This annex describes the safeguarding lines used on the maps of this report. The purpose of the lines is to show the extent where the PW A, PW B and VF should apply. These distances are based on worst case. There have been no significant storage explosions in Australia. The tables assume a probability of 1, that the store is at maximum capacity and all the explosives detonates at full strength. The likelihood of all of these occurring is quite remote and indicate that the tables are conservative risk values.
2. The basis for these distance calculations is based on the effects of overpressure and to a lesser extent projections from a known amount of high explosives. These tables have been calculated on formulas, experience from both deliberate instrumented explosions and unplanned explosives events. Significant analysis internationally to verify the outcomes from an explosion. The tables are conservative estimates,
3. The projections are an approximation in relation to the tables that also include certain minima where persons are likely to be exposed in PW B and VF situations. The lines are described in the following paragraphs and include likely effects of personal injury and building damage.⁶
4. A description follows for each of the lines:
 - a. Green Line (PW A) Public traffic route, open areas). Areas outside the green line are regarded as acceptable risk for those places described in the definition of PW A. In the unlikely event of an explosion occurring the physical effects at that distance are:
 - i. The expected overpressure in the vicinity of the green line is 9 kPa.
 - ii. Personal Injury
 - (1) Temporary loss of hearing.
 - (2) Possible skin laceration by missiles and small glass fragments.
 - (3) Low risk if inside a resistant structure.
 - iii. Expected Building Damage at 9 kPa (note: dwellings not in this area!)
 - (1) Up to 99% of exposed glass panes will break.
 - (2) Partial demolition of house – rendered inhabitable.
 - b. Yellow Line (PW B) Dwellings and Occupied Buildings Areas outside the yellow line are regarded as acceptable risk for those places described in the definition of PW A. This assumes an explosion will occur and at the distance from the PW B table the results would be acceptable. If a person or dwelling is outside the yellow line it is regarded as an acceptable risk. In the unlikely event of an explosion occurring the physical effects at that distance are:
 - i. The expected overpressure in the vicinity of the yellow line is 5 kPa.
 - ii. Projections hazard will occur but at the distance from the table the effect of projections is diminishing. (especially if greater than 400m)
 - iii. Personal Injury at 5kPa could include:
 - (1) Wounds from glass fragments
 - (2) Temporary loss of hearing

⁶ Information drawn from Defence Publication e DEOP 101 Regulation 5.4 Appendix 4 to Annex A.

- iv. Expected Building Damage at 5 kPa
 - (1) Up to 90% of exposed glass panes will break.
 - (2) House roof tiles displaced.
 - (3) Limited minor structural damage.
 - c. Purple Line (VF) Vulnerable facilities such as hospitals, schools, large glassed buildings – all with persons. Areas outside the purple line are regarded as acceptable risk for those places described in the definition of VF. In the unlikely event of an explosion occurring the physical effects at that distance are:
 - i. The expected overpressure in the vicinity of the purple line is 2 kPa.
 - ii. Projections hazard will occur but at the distance the effect of projections is negligible.
 - iii. Personal Injury
 - (1) Threshold for temporary loss of hearing.
 - (2) Injury of any kind unlikely.
 - iv. Expected Building Damage at 2 kPa.
 - (1) Up to 75% of exposed glass will break.
5. The summary is that there are unlikely to be serious injuries or death and no significant property damage if the standard is followed. This is because the distances nominated in the standard and codes provide sufficient distance to mitigate the effects of blast and projection hazards. This assumes that an explosives event will occur (unrealistic probability of 1), the maximum allowable amount of explosives is in the PES and that all the explosives will detonate.

Annex E ALL Layer Reference Map

CALCULATION OF IMPACT OF AN EXPLOSIVES EVENT ON STAGE 3
 DEVELOPMENT AREA FROM EXPLOSIVES FACILITY

