Core Engineering Group • Fire • Risk • Emergency Management

Goodman Property Services (Aust) Pty Ltd
1-11 Hayes Road
Rosebery NSW 2018

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Fire Safety Strategy

Lot 4E

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Report Details

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Report Revision History

REV	DATE ISSUED	COMMENT	PREPARED BY	REVIEWED BY	VERIFIED BY
01	31/05/2021	Draft Issue for comment	**Julian Rajkumar** *BEng (Mechanical Engineering)*	**Dean Watt** *BEng (Chemical Engineering) (Hons)*	**Graham Morris** *MEng (Structural and Fire Safety)* *MIEAust CPEng NER (Fire Safety)* *Registered Certifier – Fire Safety (3200)* 
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EXECUTIVE SUMMARY

CORE Engineering Group have been engaged by Goodman Property Services (Aust) Pty Ltd to develop a Fire Safety Strategy (FSS) for the proposed building, Lot 4E of the Oakdale West Industrial Estate in Kemps Creek. This FSS provides an overview of the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building.

Due to the complexity of the building design, a fully prescriptive approach of complying with the Building Code of Australia 2019 Amendment 1 (BCA) [1] Deemed-to-Satisfy (DtS) provisions for occupant egress, fire resisting construction, fire services, and fire brigade intervention is unlikely to satisfy the desired architectural and client aspirations. As such, Performance Solutions to satisfy the Performance Requirements of the BCA have been proposed to account for the following issues which have been identified within the BCA Report not to comply with the DtS Provisions:

- C2.4 – Perimeter vehicular access with minor non-conformances.
- D1.4 – Extended travel distances to the nearest exit within the warehouse.
- D1.5 – Extended travel distances between alternative exits within the warehouse.
- E1.3 – External hydrants positioned beneath awnings.
- E1.5 – Sprinkler booster location.
- E2.2 – Manual smoke clearance system installed in lieu of an automatic smoke exhaust system.

This FSS provides a holistic summary of the fire and life safety measures anticipated to be necessary in developing the above listed Performance Solutions. These measures include passive and active fire protection systems, egress provisions, occupant first aid firefighting, fire brigade intervention, and future building management provisions.

The complete fire engineering analysis will be included within the Fire Engineering Report (FER), undertaken in accordance with the International Fire Engineering Guidelines (IFEG), and as such is not documented herein.

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1 INTRODUCTION

1.1 OVERVIEW

This Fire Safety Strategy has been undertaken to nominate proposed Performance Solutions for assessing compliance with the nominated Performance Requirements of the BCA [1] in accordance with the methodologies defined in the IFEG [3] and provide a workable and safe Fire Safety Strategy through a trial design. In order to develop and assess the nominated non-compliances the following flowchart process is to be adopted.

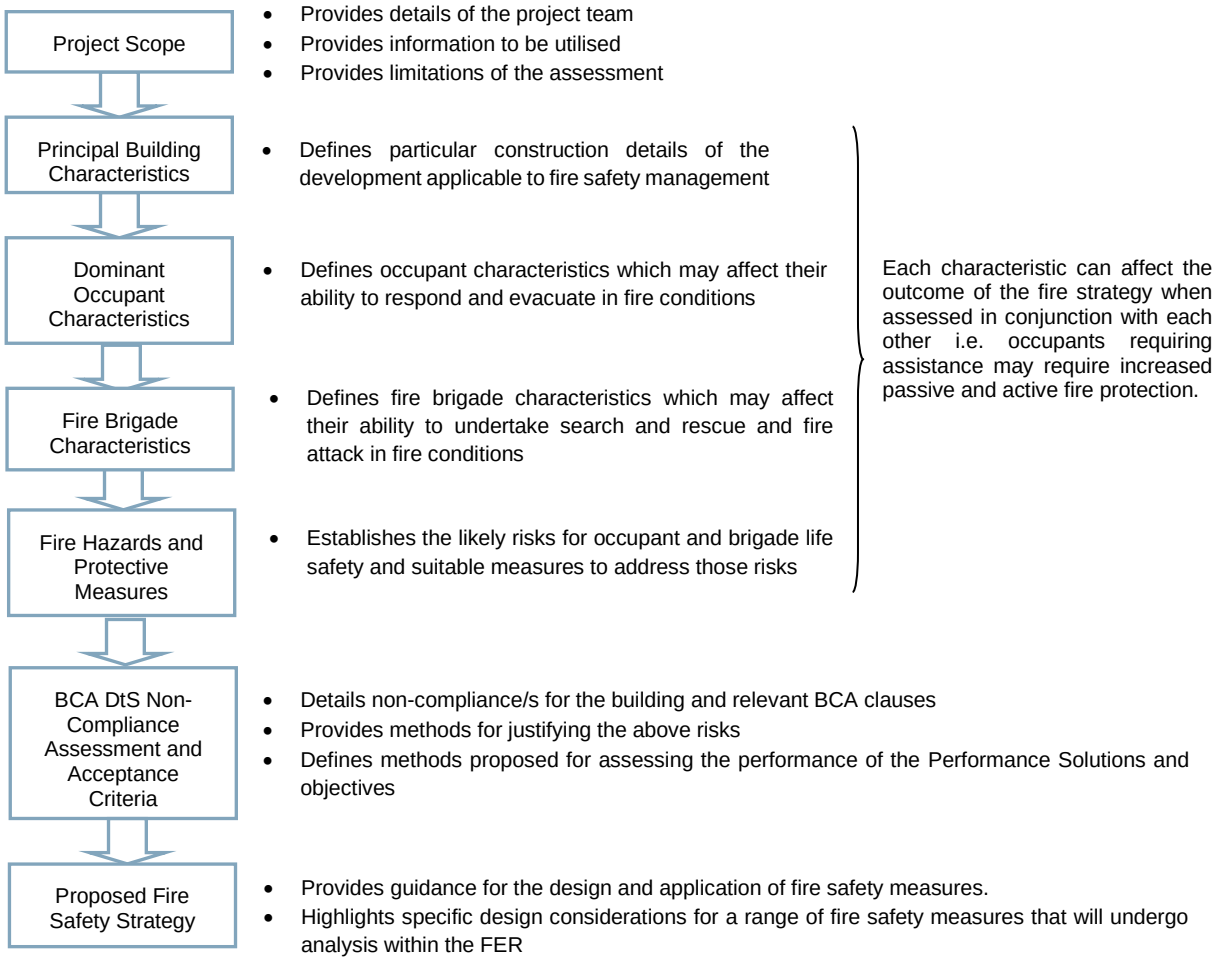


Figure 1-1: Fire Safety Strategy Process

1.2 FIRE SAFETY OBJECTIVES

The objective of this Fire Engineering Assessment is to develop a Fire Safety System, which satisfies the performance requirements of the BCA whilst maintaining an acceptable level of life safety, protection of adjacent property and adequate provisions for Fire Brigade intervention. At a community level, fire safety objectives are met if the relevant legislation and regulations are complied with. As stated in the BCA, "*A Building Solution will comply with the BCA if it satisfies the Performance Requirements*". In addition to this, certain non-regulatory objectives exist as detailed below.

1.2.1 Building regulatory objectives

The following items are a summary of the fire and life safety objectives of the BCA:

- **Life safety of occupants -** the occupants must be able to leave the building (or remain in a safe refuge) without being subject to hazardous or untenable conditions. The objective of the Fire Engineering

Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of exposing building occupants to hazardous or untenable conditions in an event of a fire.

- **Life safety of fire fighters -** fire fighters must be given a reasonable time to rescue any remaining occupants before hazardous conditions or building collapse occurs. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would facilitate fire brigade intervention and minimise the risk of exposing fire fighters to hazardous or untenable conditions in an event of a fire.
- **Protection of adjoining buildings** - structures must not collapse onto adjacent property and fire spread by radiation should not occur. The objective of the Fire Engineering Assessment is to demonstrate that the proposed building design and fire safety systems would minimise the risk of fire spreading from one building to another.

1.2.2 Fire Brigade objectives

The overall philosophical Fire Brigade objectives throughout Australia are to protect life, property and the environment from fire according to the Fire Brigade Intervention Model (FBIM) [5] as per the Fire Services State and Territory Acts and Regulations.

Over and above the requirements of the BCA, the Fire Brigade has functions with regard to property and environmental protection and considerations regarding occupational health and safety for its employees.

1.2.3 Non-prescribed objectives

Fire Engineering has an overarching benefit to many facets of the built environment where non-prescribed objectives can have an influence on the Fire Safety Strategy adopted. Although not assessed within, the following can be considered if requested.

- **Business continuity -** will the loss of a particular facility due to fire / smoke damage result in excessive financial impact on the client? For example, is the facility critical to business continuity?
- **Public perception -** should a fire occur within the facility is there likely to be questionable public perception about the safety and operation of the facility?
- **Environmental protection -** fires of excessive sizes can have significant effects on the environment which may require a detailed risk assessment to minimise such outcomes.
- **Heritage salvation -** buildings can have a heritage value for both cultural and educational purposes which can be destroyed by insufficient fire protection.
- **Risk mitigation / insurance limitations -** are there specific limitations on insurance with respect to risk mitigation and fire safety design? i.e. Does the relevant insurer have concerns with respect to open voids through the building?
- **Future proofing (isolation of systems) -** what flexibility is required in the overall design to allow for future development or changes in building layout?
- **Occupational Health and Safety (OHS) requirements -** buildings may have specific fire safety requirements pertaining to OHS requirements.

1.3 REGULATORY FRAMEWORK OF THE FIRE ENGINEERING ASSESSMENT

1.3.1 Building Code of Australia

One of the goals of the BCA is the achievement and maintenance of acceptable standards of safety from fire for the benefit of the community. This goal extends no further than is necessary in the public interest and is considered to be cost effective and not needlessly onerous in its application.

Section A2.1 of the BCA [1] outlines how compliance with the Performance Requirements can be achieved, being satisfied by one of the following:

(a) A Performance Solution which demonstrates–

  (i) Compliance with all relevant Performance Requirements; or

  (ii) The solution is at least equivalent to the Deemed-to-Satisfy Provisions; or

(b) A Deemed-to-Satisfy Solution; or

(c) a combination of (1) and (2).

Section A2.2 of the BCA provides several different methods for assessing that a Performance Solution complies with the Performance Requirements, through one or a combination of the following Assessment Methods:

(a) Evidence of suitability that shows the use of a material, product, form of construction or design meets the relevant Performance Requirements.

(b) A Verification Method including the following:

  (i) the Verifications Methods in the NCC; or

  (ii) other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements.

(c) Expert Judgement.

(d) Comparison with the Deemed-to-Satisfy Provisions.

Where a Performance Requirement is satisfied entirely by a Performance Solution, the following method must be used to determine the Performance Requirements relevant to the Performance Solution:

(a) Identify the relevant Performance Requirement from the Sections or Part to which the Performance Solution applies.

(b) Identify Performance Requirements from other Sections of Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Performance Solution.

Under Section A2.4, the following method must be used to determine the relevant Performance Requirements when using a Performance Solution in combination with a Deemed-to-Satisfy Solution: These methods are summarised as follows:

(a) Identify the relevant Deemed-to-Satisfy Provisions of each Section or Part that are to be the subject of the Performance Solution.

(b) Identify the Performance Requirements from the same Section or Part that are relevant to the identified Deemed-to-Satisfy Provisions.

  (i) Identify Performance Requirements from the other Sections and Parts that are relevant to any aspects of the Performance Solution proposed or that are affected by the application of the Deemed-to-Satisfy Provisions that are the subject of the Performance Solution.

1.3.2 International Fire Engineering Guidelines

The IFEG [3] document has been developed for use in fire safety design and assessment of buildings and reflects world's best practice. The document is intended to provide guidance for fire engineers as they work to develop and assess strategies that provide acceptable levels of safety.

The document is particularly useful in providing guidance in the design and assessment of Performance Solutions against the Performance Requirements of the BCA. The prescribed methodology set out in the IFEG has been generally adopted in the Fire Engineering Report.

2 PROJECT SCOPE

2.1 OVERVIEW

CORE Engineering Group has been engaged to develop a FSS for the construction of Lot 4E at Oakdale West Industrial Estate, Kemps Creek, NSW 2178. The purpose of this FSS is to outline the fire engineering principles that will be utilised in ensuring that the prescriptive DtS non-compliances identified in the BCA report are resolved in order to conform to the building regulations and permit development approval.

The complete fire engineering analysis will be included within the FER, and as such is not documented herein. This document does however outline the construction and management requirements considered necessary to achieve an acceptable level of life safety within the building as a result of the Performance Solution and to satisfy the Performance Requirements of the BCA.

2.2 RELEVANT STAKEHOLDERS

This Performance Solution has been developed collaboratively with the relevant stakeholders as identified below:

Table 2-1: Relevant Stakeholders

ROLE	NAME	ORGANISATION
Development Manager	Stephanie Partridge	Goodman Property Services
BCA Consultant	Dean Goldsmith	Blackett Maguire + Goldsmith
Architect	Greg Baird William Ly	SBA Architects
Fire Engineer	Dean Watt Julian Rajkumar	Core Engineering
Registered Certifier – Fire Safety	Graham Morris	

It should be noted that at times some parties may have a vested interest in the outcome of the Fire Engineering assessment. Such parties can include local fire brigades, insurers, Environmental Protection Authority (EPA), project control groups, end users and community representatives. Although not always a legislative requirement, the design team should give due consideration to their inclusion in the Fire Engineering process. Where not required by legislation it is the client's decision to involve such parties, especially local fire brigade, to ensure a transparent and adequate fire safety solution for all. Where we are not notified of the inclusion of such parties it is assumed the client / representative has given due consideration to the above.

2.3 SOURCES OF INFORMATION

The following sources of information have been provided by the design team:

- BCA Report (No. 210239 Rev 0) by BM+G dated 26 May 2021.
- SEPP 33 Report (No. RCE-21076_SEPP33_Final_Rev(0)) by RiskCon dated 23 June 2021
- Architectural plans provided by SBA Architects, as indicated in Table 2-2.

Table 2-2: Drawings

DRAWING NO.	DESCRIPTION	ISSUE	DATE
OAK MP 01	Cover Sheet / Location Plan	B	28/05/2021
OAK MP 02	Estate Masterplan	C	02/06/2021
OAK 4E DA 30	Proposed Industrial Facility – 4E	C	25/06/2021

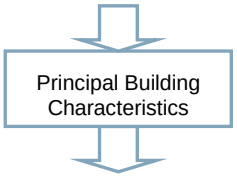
2.4 LIMITATIONS AND ASSUMPTIONS

In this instance the FSS is developed based on applicable limitations and assumptions for the development which are listed as follows:

- The report is specifically limited to the project described in Section 3.
- The report is based on the information provided by the team as listed above in Section 2.3.
- Building and occupant characteristics are as per Section 3 and 4 respectively of this report. Variations to these assumptions may affect the FSS and FER, and therefore should be reviewed by a suitably qualified Fire Engineer should they differ.
- As per any building design, DtS or otherwise, the report is limited to the fire hazards and fuel loads as prescribed in the IFEG [3]. The report does not provide guidance in respect to areas which are used for Dangerous Goods (DG) storage, processing of flammable liquids, explosive materials, multiple fire ignitions, or sabotage of fire safety systems.
- The development complies with the fire safety DtS provisions of the BCA [10] with all aspects in regards to fire and life safety unless otherwise stated in this report. Where not specifically mentioned, the design is expected to meet the BCA DtS requirements of all relevant codes and legislation at the time of construction and/or at the time of issue of this report.
- The assessment is limited to the objectives of the BCA and does not consider property damage such as building and contents damage caused by fire, potential increased insurance liability, and loss of business continuity.
- Malicious acts or arson with respect to fire ignition and safety systems are limited in nature and are outside the objectives of the BCA. Such acts can potentially overwhelm fire safety systems and therefore further strategies such as security, housekeeping, and management procedures may better mitigate such risks.
- This report is prepared in good faith and with due care for information purposes only, and should not be relied upon as providing any warranty or guarantee that ignition or a fire will not occur.
- The FSS and FER is only applicable to the completed building. This report is not suitable, unless approved otherwise, to the building in a staged handover.
- Where parties nominated in Section 2.2 have not been consulted or legislatively are not required to be, this report does not take into account, nor warrant, that fire safety requirements specific to their needs have been complied with.

3 PRINCIPAL BUILDING CHARACTERISTICS

3.1 OVERVIEW



Building characteristics are assessed as part of the fire engineering assessment due to the following:

1. The location can affect the time for fire brigade intervention and potential external fire exposure issues.
2. The structure will impact on the ability to resist a developing fire and support condition to allow occupants to escape the building and the fire brigade to undertake firefighting to the degree necessary.
3. The floor area determines the potential fire size and area required to be evacuated in the event of a fire.
4. BCA details such as Type of Construction, Class and Height will dictate passive and active fire safety systems.

3.2 SITE LOCATION

The development site is located in Kemps Creek, approximately 36 km west of Sydney's central business district. The Oakdale West Industrial Estate consists of 5 precincts which each contain several warehouses. This subject development is concerned with Lot 4E, located within Precinct 4 (refer to Figure 3-1).

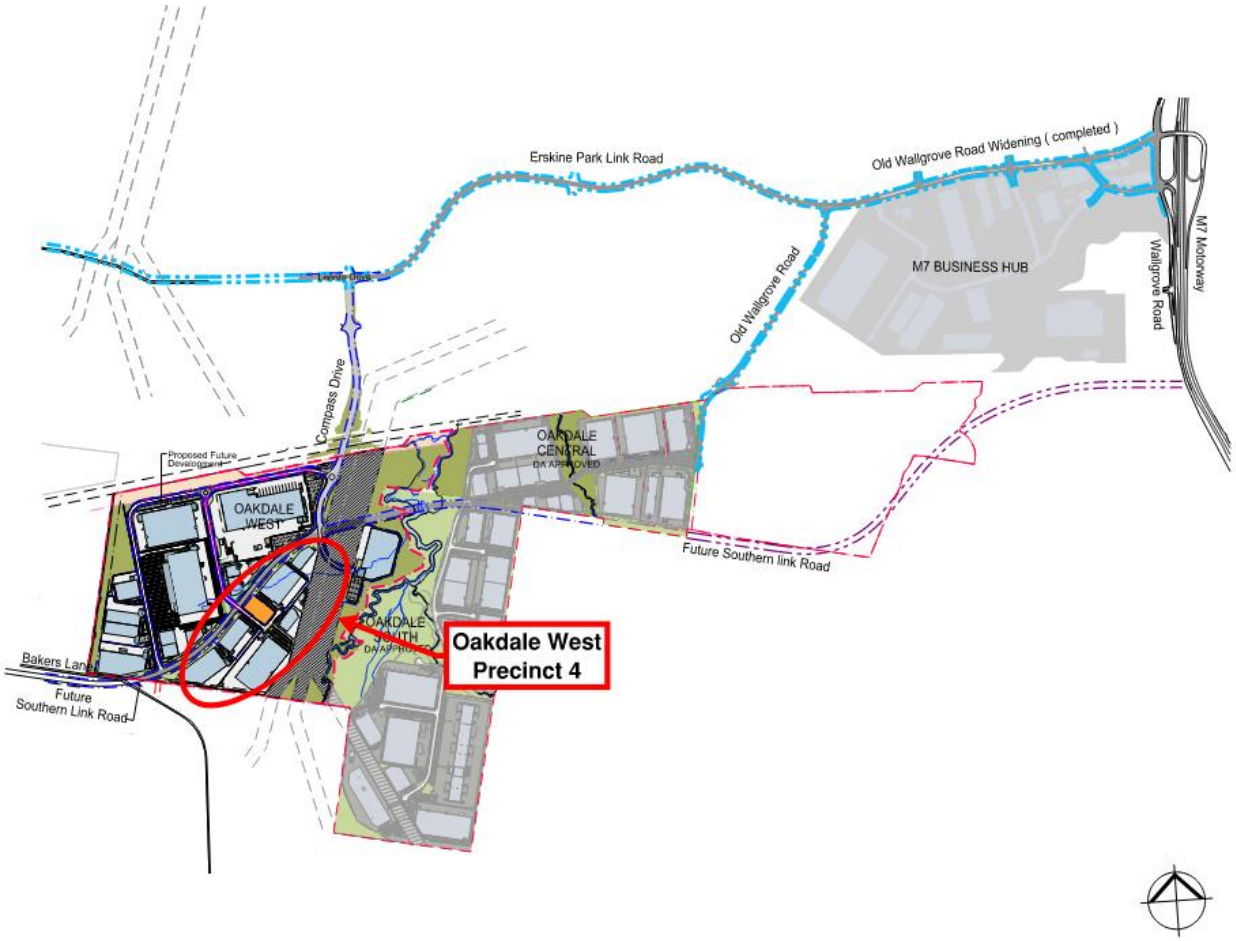


Figure 3-1: Oakdale West Location and Arrangement

Figure 3-2: Oakdale West – Estate Plan

The building site influences the likely fire brigade intervention times, and given the close proximity to the nearest fire station is expected to facilitate a relatively convenient and expedient fire brigade response. Furthermore, being located in an outer suburb of a major city, the development is provided with the services and facilities expected in an urban setting. The two nearest fire brigade stations provided with permanent staff are Huntingwood and Mount Druitt which are approximately 10.7 km and 10.9 km from the site, respectively, when considering actual driving directions.

3.3 SITE LAYOUT

The proposal includes the construction, fit-out and use of Building 4E as the first stage of development within Precinct 4 of the Oakdale West Estate (Stage 4 Development). The total area of the Lot 4E development site is approximately 73,650 m^2 and comprises of a single 34,000 m^2 warehouse, an attached two-storey office building totalling 1,000 m^2, two dock offices totalling 295 m^2 and a maintenance workshop totalling 200 m^2. Hardstand areas are available to the north-western, southern and south-eastern sides of the warehouse, with external carparking to the north-east.

It is also noted that the site shall be provided with two gate-houses, one adjacent to the main entry and another adjacent the eastern rainwater tanks, the combined area of which totals 65 m^2.

The warehouse is approved for subdivision, although this is not planned at this stage. The proposed development will facilitate warehouse and distribution uses consistent with the IN1 General Industrial zone under the State Environmental Planning Policy (Western Sydney Employment Area) 2009 and includes the storage and distribution of liquor. The layout of the site is depicted in Figure 3-3.

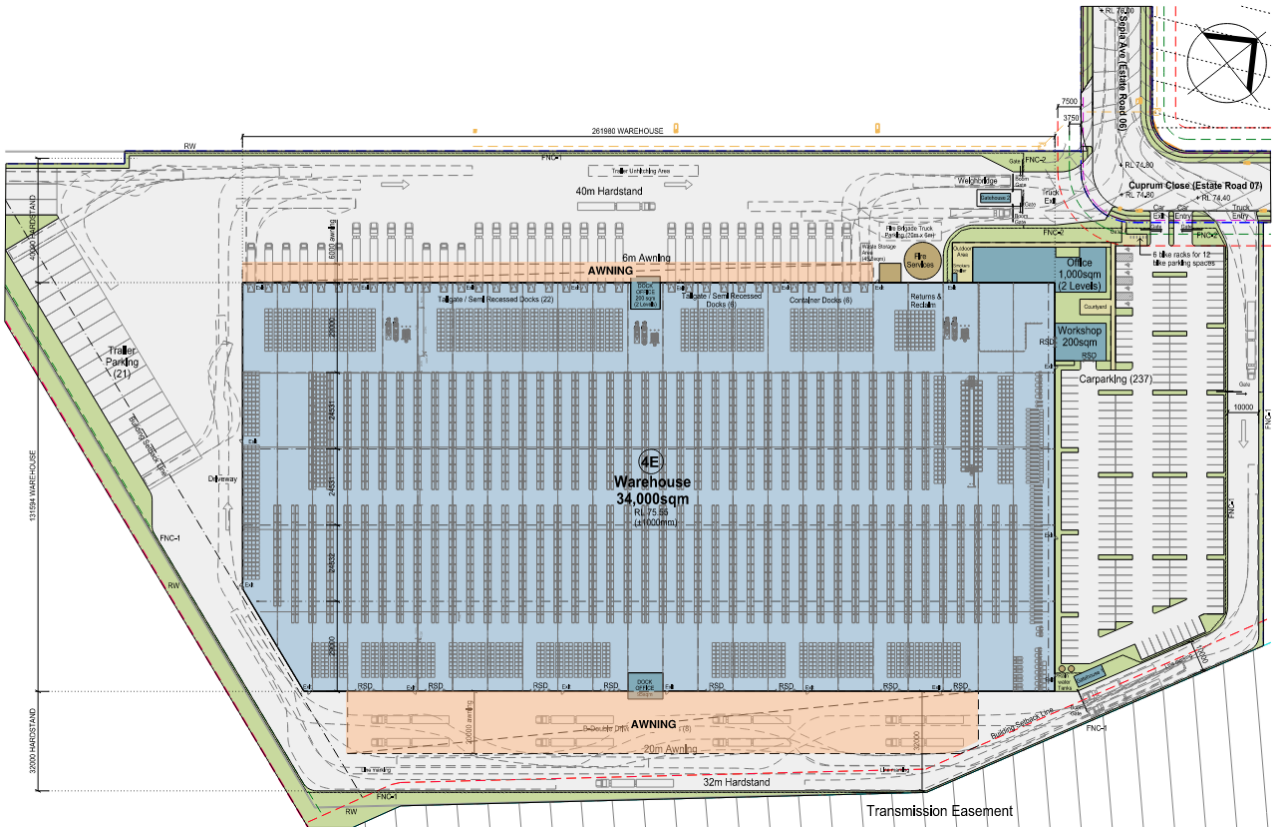


Figure 3-3: Site Plan

3.4 BUILDING STRUCTURE

The warehouse shall be constructed as a steel portal frame structure with dado panel walls and a metal sheet roof with internal steel columns. All materials and elements should achieve the requisite Fire Resistance Levels (FRL) and fire hazard properties associated with Type C construction.

It is noted that should the gatehouses be placed within 6 m of the main building, the openings are to be protected in accordance with Provision C3.3, with external walls achieving an FRL in accordance with Specification C1.1.

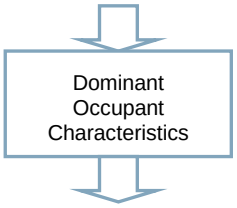
3.5 BCA ASSESSMENT SUMMARY

Table 3-1: BCA Building Characteristics

CHARACTERISTIC	DESCRIPTION	
Classification	Class 7b (Warehouse); Class 5 (Office)	
Construction Type	Type C Construction (Large-isolated building)	
Rise in Storeys	Two (2)	
Effective Height	Less than 12 m	
Floor Area	**Total:**	**35,560 m²**
	Warehouse	34,000 m²
	Main Office	1,000 m²
	Dock Offices	295 m²
	Workshop	200 m²
	Gatehouses	65 m²

4 DOMINANT OCCUPANT CHARACTERISTICS

4.1 OVERVIEW



The occupant characteristics are assessed within the Fire Safety Strategy due to the following:

1. Population numbers can dictate the time required to evacuate the building and the required life safety systems to be provided due to evacuation times.
2. Physical and mental attributes affect the occupants' capacity to respond to various fire cues and react accordingly.
3. Familiarity of occupants can affect the time taken to evacuate the building and subsequent active / passive requirements.

4.2 OCCUPANT NUMBERS AND DISTRIBUTION

The BCA assumes the following occupant densities per an area's function and use according to Table D1.13 [10]:

- Warehouse: 30 m² per person
- Office: 10 m² per person
- Workshop: 30 m² per person

These values result in the following estimated populations shown in Table 4-1 based on the floor areas provided in Section 3.5.

Table 4-1: Estimated Building Population (DtS Table D1.13)

BUILDING PART	FLOOR AREA	OCCUPANT NUMBER
Warehouse	34,000 m²	1134
Main Office	1,000 m²	100
Dock Offices	295 m²	30
Workshop	200 m²	7
Gatehouses	65 m²	7

In the absence of specific occupant numbers provided by the tenant, the population estimated from Table D1.13 of the BCA DtS Provisions will be utilised in the analysis. Whilst being highly unlikely for a facility of this nature, this therefore provides a conservative population in the warehouse parts.

It is noted that these numbers are only listed at this stage to provide conservative inputs to the fire engineering analysis and do not form the requirements for amenities and the like.

4.3 OCCUPANT ATTRIBUTES

Occupants in the building may be of mixed age, although the elderly and children are generally not expected to be present. The population is therefore expected to be that of the general working public and be adults between the ages of 16 to 70. Due to the expected nature of the work conducted the majority of occupants are assumed to be able bodied people with a small number of less mobile occupants requiring assistance during an evacuation.

All occupants are expected to be awake and alert adults or in the direct company of an adult, capable of entering the leaving the building under their own volition. Occupants in all of these areas are not expected to be adversely impaired by drugs, alcohol, fatigue or other adverse conditions to degrees greater than in other warehouse and office buildings.

- ***Staff and Security*** are expected to be mobile with normal hearing and visual abilities, and occupants in this group are considered to take and implement decisions independently, and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the building; and
- ***Clients / Visitors*** are expected to be mobile with normal hearing and visual abilities, this occupant group are expected to be capable of making and implementing decisions independently however may require assistance in locating the nearest and safest egress path in an emergency; and

- ***External Maintenance Contractors*** are expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. The contractors are expected to be awake and aware of their surroundings at all times when inside the building; and
- ***FRNSW*** are expected to be equipped with safety equipment and will be educated in firefighting activities and the dangers associated with fire incidents. This occupant group would be expected to be in a position to assist other occupants requiring assistance to evacuate. It is not expected that this occupant group would be present in the building at the time of fire ignition; however, they are expected to enter the building at a later stage to assist with the evacuation of occupants, if required, and to undertake fire suppression activities.

4.4 OCCUPANT FAMILIARITY

The majority of occupants within the building are expected to be staff and therefore the population in general are likely to react favourably in an emergency situation.

- ***Staff, Maintenance and Security*** can be expected to have a good familiarity with the building and the fire safety systems provided and may be trained in emergency procedures; and
- ***Clients and /or Visitors*** may or may not be familiar with the layout of the building and may require assistance in locating the exits; and
- ***External Maintenance Contractors*** this occupant group is expected to have a reasonable familiarity with the building as they would have to undergo site specific induction prior to commencement of work on site; and
- ***FRNSW*** are not expected to have any familiarity of the building layout, however are assumed to obtain the required information from the site block plans and tactical fire plans available prior to entering the building. Notwithstanding this they will be equipped with breathing apparatus and specialist equipment to prevent them from being adversely affected by fire hazards.

4.5 EMERGENCY TRAINING

Occupants should be familiar with escape procedures through fire drills and designated fire wardens being appointed to mitigate risks under Workplace Health and Safety legislation (AS 3745:2010). Clear escape routes should be maintained with doors unlocked, and no obstructions or rubbish to hinder evacuation.

5 FIRE BRIGADE CHARACTERISTICS

5.1 OVERVIEW

Fire brigade characteristics are assessed within the FSS as brigade characteristics can dictate the time required for fire brigade intervention including search and rescue, and fire attack.

5.2 FIRE BRIGADE ASSESSMENT

Figure 5-1 illustrates the site plan with fire services provided on the site. These include the fire indicator panel (FIP) within the Main Office, fire hydrant booster, sprinkler booster, sprinkler tank, pump room, and perimeter vehicular access path. It is noted that some of these locations are yet to be shown on the architectural drawings and therefore are to be confirmed.

It should be further noted that the hardstand area serving the sprinkler booster connection must be positioned at an angle no greater than 45° from the outlet's longitudinal direction as per Section 8.2 of FRNSW 'Fire Safety Guideline document *"Access for fire brigade vehicles and firefighters*' (refer to Figure 5-2).

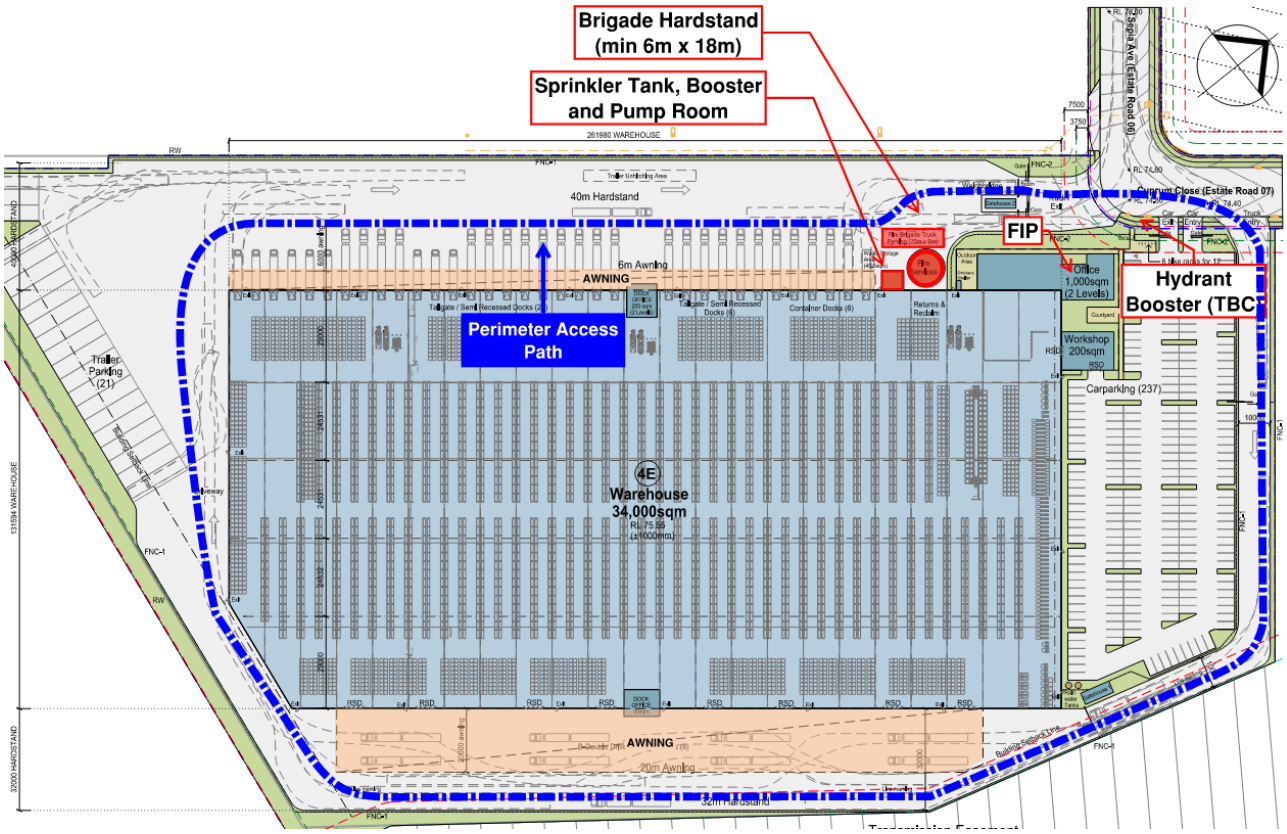


Figure 5-1: Fire Brigade Access and Sprinkler Booster Hardstand

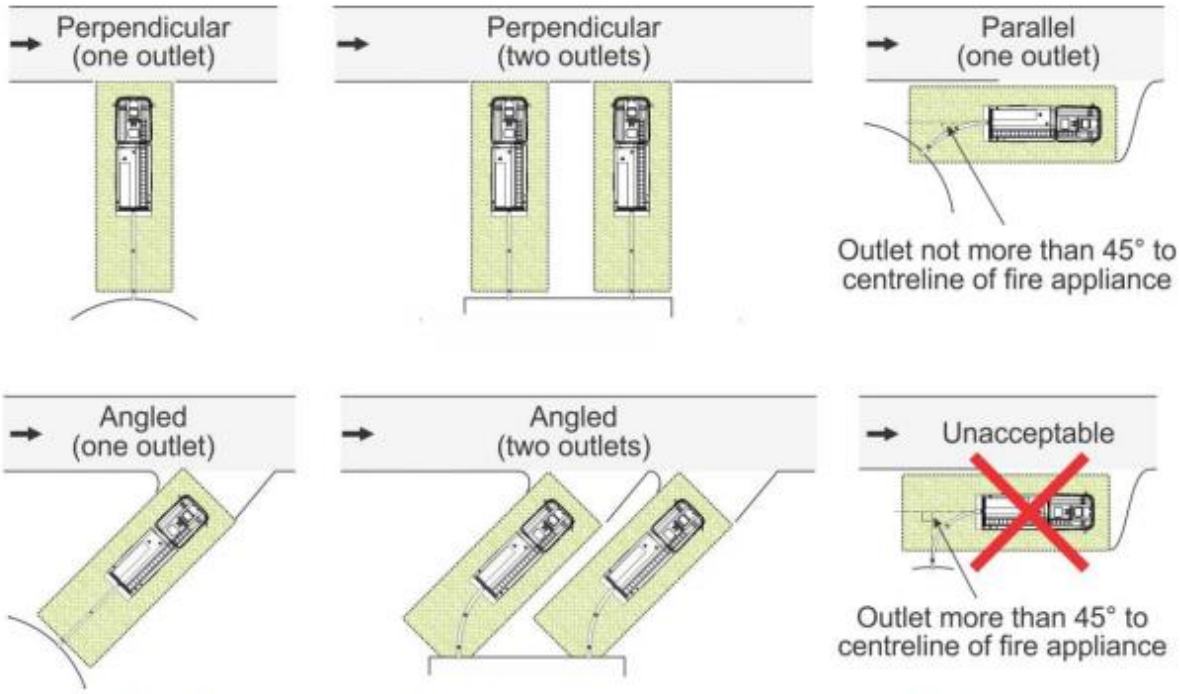


Figure 15 Example of orientation of hardstand area for suction-connection outlets

Figure 5-2: Excerpt from FRNSW Guideline – Hardstand and Booster Outlet Connection

6 FIRE HAZARDS AND PROTECTIVE MEASURES

6.1 OVERVIEW

The fire hazard analysis forms the basis for the review of non-compliances within the building. In assessing expected and statistically validated hazards, preventative and protective measures are developed commensurate with those expected risks. The following section reviews applicable hazards and recommends possible measures to address those risks. Furthermore, the hazards identified can form a justified basis for selected scenarios.

6.2 FIRE HAZARDS

Subsequent to a review of the relevant documentation, the identified fire hazards of this site are summarised below.

6.2.1 Combustible External Cladding

This building prescriptively requires Type C construction, where there is no restriction on combustible materials within the external walls of the buildings. However, should the design of the building propose any combustible elements, a detailed review and risk assessment is recommended.

6.2.2 Substation

A large network substation is proposed in the lot adjacent Lot 4E, as depicted in Figure 3-1. It should be noted that in accordance with Clause 3.2.2.2(f) of AS 2419.1:2005 all external fire hydrants and the fire hydrant booster must be located in a position not less than 10 m from any high voltage equipment, including the substation lot. The width of the road is approximately 15 m, which shall provide an adequate amount of separation between the substation lot and Lot 4E. It is also for this reason that brigade intervention is not expected to be impacted, despite FRNSW travelling directly adjacent the substation lot from the north-eastern side of the perimeter access path (refer to Figure 5-1).

6.2.3 Insulated Sandwich Panels

Should insulated sandwich panels be proposed within the facility (typically temperature-controlled areas or clean rooms), these shall be installed in accordance with the Code of Practice, IPCA Ltd Code of Practice (CoP) Version 4.3 dated 2017.

- ISPs must have a Group 1 Certificate when tested to AS ISO 9705 2003, or Class 1 to FM 4880 (relevant to PIR) and their fire performance is to be in accordance with the CoP.
- Certification should be provided from the accredited installer (e.g. a Code Compliant Company with the Code of Practice) that the panels (All EPS must meet AS 1366.3 1992, use only 100% FR bead) and the installation complies with the requirements of the CoP.
- The use of ISP's should be identified in accordance with the requirements of the CoP e.g. labels (see Annexure B of CoP for examples) being placed on all doors leading into the rooms that have utilised ISP systems;
- The key diagram required by the CoP is to be located at the fire indicator panel. The key diagrams shall indicate the locations and specification of all ISPs in the building and can assist firefighters when making operational decisions.

6.2.4 Dangerous Goods

The warehouse intended for the storage and distribution of liquor, expected to contain a maximum quantity of 87,000 kg at any one time. A portion of the alcohol products stored exceeds an ethanol percentage of 24%, resulting in a classification as a Class 3 Flammable Liquid under the Australian Dangerous Goods Code (ADGC).

A SEPP 33 analysis has been conducted by RiskCon Engineering (Report No. RCE-21076_Rev(0) dated the 23rd of June 2021). The analysis concluded that '*the facility will be compliant with "Applying SEPP 33" and thus the EPA regulation if the storage of flammable liquids is no closer than 10 m to the boundary"* – which is expected to be achieved in this instance.

Therefore, the SEPP 33 report has identified that as the facility is not classified as potentially hazardous, it is not necessary to prepare a Preliminary Hazard Analysis for the facility, as SEPP 33 does not apply.

The following recommendations are provided by RiskCon:

- *The documentation required by the Work Health and Safety Regulation 2017, applicable to the site DG storage(s), shall be prepared for the site prior to occupation.*
- *Review of the DG storage design against the applicable Australian Standards to ensure that the risks posed have been managed So Far As is Reasonably Practicable (SFARP).*

As a general note, to avoid being subjected to the storage requirements of AS1940:2017, potable spirits with an alcohol content of 24% or greater must be stored in containers of less than 5 L in capacity.

AS2118.1:2017 documents the commodity storage arrangement and sprinkler system guidelines for a building used for the storage of alcohol within Section 13. Within Table 13.3.2.1 of this standard, alcohol storage is divided into five distinct groups; Group 1 (71-100% v/v), Group 2 (51-70% v/v), Group 3 (31-50% v/v), Group 4 (21-30% v/v), Group 5 (0-20% v/v). Clause 13.3.1(a) states that Group 5 water-miscible liquids are not ignitable liquids, and therefore are not subjected to additional protection requirements.

For storage of alcohol which exceeds 20% v/v, it is expected that additional protection will be required in order to comply with AS2118.1:2017, i.e. Scheme A in-rack protection, or location of these spirits in area with reduced ceiling heights (TBC once tenant requirements are established and sprinkler design has been reviewed).

6.3 PREVENTATIVE AND PROTECTIVE MEASURES

6.3.1 Fire Initiation and Development and Control (Sub-System A)

To minimise the risk of fires initiating and growing to a size which may impact on the building occupants, fire safety systems are to be utilised within the building as listed in the following sections.

6.3.2 Smoke Development and Spread and Control (Sub-System B)

It is recognised that smoke is one of the most serious threats to life safety in the event of a fire. Whilst this warehouse will not be fitted with an automatic smoke exhaust system:

- The volume of the building will act as a large smoke reservoir to increase the available evacuation time for occupants.
- A manual smoke clearance system is to be provided in the warehouse.

6.3.3 Fire Spread and Impact and Control (Sub-System C)

To limit the extent and impact of fire spread through the building, the following are to be implemented.

- Type C construction.
- Sprinkler systems documented in Sub System D.
- The distances from the nearest fire source feature (site boundary) are greater than 3 m on all sides.

6.3.4 Fire Detection, Warning and Suppression (Sub-System D)

The following active systems are to be used within the building to facilitate occupant warning and suppress a potential fire.

- Occupant warning system.
- Storage mode sprinkler system at warehouse roof level.
- Sprinkler system to offices, car parks, and beneath awnings.
- Fire hose reels.
- Fire extinguishers.

6.3.5 Occupant Evacuation and Control (Sub-System E)

The building is to be provided with the following systems to assist in the evacuation of occupants:

- Emergency lighting.
- Exit signage.
- Multiple exits located on all four sides of the building.
- Emergency management plan.

6.3.6 Fire Services Intervention (Sub-System F)

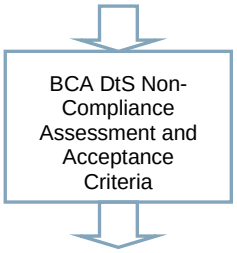
The building is to be provided with the following systems to assist in fire brigade intervention:

- Fire hydrant system.

- Automatic link to fire brigade.
- Control and indicating equipment (FIP).
- Continuous vehicular perimeter access with minor non-conformances.

7 BCA DTS NON-COMPLIANCE ASSESSMENT

7.1 OVERVIEW



In this instance the BCA DtS non-compliances have been formulated based on the regulatory review as provided by the principal certifying authority. Where not listed herein the building is required to achieve compliance with relevant DtS provisions or if existing, comply with relevant codes, reports and / or Standards approved at the time of consideration.

The following table lists the departures from the DtS provisions of the BCA for the proposed building and the analysis methodology proposed for the Fire Engineering assessment, which is to be generally in accordance with the IFEG [3].

7.2 BCA DTS NON-COMPLIANCE ASSESSMENT

Table 7-1: Summary of Performance Solutions

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
Perimeter Vehicular Access **BCA DtS Provisions** Provision C2.4: Requirements for open spaces and vehicular access **Performance Requirements** CP9	**Relevant BCA DtS Provisions** Provision C2.4: The building must be provided with continuous perimeter vehicular access with no part of the roadway less than 6 m in width and no more than 18 m from the building. **DtS Variation** The following non-conformances are present regarding the perimeter access pathway serving the building. • The vehicular access path is seen to be a maximum of 30 m away from the external wall of the building at the northern entry to the site. • The vehicular access path is seen to be up 60 m away from the external wall of the building along the north-eastern perimeter where the carpark is present. **Performance Solution** The Performance Solution relies upon the fact that staging for brigade appliances is available around the full extent of the continuous access path. The north-eastern carpark can be utilised as an alternative pathway to facilitate the access of personnel and smaller emergency vehicles.
Warehouse – Extended Travel Distances & Smoke Hazard Management **BCA DtS Provisions** Provision D1.4: Exit travel distances Provision D1.5: Distance between alternative exits Provision E2.2: Smoke hazard management –	**Relevant BCA DtS Provisions** Provision D1.4: travel distances to the nearest exit must not exceed 40 metres. Provision D1.5: travel distances between alternative exits must not exceed 60 metres. Provision E2.2 (Table E2.2a): requires a large isolated building be provided with an automatic smoke exhaust system with extraction rates as detailed in BCA Specification E2.2b and smoke zones no greater than 2,000 m². **DtS Variation** The following non-compliances exist within building: • Travel distances extend up to 90m to the nearest exit and 180 m between alternative exits. • A manual smoke clearance system is to be provided in lieu of an automatic smoke exhaust system. **Performance Solution** The Performance Solution relies upon the volume of the warehouse enclosure to provide a large smoke reservoir, and hence a longer time is available to permit occupant egress before the smoke descends. The population density inside the warehouse is expected to be low, with occupants likely to be awake, able bodied and capable of evacuating the building while tenability is maintained.

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
General requirements **Performance Requirements** DP4 & EP2.2	
Hydrants Under Awnings & Radiant Heat Shield Protection **BCA DtS Provisions** Provision E1.3: Fire hydrants **Performance Requirements** EP1.3	**Relevant BCA DtS Provisions** Provision E1.3: requires that a fire hydrant system is provided and installed in accordance with AS2419.1, which in turn requires internal hydrant to achieve coverage from a single hose length. **DtS Variation** Hydrants located beneath the warehouse awnings shall be treated as external hydrants, thereby allowing two hose lengths for coverage. External hydrants shall not be afforded the protection of a 90/90/90 FRL radiant heat shield 3 m above and 2 m either side of hydrant connection points, under the precedence set by the Standard AS2419.1:2017 for sprinklered buildings. **Performance Solution** The hydrants located beneath the awnings are to have all the requirements of an external hydrant per AS2419.1:2005, except that they are located under the building footprint and are not provided with 90/90/90 FRL heat shields. Fall-back hydrants are to be provided on the hardstand to provide coverage under the awnings.
Sprinkler Booster Location **BCA DtS Provisions** Provision E1.5: Sprinklers **Performance Requirements** EP1.4	**Relevant BCA DtS Provisions** Provision E1.5: A sprinkler system must comply with Specification E1.5 and hence AS2118.1:2017. **DtS Variation** The proposed location of the sprinkler booster assembly presents a technical non-compliance with AS2118.1:2017 under Clause 4.14 entitled “fire brigade booster assembly“. **Performance Solution** The sprinkler system is to meet all the requirements of AS2118.1:2017, except that the location of the sprinkler booster shall not conform explicitly with the requirements of Clause 4.14.1. Fire brigade access to the sprinkler booster shall not be hindered as a dedicated hardstand is provided, as per FRNSW guideline.

8 PROPOSED FIRE SAFETY STRATEGY

8.1 OVERVIEW

The FSS outlined below has been proposed to satisfy the fire and life safety objectives specified for this project by the relevant stakeholders. In addition, the FSS is required to adequately address the specific fire and life safety hazards identified for the proposed development, and as such have been generally derived from the preventative and protective measures outlined within the BCA, and fire engineering literature and research. Where items of non-compliance have not been identified by the design team in the concept design phase, it is expected that those items will be DtS solutions.

This section provides guidance for the design and application of fire safety measures. It highlights specific design considerations for a range of fire safety measures that will undergo analysis as part of the FER to ascertain whether the relevant Performance Requirements of the BCA are satisfied. Design guidance (general informative details and specific requirements) for a range of specific fire safety measures is provided. This list is not exhaustive and the use of other fire safety measures including new technologies will require additional review.

8.2 PASSIVE FIRE PROTECTION

8.2.1 Type of Construction Required

The building shall be built in accordance with the BCA DtS provisions for Type C fire-resisting construction, as a large-isolated building. As the building is greater than 3 m from a fire source feature, this means that no structural elements require an FRL.

8.2.2 Combustibility of External Wall

Warehouse 4E requires Type C construction, and as such there is no prescriptive requirement for materials in the external wall build-up to be non-combustible. However, given the global scrutiny on combustible façade materials, it is recommended to specify non-combustible cladding materials.

8.3 VEHICULAR PERIMETER ACCESS

The warehouse building is considered to be a large-isolated building. As such, a perimeter vehicular access pathway should be provided and shall be designed and constructed with an all-weather surface capable of supporting all FRNSW appliances in accordance with BCA Provision C2.4 and the FRNSW Fire Safety Guideline '*Access for Emergency Vehicles And Emergency Service Personnel*', available at http://www.fire.nsw.gov.au, with the following exceptions permitted:

- The vehicular access path is seen to be a maximum of 30 m away from the external wall of the building at the northern entry to the site.
- The vehicular access path is seen to be up 60 m away from the external wall of the building along the north-eastern perimeter where the carpark is present.

These non-compliant locations are depicted in Figure 8-1. To facilitate the perimeter access non-conformances, the following measures should be provided as part of the Performance Solution:

- The load-bearing capacity and vehicle swept path of the indicated vehicular access paths and carparks must be compatible with fire brigade vehicle requirements, and allow for travel in a forward motion.
- All gates, security fencing, and boom gates should be readily openable by the fire authorities. This can be achieved through one, or a combination of, the following [9]:
  - Any vehicle access gate that is required to be locked should be secured with a non-hardened metal chain and lock.
  - All locks fitted to vehicle access gates and security devices are to be keyed alike, and a copy of the key deposited with the two nearest FRNSW fire brigade stations or kept with the site security if 24/7 security is provided for the site.
  - Any electrically operated vehicle access gate or security device should incorporate either mechanical override, fail-safe open mode, or activated by site security so that fire appliances can access the site in the event of fire.

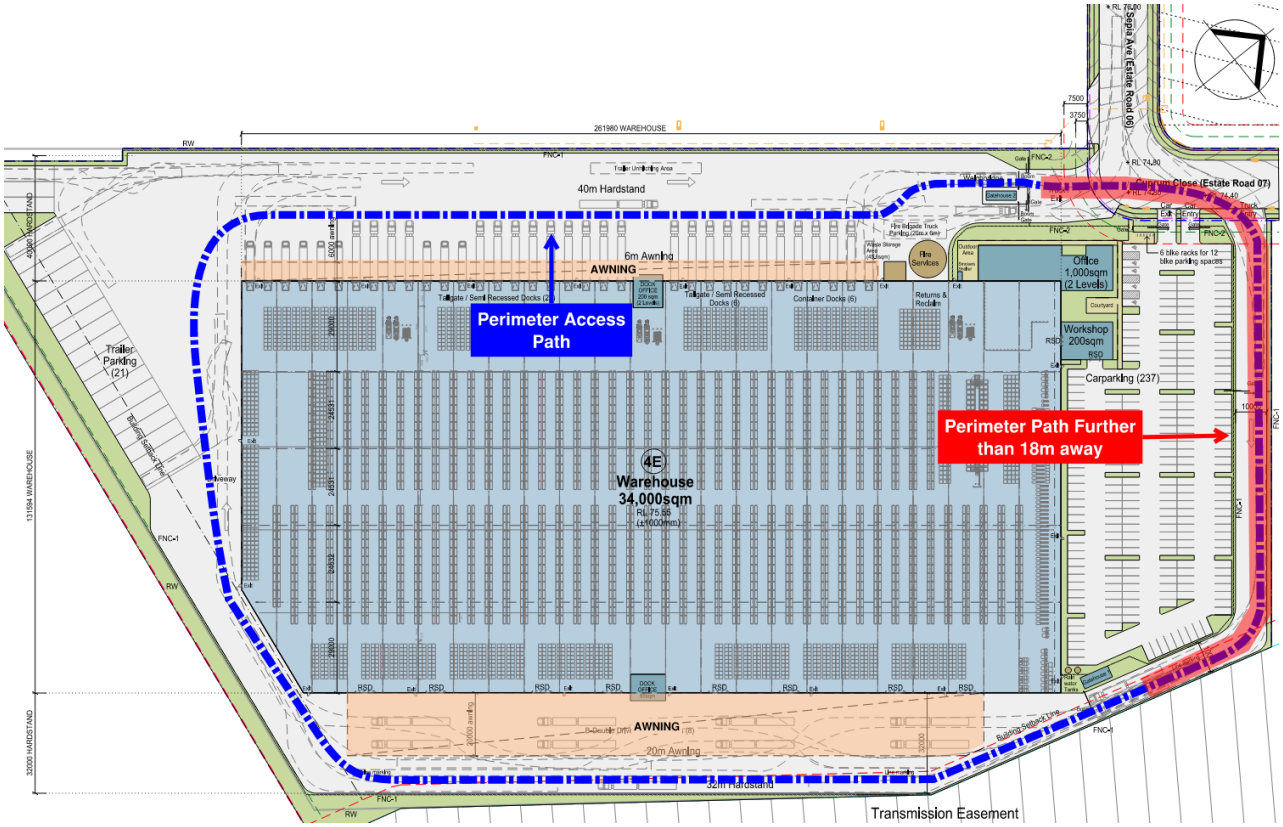


Figure 8-1 Non-Compliant Perimeter Access Path

8.4 EGRESS PROVISIONS

8.4.1 Evacuation Strategy

Activation of any sprinkler heads or detectors should initiate the evacuation of all areas of the building. Dedicated fire wardens from the warehouse and office areas should ensure that all clients, visitors, and staff are promptly evacuated.

8.4.2 Travel Distances

In the warehouse, the travel distances to the nearest exit and between alternative exits must be compliant with the BCA DtS requirements with the following exceptions identified:

- Within the warehouse, travel distances may extend up to 90 m to the nearest exit and 180 m between alternative exit, in lieu of 40 m and 60 m respectively.

These non-conformances shall be addressed through a Performance Solution.

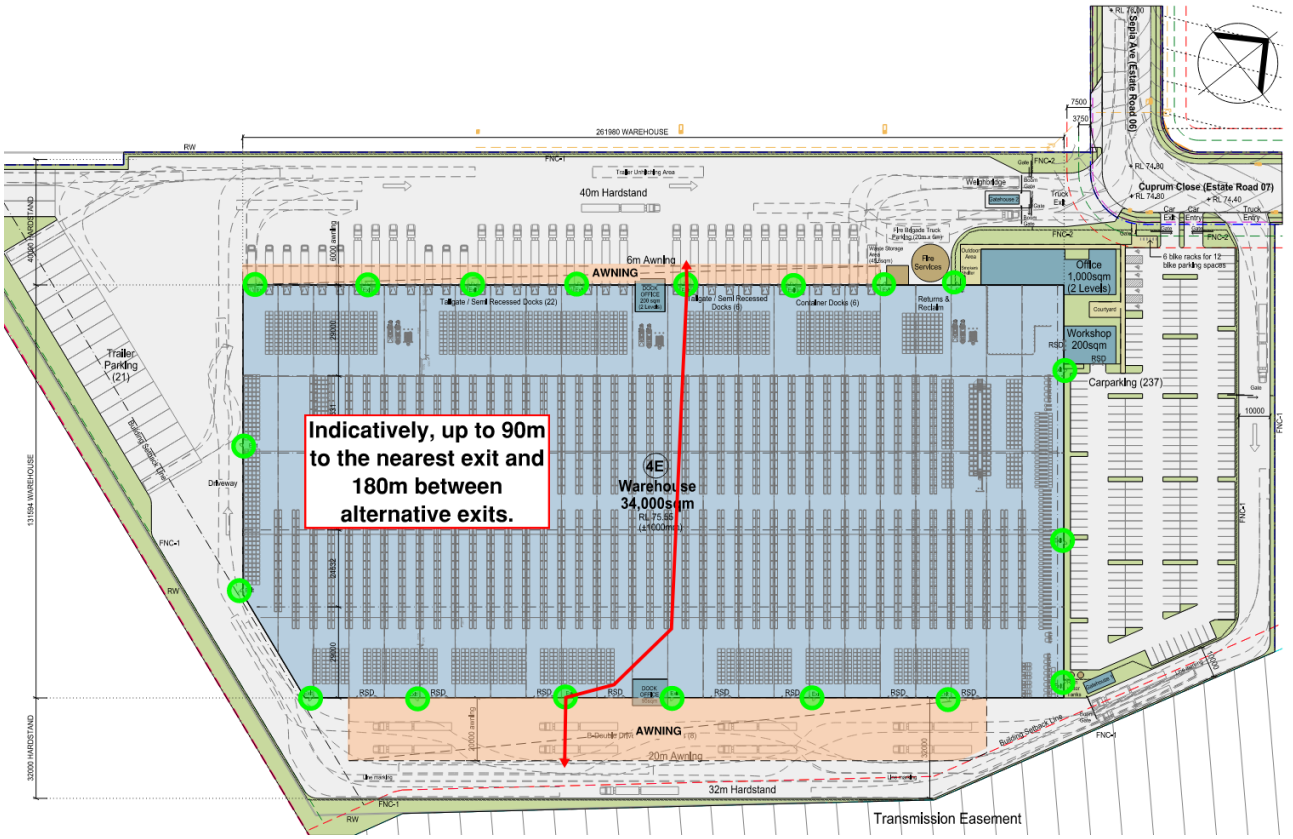


Figure 8-2: DtS Non-Compliant Travel Distances in the Warehouse

8.4.3 Door Hardware, Operation and Mechanisms

All exit doors and doors in a path of travel to an exit are required to be DtS compliant throughout the building. This includes the swing of doors, the applied latching and locking mechanisms and the force required on mechanism used to open sliding doors.

8.5 FIRE FIGHTING EQUIPMENT

8.5.1 Fire Hydrants

A dedicated fire hydrant system is proposed to serve Warehouse 4E, in accordance with BCA Provision E1.3 and AS2419.1:2005, with the following specifications:

- As far as possible, the hydrant system should consist of external hydrants. It appears possible based on the current arrangement to achieve coverage solely from external hydrants (including those beneath awnings)
- Hydrants located beneath the warehouse awnings can be considered external for coverage purposes, by way of a Performance Solution.
  - In this case, coverage of the area beneath the awning must be provided by compliant external hydrants i.e. additional fallback hydrants.
  - The hydrants under the awning must be designed with all requirements of external hydrants, other than that radiant heat shields are not required.
- Should future fit-out arrangements drive the requirement for internal hydrants to be provided, internal fire hydrants shall achieve floor coverage in accordance with the requirements of AS2419.1, and therefore such hydrants should be located to allow progressive movement of firefighters towards the central parts of the building, per the request of FRNSW.
  - When working from an external hydrant, the next additional hydrant should be located into the building not more than 50 m from the external hydrant.

  - When working from an internal hydrant (either from within a fire isolated exit or passageway, within 4 m of an exit or another additional hydrant), the next additional hydrant should be located not more than 25 m from that hydrant.[1]
  - An external hydrant should be provided adjacent to or within close proximity of each external entry/exit point around the building.
- All points on the floor shall be within 100 m of an external hydrant, as per FRNSW recommendation.
  - Pending confirmation of final fit-out, it is expected that the hydrant design is readily able to satisfy this requirement.
- A Performance Solution is proposed to omit radiant heat shield protection to external hydrants (including those under awnings), on the basis of the concession provided with AS2419.1:2017.
- The hydrant system must incorporate a ring main with isolation valves that are external to the building and numbered with the corresponding numbers indicated on the block plan at the booster assembly.
- All hose connections in the system are to be fitted in accordance with FRNSW Technical information sheet – FRNSW compatible hose connections (available at firesafety.fire.nsw.gov.au). These couplings should be tested as part of the system when the commissioning tests are undertaken.
- The hydrant booster assembly is proposed to be located at the entrance to the site, within sight of the main building entry (refer to Figure 5-1).

8.5.2 Fire Hose Reels

Fire hose reels shall be provided throughout the building in accordance with Provision E1.4 of the BCA and AS2441:2005.

All points on the floor should be within reach of a 4 m hose stream issuing from a nozzle at the end of the hose laid on the floor with a hose length not exceeding 36 m (i.e. a maximum of 40 m from the hydrant location).

However, should it be desired, it is possible to present a Performance Solution to enable the installation of 50 m fire hose reels – generally to enable hose reels located around the building perimeter only, or to limit the installation of hose reels in cold stores. Additional requirements to permit the use of 50 m hose reels are as follows:

- 50 m fire hose reels must be tested and certified to AS/NZS1221.
- The pressure and flow at the nozzle of the 50 m hose reel is to achieve compliance with the pressure and flow requirements of AS2441.1-2005.
- Coverage is to be achieved with no more than two bends in the hose.
- Staff training in the use of the 50 m length fire hose reels is to occur at least every 12 months to maintain occupant familiarity with the increased weight and length of the extended hose reels.

8.5.3 Fire Sprinkler System

A dedicated sprinkler system is to be provided to serve Warehouse 4E, in accordance with the relevant regulatory requirements.

- In the offices and beneath the warehouse awnings the system shall comply with BCA Specification E1.5 and AS2118.1:2017. If awning areas are proposed to be used for rack storage, the storage system will need to be extended to the awnings.
- In the warehouses, a storage system shall be provided in accordance with BCA Specification E1.5 and AS2118.1:2017. Sprinkler activation temperature must be no greater than 101°C and have a Response Time Index (RTI) of less than 50 $m^{1/2}s^{1/2}$ (i.e. fast response type).
- Additional measures to address the presence of Dangerous Goods are to be provided in accordance with AS2118.1:2017, as appropriate.

Upon sprinkler activation the building occupant warning alarm shall be initiated throughout the building and the direct brigade notification activated.

1 25 m and 50 m distances have been recommended by FRNSW to make allowance for shorter-than-standard hoses (repairs etc.) and unknown variables in the building layout and fixtures etc.

If deemed necessary, a Performance Solution may be proposed to assess the location of the sprinkler booster (i.e. does not conform explicitly with the requirements of Clause 4.14.1), based on previous FRNSW precedent of approval. This would be on the basis of:

- The fire sprinkler booster and the dedicated hardstand for fire brigade appliances being located as depicted within Figure 5-1. As per FRNSW's Guideline for Emergency Vehicle Access [9], each hardstand should be designed to be 18 m long by 6 m wide at a minimum, whilst allowing other fire brigade appliances to pass. The hardstand area serving a suction-connection outlet is to be positioned at an angle not greater than 45° from the outlet's longitudinal direction (refer to Figure 5-2).
- The fixed suction criteria being met, as set out in Clause 4.4 of AS2419.1:2017.

8.5.4 Portable Fire Extinguishers

Portable fire extinguishers are to be provided throughout the building in accordance with Table E1.6 of the BCA and selected, located, and distributed in accordance with AS2444:2001.

8.5.5 Control & Indicating Facilities

The FIP is to be provided within the main office of Building 4E as a fire control centre in accordance with DtS Provision E1.8. The FIP shall be installed in accordance with BCA Specification E2.2a and AS1670.1:2018 and have the following capabilities:

- Th FIP must be capable of isolating, resetting, and determining the fire location within the building.
- Red strobes shall be installed at the entry door to the FIP to alert arriving fire brigade of the fire alarm.
- Smoke clearance fan controls shall be placed at the FIP, and shall include clear signalling of the operational status of the fans.

In the event of future subdivisions, an additional Sub-FIP may need to be provided within the main entry of each tenancy if applicable.

8.6 SMOKE HAZARD MANAGEMENT

8.6.1 Smoke Detection System

A smoke detection system for occupant warning is unlikely to be required throughout the warehouse due to its large volume.

- In the event of future subdivisions of warehouse building into smaller tenancies, there might arise a need for smoke detection due to the reduced smoke reservoir volumes.
- In the event of travel distances in excess of the DtS Provisions being present in the building offices, detection will likely be required throughout each affected office in accordance with AS1670.1:2018.

8.6.2 Manual Smoke Clearance System

In lieu of the BCA DtS required automatic smoke exhaust system, the warehouse is to be provided with a manually operated smoke clearance system, and should be designed to achieve the following minimum requirements.

- System capacity must be capable of an exhaust rate equal to one enclosure air change per hour.
- Adequate make-up air should be provided at low level to facilitate the clearance system's designed operational capacity, whilst ensuring the inlet velocity does not exceed 2.5 m/s. The make-up air should be provided at a low level by:
  - Permanently open natural ventilation louvers; and/or
  - Perforated roller shutters; and/or
  - Mechanically operated louvers that open upon activation of the fans. All motors and cables to automatic louvers, vents or supply fans must be fire rated to operate at 200°C for a period of 60 minutes.
- Initiation switches should be located at the FIP.
- Signs and a mechanical block plan alerting the fire brigade to the operation of the smoke clearance system must be provided at the FIP.
- Fire rated fans and fire rated cabling should be designed to operate at 200°C for a period no less than 60 minutes.
- The fans shall be served by essential power.
  - Should it be proposed to locate the main switchboard internally, the DtS Provisions and fire engineering assessment do not rely on the main switchboard to be fire-rated as it does not sustain emergency

equipment operating in the emergency mode (for the reason that manual clearance fans are for post incident clear-up). However, it must be noted that FRNSW are currently reviewing their recommendations in this area and therefore if the design is progressed without a fire rated enclosure, this represents an FRNSW approval risk and limits flexibility for future tenants, for which the clearance system may need to be reprogrammed to be automatic.

- It is recommended that multiple fans be provided and be evenly distributed to otherwise comply with the requirements of Specification E2.2b Clause 5 of the BCA.

8.6.3 Building Occupant Warning System

A building occupant warning system should be provided throughout all parts of the building. The system should be in accordance with the prescriptive requirements of Specification E1.5 and Clause 7 of Specification E2.2a and AS1670.1:2018.

- The occupant warning alarm should be sounded throughout all areas of the building upon activation of the smoke detection or sprinkler systems.

8.7 VISIBILITY IN AN EMERGENCY

Emergency lighting and exit signage is to be provided throughout the building in accordance with BCA DtS Part E4 and AS2293.1:2018.

However, it is anticipated that the directional signage at the end of the racking aisles and above block storage areas can be installed at a height greater than 2.7 m. Should a Performance Solution be desired, it shall be on the basis of the following:

- Exit signs and directional signs shall be “Jumbo size” to increase the visibility to occupants.
- The final height and location of the directional exit signs shall be determined through the fire engineering analysis, to be no greater than 4.5 m AFFL.

8.8 BUILDING MANAGEMENT PROCEDURES

The ongoing management of the building is as important in maintaining a high level of life safety as the provisions recommended during the design phase of the building.

8.8.1 Maintenance of Fire Safety Equipment

The fire safety systems should be tested and maintained in accordance with Australian Standard AS1851 or other relevant testing regulatory.

The smoke clearance system should be tested in accordance with the AS1851 requirements for an automatic smoke clearance system as applicable.

8.8.2 Evacuation Plan

An emergency management plan should be developed for the site in accordance with AS3745:2010.

9 NOMENCLATURE

ACRONYM	EXPANSION
ABCB	Australian Building Codes Board
ADGC	Australian Dangerous Goods Code
AFSS	Annual Fire Safety Statement
BCA	Building Code of Australia
CFD	Computational Fluid Dynamics
DG	Dangerous Goods
DtS	Deemed-to-Satisfy
EPA	Environmental Protection Authority
FCC	Fire Control Centre
FER	Fire Engineering Report
FIP	Fire Indicator Panel
FRL	Fire Resistance Level
FRNSW	Fire Rescue NSW
FSS	Fire Safety Strategy
IFEG	International Fire Engineering Guidelines
NCC	National Construction Code
NFPA	National Fire Protection Association
OHS	Occupational Health and Safety
RTI	Response Time Index

10 REFERENCES

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