Core Engineering Group • Fire • Risk • Emergency Management

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Fire Safety Strategy

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Report Details

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Report Revision History

REV	DATE ISSUED	COMMENT	PREPARED BY	REVIEWED BY	VERIFIED BY
01	07/04/21	Draft Issue for comment	**Dean Watt** *B Eng (Chemical Engineering) (Hons)* *M Eng (Fire Safety)*	**Sandro Razzi** *BE (Building)* *Grad Dip (Performance Based Building & Fire Codes)*	
02	11/05/21	Final Issue			**Sandro Razzi** *BE (Building)* *Grad Dip (Performance Based Building & Fire Codes)* *Accredited Fire Engineer* *BPB 0501* *FIEAust* *CPEng 2180287*
03	05/04/22	Final Issue (revised scheme)			
04	30/06/22	Updated Issue (revised masterplan scope)		**Graham Morris** *MEng (Structural and Fire Safety)* *CPEng MIEAust NER*	

EXECUTIVE SUMMARY

CORE Engineering Group have been engaged by The GPT Group to develop a Fire Safety Strategy (FSS) for the proposed estate of 2 prospective warehouses under Stage 1, at 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 in the BCA Compliance Report not to comply with the DtS Provisions with respect to Warehouses 1 and 3:

- C2.4 – Perimeter vehicular access paths with minor non-compliances.
- 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 – Hydrants located under awnings.
- 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 Engineering Report 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.

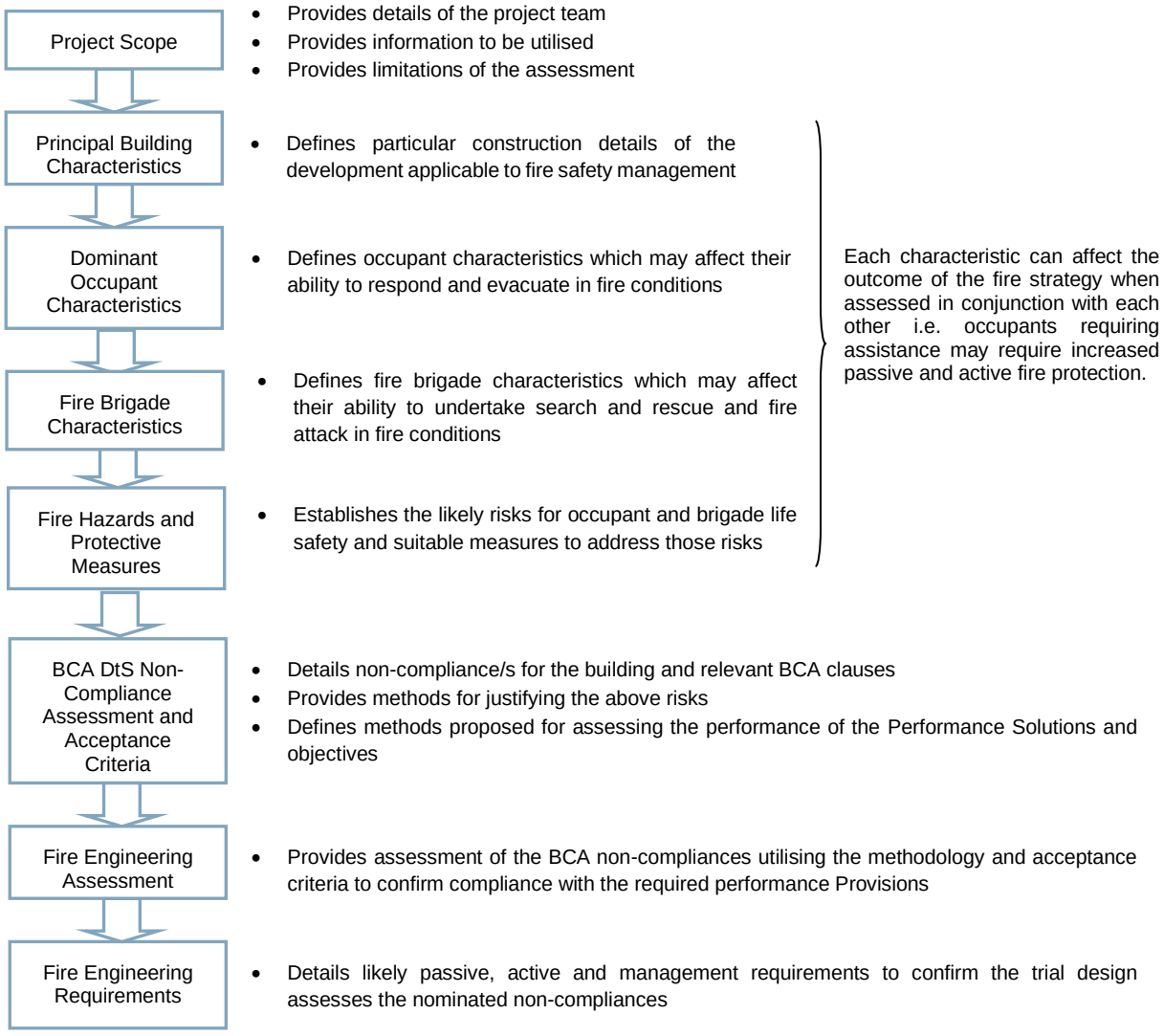


Figure 1-1: Fire Engineering Report Process

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) [7] 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 a warehouse estate at 754-770 & 784-786 Mamre Rd, Kemps Creek NSW 2178 which consists of 5 warehouse buildings, each provided with their own associated office spaces and hardstands. 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	Tom Falconer	The GPT Group
Principal Certifying Authority/BCA Consultant	Tom Johnston Dean Goldsmith	Blackett Maguire + Goldsmith
Architect	Alex Lai	SBA
Fire Safety Engineer	Dean Watt	CORE Engineering Group
C10 Accredited Fire Engineer	Sandro Razzi	

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 (210110, Revision 0) prepared by Blackett Maguire + Goldsmith for Stage 1 (consisting of Warehouses 1 & 3), dated 14 April 2021.
- Architectural plans provided by SBA Architects, as indicated in Table 2-2.

Table 2-2: Drawings

DRAWING NO.	DESCRIPTION	ISSUE	DATE
20194 – MP 01	SSDA Estate Masterplan	B	06/03/22
20194 – MP02	Estate Works Staging Plan	B	06/03/22
20194 – DA 110	Site & Warehouse E1 Plan	B	06/03/22
20194 – DA 310	Site & Warehouse 3 Plan	P4	07/05/21

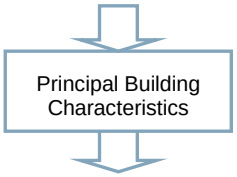
2.4 LIMITATIONS AND ASSUMPTIONS

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 39 km west of Sydney's central business district. The proposed estate shall consist of five lots located off Mamre Road, utilising proposed access roads.

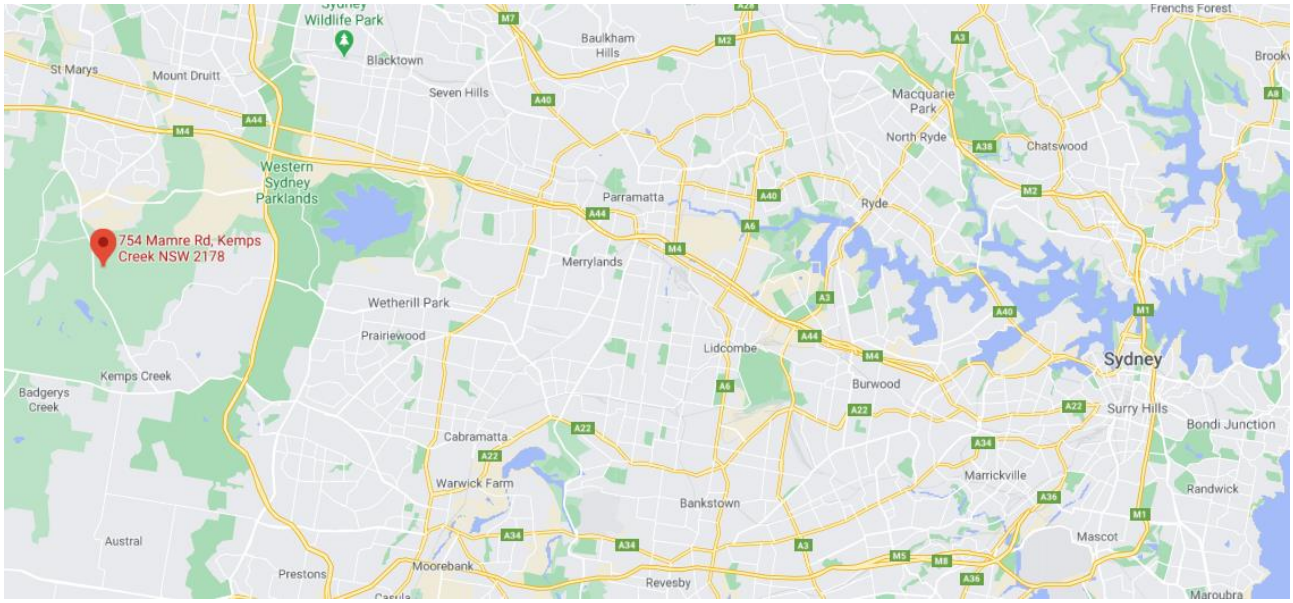


Figure 3-1: Site Location

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 St Marys and Mount Druitt which are approximately 9.2 km and 11.9 km from the site respectively, when considering actual driving directions.

3.3 SITE LAYOUT

The total area of the prospective estate is 332,000 m² and is proposed to have the layout as illustrated in Figure 3-2. The estate is not proposed to be subdivided and GPT will therefore continue to manage all lots on the estate. All constructed facilities will be leased to third party businesses.

Each site is anticipated to have a warehouse with a ridge height of 13.7 m, as well as ancillary offices depending on the number of tenancies proposed.

Onsite external carparking is available around the perimeter of the buildings, generally facing the new internal estate access road. Loading docks and associated hardstand for the warehouses are located off the estate access road.

Warehouses 1 & 3 are proposed to be included under Stage 1 works, which are depicted in Figure 3-3. Specifically:

- The northern road corridor (extent outlined in red) shall not be constructed at the time of Stage 1, being completed at a future time.
- A temporary turning circle (extent outlined in blue) shall be constructed during Stage 1, until the southern link road is completed at a future time.

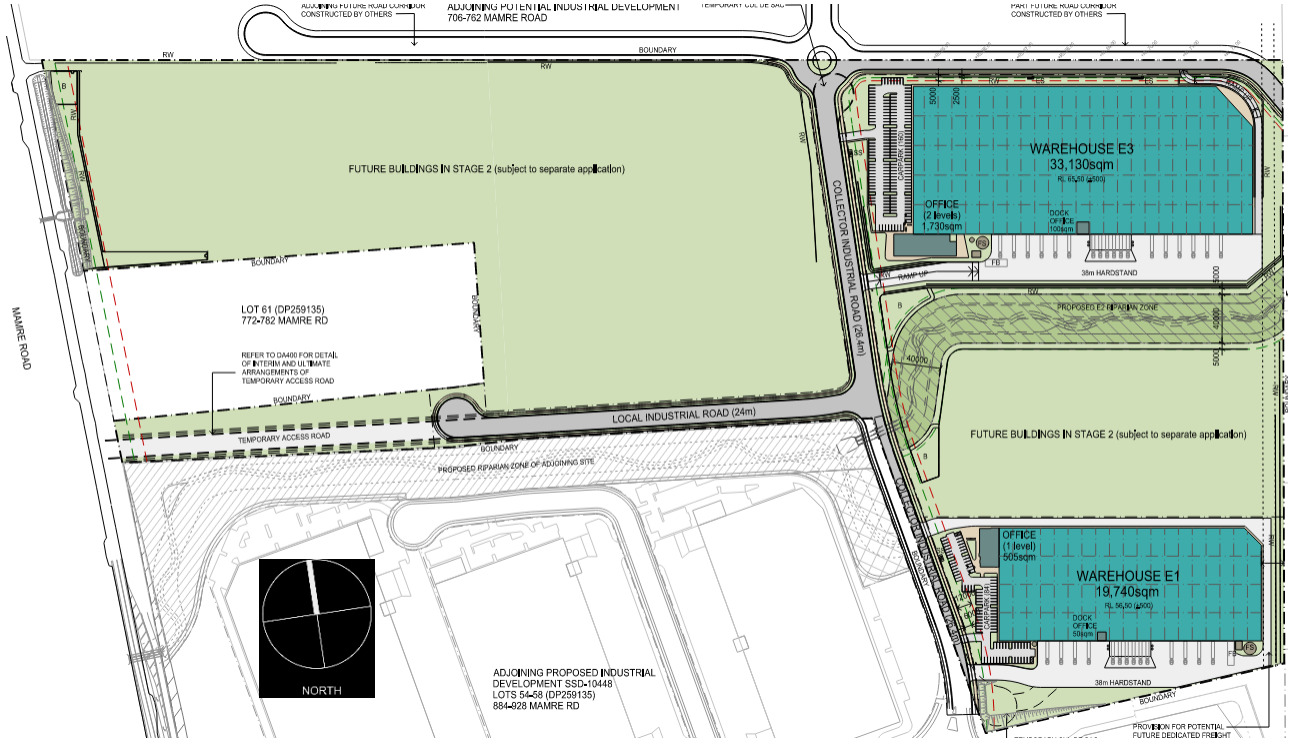


Figure 3-2: Estate Plan

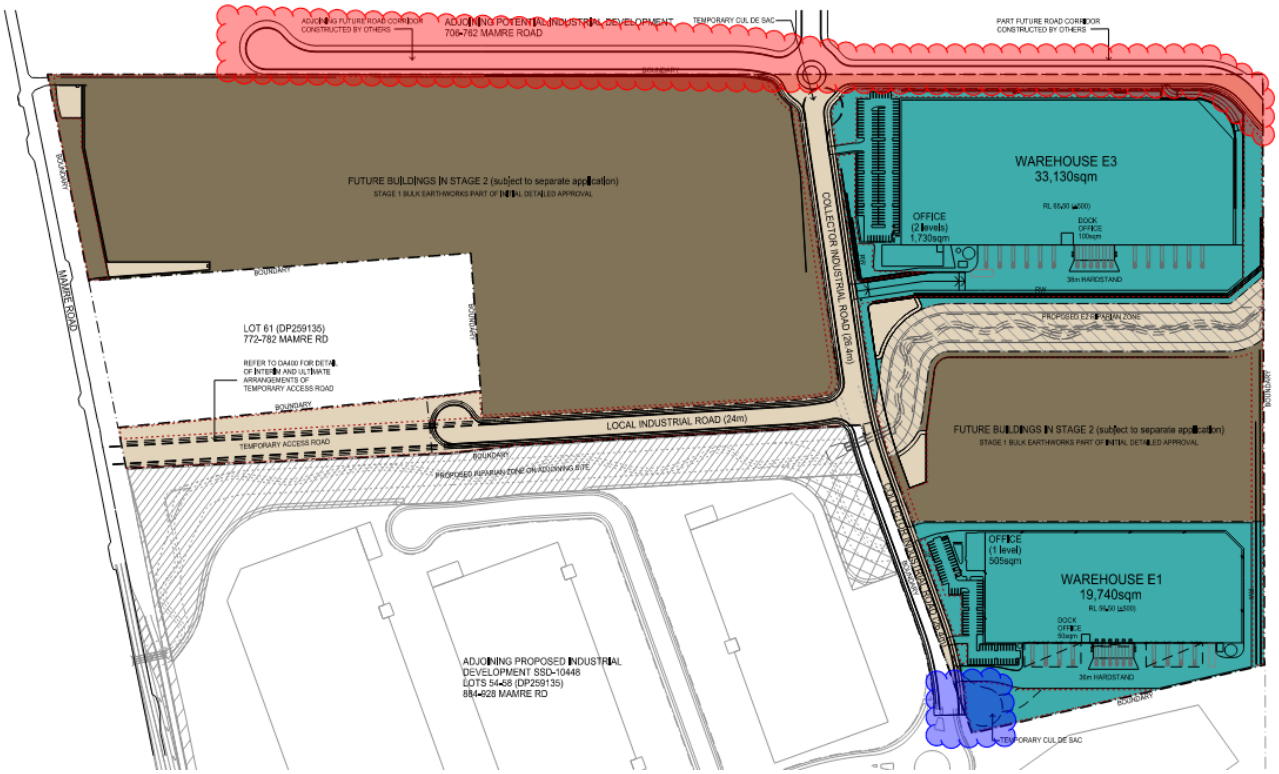


Figure 3-3: Estate Plan – Stage 1

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.

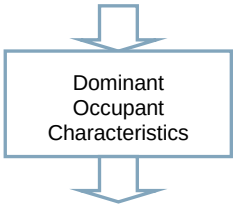
3.5 BCA ASSESSMENT SUMMARY

Table 3-1: BCA Building Characteristics

CHARACTERISTIC	DESCRIPTION
Classification	Class 7b (Warehouse); Class 5 (Office)
Construction Type	All warehouses: Type C Construction (Large-isolated building)
Rise in Storeys	Warehouse 1: One (1)* Warehouse 3: Two (2) **Potentially two (2), if offices are proposed to be 2 storeys*
Effective Height	Less than 12 m for each building
Floor Area	The total floor areas of each building are detailed below, and can be confirmed as more detailed drawings are provided. <u>Site 1:</u> • Warehouse 1: 19,740 m² • Office 1: 505 m² Total: **20,245 m²** <u>Site 3:</u> • Warehouse 3: 33,130 m² • Office 3 – Ground: 885 m² • Office 3 – Level 1: 845 m² Total: **34,860 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

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 1	19,475 m²	649
Office 1	505 m²	50
Dock Office 1	50 m²	5
Warehouse 3	36,320 m²	1,210
Office 3	1,730 m²	173
Dock Office 3	100 m²	10

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 these figures are highly unlikely for facilities of this nature, they therefore provide 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

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

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

The following figures illustrate the site plan with fire services provided on the site, including the fire hydrant boosters, sprinkler booster, sprinkler tanks, pump rooms and perimeter vehicular access path. System infrastructure such as hydrant boosters are yet to be depicted on the architectural schemes, and therefore are to be confirmed.

Each site shall be provided with a Main FIP within the site entry (i.e. office) which shall function as the Fire Control Centre. Where multiple tenancies are present within a single building, each office serving that respective tenancy shall be provided with a Sub-FIP.

Figure 5-1 depicts the final arrangement of infrastructure and perimeter access for Warehouse 1, while Figure 5-2 depicts the final arrangement of perimeter access for Warehouse 3 once the elevated northern road corridor is constructed. In the staged arrangement of Warehouse 3, the interim solution affords an encircling fire trail around the northern boundary.

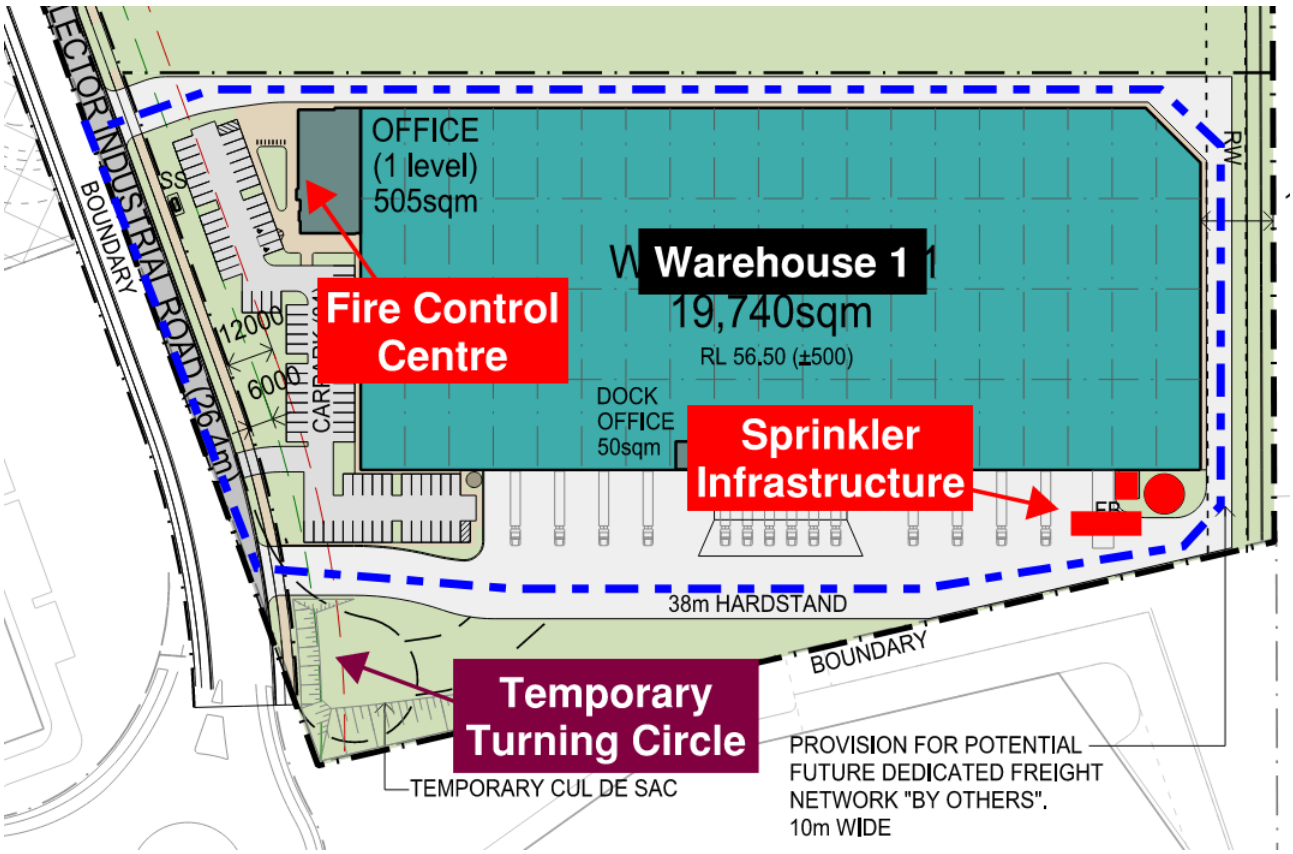


Figure 5-1: Fire Brigade Access and Site Facilities – Warehouse 1

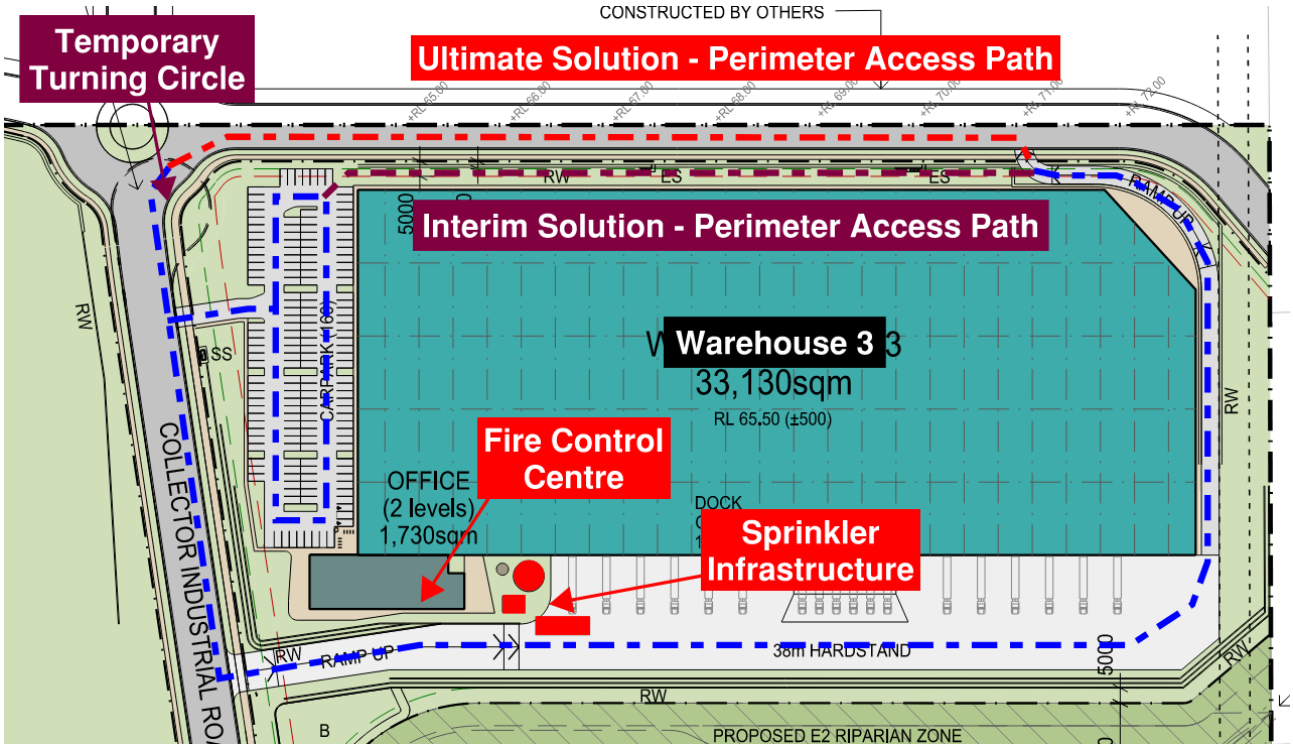


Figure 5-2: Fire Brigade Access and Site Facilities – Warehouse 3 (interim & ultimate solution)

The building is located within the Fire and Rescue New South Wales (FRNSW) jurisdictional turnout area. The closest two fire stations to the site that are provided with permanent staff are located in St Marys and Mount Druitt which are approximately 9.2 km and 11.9 km from the site, respectively.

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

The buildings included within this report prescriptively require 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 Insulated Sandwich Panels

Should insulated sandwich panels be proposed within the subject facilities (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 4881 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 respective 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.

6.2.3 Dangerous Goods

At this stage of the project, no tenants have been identified within the subject tenancies and so no Dangerous Goods storage requirements have been acknowledged.

Should the storage of Dangerous Goods be proposed, this must be in accordance with the relevant workplace health and safety regulations which will apply governing storage allowances (quantity) and requirements. The presence of DGs can also impact on the fire safety strategy and therefore must be reviewed in the context of fire spread, occupant evacuation and fire brigade intervention.

6.2.4 Automatic Storage and Retrieval Systems

There are various automated racking systems in the market for storage facilities as a general trend towards efficiency in distribution facilities. With the efficiency comes additional fire hazards to be considered. While automated racking systems have not been proposed in this facility at this stage, the following potential hazards will need further consideration if such a system is proposed:

- The dense storage arrangement restricts access to maintenance personnel only, with subsequent egress being typically complex in nature.
- The restricted access limits the ability for firefighters by conventional means to access the racking arrangement to suppress a fire and/or confirm a fire is extinguished.

- The live electrical system can create additional hazards for attending firefighters.
- The automated nature (moving parts) can contribute to fire spread and result in multiple sprinkler heads operating.

Should an automated system be proposed, this is likely to alter the fire safety strategy and the consideration of the holistic hydrant design (as this would be outside the scope of AS2419.1:2021), and so detailed consideration of the inherent risks to fire spread, occupant evacuation and fire brigade intervention is required.

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 each 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 the subject warehouses will not be fitted with an automatic smoke exhaust system:

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

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

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

- 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 buildings to facilitate occupant warning and suppress a potential fire.

- Occupant warning system.
- Storage mode sprinkler system within the warehouses at 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)

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

- Emergency lighting.
- Exit signage.
- Multiple exits located around the perimeter of each building.

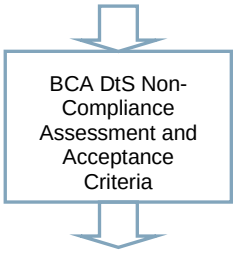
6.3.6 Fire Services Intervention (Sub-System F)

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

- Dedicated fire hydrant systems for each building with a hydrant booster valve.
- Fire hydrant coverage solely via external hydrants for Warehouse 1, with both external and internal hydrants required to serve Warehouses 3.
- Automatic link to fire brigade.
- Control and indicating equipment (FCC for each site).
- Vehicular perimeter access with minor non-conformances.
- Sprinkler booster valve.

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: Each building must be provided with continuous perimeter vehicular access with no part of the roadless less than 6 m in width and no more than 18 m from the building. The pathways must also permit the passage and operations of fire brigade appliances. **DtS Variation** The following non-conformances are present regarding the perimeter access pathways serving the subject buildings: • The perimeter access path serving Warehouse 1 is greater than 18 m along the western perimeter. • The perimeter access path serving Warehouse 3 is greater than 18 m along the western perimeter, and greater than 18 m along the northern perimeter for the ultimate solution. **Performance Solution** The Performance Solution relies upon the fact that staging for brigade appliances is available at all points along the provided vehicular access paths and upon the hardstands serving each warehouse. Additionally, brigade personnel are able to approach the building on foot in areas where the path exceeds 18 m from the building served. Carparks can also be utilised as an alternative pathway to facilitate the access of personnel and smaller emergency vehicles.
Warehouses – Extended Travel Distances & Smoke Hazard Management **BCA DtS Provisions** Provision D1.4: Exit travel distances	**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 to be provide 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 the subject buildings: • Travel distances extend up to 70 m to the nearest exit and 140 m between alternative exits within Warehouse 1. • Travel distances extend up to 90 m to the nearest exit and 180 m between alternative exits within Warehouse 3. • A rationalised smoke exhaust system is to be provided in each warehouse tenancy.

BCA DTS PROVISIONS	DETAILS OF PERFORMANCE BASED SOLUTION
Provision D1.5: Distance between alternative exits Provision E2.2: Smoke hazard management – general requirements **Performance Requirements** DP4 & EP2.2	**Performance Solution** The Performance Solution relies upon the large volumes of each warehouse enclosure to provide a large smoke reservoir and the automatic smoke exhaust system that initiates on sprinkler activation to increase the available time to permit occupant egress before the smoke layer descends.
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. Furthermore, AS2419.1 requires that external hydrants within 10 m of a building served must be provided with a 90/90/90 FRL radiant heat shield 3 m above and 2 m either side of hydrant connection points. **DtS Variation** Hydrants located beneath warehouse awnings shall be treated as external hydrants, thereby allowed two hose lengths for coverage. Further, external hydrants shall not be provided with radiant heat shielding. **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 on the basis that the buildings, including the awnings, are fully sprinkler protected. Fall-back hydrants are to be provided on the hardstand to provide coverage to hydrants located 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 assemblies presents a technical non-compliance with AS2118.1:2017 under Clause 4.14 entitled “fire brigade booster assembly“. **Performance Solution** Each sprinkler system is to meet all the requirements of AS2118.1:2017, except that the location of the sprinkler boosters shall not conform explicitly with the requirements of Clause 4.14.1. Fire brigade access to the sprinkler booster shall not hindered as a dedicated hardstand shall be provided in each instance, commensurate with FRNSW requirements.

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 subject buildings shall be constructed in accordance with the BCA DtS provisions for Type C fire-resisting construction, as large-isolated buildings.

The warehouses shall be constructed as a steel portal frame structure with dado panel walls and a metal sheet roof with internal steel columns.

8.2.2 Combustibility of External Wall

The subject buildings require 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 PERIMETER VEHICULAR ACCESS

The subject warehouse buildings are considered to be large-isolated buildings. As such, a perimeter vehicular access pathway should be provided to each 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 perimeter access path serving Warehouse 1 is seen to be up to 50 m away from the building along the south-western corner, in lieu of 18 m.
- The perimeter access path serving Warehouse 3 is seen to be up to 65 m away from the building along the western perimeter, in lieu of 18 m.
- The perimeter access path serving Warehouse 3 is seen to be up to 24 m away from the building along the northern perimeter for the ultimate solution, in lieu of 18 m.

These non-compliant locations are depicted in Figure 8-1 and Figure 8-2. 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 paths of the indicated vehicular access paths, hardstands and carparks must be compatible with fire brigade vehicle requirements, and allow for travel in a forward motion.
- Relevant to Warehouse 3 :
  - Interim Solution: an encircling fire trail is to be provided around the perimeter, either connecting back into the carpark or the turning circle in the north-western corner.
  - Ultimate Solution: the eastern perimeter should provide a ramp to connect the southern warehouse hardstand and the elevated east-west road corridor along the northern perimeter. The grade of this ramp must be in accordance with FRNSW's guideline, generally not being steeper than 1:8, and also having the appropriate transition grades.

- 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.

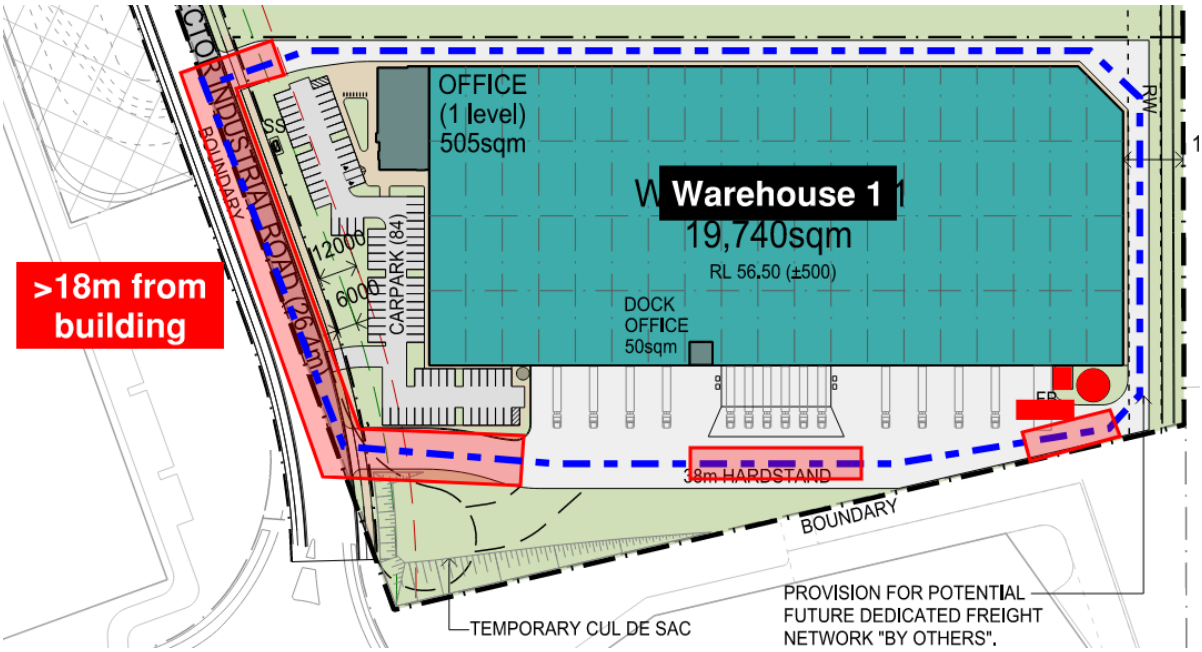


Figure 8-1 Non-Compliant Perimeter Access Path – Warehouse 1

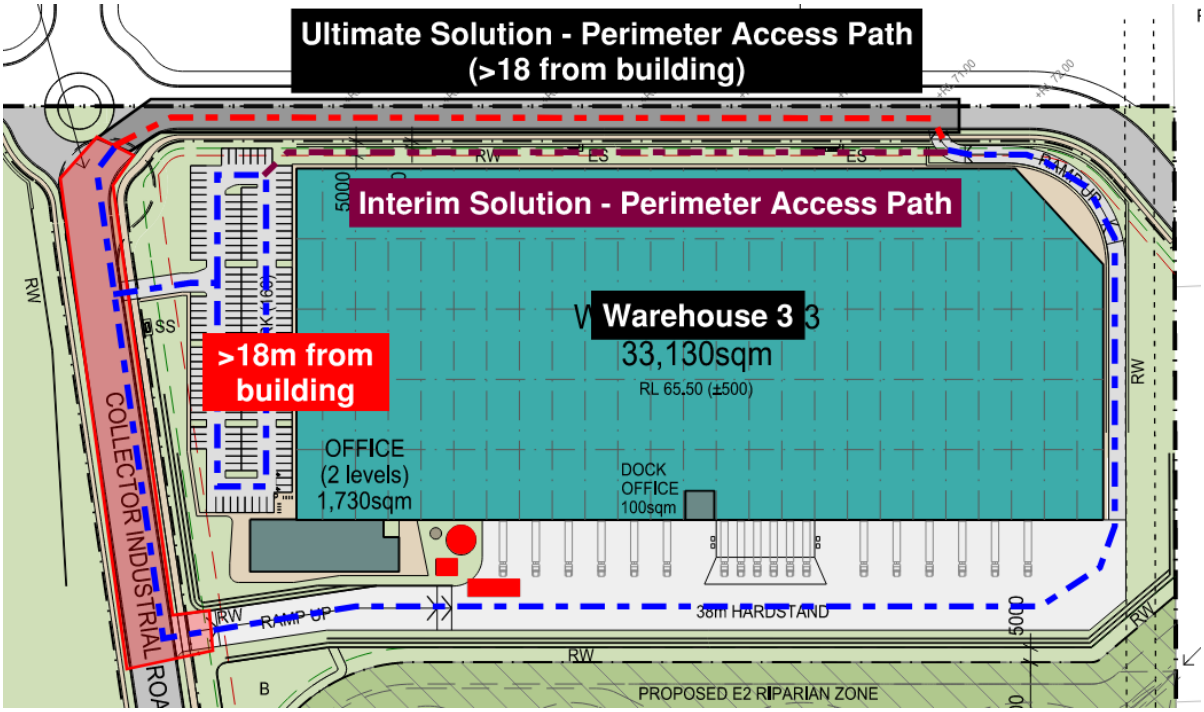


Figure 8-2 Non-Compliant Perimeter Access Path – Warehouse 3

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 respective building. Dedicated fire wardens from the warehouse and office areas of the affected building should ensure that all clients, visitors, and staff are promptly evacuated.

8.4.2 Travel Distances

In each of the subject buildings addressed within this report, the travel distances to the nearest and between alternative exits as specified by the relevant BCA DtS requirements (i.e. 40 m to the nearest and 60 m between alternatives) are exceeded. The non-compliances are presented below and illustrated in Figure 8-3 and Figure 8-4.

- Within Warehouse 1, travel distances extend up to 70 m to the nearest exit and 140 m between alternative exits.
- Within Warehouse 3, travel distances extend up to 90 m to the nearest exit and 180 m between alternative exits.

These non-conformances shall be addressed through a Performance Solution by utilising CFD modelling.

It should be noted that FRNSW has a policy of a maximum of 100 m of travel internally within a building, and recent consultation has revealed their stance is not subject to flexibility.

Further review may be undertaken following detailed design and incorporation of the fit-out. Should travel distances exceed 100 m to the nearest exit once the fit-out is coordinated, precedent would suggest that the implementation of fire-isolated tunnels is the primary method of resolution that FRNSW deem appropriate.

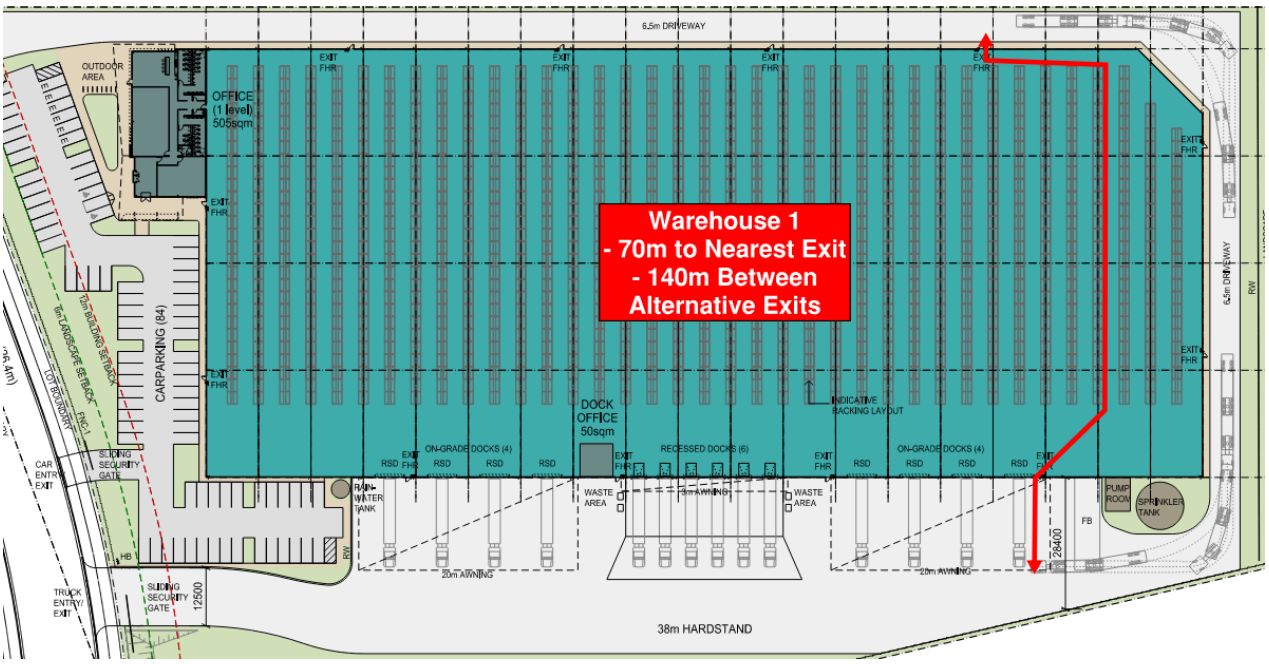


Figure 8-3 DtS Non-Compliant Travel Distances within Warehouse 1

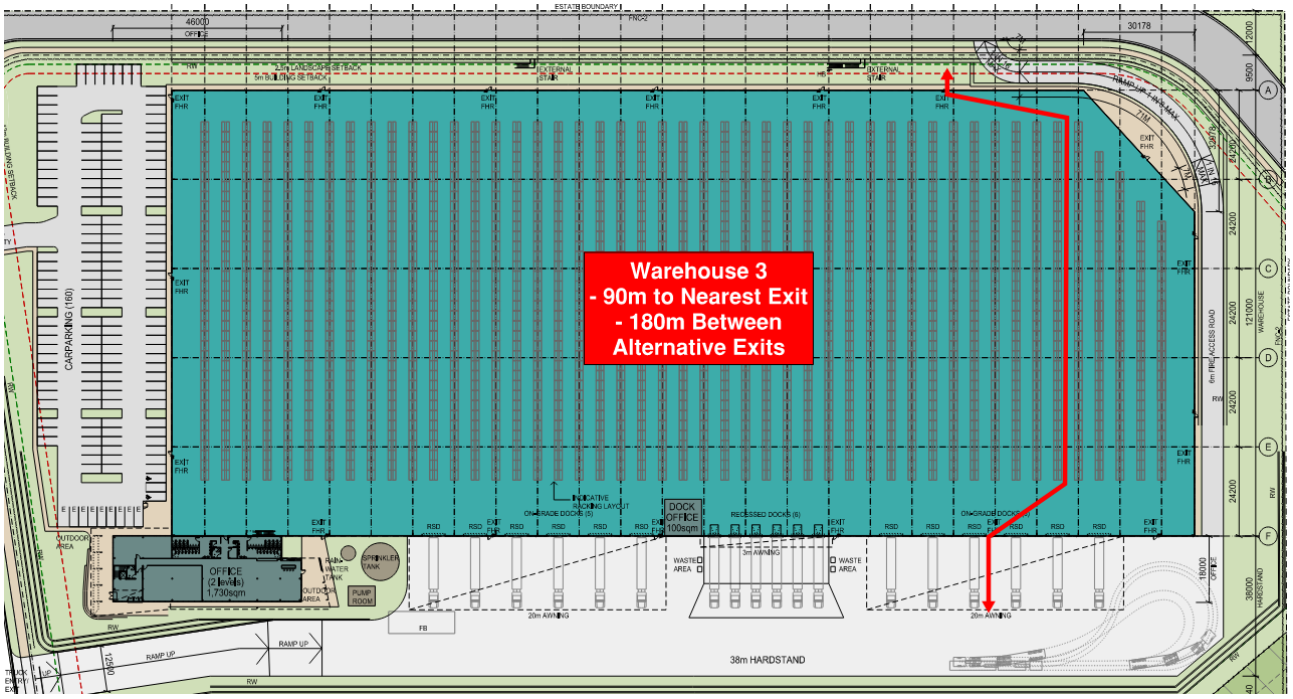


Figure 8-4 DtS Non-Compliant Travel Distances within Warehouse 3

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 each of the subject buildings, in accordance with BCA Provision E1.3 and AS2419.1:2005, with the following specifications:

- As far as possible, each hydrant system should consist of external hydrants, however internal hydrants shall be necessary to achieve coverage of Warehouses 3, 4 and 5.
- 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]
  - Where additional hydrants are provided, a localised block plan should be provided at each external hydrant pictorially and numerically illustrating the location of the next available hydrant. These localised block plans should be of a size appropriate to their notice and location, and be of all-weather fade-resistant construction.
  - An external hydrant should be provided adjacent to or within 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 the final fit-out and hydraulic coordination within Warehouses 1 & 3, it is expected that the hydrant design is readily able to satisfy this requirement.

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.

- A Performance Solution is proposed to omit radiant heat shield protection to external hydrants (including those under awnings).
- Hydrants located beneath 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.
- For Warehouse 3 under the ultimate solution, external access stairs must be being provided to afford a pedestrian connection between the elevated northern road and the warehouse.
  - External northern hydrants must be no further than 50 m from a hardstand (with the northern road corridor functioning as the hardstand in this instance).
  - These external stairs are to be in accordance with Provision D1.6 (i.e. minimum 1m clear width).
- The hydrant system for each building 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.
- In each instance hydrant booster assembly is proposed to be located at the entrance to the site, within sight of the main building entry.

Note: AS2419.1:2021 has been gazetted in NCC 2022 (preview) which shall be applicable as of 1 September 2022. As such, for any CC subsequent to that date, AS2419.1:2021 will be the DtS compliant standard of performance.

Further, specific to industrial facilities, the scope of AS2419.1:2021 is limited to:

- *"Class 7b or 8 building having a total volume not more than 108,000 m³".*
- *"Buildings that do not include automatic racked storage systems"*.
- *"Buildings and associated areas that do not include special hazards"*.

However, guidance is provided in Appendices C & E of AS2419.1:2021 for the holistic design of buildings, with these building being subject to a Performance Solution at the discretion of FRNSW. As a result, anticipated design items for review include but are not limited to:

- Increased water supply to the building (may be based on 4 or 5 hydrants operating, instead of 3) – "*A first principles analysis should be undertaken to determine the number of fire hydrants required to flow*".
- The location of the hydrant booster and other (sprinkler) infrastructure is subject to FRNSW approval – "*When operating at a LIB fire, exclusion zones of not less than 1.5 times the height of the building are established to mitigate the risk to the attending fire brigade from building collapse*".
- ASRS advice is provided in Appendix C.3 regarding:
  - Facilitating brigade access.
  - Providing hydrant coverage.
  - Power isolation, return to base functions, and manual operation of cranes.
  - Increasing water supply capabilities for the sprinkler and hydrant systems for up to 4 hours.
- All points on the floor within a Class 7b or Class 8 LIB shall be within 90 m of an exit (in lieu of 100 m as per above) – "*Where this distance is exceeded, additional exits around and from within the building should be provided*".

Whilst it is understood that FRNSW were involved in the preparation of AS2419.1:2021 and have provided a formal position statement regarding its adoption in building design, there is currently no precedence on brigade support for the above Performance Solutions relating to buildings that are outside the scope of the standard of this document.

8.5.2 Fire Hose Reels

Fire hose reels shall be provided throughout all buildings 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 perimeter of each building 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 each of the 5 buildings within the estate, 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 ESFR system will need to be extended to the awnings.
- In the warehouses, a storage mode 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).

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

A Performance Solution is proposed to assess the location of the sprinkler boosters (i.e. does not conform explicitly with the requirements of Clause 4.14.1), based on previous FRNSW precedent of approval. This is on the basis of:

- The fire sprinkler booster and the dedicated hardstand for fire brigade appliances being located as depicted within Section 5. As per FRNSW's Guideline for Emergency Vehicle Access [9], each hardstand should be designed to be 18 m long by 6 m wide, 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 (the arrangement for Warehouse 1 must be reviewed against this requirement).
- 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 following control and indicating facilities shall be provided across the development, as highlighted within Section 5 :

- A Main FIP is to be provided within the main office serving each building. In each instance, this shall serve as the Fire Control Centre.

The FIP's shall be installed in accordance with BCA Specification E2.2a and AS1670.1:2018 and have the following capabilities:

- The Main FIP (or Sub-FIP as appropriate) must be capable of isolating, resetting, and determining the fire location within that respective tenancy.
- Red strobes shall be installed at the entry door to the Main FIP and Sub-FIPs to alert arriving fire brigade of the fire alarm origin and FIP location.
- Smoke clearance fan controls shall be provided at the Main FIP or Sub-FIP as appropriate, and shall include clear signalling of the operational status of the fans.

8.6 SMOKE HAZARD MANAGEMENT

8.6.1 Smoke Detection System

Due to the extended travel distances present throughout all the tenancies addressed within this report, smoke detection systems may need to be provided to offset the extended travel distances by enabling earlier occupant notification of a fire event, to be determined following detailed CFD modelling and analysis.

- In the event of future subdivisions of the warehouse buildings 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.
    - Within the BCA report, the Warehouse 3 office has been noted to present travel distances of 45 m to an exit and 65 m between alternative exits, in lieu of 40 m and 60 m respectively. Should a Performance Solution be desired, the provision of a smoke detection system shall be necessary within the Warehouse 3 office.

8.6.2 Manual Smoke Clearance System

Each of the warehouses exceeds the 18,000 m² and 108,000 m³ limit and are therefore required to be provided with an automatic smoke exhaust system. These tenancies shall instead be provided with a rationalised automatic smoke exhaust system that initiates on sprinkler activation, which shall be designed to achieve the following minimum requirements.

- Each system shall initiate upon activation of the sprinkler system within the relevant tenancy.
- 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.
- Control switches (on/auto/off) shall be located at the indicator panel that serves the relevant tenancy.
- The exhaust and make-up air location and operation must be indicated on a mechanical block plan provided at the relevant indicator panel.
- Fire rated fans and fire rated cabling should be designed to operate at 200°C for a period no less than 60 minutes.
- 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.
- The system shall be connected to an essential power supply, which includes that the mechanical services board serving the fans be located in a fire-rated enclosure (FRL of 120/120/120) if located within the building.

8.6.3 Building Occupant Warning System

A building occupant warning system should be provided throughout all parts of each 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 affected 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
AFSS	Annual Fire Safety Statement
BCA	Building Code of Australia
CFD	Computational Fluid Dynamics
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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