PRELIMINARY HAZARD ANALYSIS
FOR
WINTERGREEN FARM
3329 OXLEY HIGHWAY SOMERTON NSW 2340

Prepared for: Wintergreen Farm
Department of Planning, Housing and Infrastructure
NSW EPA
Tamworth Regional Council

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EXECUTIVE SUMMARY

Benbow Environmental (BE) has been commissioned by Wintergreen Farm to prepare a Preliminary Hazard Analysis (PHA) for the proposed poultry farm expansion located at 3329 Oxley Highway Somerton NSW 2340. Currently, the site accommodates 240,000 birds. The proposed development is seeking to expand operations accommodate 810,510 birds within a total of fourteen (14) sheds.

The proposal would involve the storage of 8 x 7,500 L liquefied petroleum gas (LPG) bulk tanks filled to 80% capacity – 40,000 L stored.

The storage of the LPG tanks would conform to the requirements of AS/NZS 1596:2014 *The storage and handling of LP Gas.*

This PHA has been prepared in accordance with the Multi-Level Risk Assessment and Hazardous Industry Planning Advisory Papers (HIPAPs) guidelines stipulated by the Department of Planning, Housing and Infrastructure (DPHI) NSW. The purpose of the PHA is to assess whether the proposed volume of dangerous goods stored and the operations that occur at the site are offensive or hazardous, thereby posing an unacceptable risk to the surrounding community.

Section 4 of the report has identified and examined a number of potential events/consequence scenarios that could occur on site. The prevention and protection measures designed into the operations of each of the activities associated with each event were listed and discussed in Hazard Identification Charts.

From the Hazard Identification Charts, the hazardous events were deemed as unlikely to occur due to the nature of the operations and the proposed prevention and protection measures designed for the facility.

Given the outcomes of the assessment, the PHA has found that the operation of the proposed development readily meets the criteria laid down in HIPAP No. 4 *Risk Criteria for Land Use Safety Planning* and would not cause any risk, significant or minor, to the community, with the recommended safeguards in place.

Throughout the preparation of this PHA, it has been determined that the proposed development meets all the safety requirements stipulated by DPHI, and compliance with the Work, Health and Safety Regulation, 2017. The development as proposed would not be considered to be an offensive or hazardous development.

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1. INTRODUCTION

Benbow Environmental (BE) has been commissioned by Wintergreen Farm to prepare a Preliminary Hazard Analysis (PHA) for Wintergreen Farm, for the proposed poultry farm expansion of the existing farm located at 3329 Oxley Highway Somerton NSW 2340 (legally designated as Lot 175/DP755340). This document supplements the Environmental Impact Statement for the proposed development.

Currently, the site accommodates 240,000 birds. The proposed development is seeking to expand operations accommodate 810,510 birds within a total of 14 sheds. The proposal would involve the storage of 8 x 7,500 L liquefied petroleum gas (LPG) bulk tanks filled to 80% capacity – 40,000 L stored.

A PHA has been prepared to ensure that all potential hazards and risks from the proposed site are appropriately identified, managed and controlled (if controls are deemed necessary).

The PHA has been prepared in accordance with the documents entitled *"Multi-Level Risk Assessment"*, "*Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning"* (HIPAP No. 4)" and the "*Hazardous Industry Planning Advisory Paper No. 6 – Guideline for Hazard Analysis"* (HIPAP No. 6), all published by the Department of Planning, Housing and Infrastructure.

The study includes the following key aspects of the assessment:

- Assessment of the proposed development with consideration to the provisions of State Environmental Planning Policy (SEPP) (Resilience and Hazards) 2021 – Chapter 3 Hazardous and Offensive Developments and compliance with SafeWork requirements;
- Evaluation of any potential hazards imposed by the proposed site operations on the surrounding environment and communities; and
- Making recommendations on the relevant prevention/protection strategies necessary to minimise the impact and risk of human fatalities, property damage and environmental pollution.

1.1 SITE LOCATION

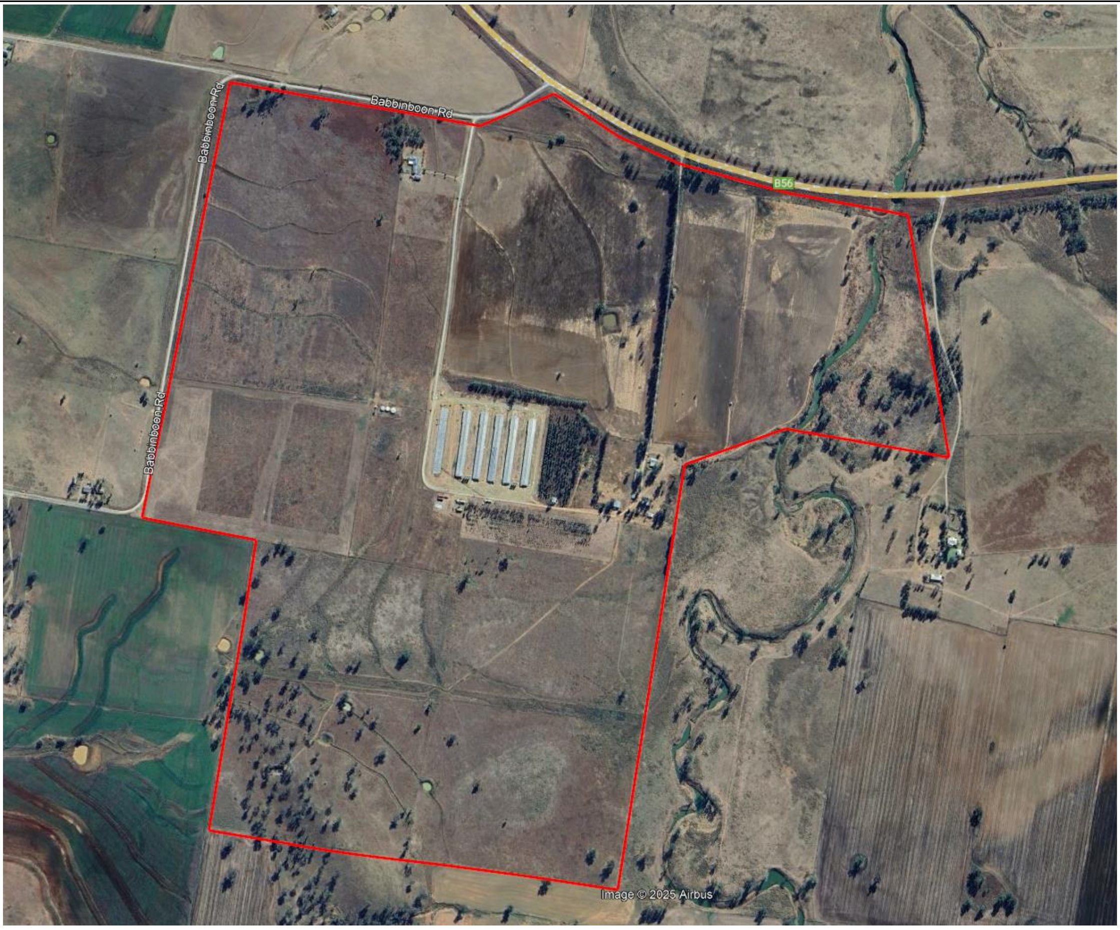
Site identification information and land use is summarised in the table below.

Table 1-1: Site Identification

Lot and DP Numbers (Address)	Lot 175/DP755340
Approximate Site Area	2,150,000 m^2 (215 ha)
Local Government Area	Tamworth Regional Council
Current Land Zoning	RU1 – *Primary Production*

The site location is presented in Figure 1-1 as an aerial photograph of the site displaying the approximate site boundaries.

Figure 1-1: Approximate Site Boundaries



Source: Google Earth 2023

N Not to scale	**LEGEND** Approximate site boundary	Benbow Environmental 27-29 Sherwood Street, Northmead NSW 2152

1.2 SURROUNDING AREA

The small township of Somerton is located approximately 3 km northwest of the site. Besides the town of Somerton zoned as RU5 – *Village*, the development land and the surrounding area are zoned as RU1 – Primary Production. The land use zoning map is presented in Figure 1-2.

Currently, the site accommodates 240,000 birds at any one time. The proposed development is seeking to expand operations to accommodate 810,510 birds at any one time within a total of 14 sheds. Operations are to be established under an 8-week cycle, with an additional 2 weeks of in-between cycle break (9-10 week production cycle).

Figure 1-2: Land Zoning Map

Source: ePlanning Spatial Viewer 2025

↑N Not to scale	**LEGEND** Site boundary RU1 - Primary Production	Benbow Environmental 27-29 Sherwood Street, Northmead NSW 2152

The surrounding area is presented in Figure 1-3 as an aerial photograph of the region displaying the approximate site boundaries.

There are no other known animal agricultural activities in the immediate surrounding activities. Aerial inspection showed that there are three poultry sheds are located to the northwest of the site, approximately 4 km, 5 km and 10 km respectively. Another is located approximately 7 km east of the site.

Figure 1-3: Area Surrounding Site

Source: Google Earth 2025

↑N Not to scale	**LEGEND** Approximate site boundary	Benbow Environmental 27-29 Sherwood Street, Northmead NSW 2152

1.3 Site Layout

The proposed poultry farm expansion will use tunnel ventilation for all 14 sheds. Figure 1-4 shows the orientation of the sheds on the property. The existing sheds have an internal floor area of 2,323 m^2 and the proposed sheds will have an internal floor area of 2,970 m^2.

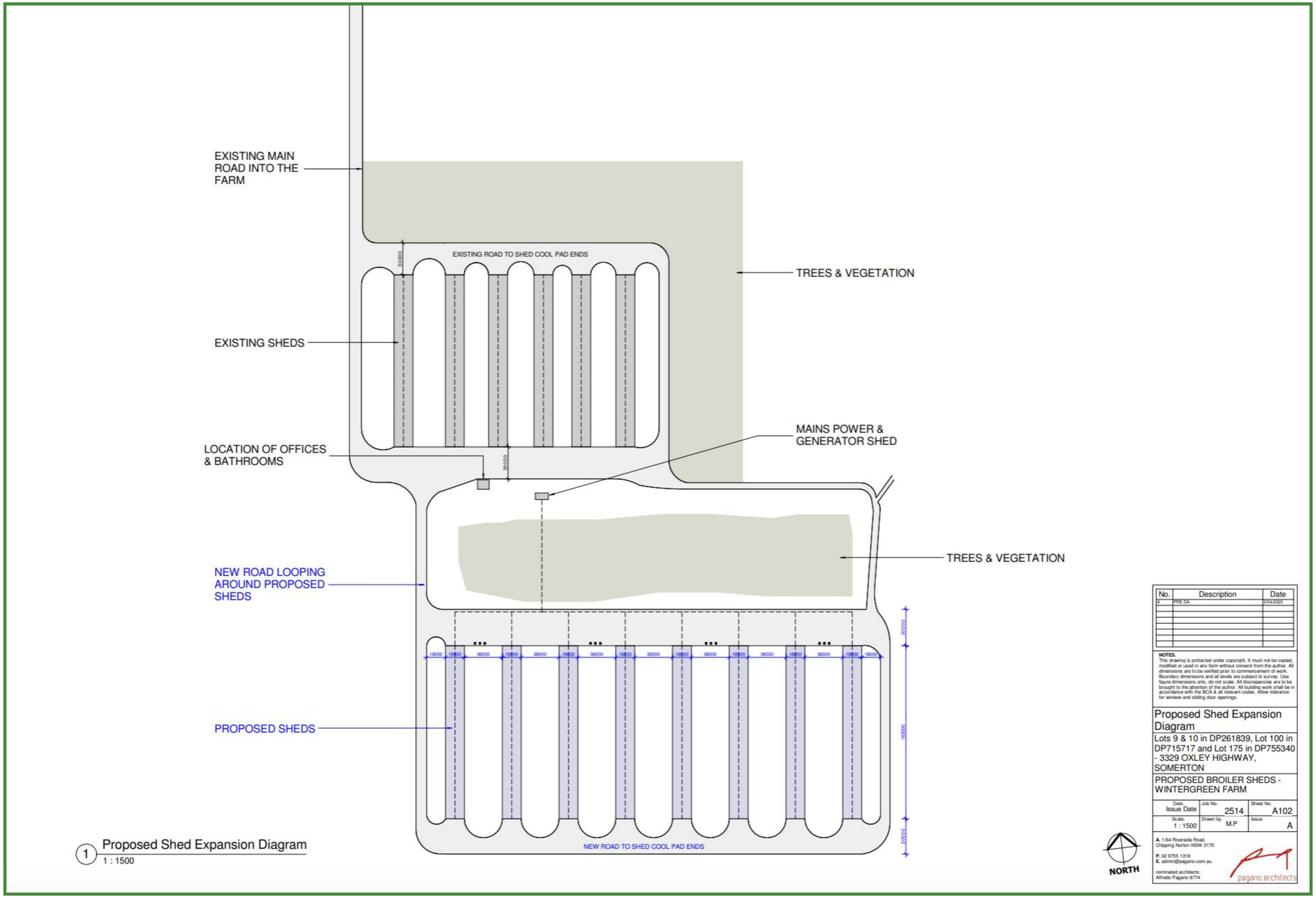
Details of the sheds are provided in Table 1-2.

The farm will house a total of approximately 810,510 birds and will be grown over a cycle period of approximately 8 weeks, plus two weeks of in-between cycle break that includes cleaning activities.

Table 1-2: Shed Details

Sheds	Length (m)	Width (m)	Height (m)	Area (m^2)	No. of Birds / shed
Existing sheds	152	15.28	2.4	2,323	49,945
Proposed 8 sheds	165	18	2.37	2,970	63,855
					810,510 birds

Figure 1-4: Site Plan



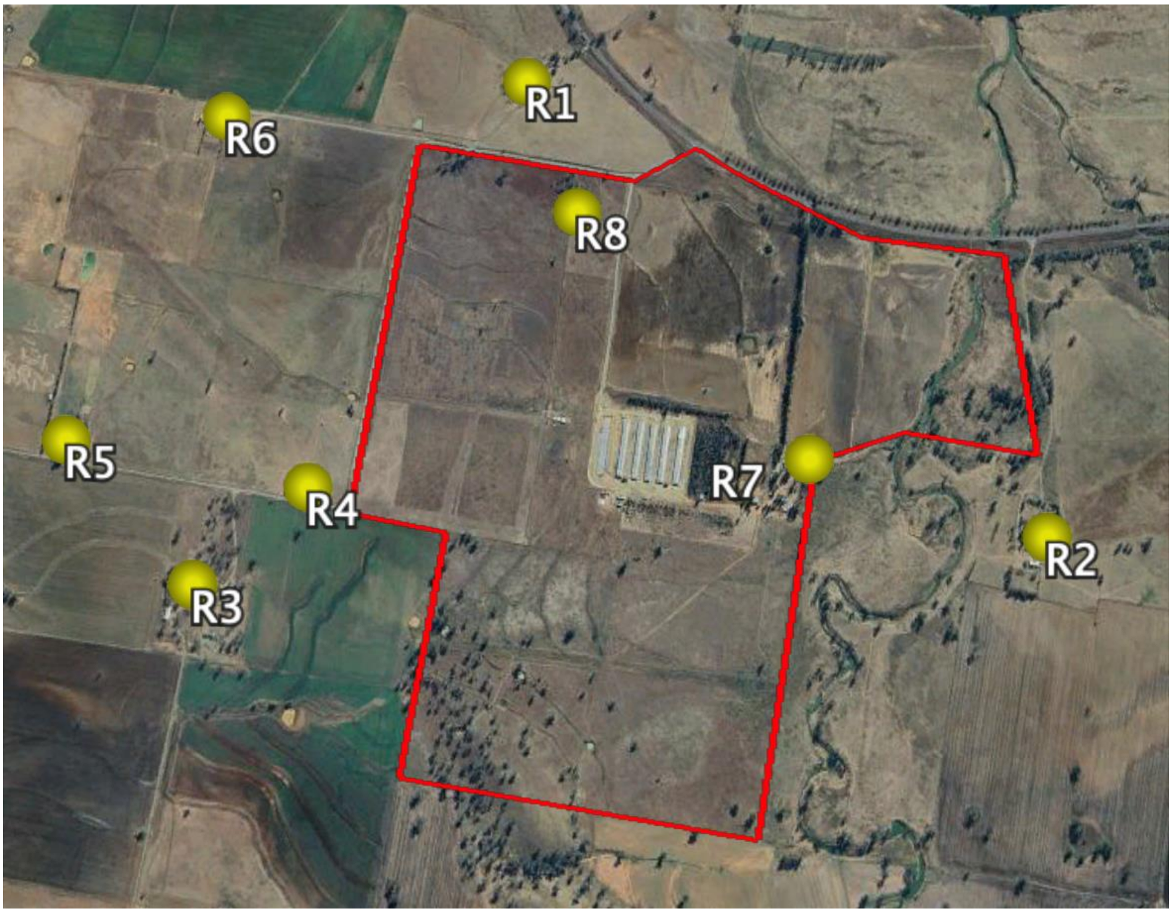
1.4 NEAREST SENSITIVE RECEPTORS

The site is surrounded by rural developments and two caretakers cottages are also located onsite. Table 1-3 identifies the nearest sensitive receptors that have the potential to be affected by the proposal. The aerial photographs of the sensitive receivers are shown in Figure 1-5. These receptors were selected based on their proximity and directional bearing from the subject site.

Table 1-3: Nearest Sensitive Receptors

Receptor ID	Address	Lot & DP	Approximate Distance and Direction from Nearest Shed	Receptor Type
R1	Oxley Highway, Somerton	Lot 173/ DP657385	950 m N	Rural-Residential
R2	3269 Oxley Highway Bective	Lot 11/ DP1002595	970 m E	Rural-Residential
R3	207 Babbinboon Road Somerton	Lot 177/ DP755340	1,060 W	Rural-Residential
R4	190 Babbinboon Road Somerton	Lot 4/ DP249697	740 m W	Rural-Residential
R5	250 Babbinboon Road Somerton	Lot 3/ DP249697	1,370 m W	Rural-Residential
R6	76 Babinboon Road Somerton	Lot 5/ DP249697	1,320 m W	Rural-Residential
R7	3329 Oxley Highway Somerton	Lot 10/ DP261839	270 m E	Caretakers Cottage
R8	3329 Oxley Highway Somerton	Lot 10/ DP261839	540 m NW	Caretakers Cottage

Figure 1-5: Receptor Locations



Source: Google Earth 2023

↑N	**LEGEND** Site Location	Benbow Environmental 27-29 Sherwood Road Northmead NSW 2152

2. DESIGN AND OPERATION OF THE POULTRY FACILITY

The proposed development would comprise fourteen (14) tunnel ventilated sheds and provide a maximum farm capacity of approximately 810,510 broiler chickens – based on approximately 49,945 birds per existing shed and 63,855 birds per proposed shed. The sheds are operated through a 10-week production cycle consisting of an approximate 8 weeks of growing phase, and 2 weeks of in-between cycle break and shed cleanout.

LPG is used to heat the sheds to maintain the sheds at target temperatures. As the birds feather and grow larger, the target temperature changes from around 35°C in the first week reducing by approximately 2 degrees per week to approximately 21°C by week 8.

The sheds are grouped into two pods of 6 sheds; each pod will have 4 x 7,500 L LPG bulk tanks, approximately 1 tank servicing two sheds. The total LPG storage on the site is 40,000 L. It is expected that the tanks will be refilled approximately 10 times a year with increased frequency during the colder months.

Figure 2-1: Site Plan

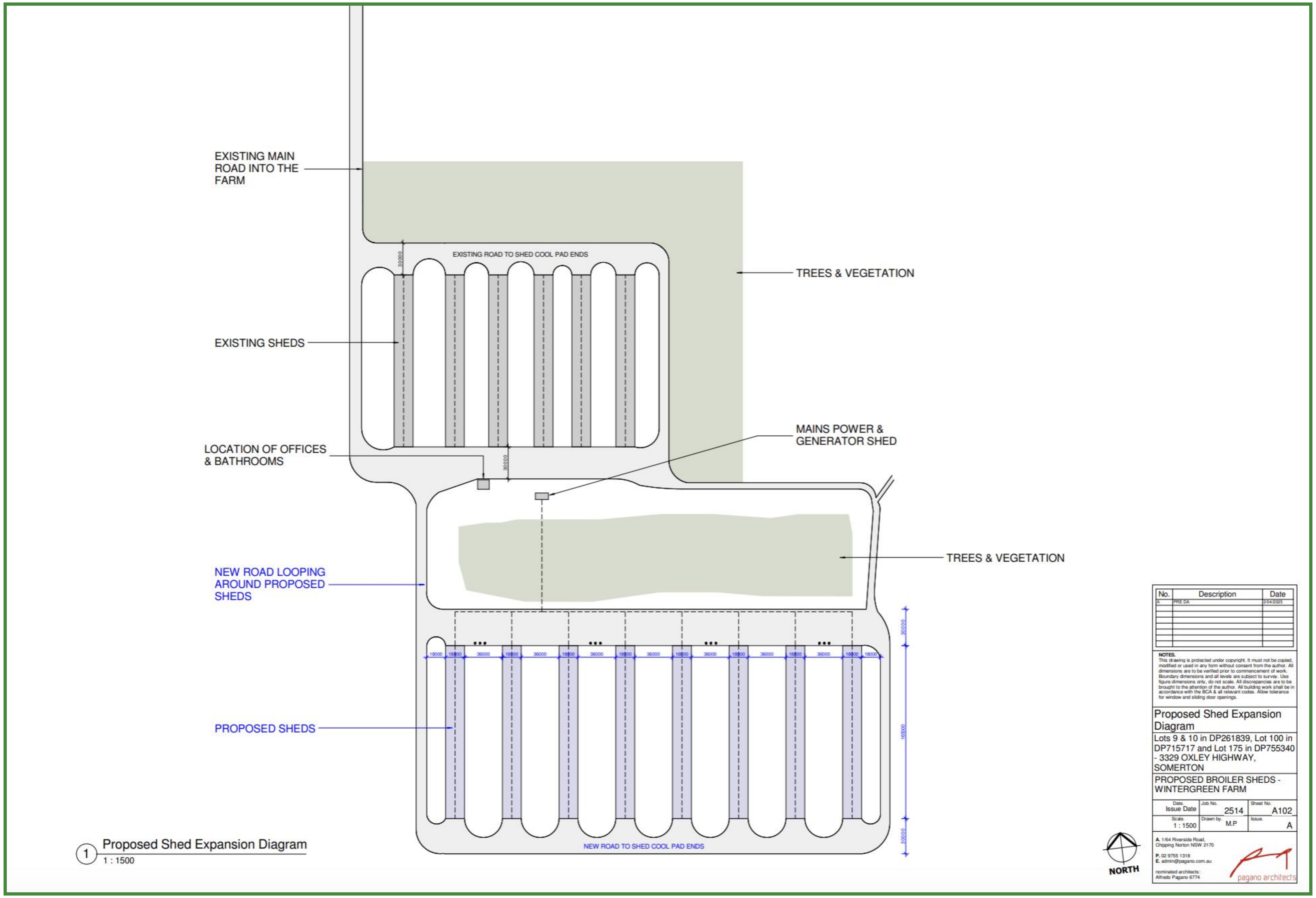


Figure 2-2: Proposed Shed Layout Plan

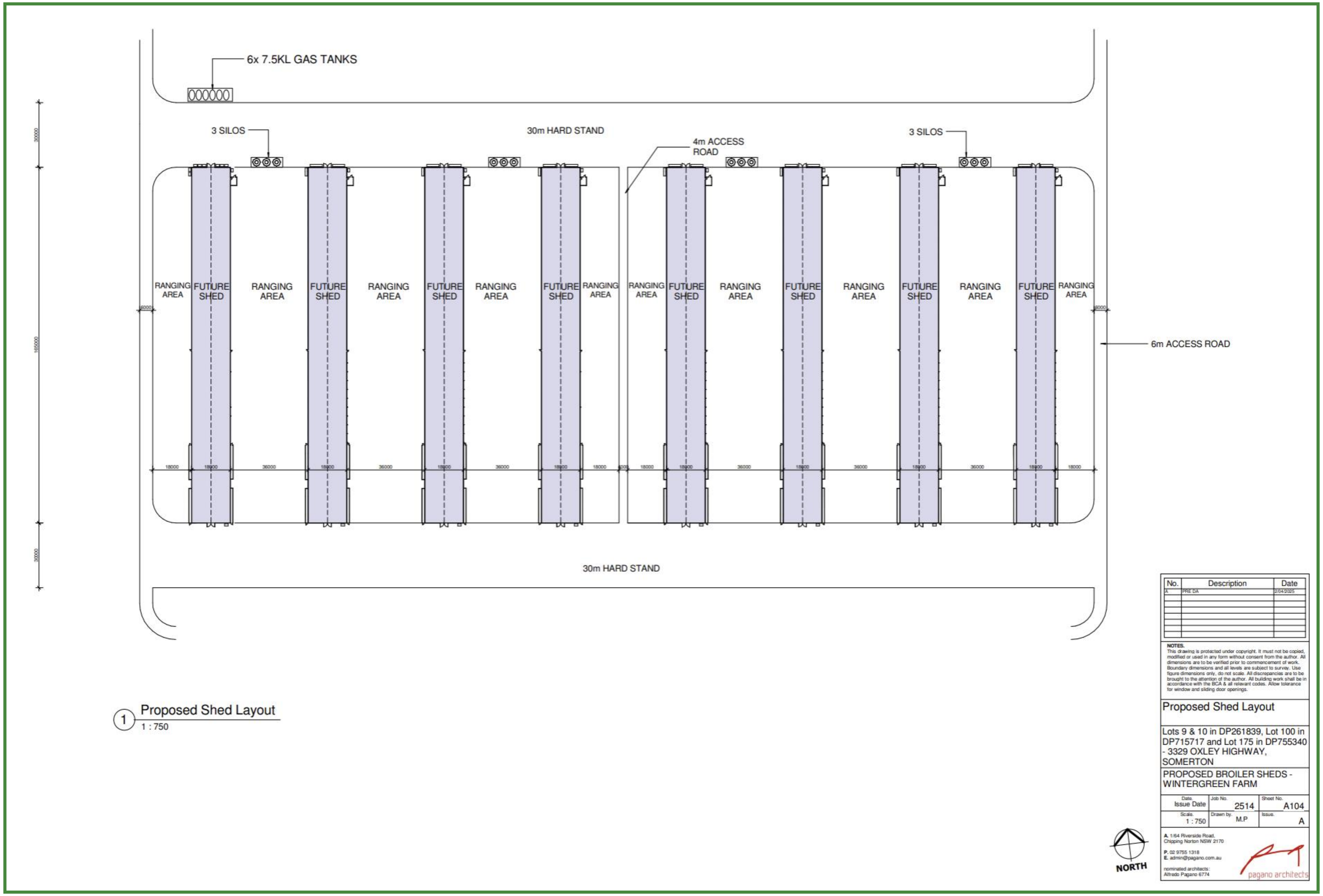
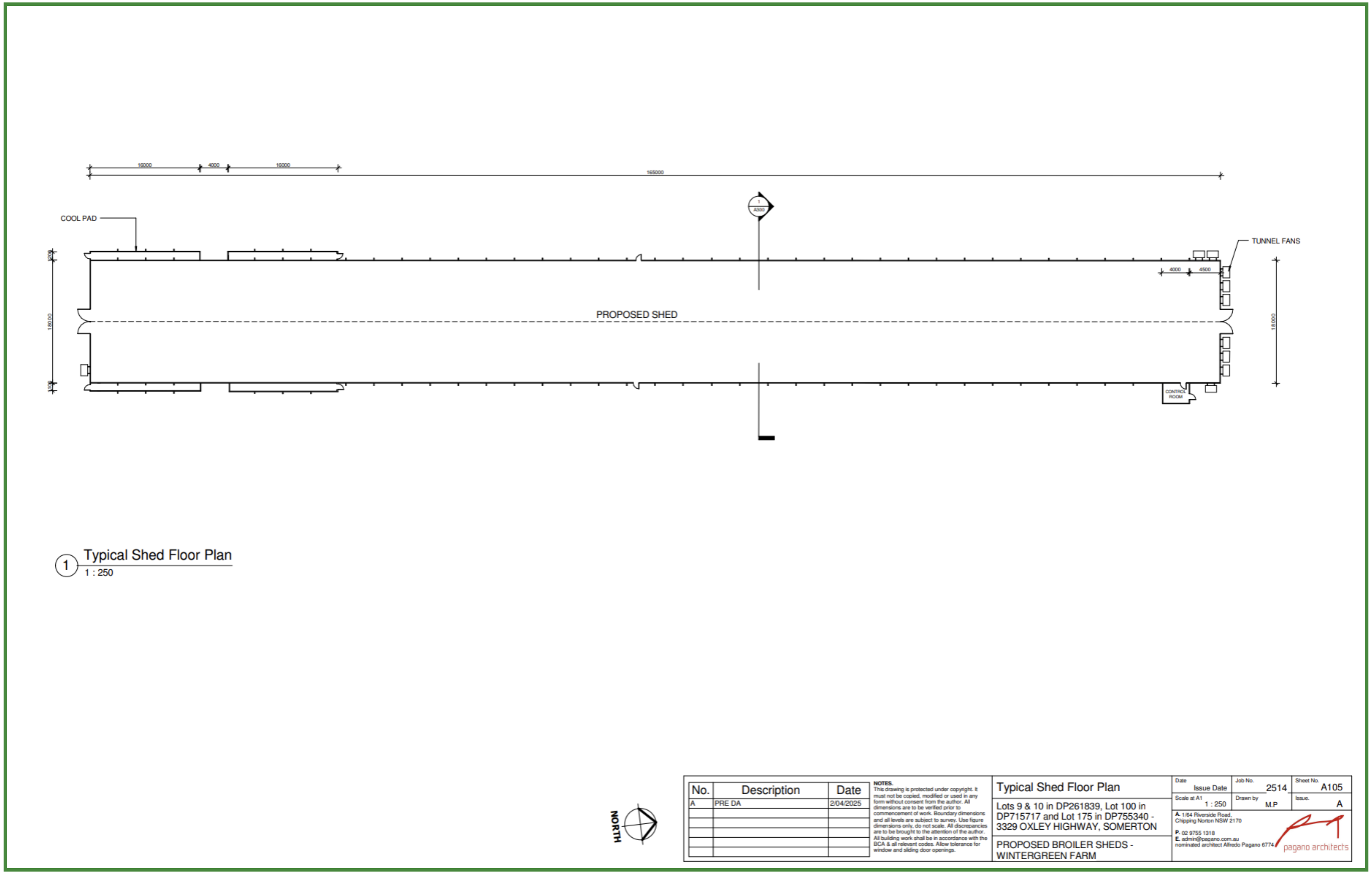


Figure 2-3: Proposed Shed Floor Plan



3. DANGEROUS GOODS STORAGE & HANDLING

This section of the PHA discusses the aspects relevant to dangerous goods storage and handling.

3.1 QUANTITIES OF DANGEROUS GOODS

Storage descriptions are provided, while Table 3-2 provides the details of the chemicals.

LPG is a flammable gas that belongs to the Australian Dangerous Goods (ADG) Code of Transport Class 2.1. As it is stored in liquid form it is under pressure. It is commonly used throughout the community and finds use in residences, commercial buildings, hospitals and industry. LPG is a hydrocarbon fluid composed of mixtures of all or any of: propane (C_3H_8), propylene (C_3H_6), butane (C_4H_{10}) or butylenes (C_4H_8).

LPG as a gas is denser than air, and therefore has required separation distances to drain pits, underground tank covers and land that has depressions as the gas may accumulate. As a flammable gas, it readily ignites and if allowed to cause an explosive mixture with air may generate an overpressure if ignited.

The lower explosive limit (LEL) depending on the % of propane and butane would be in the range of 1,900 - 2,100 ppm, meaning that a relatively low concentration from a release of LPG would be available to cause an explosion or fire.

The risks are readily managed through adherence to the design requirements in the AS and AS/NZS already referenced i.e. AS/NZS 1596:2014 *The storage and handling of LP Gas.*

The following are the necessary separation distances.

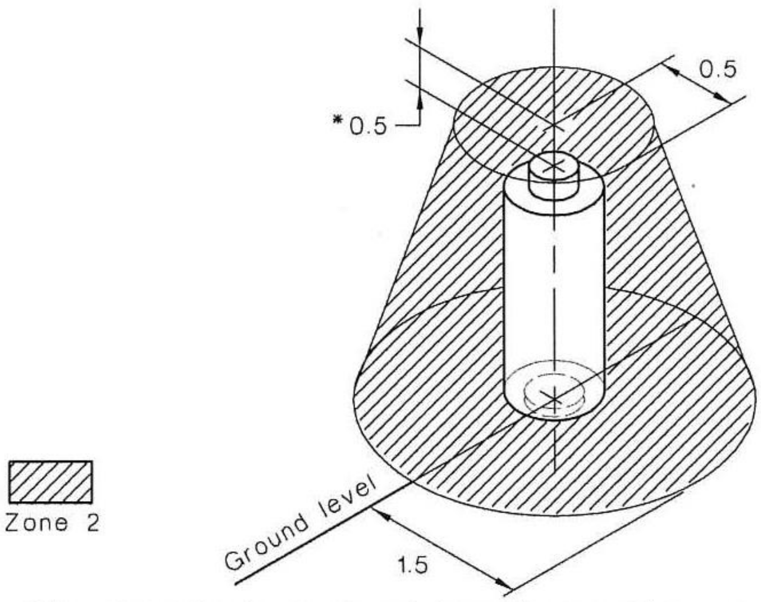
Table 3-1: Separation Distances

Location	Site Boundary	Protected Place	Adjacent LPG Tank
Aboveground 7,500 L tank	6 m	11 m	Diameter of the largest tank

Explosive gas atmospheres may be present if a leakage should occur. The following are a guide for hazardous areas. Reproduced from AS/NZS 1596:2014, Appendix E. A layman's explanation of what hazardous area zones 0, I and II mean is provided in Attachment 1.

For tanker filling, Clause 6.6.7 provides separation distances for connection points.

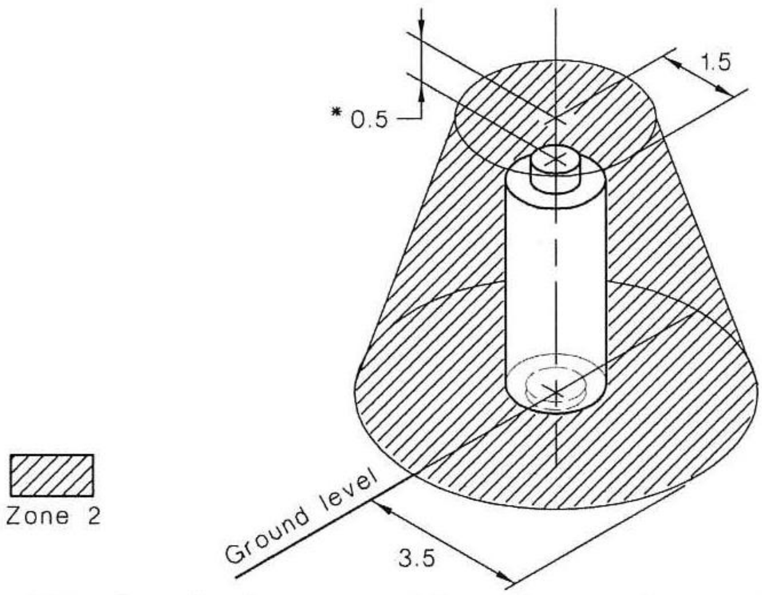
Figure 3-1: Guide for Hazardous Areas



*This dimension is measured from the top of any cylinder valve.

DIMENSIONS IN METRES

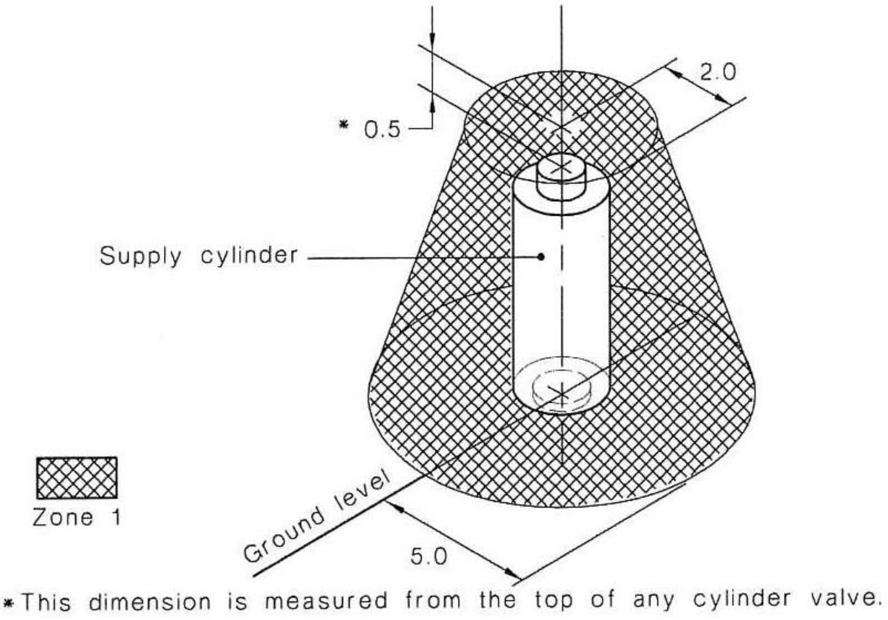
FIGURE F1 EXCHANGE CYLINDER



*This dimension is measured from the top of any cylinder valve.

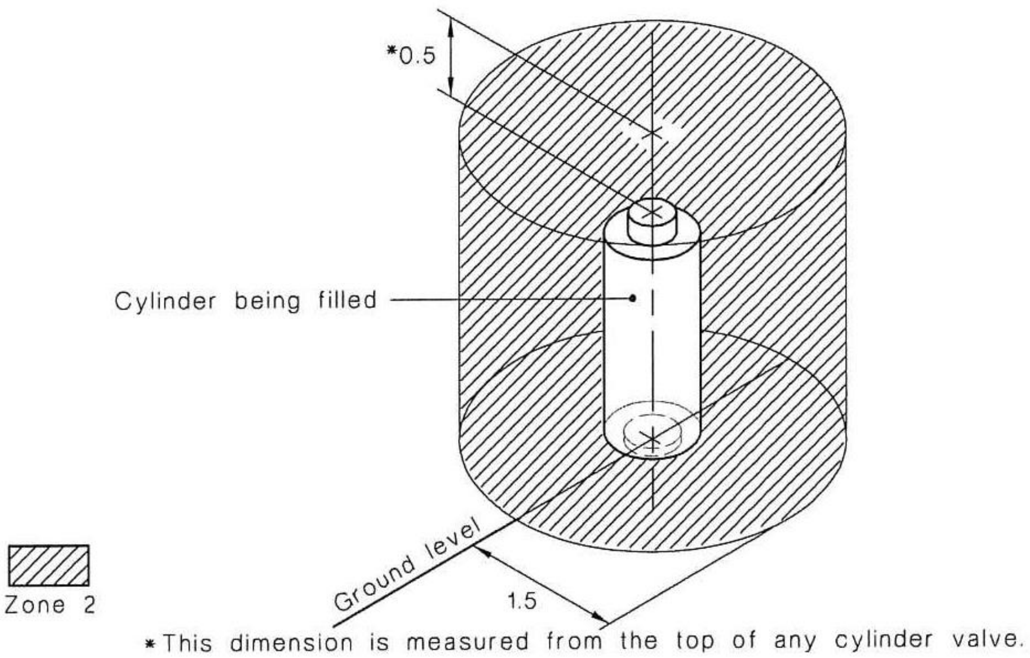
DIMENSIONS IN METRES

FIGURE F2 IN-SITU FILL CYLINDER



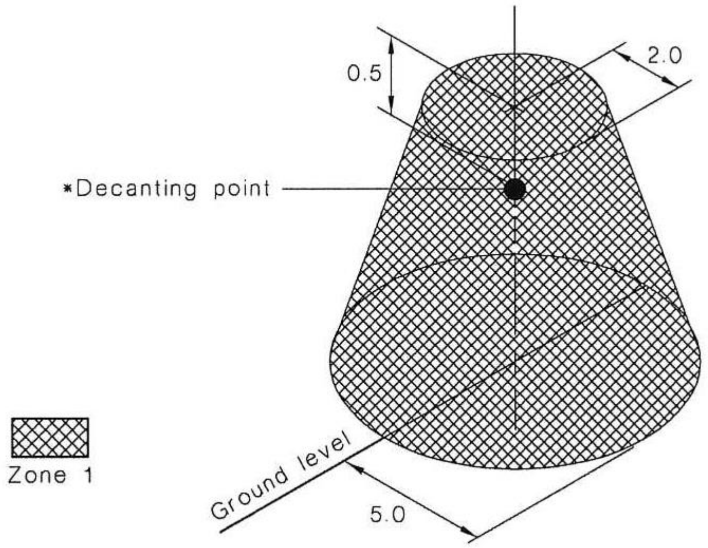
DIMENSIONS IN METRES

FIGURE E3 FILLING WITH GAS BLEEDING, IN ADEQUATELY VENTILATED LOCATION



DIMENSIONS IN METRES

FIGURE E4 FILLING WITHOUT GAS BLEEDING, IN ADEQUATELY VENTILATED LOCATION



* Decanting point: the point where the decanting hose is connected to the supply. It may be—
(a) a cylinder valve; or
(b) another supply point, e.g. a tank.

DIMENSIONS IN METRES

FIGURE E5 FILLING FROM CYLINDER OR TANK SUPPLY, IN ADEQUATELY VENTILATED LOCATION

The following signage requirements are reproduced from AS/NZS 1596:2014.

Figure 3-2: Signage Requirements

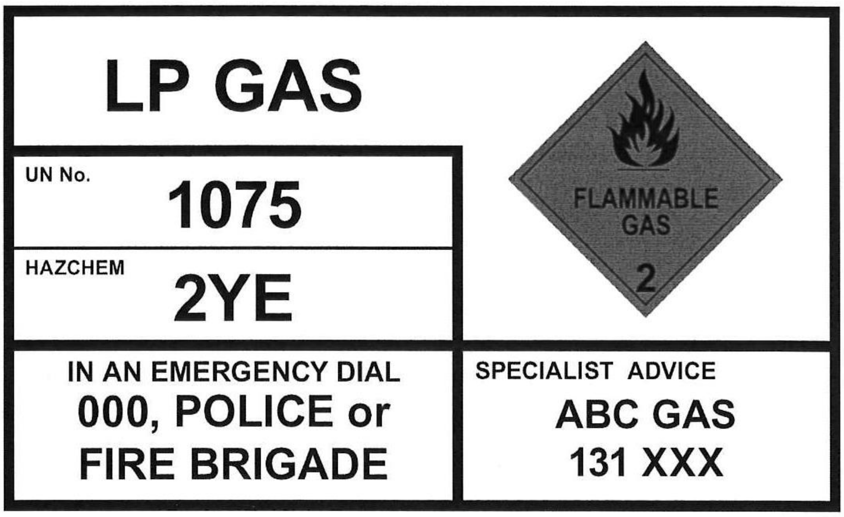


FIGURE D1 TYPICAL EXAMPLE OF PLACARD

FIGURE D2 WARNING SIGN

LP GAS EMERGENCY PROCEDURE

(Provide the address of this site on or adjacent to the notice.)

GAS LEAK

1 Shut emergency stop.
2 Close all valves of tank.
3 Keep bystanders away.
4 No smoking. No naked lights.
5 No engine to be started.
6 Phone fire brigade (*insert telephone number of local station, or general emergency number*).
7 Phone (*insert name and all-hours number for LP Gas distributor or site 24-hour emergency response contact*).
8 Isolate electricity (*by supply authority if main switchboard unsafe*).

FIRE

1 Shut emergency stop.
2 Phone fire brigade (*insert telephone number of local station*).
3 Phone (*insert LP Gas distributor's name and all-hours number*).
4 Close all valves of tank.
5 Keep bystanders away.
6 Isolate electricity (*by supply authority if main switchboard unsafe*).
7 Follow firefighting instructions.

NOTE: Text in italics needs to be completed by the site operator.

FIGURE D3 GAS EMERGENCY PROCEDURE NOTICE

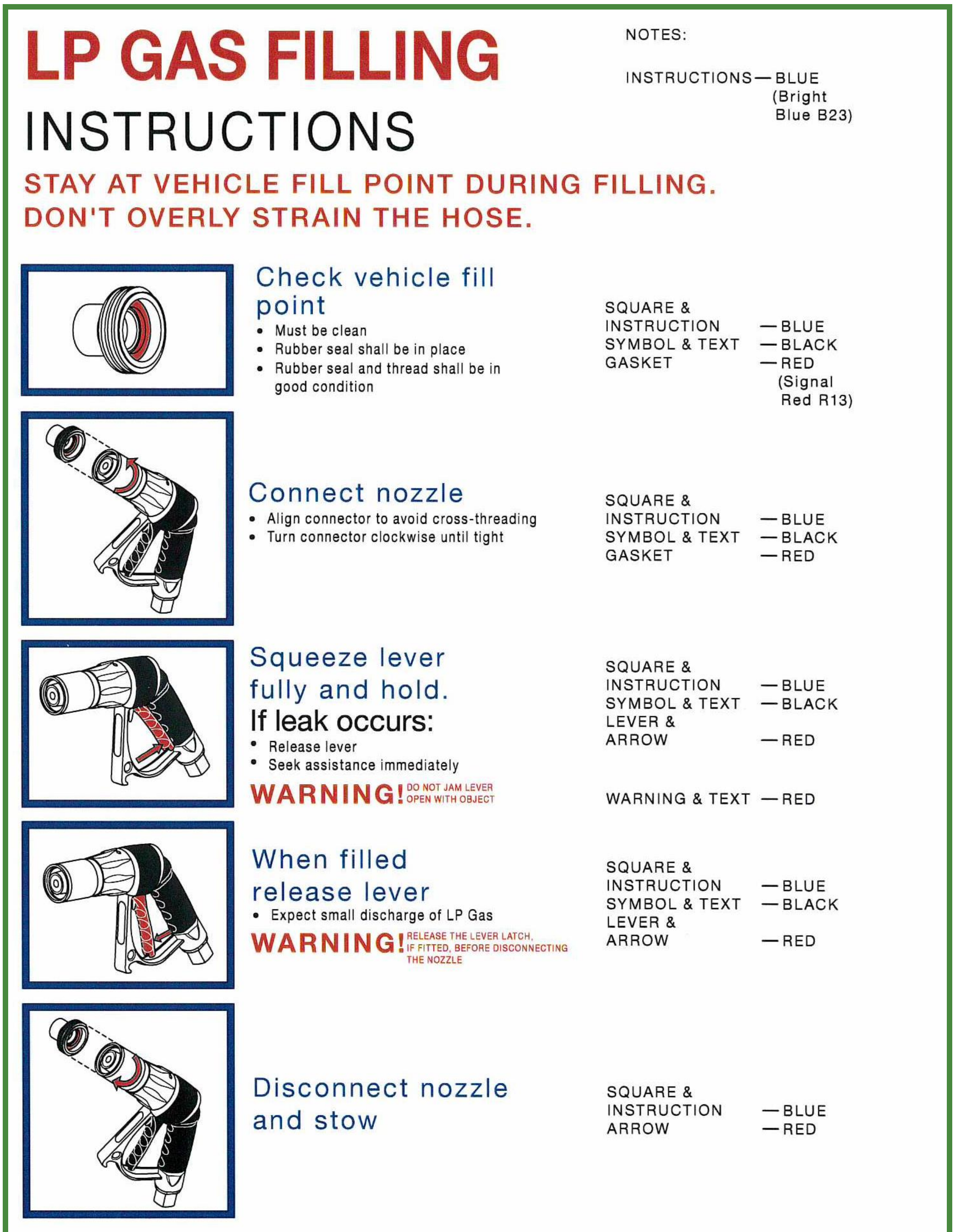
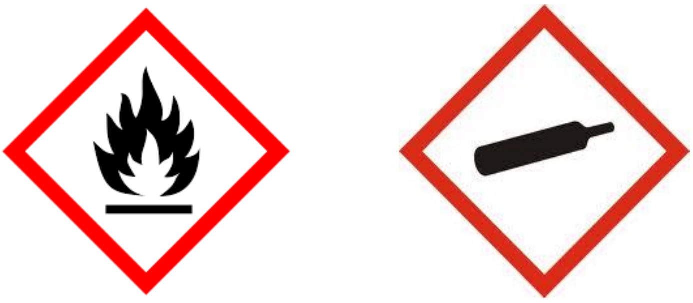


FIGURE D4 FILLING INSTRUCTIONS

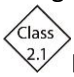
The GHS symbols are displayed below.

Figure 3-3: GHS symbols



The site will need a HAZCHEM sign at the entrance. A placard is shown from the AS/NZS 1596:2014 Appendix D, Figure D1 (see Figure 3-2A above).

The gas cylinder store will need:

- Danger Keep Fire Away;
- No Smoking;
- No ignition sources; and
- 

Diamond sign 250 x 250 mm size on each wall.

A manifest drawing showing the nearest details required in the Work Health and Safety Regulation will be needed to submit with the Notification to SafeWork. MSDSs (now known as SDS) will be needed with an Emergency Plan – prepared to the guidelines of Fire and Rescue NSW.

Table 3-2: Chemical Storage

Chemical Name	Storage Type	Estimated Onsite Maximum Quantity (kg or Litres)	ADG Class
Biosolve HDD	20 L drums in lockable chemical shed	270 L	Non-Dangerous Good
Virkon S	20 L drums in lockable chemical shed	160 L	Non-Dangerous Good
LarvaBETA	1 L bottles in lockable chemical shed	12 L	Non-Dangerous Good
RoundUp	20 L drum in lockable chemical shed	20 L	Non-Dangerous Good
SureFire Block Baits	8 kg tubs in lockable chemical shed	16 kg	Non-Dangerous Good
Diesel	Steel tank	2,000 L	Non-Dangerous Good C1 – Combustible Liquid
Unleaded Petrol	Steel tank	2,000 L	Class 3 – Flammable Liquid PG II
LPG	80% full 8 x 7,500 L Bulk storage tanks	40,000 L	Class 2.1 – Flammable Gas

3.2 Dangerous Goods Screening Against SEPP Thresholds

Dangerous Goods to be stored onsite have been assessed against the screening threshold limits outlined in SEPP (Resilience and Hazards) 2021 Chapter 3 – Hazardous and Offensive Development (formerly SEPP 33) and Applying SEPP 33, a guideline published by the Department of Planning, Housing and Infrastructure. This initial screening process determines whether the proposal is potentially hazardous, and provides guidance on the level of analysis that is required.

Table 3-3: SEPP 33 Preliminary Risk Screening

Class	Screening Threshold	Description	Site Specific Description	Quantity to be stored	Triggers SEPP 33
Class 1.1	Assessed by reference to figure 5 of applying SEPP 33	Explosives	None	None	No
Class 1.2	5 tonne or are located within 100 m of a residential area	Explosives	None	None	No
Class 1.3	10 tonne or are located within 100 m of a residential area	Explosives	None	None	No
Class 2.1	**(LPG only — not including automotive retail outlets[1])** 10 tonne or 16 m^3 if stored above ground 40 tonnes or 64 m^3 if stored underground or mounded	**Flammable Gases**	**8 x 7,500 L bulk above ground storage (80% full)**	**40,000 L**	**Yes**
	(Excluding LPG) Assessed by reference to figure 6 of applying SEPP 33	Flammable Gases Pressurised	None	None	No
	(Excluding LPG) Assessed by reference to figure 7 of applying SEPP 33	Flammable Gases liquified under pressure	None	None	No
Class 2.2	Not relevant	Non-flammable, non-toxic gases	None	None	Not relevant
Combustible Liquid C1	**Not relevant**	**Combustible liquid with flashpoint of 150°C or less**	**Diesel in steel tank**	**2,000 L**	**Not relevant**
Combustible Liquid C2	Not relevant	Combustible liquid with flashpoint exceeding 150°C	None	None	Not Applicable

Table 3-3: SEPP 33 Preliminary Risk Screening

Class	Screening Threshold	Description	Site Specific Description	Quantity to be stored	Triggers SEPP 33
Class 2.3	5 tonne	Anhydrous ammonia, kept in the same manner as for liquefied flammable gases and not kept for sale	None	None	No
	1 tonne	Chlorine and sulphur dioxide stored as liquefied gas in contains <100 kg	None	None	No
	2.5 tonne	Chlorine and sulphur dioxide stored as liquefied gas in containers >100 kg	None	None	No
	100 kg	Liquefied gas kept in or on premises	None	None	No
	100 kg	Other toxic gases	None	None	No
Class 3	**Assessed by reference to figures 8 & 9 of applying SEPP 33**	**Flammable liquids PG I, II and III**	**Unleaded petrol in steel tank**	**2,000 L**	**No**
Class 4.1	5 tonne	Flammable Solids	None	None	No
Class 4.2	1 tonne	Substances liable to spontaneous combustion	None	None	No
Class 4.3	1 tonne	Substances which, in contact with water, emit flammable gases	None	None	No
Class 5.1	25 tonne	Ammonium nitrate – high density fertiliser grade, kept on land zoned rural where rural industry is carried out, if the depot is at least 50 metres from the site boundary	None	None	No
	5 tonne	Oxidising substances, and ammonium nitrate elsewhere	None	None	No
	2.5 tonne	Dry pool chlorine — if at a dedicated pool supply shop, in containers	None	None	No
	1 tonne	Dry pool chlorine — if at a dedicated pool supply shop, in containers >30 kg	None	None	No

Table 3-3: SEPP 33 Preliminary Risk Screening

Class	Screening Threshold	Description	Site Specific Description	Quantity to be stored	Triggers SEPP 33
	5 tonne	Any other Class 5.1	None	None	No
Class 5.2	10 tonne	Organic peroxides	None	None	No
Class 6.1 PGI	0.5 tonne	Toxic substances	None	None	No
Class 6.1 PGII & III	2.5 tonne	Toxic substances	None	None	No
Class 6.2	0.5 tonne	Infectious substances, includes clinical waste	None	None	No
Class 7	All	Radioactive Material, should demonstrate compliance with Australian codes	None	None	No
Class 8 PGI	5 tonne	Corrosive substance	None	None	No
Class 8 PGII	25 tonne	Corrosive substance	Packages	None	No
Class 8 PGIII	50 tonne	Corrosive substance	Packages	None	No

This PHA is prepared on the basis of triggering the SEPP (Resilience and Hazards) 2021 Chapter 3 – Hazardous and Offensive Development threshold for Class 2.1 – Flammable Gases.

3.3 DANGEROUS GOODS STORAGE REQUIREMENTS

The site would be designed to conform to the *Work Health and Safety Regulation 2017,* and relevant Australian Standards.

All dangerous good storage and handling practices would comply with:

- Work Health and Safety Act 2011;
- Work Health and Safety Regulation 2017;
- Dangerous Goods (Road and Rail Transport) Act 2008;
- Dangerous Goods (Road and Rail Transport) Regulation 2022;
- How to Manage Work Health and Safety Risks Code of Practice 2019;
- AS/NZS 4804:2001 – *Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques*;
- AS1940-2017 – *The storage and handling of flammable and combustible liquids;*
- AS/NZS 1596:2014 – *The storage and handling of LPG gas*;
- SafeWork Australia – National Standard for the Storage and Handling of Dangerous Goods [NOHSC:1015 (2001)];
- SafeWork Australia – National Code of Practice for the Storage and Handling of Dangerous Goods [NOHSC:2017 (2001)];
- Managing Risks of Hazardous Chemicals in the Workplace - SafeWork NSW Code of Practice (2022);
- Globally Harmonised System of Classification and Labelling of Chemicals 4th Revised Edition (2011);
- Guidance on the Classification of Hazardous Chemicals under the WHS Regulations (Safe Work Australia ISBN 978-0-642-78340-0; and
- Australian Dangerous Goods (ADG) Code 7th Edition.

4. HAZARD ANALYSIS

4.1 LEVEL OF ASSESSMENT

The Multi-Level Risk Assessment approach has been developed and recommended by the Department of Planning, Housing and Infrastructure. It relies on a systematic and analytical approach to the identification and analysis of hazards and the quantification of offsite risks assessing any risk tolerability and landing use safety implications. The DPHI has advocated a merit-based approach, wherein the level and extent of analysis must be appropriate to the hazards present and therefore, need only progress to the extent necessary for the particular case.

There are three levels of assessment specified in the Multi-Level Risk Assessment (DPHI 2011) document and they are listed below.

Level 1 – Qualitative Analysis: primarily based on the hazard identification techniques. A level 1 assessment can be justified if the analysis of the facility demonstrates Societal Risk in the *negligible zone* and there are no potential accidents with significant off-site consequences.

Level 2 – Partially Quantitative Analysis: using hazard identification and the focused quantification of key potential off-site risk contributors. A level 2 assessment can be justified when the Societal Risk estimates fall within the middle *ALARP zone* or if one or more significant risk contributors had been identified but the frequency of risk contributors having off-site consequences is relatively low.

Level 3 – Fully Quantitative Risk Analysis: based on the full and detailed quantification of risks, consistent with HIPAP No. 6. A level 3 assessment is required where the Societal Risk from the facility estimates fall within the *intolerable zone* or where there are significant off-site risk contributors, and a level 2 assessment is unable to demonstrate that the risk criteria will be met.

4.2 METHODOLOGY

The procedures adopted in assessing hazardous impacts, depending on the level of risk assessment required, may involve the following steps:

Step 1: Hazard identification;
Step 2: Hazard analysis (consequence and probability estimations); and
Step 3: Risk evaluation and assessment against specific criteria.

The following sections of the report discuss the hazard identification process as prescribed by the Department of Planning, Housing and Infrastructure (DPHI 2011) in the documents *Multi-Level Risk Assessment* and *Hazardous Industry Planning Advisory Paper No* 4 (*HIPAP No. 6) – Guidelines for Hazard Analysis.*

4.2.1 Hazard Identification

This is the first step in the risk assessment. It involves the identification of all theoretically possible hazardous events as the basis for further quantification and analysis. This does not in any way imply that the hazard identified or its theoretically possible impact will occur in practice. Essentially, it identifies the particular characteristics and nature of hazards to be further evaluated in order to quantify potential risks.

To identify hazards, a survey of operations was carried out to isolate the events which are outside normal operating conditions and which have the potential to impact outside the boundaries of the site. In accordance with HIPAP 6, these events do not include occurrences that are a normal part of the operation cycles of the site but rather the atypical and abnormal, such as the occurrence of a significant liquid spill during product transfer operations.

4.2.2 Hazard Analysis

After a review of the events identified in the hazard identification stage and the identification of prevention/protection measures incorporated into the design of the site, any events which are considered to have the potential to result in impacts offsite or which have the potential to escalate to larger incidents are carried over to the next stage of analysis.

4.2.2.1 Consequence Estimation

This aspect involves the analysis and modelling of the credible events carried forward from the hazard identification process in order to quantify their impacts outside the boundaries of the site. In this case, these events typically include fire and the potential effects on people and/or damage to property.

4.2.2.2 Probability Likelihood Estimation

If necessary, the likelihood of incidents are quantified by adopting probability and likelihood factors derived from published data.

4.2.3 Risk Evaluation and Assessment against Specific Criteria

The risk analysis includes the assessment of consequences for each hazardous event and the frequencies of each initiating failure. The results of these consequence calculations together with the probabilities and likelihood figures estimated were then compared against the accepted criteria, as specified by DPHI. Whether it is considered necessary to conduct the predictions would depend on the probability figures, likelihood estimations, and if the risk criteria are exceeded.

4.3 Assessment Criteria

The risk criteria applied by Department of Planning, Housing and Infrastructure are published in the document *Hazardous Industry Planning Advisory Paper No 4* (HIPAP No. 4) - *Risk Criteria for Land Use Safety Planning* (DPHI 2011). The following is a general discussion of the criteria that is used to assess the risk of a development on the surrounding community and environment.

4.3.1 Individual Fatality Risk Levels

The following paragraphs have been reproduced from HIPAP No. 4 to describe individual fatality risk levels:

> *"People in hospitals, children at school or old-aged people are more vulnerable to hazards and less able to take evasive action, if need be, relative to the average residential population. A lower risk than the one in a million criteria (applicable for residential areas) may be more appropriate for such cases. On the other hand, land uses such as commercial and open space do not involve continuous occupancy by the same people.*
>
> *The individual's occupancy of these areas is on an intermittent basis and the people present are generally mobile. As such, a higher level of risk (relative to the permanent housing occupancy exposure) may be tolerated. A higher level of risk still is generally considered acceptable in industrial areas."* (DPHI 2011)

The risk assessment criteria for individual fatality risk are presented below.

Table 4-1: Individual Fatality Risk Criteria (HIPAP No. 4)

Land Use	Risk Criteria x 10^{-6} (per year)
Hospitals, schools, childcare facilities, old age housing	0.5
Residential, hotels, motels, tourist resorts	1
Commercial developments including retail centres, offices and entertainment centres	5
Sporting complexes and active open space	10
Industrial	50

4.3.2 Injury Risk Levels

HIPAP No. 4 provides guideline criteria for heat of radiation, explosion overpressure and toxic exposure. The quoted requirements from the referenced document have been summarised as follows:

- Guideline criteria for heat of radiation:

  "Incident heat flux radiation at residential and sensitive use areas should not exceed 4.7 kW/m^2, at frequencies of more than 50 chances in a million per year."

- Guideline criteria for explosion overpressure:

  "Incident explosion overpressure at residential and sensitive use areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year."

- Guideline criteria for toxic exposure:

  "Toxic concentrations in residential areas should not exceed a level that would be seriously injurious to sensitive members of the community following a relatively short period of exposure at maximum frequency of 10 in a million per year."

  and

  "Toxic concentrations in residential areas should not cause irritation to the eyes or throat, coughing or other acute physiological responses in sensitive members of the community over a maximum frequency of 50 in a million per year."

Please note that a risk hazard assessment only examines events that are considered to have the potential for significant off-site consequences and may not entirely reflect all variations in people's vulnerability to risk. A review of the adjoining sites confirms that while there are nearby businesses such as car repair workshops, steel fabrication facilities, and souvenir stores, there are no known dangerous goods storage areas in the immediate vicinity.

4.3.3 Risk of Property Damage and Accident Propagation

HIPAP No. 4 indicates that siting of a hazardous installation must account for the potential for propagation of an accident, causing a "domino" effect on adjoining premises. This risk would be expected within an industrial estate where siting of hazardous materials on one site may potentially cause hazardous materials on an adjoining premises to further develop the size of the accident.

The criteria for risk of damage to property and of accident propagation are stated as follows:

> *"Incident heat flux at neighbouring potentially hazardous installations or at land zones to accommodate such installations should not exceed a risk of 50 in a million per year for the 23 kW/m^2 heat flux level."*
>
> and
>
> *"Incident explosion overpressure at neighbouring potentially hazardous installations, at land zoned to accommodate such installations or at nearest public buildings should not exceed a risk of 50 in a million per year for the 14 kPa explosion overpressure level."*

4.3.4 Criteria for Risk Assessment to the Biophysical Environment

The assessment of the ultimate effects from toxic releases into the natural ecosystem is difficult, particularly in the case of atypical accidental releases. Consequence data is limited and factors influencing the outcome are variable and complex. In many cases, it may not be possible or practical to establish the final impact of any particular release. Because of such complexity, it is inappropriate to provide generalised criteria to cover any scenario. The acceptability of the risk will depend upon the value of the potentially affected zone or ecosystem to the local community and wider society.

The suggested criteria for sensitive environmental areas relate to the potential effects of an accidental release or an emission on the long-term viability of the ecosystem or any species within it and are expressed as follows:

> *"Industrial developments should not be sited in proximity to sensitive natural environmental areas where the effects or consequences of the more likely accidental emissions may threaten the long-term viability of the ecosystem or any species within it."*
>
> and
>
> *"Industrial developments should not be sited in proximity to sensitive natural environmental areas where the likelihood or probability of impacts that may threaten the long-term viability of the ecosystem or any species within it is not substantially lower than the existing background level threat to the ecosystem."*

4.4 Assessment Criteria Applicable to the Proposed Development Application

In accordance with *HIPAP No 4 Risk Criteria for Land Use Safety Planning*, the following discussion of the risk assessment criteria considered applicable to the proposed development has been provided.

4.4.1 Heat-Flux Radiation Criteria

As the chemical to be stored on site include Class 3 flammable goods, the heat flux radiation criteria have been deemed applicable to the site. Heat radiation models have been conducted to determine compliance with these criteria.

The effects of various heat fluxes (radiation) as a result of a fire incident are given in Table 4-2. The HIPAP No 4 paper (DPHI 2011) suggests a heat flux of 4.7 kW/m^2 and a frequency of 50 in a million per year to be used as the risk injury criterion for thermal effects at residential and sensitive use areas.

Table 4-2: Consequences of Heat Radiation (HIPAP No. 4)

Heat Radiation (kW/m^2)	Effect
1.2	Received from the sun at noon in summer
2.1	Minimum to cause pain after 1 minute
4.7	Will cause pain in 1 5–20 seconds and injury after 30 seconds' exposure (at least second degree burns will occur)
12.6	• Significant chance of fatality for extended exposure. High chance of injury. • Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure. • Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure.
23	• Likely fatality for extended exposure and chance of fatality for instantaneous exposure. • Spontaneous ignition of wood after long exposure. • Unprotected steel will reach thermal stress temperatures which can cause failure. • Pressure vessel needs to be relieved or failure would occur.
35	• Cellulosic material will pilot ignite within one minute's exposure. • Significant chance of fatality for people exposed instantaneously.

4.4.2 Explosion Over-Pressure Criteria

Table 4-3: Effects of Explosion Overpressure (HIPAP No. 4)

Explosion Overpressure	Effect
3.5 kPa (0.5 psi)	• 90% glass breakage. • No fatality and very low probability of injury.
7 kPa (1 psi)	• Damage to internal partitions and joinery but can be repaired. • Probability of injury is 10%. No fatality.
14 kPa (2 psi)	• House uninhabitable and badly cracked.
21 kPa (3 psi)	• Reinforced structures distort. • Storage tanks fail. • 20% chance of fatality to a person in a building.
35 kPa (5 psi)	• House uninhabitable. • Wagons and plants items overturned. • Threshold of eardum damage. • 50% chance of fatality for a person in a building and 1 5% chance of fatality for a person in the open.
70 kPa (10 psi)	• Threshold of lung damage. • 100% chance of fatality for a person in a building or in the open. • Complete demolition of houses.

4.4.3 Toxic Criteria

The toxic exposure criteria have been deemed applicable due to the potential for toxic vapour releases and toxic combustion emissions. HIPAP No. 4 indicates that citing of potentially hazardous developments also needs to consider the risk from accidental releases into the biophysical environment.

The National Institute for Occupational Safety and Health (NIOSH) and the American Industrial Hygiene Association (AIHA) provides the following 4 categories of health impact criteria which are of relevance during an emergency event:

- Immediately Dangerous to Life or Health (IDLH);
- Emergency Response Planning Guideline 1 (ERPG1);
- Emergency Response Planning Guideline 2 (ERPG2); and
- Emergency Response Planning Guideline 3 (ERPG3).

The purpose of the values given for each of these limits for a particular chemical is to assess the capabilities of mitigation safeguards and emergency or accident response plans for the workplace.

These are explained in more detail.

The IDLH limit is defined by the Occupational Safety and Health Administration (OSHA) as:

> *"An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere."*

The following are definitions for each ERPG level as defined by American Industrial Hygiene Association, 2008 Emergency Response Planning Guidelines (ERPG) and Workplace Environmental Exposure Levels (WEEL) Handbook:

> *"The ERPG-1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.*
>
> *The ERPG-2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.*
>
> *The ERPG-3 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects."*

The ERPG-2 level can be considered synonymous to the IDLH limit, although it has been observed that both slightly vary from each when comparing values for each contaminant. For this reason, both IDLH and ERPG limits were required to be considered in this assessment.

The toxic exposure criteria adopted in this assessment for the toxic chemicals potentially emitted from the site are defined in Table 4-4.

Table 4-4: Adopted Health Criteria Based of Potential Pollutants

Chemical	Health Limits (in mg/m^3)			
	IDLH	ERPG-1	ERPG-2	ERPG-3
LPG	3,600	–	–	–

***Note**: - indicates that no limits are available for this substance.*

4.4.4 Biophysical Environment Risk Criteria

Best practice in housekeeping and operational procedures would be implemented on site. Given this consideration, the proposed development would not introduce any additional risk that may threaten the long-term viability of the development and its effect to the local environment. Consequently, the DPHI-based criteria have been determined to be readily satisfied and no further analyses or discussions were considered necessary.

4.5 Consequence and Frequency Estimations

The consequences of an accident involving a particular hazardous substance depends on the type and quantity of hazardous substance, the type of activity using the substance as well as the exposed population.

A preliminary risk analysis of the proposed storage of LPG has been conducted in accordance with the prescribed Multi-Level Assessment guidelines document provided by DPHI. Following is a summary of the risk analysis results.

4.5.1 Risk Classification and Prioritisation

The Department of Planning, Housing and Infrastructure document Multi-Level Risk Assessment (DPHI 2011) outlines a method of risk classification and prioritisation to assist in assessment of risk. The technique is based on the Manual for classification of risks due to major accidents in process and related industries (IAEA, 1993). The IAEA method was developed to produce a broad estimate of the risks due to major accidents from the manufacture, storage, handling and transport of hazardous materials. The technique involves three stages:

- Estimation of the consequences of a major accident;
- Estimation of the probability of a major accident happening; and
- Estimation of societal risk.

4.5.1.1 Estimation of Consequence in Terms of Potential Fatalities

The consequences of a major accident depend on the type of substance and activity and the quantity involved, as well as the exposed population. After excluding those substances and activities, which neither present a significant off-site risk nor could potentially affect adjacent inventories, the following steps are undertaken:

- Classify the activity;
- Estimate the effect distance and area;
- Estimate the population distribution; and
- Consider Mitigation Correction Factors, which takes into account possible mitigation actions that people could take, such as evacuation and sheltering.

An estimate of the external consequences of a major accident may be calculated using these factors.

4.5.1.2 Estimation of Probability of a Major Accident Happening

The method used for estimating probability is based on probability numbers related to the type of installation and hazardous substance used, together with the following probability correction factors:

- Frequency of loading/unloading operations;
- Provision of safety systems associated with the storage and handling of flammable substances;
- A quantitative assessment of the management and safety levels of the organisation; and
- A quantitative assessment of the wind direction towards a populated area.

An estimate of the probability of major accident may be calculated using these factors.

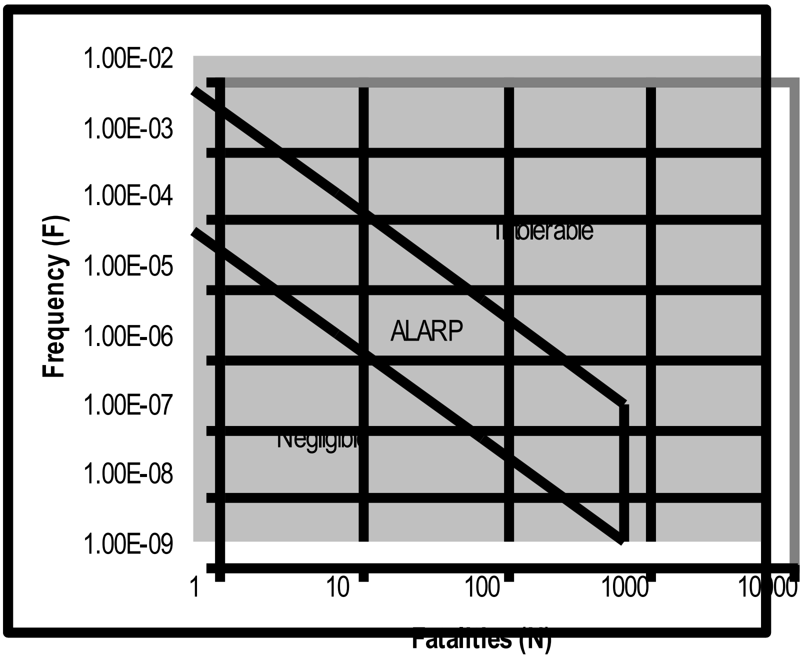
4.5.1.3 Estimation of Societal Risk

At this stage, pairs of numbers have been calculated for each activity, comprising the number of fatalities per accident and expected frequency of the accident. The results may be transferred to a plot of frequency verses consequence (F-N curve) and a direct estimate of societal risk can be determined. The F-N curve is divided into three regions:

- Negligible - accidents are not considered to have significant off-site consequences;
- ALARP - while risk of an accident may be tolerable, steps should be taken to reduce the risk level to as low as reasonably possible (ALARP); and
- Intolerable - risk of an accident with the potential for significant off-site consequences is unacceptable.

The F-N curve used to classify societal risk is shown in Figure 4-1.

Figure 4-1: IAEA F-N Curve



4.5.1.4 Storage of Class 2.1 in Aboveground Tanks

The risk associated with the storage of Class 2.1 flammable gases has been assessed using the IAEA method as outlined in the Department of Planning, Housing and Infrastructure Multi-level Risk Assessment (January 2011). The analysis was conducted in accordance with Clause A1.2 from the prescribed guidelines. Refer to Appendix 1 of the prescribed guidelines for a complete listing of the IAEA tables referenced below.

The following is a summary of the consequence calculation:

a) IAEA Table IV(a): The quantity of substance stored (Class 2.1) is classified as DI for aboveground tanks. Based on 50-200 tonnes. The LPG tanks are considered to have "effective physical isolation and separation between the storage vessels of a particular substance, then the quantity used in estimating the effect of an incident would typically be the content of the largest storage vessel." Note: The tanks would be approximately 70m apart from one another.
b) IAEA Table III for a Classification of Substance by Effect Category D shows a maximum distance of 100-200m with an effect area for D1 category of 12 hectares. This provides the value of A in Equations 1 & 2 (following page).
c) The Site is located in a rural area. From IAEA Table VI, the population density is estimated to be d = 5 persons/hectare, farmland, scattered houses. This provides the value of d.
d) IAEA Table VII shows that for a populated fraction of 5%, the Population Correction Factor for BI is 0.05. This provides the value of the factor f_A.
e) IAEA Table VIII for Flammables (1-12) gives a correction factor for mitigation, which takes into account possible mitigatory actions that people may take, such as evacuating and sheltering. For flammable substances the Mitigation Factor is $f_m = 1$.

f) The external consequences are the following:

Equation 1: Aboveground tank
$C_{a,s} = A * d * f_A * f_m = 12 * 5 * 0.05 * 1 =$ **3 fatalities/accident**

Following is a summary of the probability calculation.

(i) IAEA Table IX shows that for Flammable Gases (Reference No 9) the Average Probability Number ($N^*_{I,S}$) for storage activity is 6 for the bulk storage.
(ii) IAEA Table VIII shows that for a frequency of loading/unloading per year of 10-50 a parameter of $N_L = 0$ applies.
(iii) IAEA Table XI, no correction parameters apply in this instance. $N_F = 0$.
(iv) IAEA Table XII shows that for an Average Industry Practice an organisation's safety correction factor of $N_O = 0$ will be used.
(v) IAEA Table XIII shows a wind direction factor of $N_P = 0$ will be used.
(vi) The Probability Number is calculated as follows:

Aboveground tank

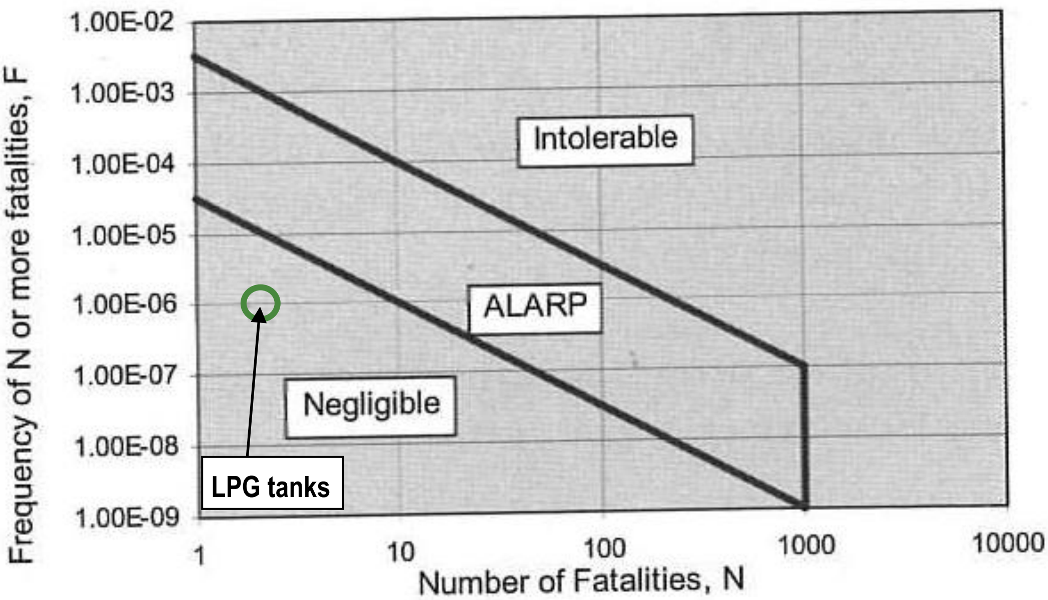
$$N_{i,S} = N^*_{I,S} + N_L + N_F + N_O + N_P = 6 + 0 + 0 + 0 + 0 = 6$$

(vii) IAEA Table XIV converts this to a frequency for the bulk tank of $P = 1 \times 10^{-6}$ accidents/year.
(viii) The IAEA F-N Curve (Figure A4) shows that <1 fatalities/accident at a frequency of 1×10^{-6} accidents/year falls within the **Negligible** zone of the curve for aboveground tanks. Therefore detailed consequence and frequency estimations detailing the safeguards to be implemented are not required. However further analysis was undertaken as a precaution as the position on the FN is very near ALARP.

4.5.1.5 Estimation of Societal Risk

An estimation of the overall societal risk from the probabilities and consequences calculated above has been provided as an F-N Curve, Figure 4-2. The overall level of societal risk falls within the negligible range. Detailed frequency and consequence analysis were conducted for significant identified credible events. This analysis has been provided throughout this report.

Figure 4-2: F-N Curve for Overall Societal Risk



Detailed consequence estimations are conducted using a modelling package. Effects and Damage by TNO safety software are utilised for determining consequences of specific events. Effects and Damage are software packages for personal computers developed by The Netherlands Organisation for Applied Scientific Research (TNO), Department of Industrial Safety. Effects performs calculations to predict the physical effects (gas concentrations, heat radiation, etc.) of the escape of hazardous materials. Damage performs calculations to predict the consequences (human lethality, first/second degree burns, etc.) due to exposure to physical effects of the escape of hazardous materials.

The models used in Effects and Damage are based upon two books published by The Netherlands Committee for the Prevention of Disasters, "Methods for the Calculation of Physical Effects" (Yellow Book), 3rd edition, 1997 and "Methods for the Determination of Possible Damage" (Green Book), 1st edition, 1992.

4.6 Hazard Identification

The level of assessment required is dependent on a risk-based method which relies on broad estimations of consequences and likelihood of accidents. Based on the risk classification and prioritisation technique used in the previous section, it can then be concluded that the hazards associated with the storage of LPG falls under the ALARP zone. This means that off-site risks may be significant but are likely to be well within the quantitative criteria. Therefore a Level 2 Partially Quantitative Risk Assessment has been undertaken to determine the level of risk of the proposed development, in particular the storage of LPG, to its surroundings.

A level 2 risk assessment involves the hazard identification step, which examines all possible failure scenarios and their consequences to ensure that all incidents with possible off-site consequences are identified. Those events that could contribute to off-site risk will then be examined in further detail of the consequences and likelihood in order to demonstrate that quantitative risk criteria will not be exceeded.

4.6.1 Serious LPG Release During Tank filling

The LPG tanks will require weekly filling via road tanker. There is potential for a release of LPG from the connection point from the tanker to the tank inlet. A release of LPG could occur in the event of the flexible house rupturing, equipment leak, or driver failure to properly follow procedure (e.g. driving away before disconnecting the flexible hose fitting).

Control / interlock mechanisms would be installed as required by AS/NZS 1596:2014. 'Dead man' buttons would be provided to ensure the driver is always present to activate a first response mechanism upon an event occurring. The tankers also would be fitted with break interlocks, which prevent LPG from being pumped until the breaking system has been securely locked in place.

4.6.1.1 Hazard Identification Chart

A Hazard Identification Chart has been prepared for the proposed site based on operating scenarios that are relevant to the proposed development. This chart outlines the outcomes from the hazard identification phase of the assessment.

The chart consists of four columns:

<u>Column 1</u>
Heading: Functional/Operation Area
The area of the site involved with the potential event is listed.

<u>Column 2</u>
Heading: Possible Initiating Event
The individual events that are considered to be likely or realistic are then listed. Where the possible consequences are similar the events are listed together, each one individually numbered.

<u>Column 3</u>
Heading: Possible Consequences
The outcomes of an event if it occurred are listed.

<u>Column 4</u>
Heading: Prevention/Protection Measures
The measures designed into the functional/operation area and the site are listed. These measures may include for example safeguards, design features, management methods and/or operator training.

The hazard identification chart is presented in Table 4-5.

Given the information listed in Table 4-5, the potential hazards identified for further analysis have been analysed in a scenario based assessment as detailed in Table 4-6.

Table 4-5: Event/Consequence Analysis Table

Functional/Operational Area	Possible Initiating Event	Possible Consequences	Prevention/Protection Measures
1. LPG Bulk Storage Tanks	1. Catastrophic mechanical failure of the tank due to: • Faulty fabrication • Thermal stress from localised fire • Blocked vent	• Major release of flammable materials. • Spilt liquid could enter stormwater drains and escape the site. • A major fire event could occur if there is an ignition source. • Radiant heat risk to the surrounding areas.	• Tanks are designed in accordance to the relevant Australian Standards and Codes. • Tanks are tested for leaks prior to commissioning. • Regular inspection and maintenance procedures. • Employees are trained in spill response procedures. Spill materials will be available and maintained. • Hazardous zoning is implemented in accordance with AS/NZS 1596:2014 to eliminate ignition sources. • Hot work permit system is established on site. • No smoking policy.
	2. Spillage due to: • Hole in the pipework or storage tank. • Tank overfilled during bulk loading.	• Minor spill of LPG. • A localised pool fire could occur if there is an ignition source. • Radiant heat risk to the surrounding areas.	• Fire fighting measure are available on site and are maintained in accordance with the relevant Australian Standards. • Emergency procedures are available for the site and all staff will be trained in the appropriate emergency procedures. • Tank is fitted with a level monitoring equipment to allow a check to be done prior to refilling with LPG. • Pipelines are provided with protection from accidental impact damage, i.e., motor vehicles, by use of a protective metal barrier, preferably Armco railing, or concrete barriers.

Table 4-5: Event/Consequence Analysis Table

Functional/Operational Area	Possible Initiating Event	Possible Consequences	Prevention/Protection Measures
2. Transfer pipelines	1. Outdoor spillage due to: • Catastrophic pipe failure due mechanical impact. • Hole in transfer pipe.	• Release of flammable gas. • Localised fire if an ignition source is present. • Radiant heat risk to adjacent areas.	• Regular inspection and maintenance procedures for pipes, hoses and pumps. • Employees and external contractors are trained to be aware of the permanent location of the pipelines. • Unloading activities of raw materials are attended. • Bulk tank pipelines incorporate shut off valves to isolate section of pipelines that contained LPG. • Employees are trained in spill response procedures. • Emergency procedures are available for the site and all staff will be trained in the appropriate emergency procedures. • Protection from accidental impact damage by use of a protective metal barrier, preferably Armco railing, or concrete barriers.
	2. Inground spillage due to: • Catastrophic pipe failure due mechanical impact. • Hole in transfer pipe.	• Release of flammable gas, likely to be contained within the subsoil. • Potential for spillage to migrate into groundwater.	• Correct installation with proper supports for the pipeline will prevent massive rupture of the pipe.

4.7 HEAT OF RADIATION

The following scenarios were obtained from a study of a similar size LPG tank issued by NFPA and NPGA.

The scenarios were prepared by a group of experienced engineers who agreed on these scenarios, so these are considered to be credible and the assumptions valid.

The heat of radiation (kW/m^2) vs distance for models 1-7 presented in Table 4-6 below are shown in Figure 4-3. The assumptions and TNO Effects model inputs are provided in Attachment 2. It is understood the maximum radiation tenability for firefighters in 3 kW/m^2. The heat of radiation contours for worst case model 7 scenarios at 3 kW/m^2 is shown in Figure 4-4.

Table 4-6: Distances to Various Types of Propane Hazards under Different Release Models

Model #	Details of the Propane Release Model Releases from or due to		Vapour dispersion distance to LFL[1] (m)	Explosion hazard distance (m)	Fire ball radiation distance (m)
1A	Bobtail hose failure. Release of the entire inventory in the hose, quickly	1” (2.54 cm) ID × 45 m hose length	76	33	15
1B		1” (2.54 cm) ID × 36 m hose length	70	31	14
1C		1” (2.54 cm) ID × 22 m hose length	58	27	12
2	Release of the inventory in a transfer piping 1” (2.54 cm) × 9 m + @ 20 gpm for 10 min, due to failed excess flow valve		41	36	8
3	Release from the container pressure relief valve		No ignitable vapour concentration at ground level		
4	Release from a 1” (2.54 cm) ID × 45 m length transfer piping to a vaporizer and reduced flow from a partially open excess flow valve @ 20 gpm for 10 min		76	36	15
5	Leak from a corrosion hole in a transfer pipe at a back pressure of 130 psig (corresponding to 80°F (27°C)) for 60 min. Hole size is ¼” (0.6 cm) ID.		33	36	1.5
6	Release of the entire inventory in a 2” (5 cm) ID × 6 m transfer hose		59	27	12
7	Transport hose blowdown: Hose size 2” (5 cm) ID , 6 m length release for 3 min, from a Transport after the tank is filled		23	9	1.5

Note [1]: *LFL – Lower Flammable Limit ≡ LEL.*

Modelling Notes

Dispersion of Vapors: Assumes that the flashed vapor+ aerosol together disperse as a heavy gas in "F" stability weather at a wind speed of 1.5 m/s (3.4 mph).

If a puff of vapor is released followed by a long duration (at least 5-minute spill time) release time then the dispersion hazard is calculated using both the puff calculations and the continuous plume calculations.

Vapor Explosion: Assumed hazard criterion is 1 psi overpressure (Ref: eqn C-1, Offsite Consequence Analysis Guidance, EPA 1999).

If the release occurs instantaneously (as a puff of vapor + aerosols) then the mass used for the explosion hazard calculation is the total mass of flashed vapor + entrained liquid aerosols. If the release occurs over a longer period of time (continuous release), then the mass of vapor that can participate in a vapor cloud explosion is the mass of vapor + entrained aerosol released over the duration of time taken for the vapor concentration to decrease from 100% to LFL in the dispersing plume. This time is equal to the maximum downwind LFL distance divided by the wind speed.

Radiation from Pool Fire: Pool depth is assumed to be 0.5 cm for instantaneously released liquid. Also, it is assumed that all liquid formed after the flash forms a pool. In the case of continuous release the pool diameter is determined by a balance between evaporation due to fire and the full spill rate without consideration of the flashing. The evaporation rate for relatively small pool fires is given by the formula: liquid regression rate (cm/min) = 0.076 * (lower heat of combustion/latent heat of evaporation).

[Reference: Burgess D. and M. Hertzberg "Radiation from Pool "Flames", Heat Transfer in "Flames (Ed: Afghan and Beer), Scripta Book Co. Washington, DC, 1974.]

Radiation effect is calculated using equation 10-1 of Offsite Consequence Analysis Guidance, EPA 1999. The thermal radiation hazard is based on a radiant intensity of 5 kW/m2.]

Fire Ball: The hazard distance is approximately proportional to the square root of the mass of propane released. Table 30 of Offsite Consequence Analysis Guidance, EPA 1999 indicates that for 1,000 lb propane release the distance is about 264 ft (80 m). The results in OCAG (Table 30) is correlated as X (ft) = 12.83 * (M in Lbs)0.441.

The mass used is the total release in the case of instantaneous release. In the case of continuous release, the total mass used is the mass released first instantaneously + the continuous release over the period of time equal to the dispersion time to LFL centreline concentration in the plume.

Hazard Area for Plume Dispersion is calculated as the sum of two triangular areas. The first triangle is from origin to the maximum LFL downwind distance. The second triangle is from maximum LFL width location to maximum downwind distance.

The Hazard Distances from explosion and the fireball are calculated using the mass of vapor in the dispersion plume where the plume ground level concentration is above the LFL concentration. This is equal to the product of the release rate and the duration of time it takes for vapor released at the source to reach the downwind distance where the round level concentration is equal to the LFL. The vapor is assumed to move at wind speed.

Ground Level Hazard Area from Propane Releases form Relief Valves: Results from the investigation by Cornwell, et al ., of the dispersion of LPG vapours released from pressure relief valves (PRVs) on LP containers indicate that for release velocities greater than 33 m/s no LFL concentrations were found at any level below the exit section of the PRV riser pipe. It is based on the results of the work of Cornwell, et al.

The greatest potential hazard is the release of the entire amount of gas in a hose based on several lengths of hose modelled.

These distances illustrate the importance of being able to immediately isolate the flow of LPG and therefore the pressure that would cause the LPG to be released from the hoses or any leakage.

Table 4-7: Distance to Heat of Radiation

Model 1		Model 2 & 4		Model 5		Model 6		Model 7	
Distance (m)	Heat of Radiation (kW/m^2)	Distance (m)	Heat of Radiation (kW/m^2)	Distance (m)	Heat of Radiation (kW/m^2)	Distance (m)	Heat of Radiation (kW/m^2)	Distance (m)	Heat of Radiation (kW/m^2)
1	14.5	1.3	20	1.8	20	8.6	20	13.5	20
1.5	4	1.5	12	2	17	9	16.5	14	17.5
2	2	2	5	2.5	8	10	11.5	15	13.3
3	0.7	3	1.5	3	4.5	11	8.1	16	10.5
4	0.3	3.5	1	4	2	12	6	17	8.6
5	0.2	4	0.7	5	1.2	13	4.9	18	7
6	0.1	5	0.5	6	0.7	14	3.9	19	6
		6	0.3	7	0.5	15	3.1	20	5.1
		7	0.2	8	0.4	16	2.7	21	4.4
		9	0.1	10	0.3	17	2.2	22	3.9
				12	0.2	18	2	23	3.5
				14	0.1	19	1.8	24	3
						20	1.5	25	2.8
						21	1.3	26	2.5
						22	1.2	27	2.2
						23	1.1	28	2
						24	1	32	1.5
						25	0.9	37	1
						26	0.8		

Figure 4-3: Heat of Radiation vs Distance: Models 1-7

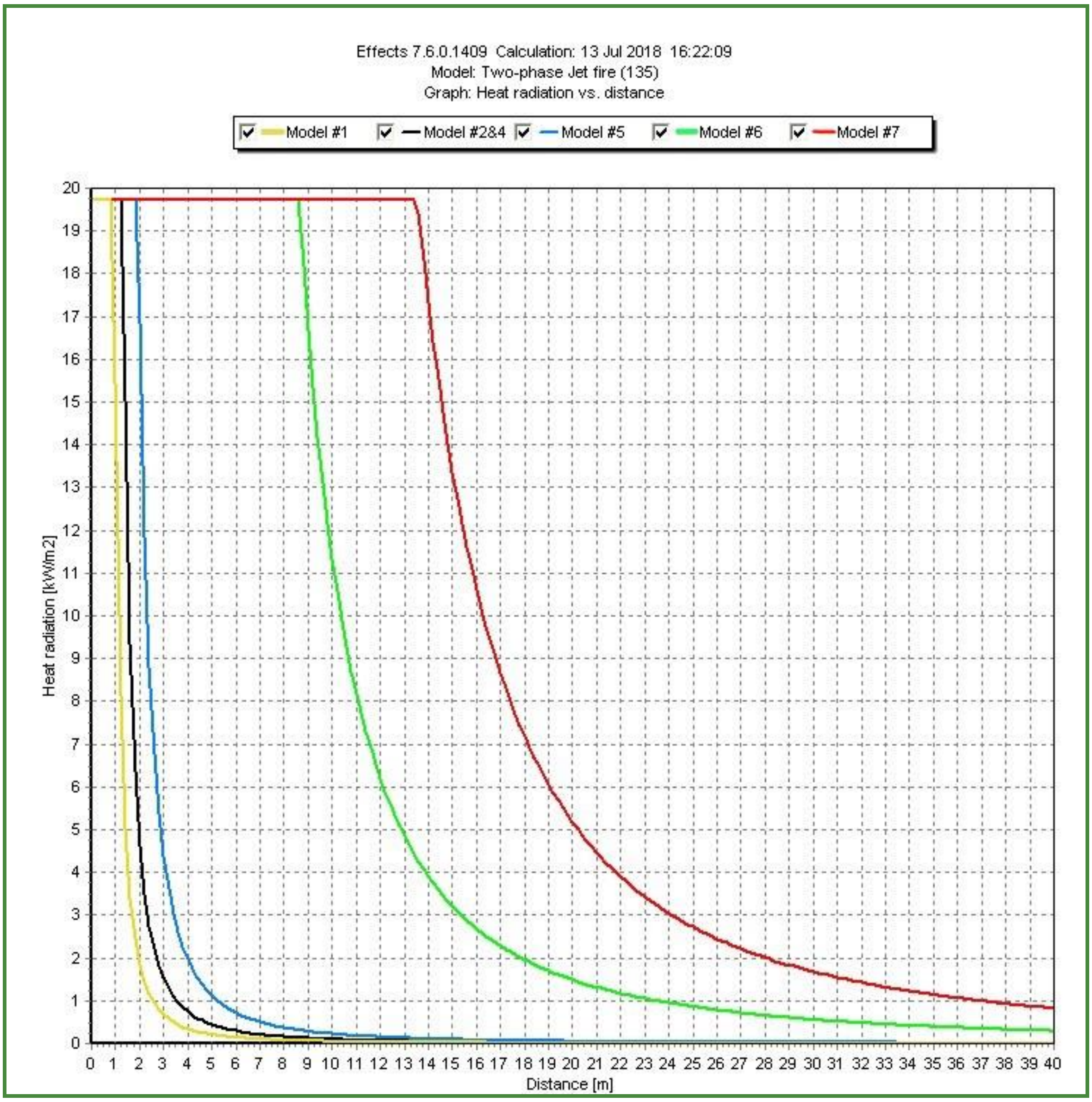
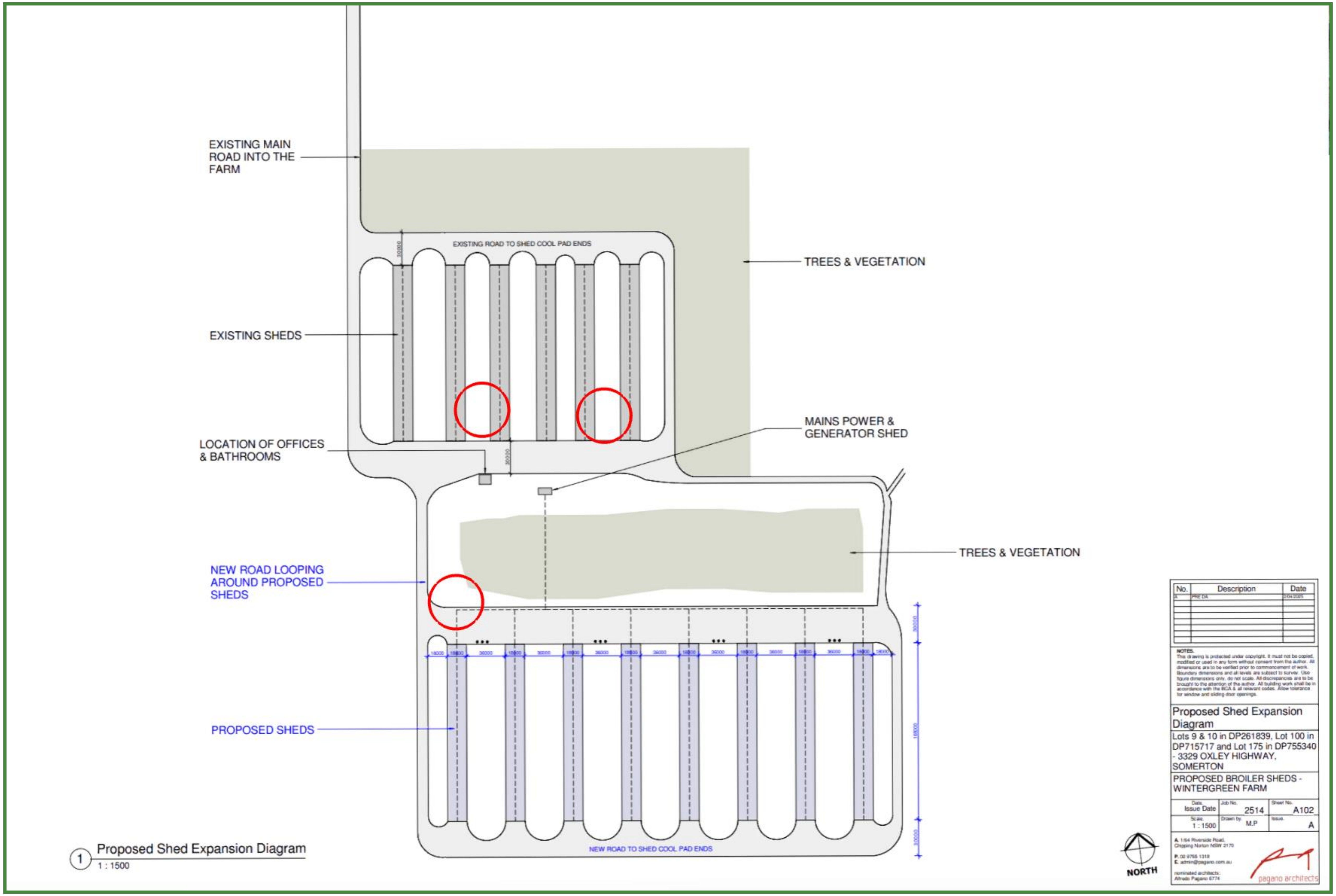


Figure 4-4: Heat of Radiation 3 kW/m^2 Contours – Model 7



5. CONSEQUENCE ESTIMATION

The consequences of an accident involving a particular hazardous substance depends on the type and quantity of hazardous substance, the type of activity using the substance as well as the exposed population.

The consequences of a fire involving flammable gases were considered in the following areas of the site:

Heat of radiation figures from the detailed analysis showed that off-site receptors and existing onsite buildings are far removed from any heat of radiation.

Further detailed heat of radiation calculations are not warranted for this site as there are no residential properties on the site boundaries, the separation distances fully comply between site boundaries and the LPG tanks. Further, on adjoining properties there are no fuels or potential sources of heat with sufficient heat of radiation generated to warrant further fire protection than what is recommended in AS/NZS 1596:2014 *The storage and handling of LP gas*.

6. FIRE PROTECTION

The reviews undertaken of AS/NZS standards and other documents, state that the most effective form of fire protection is for there to be no release of LP Gas or if any release occurs, the ability to immediately isolate the gas flow.

Good engineering design where any spillage or leakage of LP gas is able to flow away from the surface of a tank, significantly reduces the risk of a pool fire being able to engulf a tank.

Fires adjacent to a tank are limited by adopting the recommended separation distances. The risk of a jet fire occurring was investigated as part of the fire safety study and the heat of radiation has been assessed and is presented in section 4.7 it shows that the heat of radiation for 3kW/m^2 is limited to 24m distance.

By ensuring the installation is carried out to AS/NZS Standards and the installation is certified, then the risk of a jet fire is considered to be suitably managed.

Water would not be effective in extinguishing a jet fire. Isolation of the gas flow from several remote locations is considered to be the best option.

In accordance with AS 1596 section 13.5.1:

- Clause b is considered applicable as each tank is less than 8kL and is sufficiently separated, therefore the adjacent sheds are to be supplied with a basic tap water supply that is capable of operating a garden hose for minor fire risks.
- If is also recommended fire extinguishers be used as a substitute to a hose reel installation to also satisfy clause c given that water availability requirements cannot readily be met.
- A hydrant system is not required as individual tanks are less than 50kL capacity (clause e).

It is recommended the site have a Fire Fighting Trailer (typically holding 1,000L-2,000L) that can be pulled by an on-site farm vehicle be available onsite.

6.1 TRAINING PROGRAMME

Management would ensure operators are trained to understand the characteristics of LP gas, the hazard that exist, how fires occur and the action to take in the event of a gas leakage.

The Emergency Plan would include the procedures that need to be understood and be followed. The means of isolating gas flow are the most critical.

Training records need to be maintained.

7. FIRE PREVENTION/PROTECTION STRATEGY

Following is a review of the fire prevention and protection measures that shall be implemented on-site to ensure that the current development complies with the relevant Australian Standards and the BCA.

7.1 IGNITION SOURCES

The prescribed minimum separation distances to potential ignition sources shall be observed for all storage areas on-site. No smoking is permitted inside or within the close vicinity of the Class 2 storage areas. Smoking on-site is only permitted in a designated lunch area in the administration area. Only Zone 1 Class 1 forklifts shall be used on-site.

7.2 SECURITY AND SIGNAGE

Staff will be in attendance during normal operating hours. Outside of these hours when the site is closed it will be locked and secured to prevent unauthorised access.

The dangerous goods depot will display signage in accordance with the Dangerous Goods (General) Regulation 1999 and National Standard NOHSC:1015(2001) - Storage and Handling of Workplace Dangerous Goods. In accordance with Schedule 2 of NOHSC:1015(2001), a "HAZCHEM" outer warning placard will be located at all vehicle entrances to the site, to notify emergency services that hazardous chemicals are stored on the site.

7.3 SEPARATION DISTANCES TO PROTECTED WORKS AND ON-SITE FACILITIES

Adequate separation distances are a means of avoiding potential hazard escalation. The locations of the depot will comply with the minimum separation distances stipulated in of AS 4332–2004(R2016) and AS/NZS 1596:2014.

7.4 PROVISION FOR ESCAPE

Provision for escape during the event of a fire must be made in accordance with Part D1 of the BCA. Exit travel distances readily satisfy the requirements of Clause D1.4.

7.5 FIRE DETECTION

The main system for fire detection would be the staff on the Site as they would be able to quickly detect any leaks of materials, via visual or odour recognition, which may lead to an increased fire risk. Once such situations are detected appropriate *first response* action would be taken. Smoke detectors will be fitted to all administration and office areas.

7.6 FIRE PROTECTION EQUIPMENT

In accordance with AS 1596 section 13.5.1:

- Clause b is considered applicable as each tank is less than 8kL and is sufficiently separated, therefore the adjacent sheds are to be supplied with a basic tap water supply that is capable of operating a garden hose for minor fire risks.

- If is also recommended fire extinguishers be used as a substitute to a hose reel installation to also satisfy clause c given that water availability requirements cannot readily be met.
- A hydrant system is not required as individual tanks are less than 50kL capacity (clause e).

It is recommended the site have a Fire Fighting Trailer (typically holding 1,000L-2,000L) that can be pulled by an on-site farm vehicle be available onsite.

7.7 FIRE BRIGADE

The nearest fire brigade is Manilla Fire Station, approximately 16 km northwest of the site.

7.8 FIRE SERVICES DESIGN

The requirements for firefighting are principally based on AS/NZS 1596:2014.

A gas fire is expected to be terminated by stopping the flow of gas.

There is limited presence of combustible materials at this facility. Combustible materials present are the following:

- 2,000 L self-bunded diesel storage;
- Chicken litter within sheds;
- Grass and vegetation on-site;
- Building materials used in structures on site; and
- Forklift trucks and motor vehicles.

The sources of fire involving LP Gas are a release of gas which is able to find an ignition source. The LPG installation requires limited firefighting equipment by incorporating the engineered fire safety requirements of AS/NZS 1596:2014.

8. CONTAINMENT OF CONTAMINATED FIRE FIGHTING WATER

For LPG installations isolation of firefighting water would not be expected to be required given the nature of the installation being predominantly free of chemicals.

9. CONCLUSIONS

A Preliminary Hazard Analysis (PHA) has been undertaken for the proposed expansion of Wintergreen Farm to accommodate 810,510 birds across 14 tunnel-ventilated sheds. The assessment focused on the storage and handling of dangerous goods, particularly the installation of eight 7,500 L LPG tanks (40,000 L total) to service heating systems.

Key findings include:

- The volume of LPG stored exceeds the SEPP 33 screening threshold for Class 2.1 flammable gases, triggering assessment as a potentially hazardous development under SEPP (Resilience and Hazards) 2021;
- LPG tanks will be split between two areas (4 per pod of 6 sheds);
- Consequence and frequency modelling found the worst-case LPG incident falls within the *negligible* societal risk zone; and
- Identified risks are effectively mitigated through adherence to AS/NZS 1596:2014, appropriate separation distances, and emergency response procedures.

Given the outcomes of the assessment, the PHA has found that the operation of the proposed development readily meets the criteria laid down in HIPAP No. 4 *Risk Criteria for Land Use Safety Planning* and would not cause any risk, significant or minor, to the community, with the recommended safeguards in place.

Throughout the preparation of this PHA, it has been determined that the proposed development meets all the safety requirements stipulated by DPHI, and compliance with the Work, Health and Safety Regulation, 2017. The development as proposed would not be considered to be an offensive or hazardous development.

Prepared by:

[redacted]	[redacted]	[redacted]
Senior Engineer	Environmental Scientist	Principal Consultant

10. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Wintergreen Farm, as per our agreement for providing environmental services. Only Wintergreen Farm is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Wintergreen Farm for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

11. REFERENCES

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