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Fire Safety Strategy

Lot 3A

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Report Details

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Report Revision History

REV	DATE ISSUED	COMMENT	PREPARED BY	REVIEWED BY
01	11/11/15	Draft Issue for comment	**Jun Liu** *PhDEng (Chemical Engineering)*	**Sandro Razzi** *BE (Building)* *Grad Dip (Performance Based Building & Fire Codes)* *Accredited Fire Engineer* *BPB 0501* *FIEAust* *CPEng 2180287*
02	11/11/15	Final Issue		
03	13/11/15	Final Issue: Revision A *Incorporating updated architectural drawings*		
04	20/11/15	Final Issue: Revision B *Incorporating 2 stage construction for Warehouse 3B*		
05	12/02/2016	Final Issue: Revision C *Omitting Warehouse 3B and incorporating updated architectural drawings*		
06	01/06/2016	Final Issue: Revisions D *Omitting Warehouse 3D and incorporating updated architectural drawings*	**Isabella Greenhill** *BE(Civil)*	**Graham Morris** *MEng (Fire Safety and Structural Engineering)*
07	15/06/2016	Final Issue: Revision E *Incorporating updated architectural drawings*		
08	08/09/2016	Final Issue: Revision F *Incorporating updated architectural drawings for Warehouse 3A*		

09	12/09/2016	Final Issue: Revision G *Omitting Warehouse 3C*	**Isabella Greenhill** *BE(Civil)*	**Graham Morris** *MEng (Fire Safety and Structural Engineering)*

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1 INTRODUCTION

1.1 OVERVIEW

This Fire Safety Strategy has been undertaken to nominate proposed Alternative Solutions for assessing compliance with the nominated Performance Requirements of the Building Code of Australia 2015 (BCA) [1] in accordance with the methodologies defined in the International Fire Engineering Guideline IFEG [3].

In order to develop and assess the nominated non-compliances the following flowchart process is to be adopted.

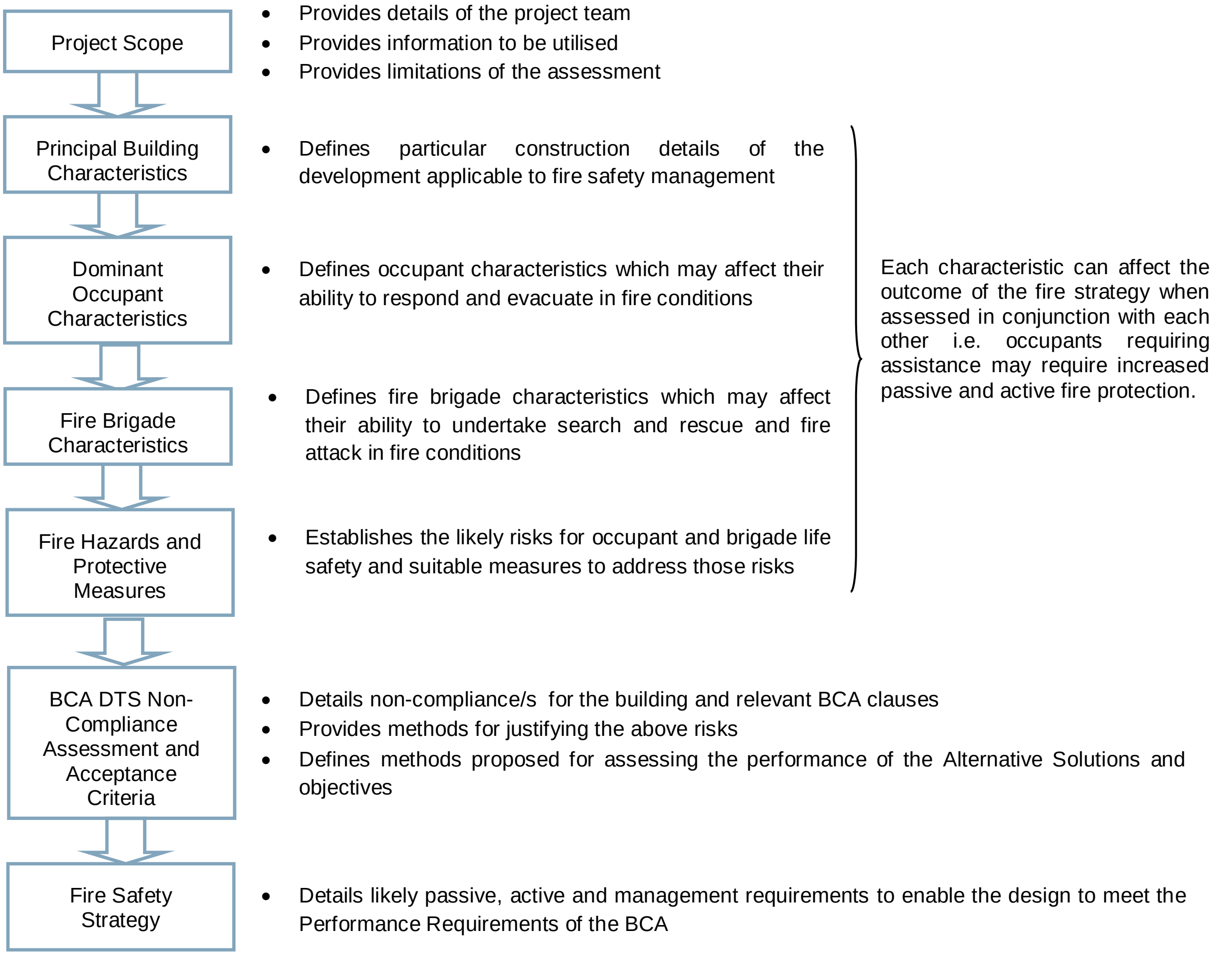


Figure 1-1: Fire Safety Strategy Process

The scope of the Fire Safety Strategy is to detail the nominated non-complying BCA Deemed-to-Satisfy (DTS) provisions with the performance requirements of the BCA and provide methodologies for establishing a workable and safe Fire Safety Strategy through a trial design.

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) [14] 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 A0.5 of the BCA [1] outlines how compliance with the Performance Requirements can be achieved. These are as follows:

(a) complying with the Deemed-to-Satisfy Provisions; or

(b) formulating an Alternative Solution which –

(i) complies with the Performance Requirements; or

(ii) is shown to be at least equivalent to the Deemed-to-Satisfy Provisions or

(c) a combination of (a) and (b).

Section A0.9 of the BCA provides several different methods for assessing that an Alternate Solution complies with the Performance Requirements. These methods are summarised as follows:

(a) Evidence to support that the use of a material, form of construction or design meets a Performance Requirement or a Deemed-to-Satisfy Provision.

(b) Verification Methods such as:

(i) the Verifications Methods in the BCA; or

(ii) such other Verification Methods as the appropriate authority accepts for determining compliance with the Performance Requirements.

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

(d) Expert Judgment.

Section A0.10 of the BCA provides methods for complying with provisions A1.5 (to comply with Sections A to J of the BCA inclusive). The following method must be used to determine the Performance Requirements relevant to the Alternative Solution: These methods are summarised as follows:

(a) Identify the relevant Deemed-to-Satisfy Provision of each Section or Part that is to be the subject of the Alternative Solution.

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

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

Project Scope

CORE Engineering Group has been engaged to develop a Fire Safety Strategy for the development of Lot 3A warehouse building at Oakdale Central, Horsley Park NSW. The purpose of this Fire Safety Strategy is to outline the fire engineering principles that will be utilised in ensuring that the prescriptive Deemed-to-Satisfy (DTS) non-compliances noted in the Building Code of Australia (BCA) report are resolved in order to conform to the building regulations and permit development approval.

The complete fire engineered analysis will be included within the Fire Engineering Report, 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 Alternative Solution and to satisfy the Performance Requirements of the BCA.

Revisions E of this document reflects minor amendments to the architectural drawings and floor areas for Warehouse 3A, while Revision G omits any references to Warehouse 3C for clarity. No changes have been made to Warehouse 3C since approval in FSS Revision E.

2.2 RELEVANT STAKEHOLDERS

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

Table 2-1: Relevant Stakeholders

ROLE	NAME	ORGANISATION
Project Manager	Guy Smith	Goodman
Principal Certifying Authority/BCA Consultant	Dean Goldsmith Tony Heaslip	Blackett Maguire + Goldsmith
Architect	Greg Baird	SBA Architects
Fire Safety Consultant	Isabella Greenhill	CORE Engineering Group
Fire Safety 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:

- Preliminary Building BCA Compliance Assessment provided by Tony Heaslip of Blackett Maguire + Goldsmith. Report No: 130335, dated 10 October 2013, Revision 0.
- Architectural plans provided by SBA Architects, as indicated in Table 2-2.

Table 2-2: Drawings

DRAWING NO.	DESCRIPTION	ISSUE	DATE
DA-07	Lot 3 Masterplan	Q	07/09/2016
DA-30	Lot 3A Site Plan	D	09/09/2016

DRAWING NO.	DESCRIPTION	ISSUE	DATE
DA-32	Lot 3A Warehouse 1 Office Plans	B	09/09/2016
DA-33	Lot 3A Warehouse 2 Office Plans	B	09/09/2016
DA-36	Lot 3A Warehouse Elevations	F	07/06/2016

2.4 LIMITATIONS AND ASSUMPTIONS

In this instance the Fire Safety Strategy 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 Fire Safety Strategy and therefore they 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 Section 6.4 and 6.6 respectively. The report does not provide guidance in respect of areas, which are used for Dangerous Good 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 [1] with all aspects for 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.

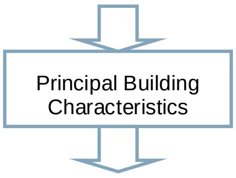
This report is prepared in good faith and with due care for information purposes only, and should not be relied upon as providing any warranty or guarantee that ignition or a fire will not occur.

The Fire Safety Strategy 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 Review due 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 fire fighting 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 Horsley Park, approximately 40km west of Sydney's central business district. The Lot 3 site is located on Millner Avenue which is accessed from Old Wallgrove Road. This development aims at Warehouse 3A, however Warehouse 3B, 3C and 3D are being developed separately. Therefore, this Fire Safety Strategy will be focused on Warehouse 3A.

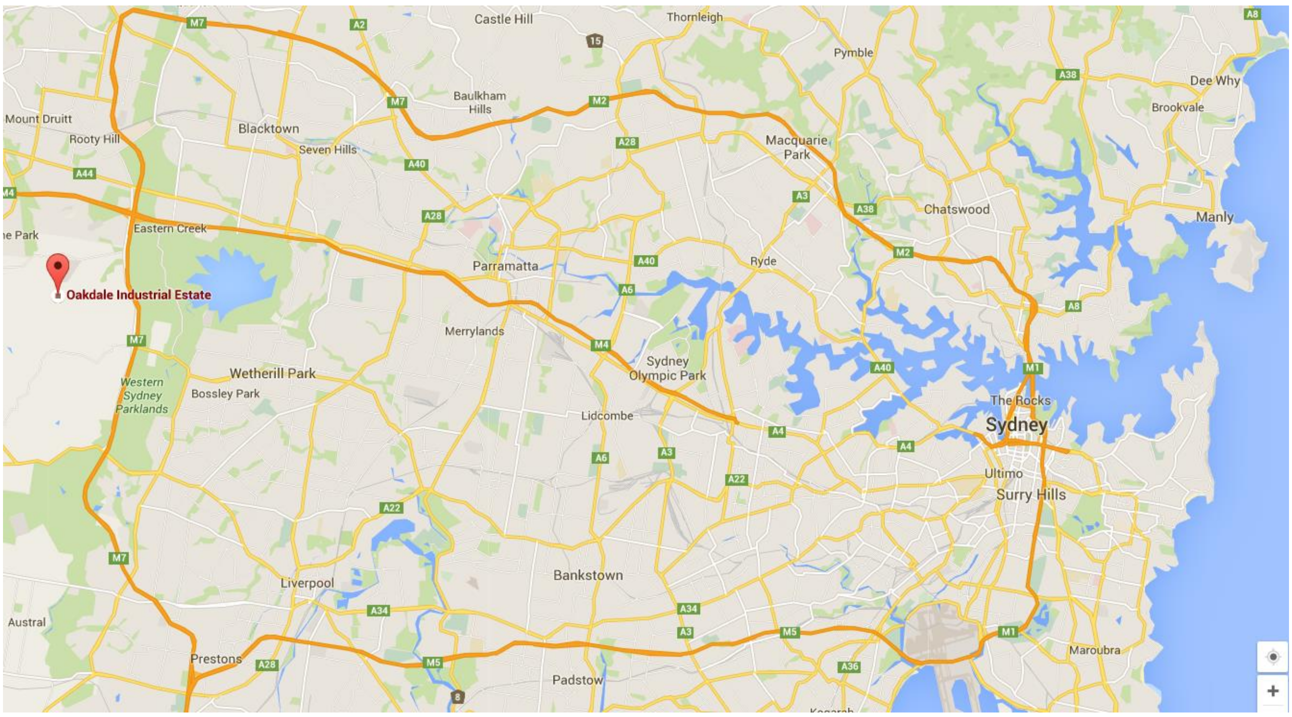


Figure 3-1: Site Location

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 Huntingwood and Mount Druitt approximately 8.5km and 11.5km from the site respectively when considering actual driving directions.

3.3 SITE LAYOUT

The Lot 3 site consists of 4 lots, i.e. Lot 3A, 3B, 3C and 3D. This Fire Safety Strategy focuses on Lot 3A.

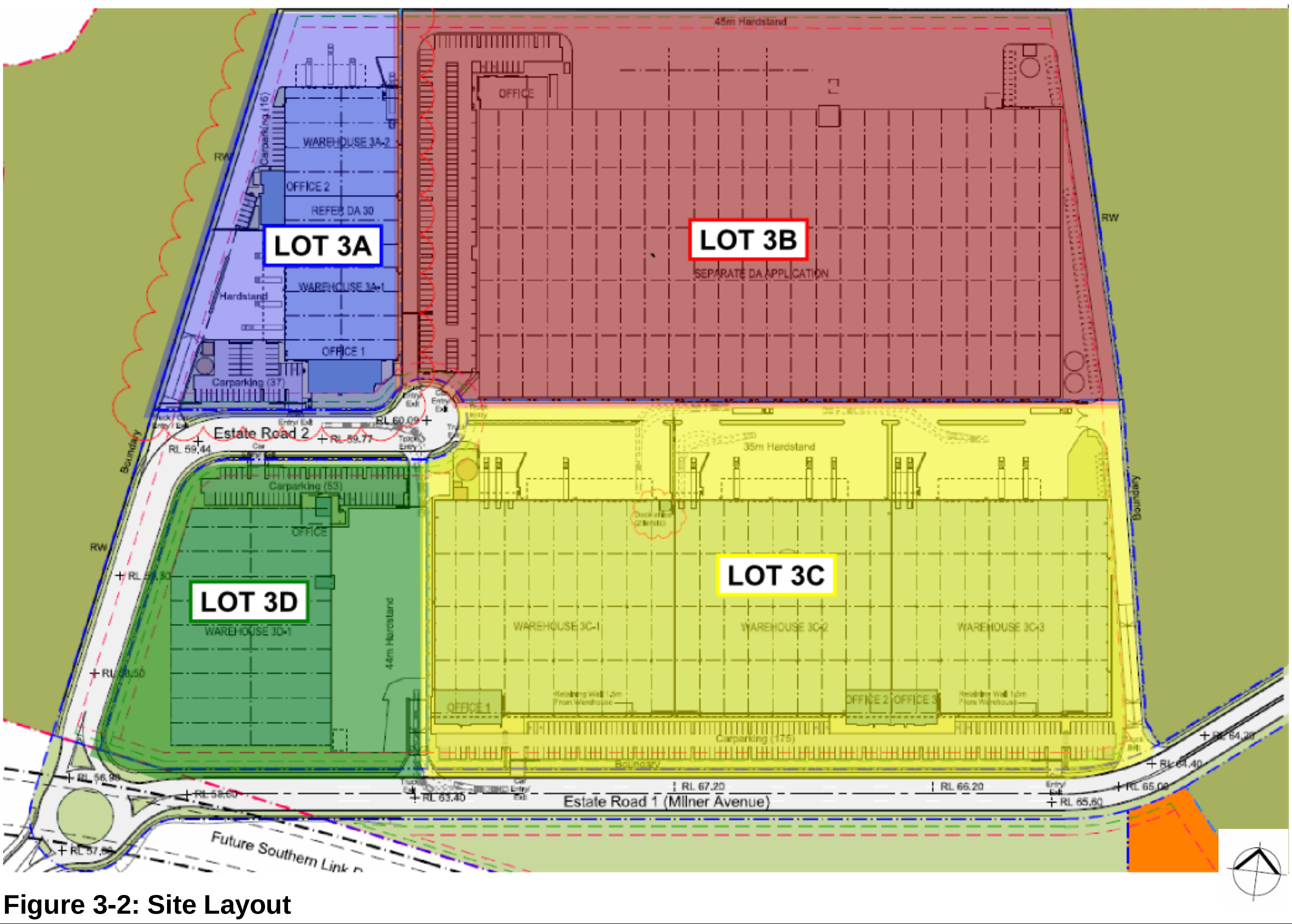


Figure 3-2: Site Layout

Lot 3A comprises of a single warehouse divided into two tenancies via an inter-tenancy wall i.e. Warehouse 3A-1 and 3A-2. It shall be noted that the Warehouse on Lot 3A is considered as a large isolated building for certification purposes. Each warehouse tenancy will be provided with an ancillary office, loading docks and onsite carparking.

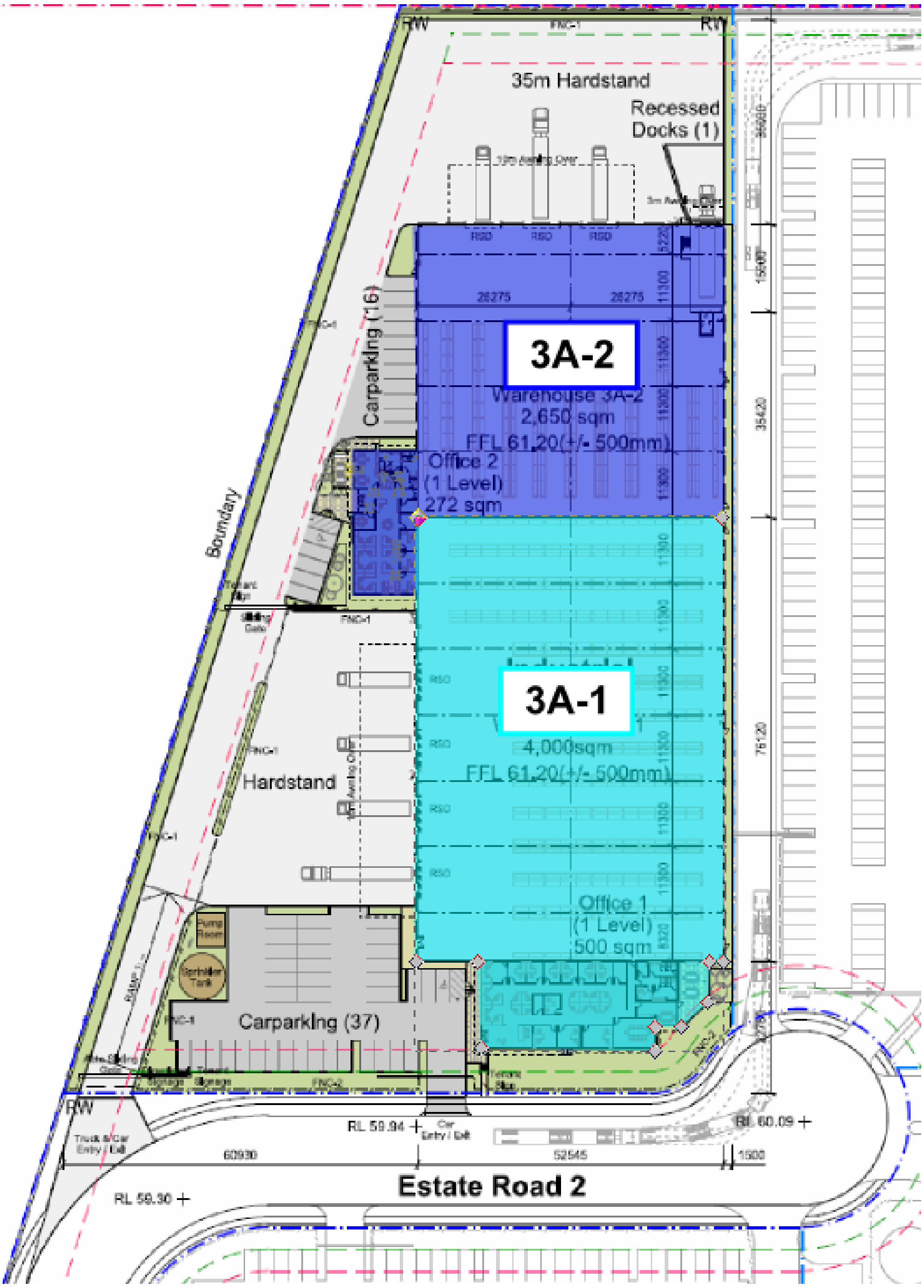


Figure 3-3: Lot 3A Warehouse

Table 3-1 illustrates the floor areas of each warehouse and its ancillary office. External carparking and loading docks are provided for each warehouse.

Table 3-1: Floor Areas of Warehouse and Ancillary Offices

BUILDING	WAREHOUSE	WAREHOUSE FLOOR AREA (M^2)	ANCILLARY OFFICES
3A	Warehouse 3A-1	4,000	office (500m^2) in the south
	Warehouse 3A-2	2,650	office (272m^2) in the south west

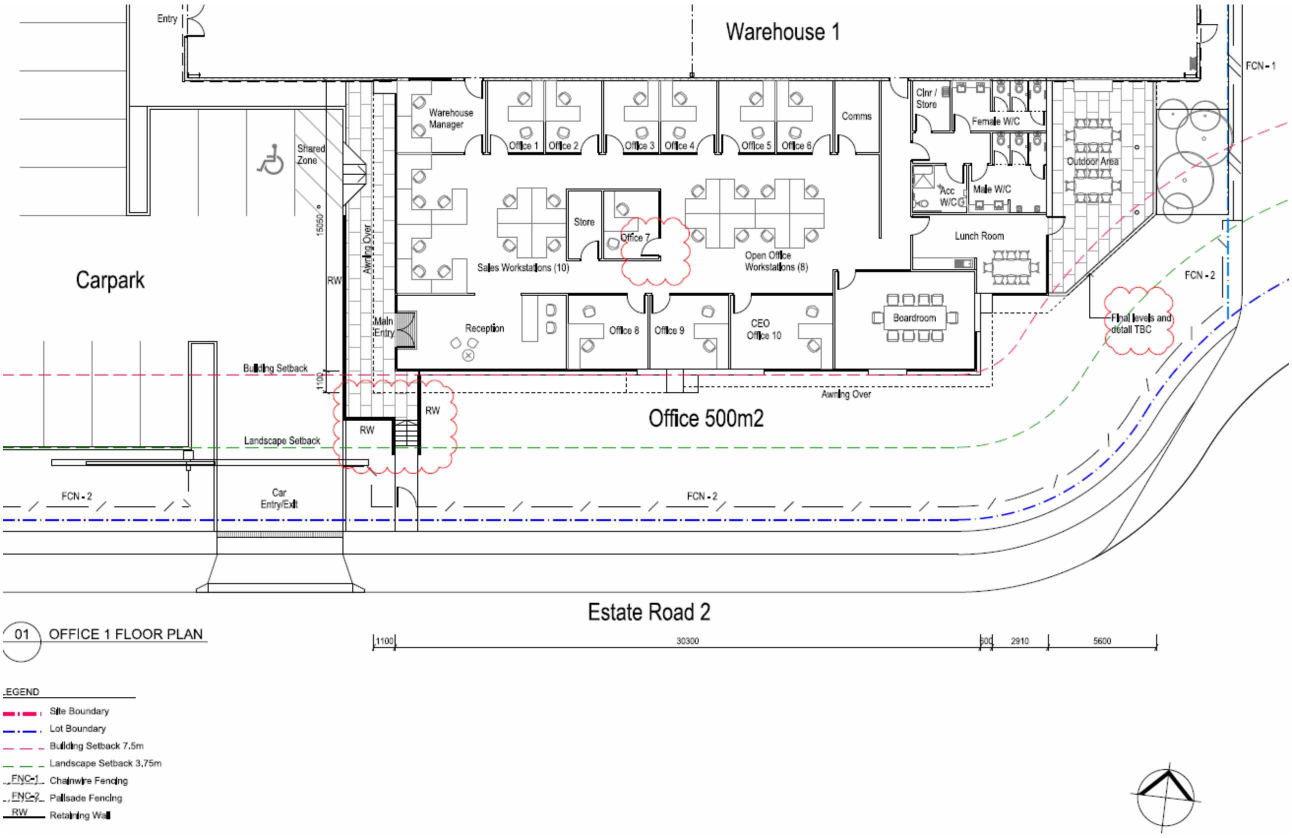


Figure 3-4: 3A-1 Office Floor Plan

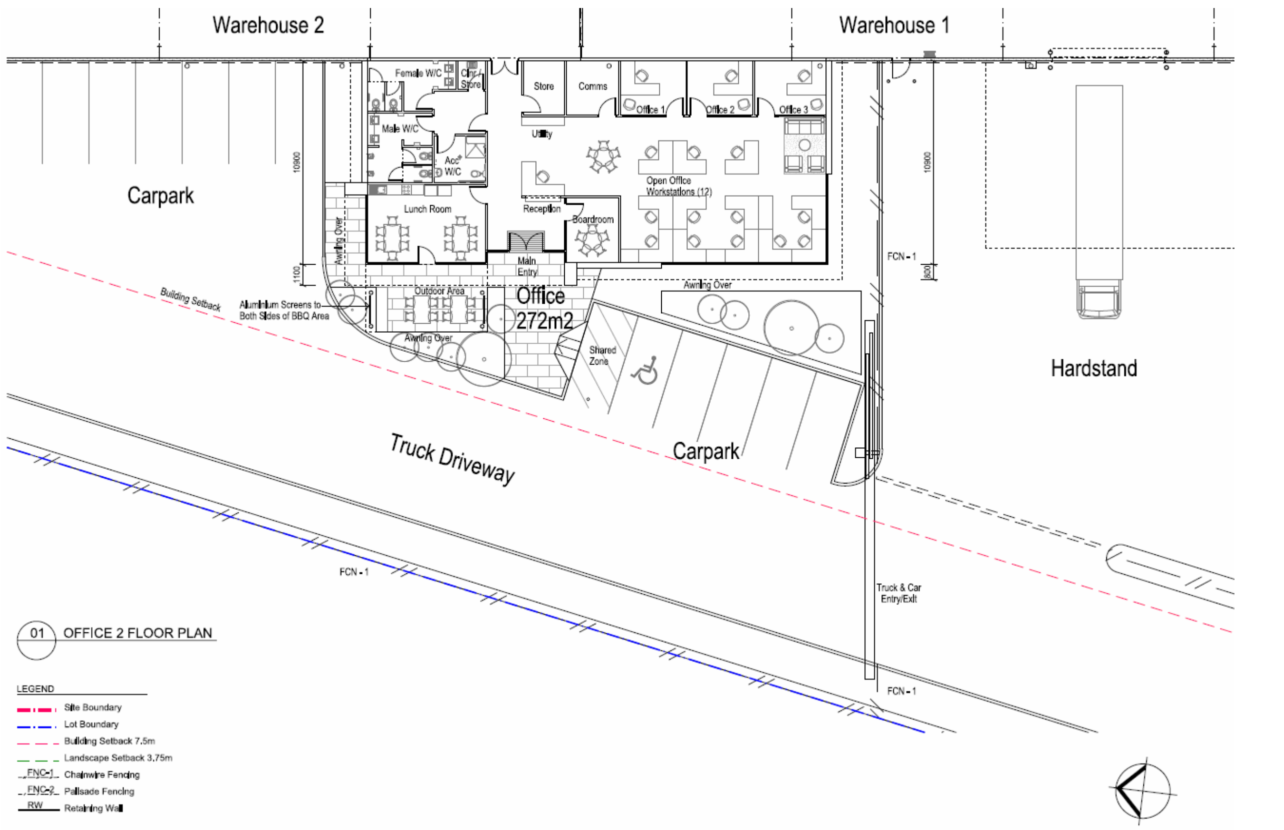


Figure 3-5: 3A-2 Office Floor Plan

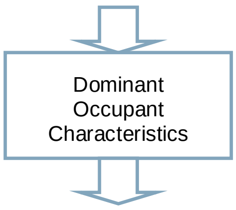
3.4 BCA ASSESSMENT SUMMARY

Table 3-2: BCA Building Characteristics

CHARACTERISTIC	DESCRIPTION
Classification	Class 5 (Office) and Class 7b (Warehouse)
Construction Type	Type C Construction
Rise in Storeys	1
Effective Height	<12m for each building
Floor Area *Approximate – for information only*	**<u>Building 3A</u>** • Warehouse 3A-1: 4,500 m^2 • Warehouse 3A-2 2,922 m^2 ***TOTAL:*** ***7,422 m^2***

4 DOMINANT OCCUPANT CHARACTERISTICS

4.1 OVERVIEW



The occupant characteristics are assessed within the Fire Engineering Report 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 number of occupants expected within each building is considered to be generally less than that assumed in the BCA Table D1.13 [1] due to the type of function and use. The BCA assumes the following occupant densities.

- 1 person per 30 square metres in the plant room and warehouse.
- 1 person per 10 square metres in the office areas.

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

BUILDING NO	BUILDING PART	TOTAL FLOOR AREA	OCCUPANT NUMBER
3A	Warehouses	6,650m^2	222
	Office	772m^2	78

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, therefore providing a conservative population in the building.

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 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 fire fighting 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.

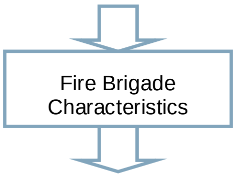
4.5 EMERGENCY TRAINING

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.

Staff and visitors are not expected to have fire suppression training and such training is not relied upon for this building population; however staff are expected to possibly attempt to extinguish a fire or limit fire spread by removing objects in the vicinity of the fire in order to defend their belongings.

5 FIRE BRIGADE CHARACTERISTICS

5.1 OVERVIEW



The fire brigade characteristics are assessed within the Fire Engineering Report due to the fact that Fire 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. Separate infrastructure is provided for each lot, consisting of; FIPs, mimic FIPs, hydrant booster, sprinkler tanks and pumps rooms. The Main FIPs are located in one tenancy office on each Lot while a mimic FIP shall be located in the remaining tenancy offices.

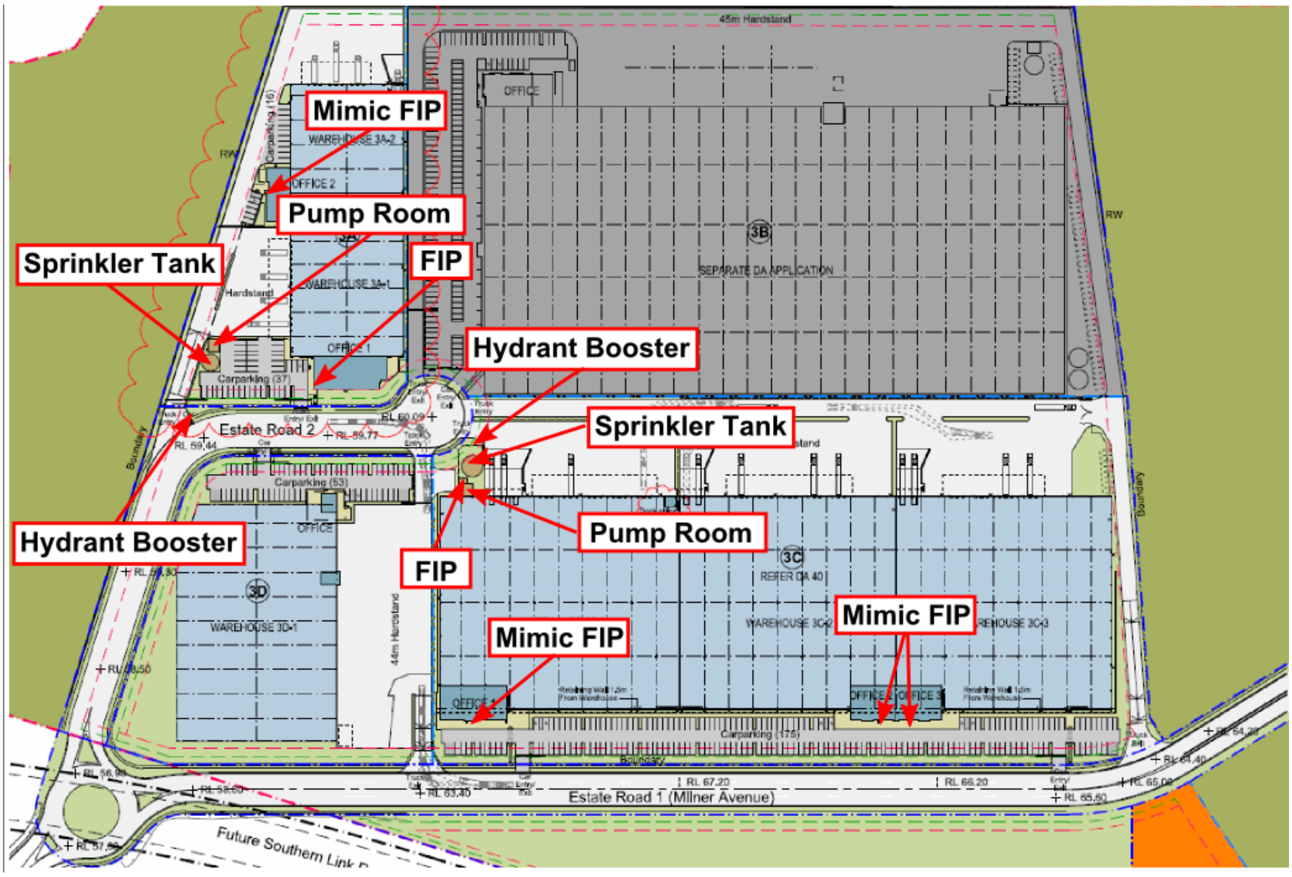


Figure 5-1: Fire Services

Figure 5-2 illustrates the perimeter vehicular access available to the Warehouse on Lot 3A which is considered to be a large-isolated building for certification purposes.

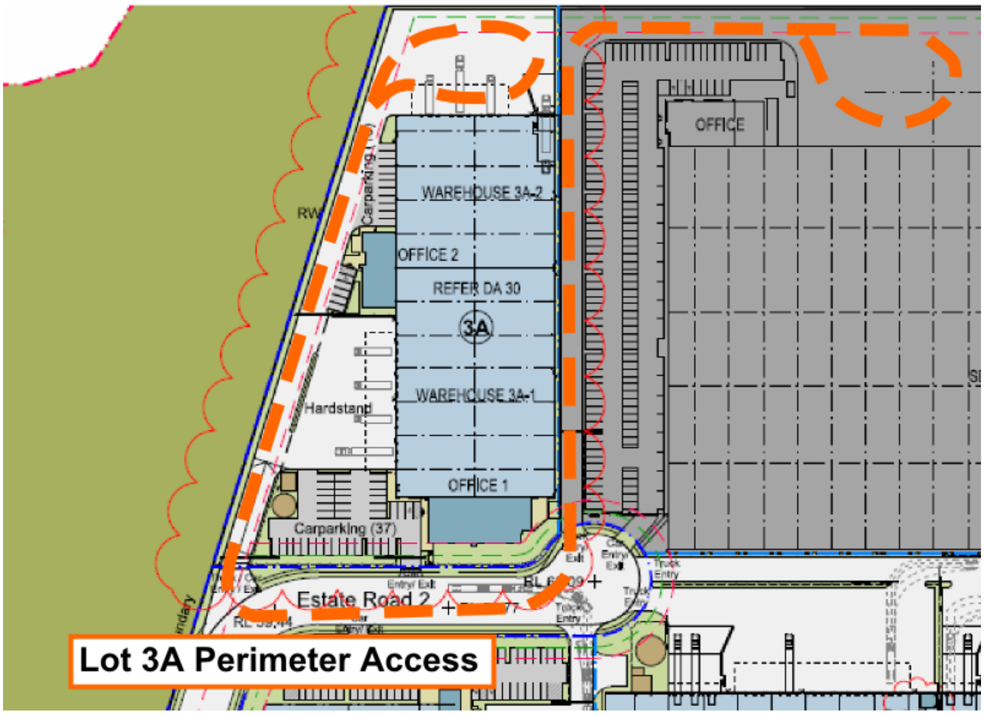


Figure 5-2: Fire Brigade Access on Lot 2

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 Huntingwood and Mount Druitt approximately 8.5km and 11.5km respectively.

6 FIRE HAZARDS AND PROTECTIVE MEASURES

6.3 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, hazards identified can form a justified basis for selected scenarios.

6.4 FIRE STATISTICS

In order to assess the most likely fire hazards within the building, and subsequently the risk presented by these hazards it is necessary to develop an understanding of the factors that have an influence on the fire safety of building occupants. The best method in doing so is to review existing statistical data.

Existing data is an invaluable tool in providing an overview of the situations in which occupant deaths have, and are likely to occur, and factors that contribute to more severe fires. This aids in understanding, and helps evaluate the effectiveness of, and the need for various fire safety systems. Reference is made to the American database as it is significantly larger than Australian data sets, but is generally considered to be representative of the Australian situation.

Table 6-1: Fire Statistics in all Building Types [5]

STRUCTURE USE	FIRES PER YEAR	CIVILIAN FATALITIES PER YEAR	CIVILIAN FATALITIES PER 1000 FIRES
Hospitals	1,288	0	0
Schools	4,060	0	0
Public assembly	14,650	5	0.34
Retail/Department Store	1,150	1	0.87
Business offices	**2,890**	**3**	**1.04**
Manufacturing	5,303	7	1.32
Vehicle Storage/Garage	6,200	10	1.61
24-hour nursing homes	2,749	5	1.82
Hotels or motels	3,610	11	3.05
Warehouse	**1,270**	**4**	**3.15**
Apartments	106,380	410	3.85
Homes	260,180	2165	8.32

From the NFPA ‘Structure Fires by Occupancy 2007-2011’ Report [5], The civilian fatality rates from 2007 to 2011 highlighted in Table 6-1 show that storage warehouses have a medium risk to life compared to other property types with 3.15 civilian deaths per 1000 fires on average. This indicates a much greater risk per fire than other non-residential occupancies; however, this is balanced by the relatively low number of fires that occur. The number of deaths caused on average by a fire in business offices is significantly less than manufacturing, garages, nursing homes, hotels, warehouses, apartments and homes.

6.4.1 Warehouse and Storage Facilities

From the National Fire Protection Association (NFPA) report on ‘Structure Fires in U.S. Warehouses’ [**5**] statistics specific to warehouses can be analysed.

A total of 1,270 structure fires were reported in warehouses between 2007 and 2011. The fires recorded resulted in 4 occupant fatalities, 23 occupant injuries and $188 million in direct property damage per year.

Overall, 19% of fires were intentionally set, however no civilian injuries were reported from these fires. Shop tools and industrial equipment caused 8% of fires; however these fires resulted in 27% of the civilian injuries recorded annually. The leading area of fire origin in warehouses comes from unclassified storage areas, resulting in 13% of fires and 18% civilian injuries.

Figure 6-1 illustrates the leading cause of structure fires in warehouses, while Figure 6-2 indicates the leading areas of origin.

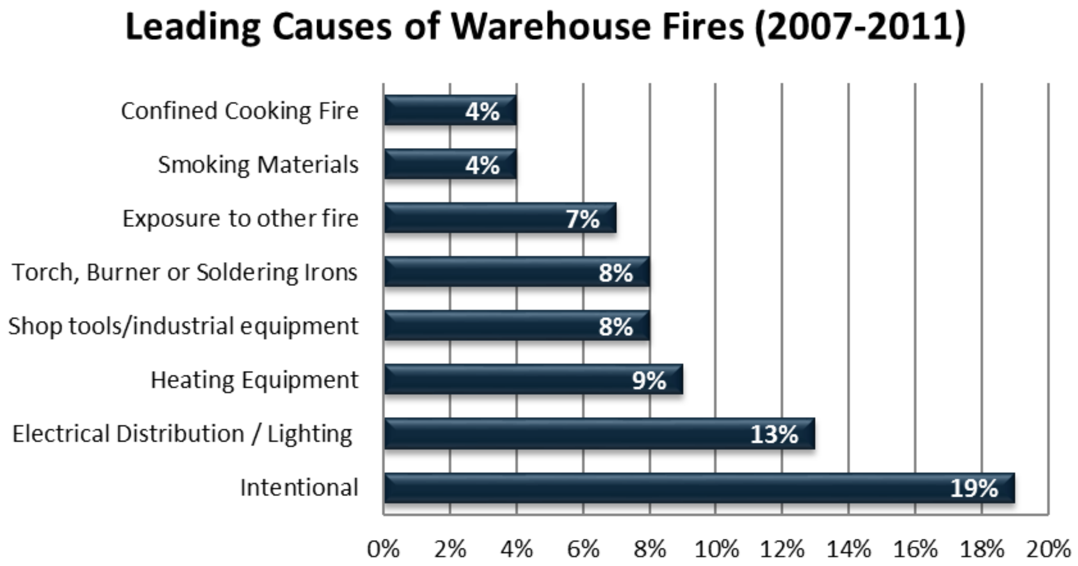


Figure 6-1: Leading Causes of Structure Fires in Warehouses

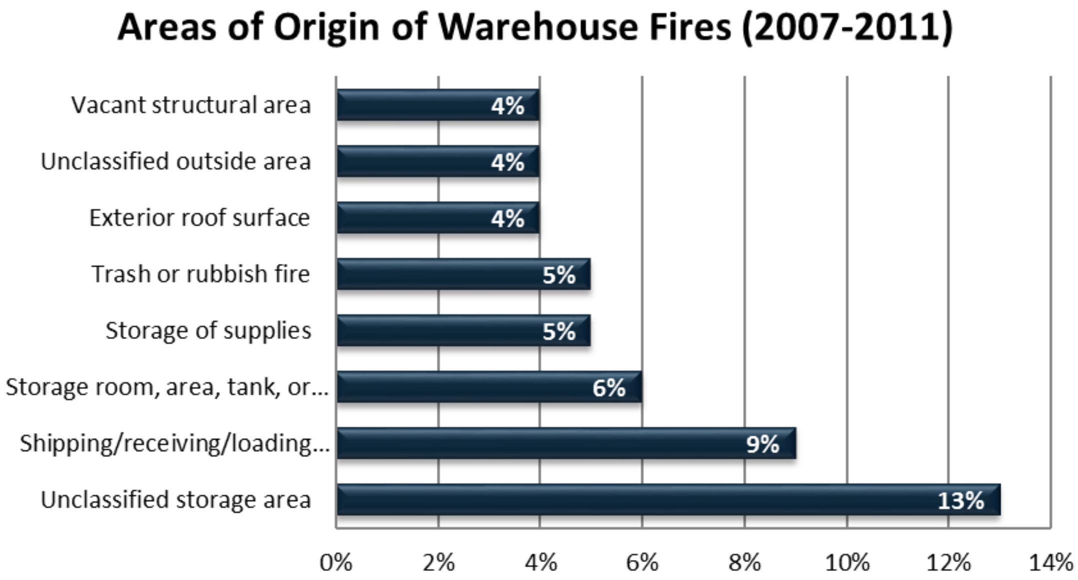


Figure 6-2: Structure Fires in Warehouse Structures by Area of Origin

6.4.2 Office Areas

From the National Fire Protection Association (NFPA) report on ‘U.S Structure Fires in Office Properties’ [**6**] statistics specific to building types relevant to this development can be analysed.

A total of 3,340 structure fires occurred in offices with 4 occupant fatalities, 44 occupant injuries and $112 million in direct property damage per year from 2007-2011.

The potential fire hazards in terms of leading areas of origins of fires and most frequent causes of fires in the office area of this building are investigated by using statistics for similar buildings. Campbell [**6**] reports that the leading cause of office fires in the US between 2007 and 2011 was cooking equipment followed by electrical/lighting equipment, and heating equipment. This is highlighted in Figure 6-3 with the areas of origin illustrated in Figure 6-4 compounding this data with the most common area of fire origin being in a cooking space. With only 4 civilian fatalities per year in office buildings, fatality data is deemed not to accurately represent risk and so has been omitted from the graphs.

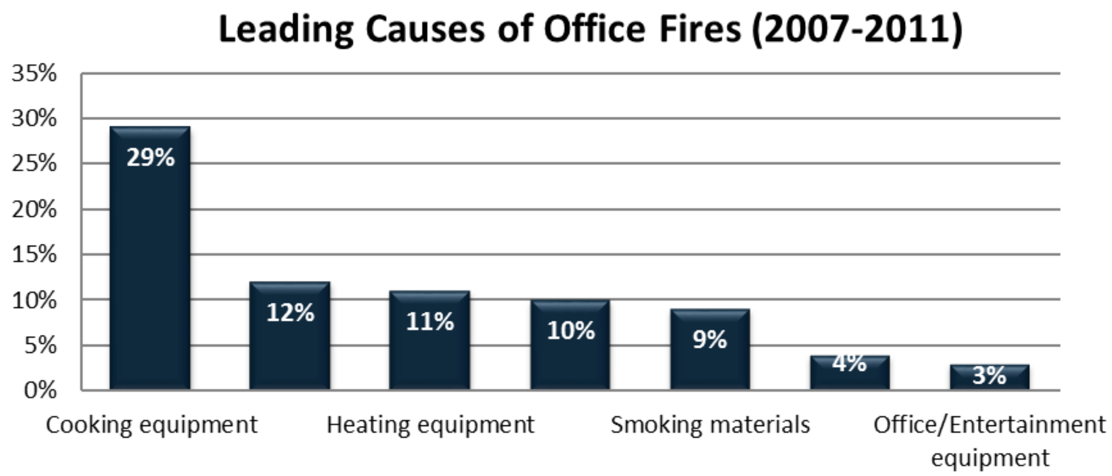


Figure 6-3: Leading Causes of Office Fires [6]

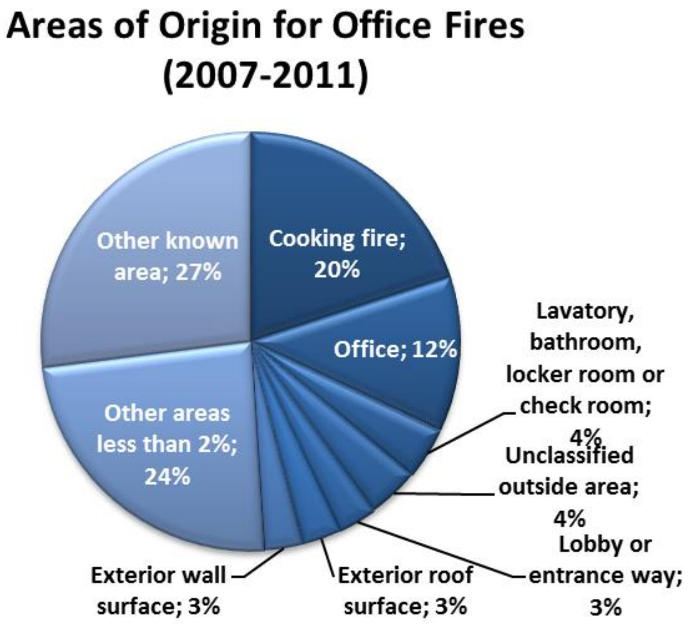


Figure 6-4: Areas of Origin for Office Fires [6]

6.5 SPRINKLER EFFECTIVENESS & RELIABILITY

The effectiveness of automatic fire sprinklers in general in limiting fire spread and growth is supported by statistics and studies undertaken into the effects of automatic fire sprinklers within buildings. These studies show that fire sprinkler systems operate and control fires in 81% to 99.5% of fire occurrences [3]. The lower reliability estimates of 81.3% [19] as well as some of the higher values of 87.6% [20] appear to reflect significant bias in data in terms of the small number of fire incidents and the lack of differentiation between fire sprinklers and other fire suppression systems. A number of the lower figures are results of dated studies.

It must be noted that the higher reliability of fire sprinklers reported by Marryatt [22] of 99.5% reflect fire sprinkler systems where inspections, testing and maintenance exceeded normal expectations and applies to installations specifically in Australia and New Zealand. The statistical data indicate that sprinklers with appropriate maintenance are highly effective in reducing the loss of life and limiting fire spread and in particular the storage (ESFR) system has an exemplary record.

With reference to FM Global data sheet (2-2) as of 2002 [17] there had been six known fires involving suppression mode sprinkler protection.

In all of these incidents, the sprinkler system was successful in suppressing the fire and no more than four sprinkler heads operated. Therefore for the purposes of this assessment, on the activation of the ESFR fire sprinkler system, the fire growth is considered to be suppressed within the area of activation.

FM Global Data Sheet 2-0 states, *"loss history over the past twenty years indicates approximately 25% of the time, the operation of a single sprinkler will control or suppress a fire if the sprinkler system has been properly designed and installed."* This percentage increases to approximately 50% of the time with the operation of 3 or fewer sprinklers, and 75% of the time with the operation of nine or fewer sprinklers.

In addition analysis of the likelihood of sprinkler failure shows that most sprinkler system failures are due to impaired water supplies such as closed valves, blocked pipes, impaired sources, etc., which tend to affect sections of or the entire system [20]. As such, system reliability can be increased by active monitoring of water supplies and controls. The general consensus within the fire protection industry is that problems with individual sprinkler heads are rare. This information combined with sprinkler reliability data is favourable when compared with the reliability of fire compartmentation [3].

Moinuddin and Thomas [20] have found that masonry fire rated construction had a reliability of 81-95%, and gypsum 69-95%, with the upper level in both instances having been reported within the IFEG [3]. Both reported ranges are considered to be less than that offered by automatic sprinkler systems. Table 6-2 lists the effectiveness of sprinkler systems in the event of a fire growing to a size that facilitates sprinkler head activation [20].

Table 6-2: Effectiveness of Sprinkler systems

PROPERTY TYPE	EFFECTIVENESS OF SPRINKLERS IN EVENTS WHERE SPRINKLERS OPERATE
Public Assembly	90%
Educational	93%
Health care / Correctional Centre	95%
Residential (average)	97%
Office / Retail	91%
Manufacturing	93%
Storage	86%
Cold Storage	89%
All properties	7%

Statistics for general sprinkler effectiveness in storage properties is provided in the table below which is drawn from the research of Rohr [23]. The data indicates over 77% of storage fires and 84% of manufacturing facility fires are confined to the area of fire origin where sprinklers are fitted.

Table 6-3: The Effectiveness of Sprinkler in Storage Facilities

EXTENT OF FLAME DAMAGE	FIRES WITH SPRINKLER PROTECTION	FIRES WITHOUT SPRINKLER PROTECTION
Confined to object of origin	50.0%	19.9%
Confined to area of origin	27.8%	14.1%
Confined to room of origin	6.7%	4.9%
Confined to fire-rated compartment of origin	1.1%	0.6%
Confined to floor of origin	2.4%	1.1%
Confined to structure of origin	10.0%	45.0%
Extended beyond structure of fire origin	2.2%	14.3%
Total:	900 fires	29,330 fires

6.6 FIRE LOAD

The fire load within a room or compartment will influence the duration and severity of a fire and resultant hazard to occupants. The effective fire load for the building has been estimated by consideration of the typical spaces within the building.

The following fire loads have been extracted from Chapter 3.4 of the International Fire Engineering Guidelines [3] and are listed in Table 6-4. This data is derived from Switzerland, however is also deemed applicable to buildings in Australia of similar use.

The warehouse is considered to generally contain mixed types of commodities, where in some cases cellulosic materials are mixed with plastics and non-combustible materials on the same racks. There is a large amount of data concerning the burning rates of items and materials; however, this information is not often presented such that it is sufficiently generic to be universally adopted.

Also, while the current tenant and stored commodities may be known during the design stages of the development the length of their occupancy cannot be definitively identified. Therefore while what can be representative of the current fuel loadings for the enclosure, these may not be the case in the future use of the building. Therefore, it would be a rare assessment in which the specific items forming the fuel load had been tested to provide the fire heat release data. As such it is considered that the application of generic burning rates, translated through simplified mathematical expression (time squared growth rates) is a suitable means of estimating fire development.

Table 6-4: Fire Load Densities

TYPE OF OCCUPANCY	AVERAGE FIRE LOAD	80^{TH} PERCENTILE VALUE	90^{TH} PERCENTILE VALUE
Office, Business	800 MJ/m^2	1200 MJ/m^2	1200 MJ/m^2
Forwarding facility dealing in; Beverages, food, furniture, glassware, plastic product, printed goods, varnish/polish.	Range from: 200 MJ/m^2 - 1700 MJ/m^2	Range from: 350 MJ/m^2 - 2550 MJ/m^2	Range from: 400 MJ/m^2 - 3400 MJ/m^2

6.7 FIRE GROWTH RATE AND INTENSITY

As the fire increases in size, the rate of fire growth accelerates. The growth rate of a fire can result in various hazards for occupants due to the following:

- Protective and preventative measures may not be adequate.
- Occupants may have insufficient time to evacuate.
- Occupants may perceive a reduced threat from slow growing fires.

The rate of fire growth is generally expressed in terms of an energy release rate. The most commonly used relationship is what is commonly referred to as a quadratic time-squared fire. The basis of the time squared fire arises from the fact that the growth during the flaming stage can be approximated by a smooth curve that can be expressed mathematically. The rate of heat release is given by the expression:

$$Q = \left({}^{t}/_{k}\right)^2$$

Where: t = time from after ignition of the fire (seconds)

K = the growth time (seconds)

Q = a heat release output of 1.055 MW.

Studies of actual fires have led to the adoption of five (5) standard fire growth rates covering a wide range of potential fire scenarios and fuel loads. It should be noted, the times of fire incubation are not included in the time-squared growth fire models. National Fire Protection Association Standard NFPA 92B [20] provides information on the relevance of time-squared approximation to real fire as depicted in the figure below.

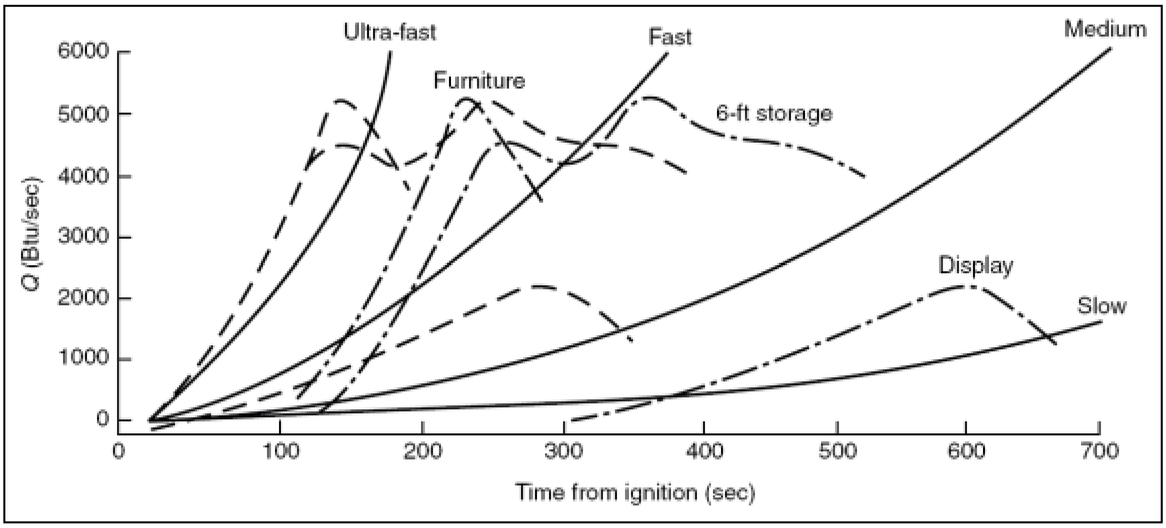


Figure 6-5: NFPA 92B: T-squared fire, rates of energy release

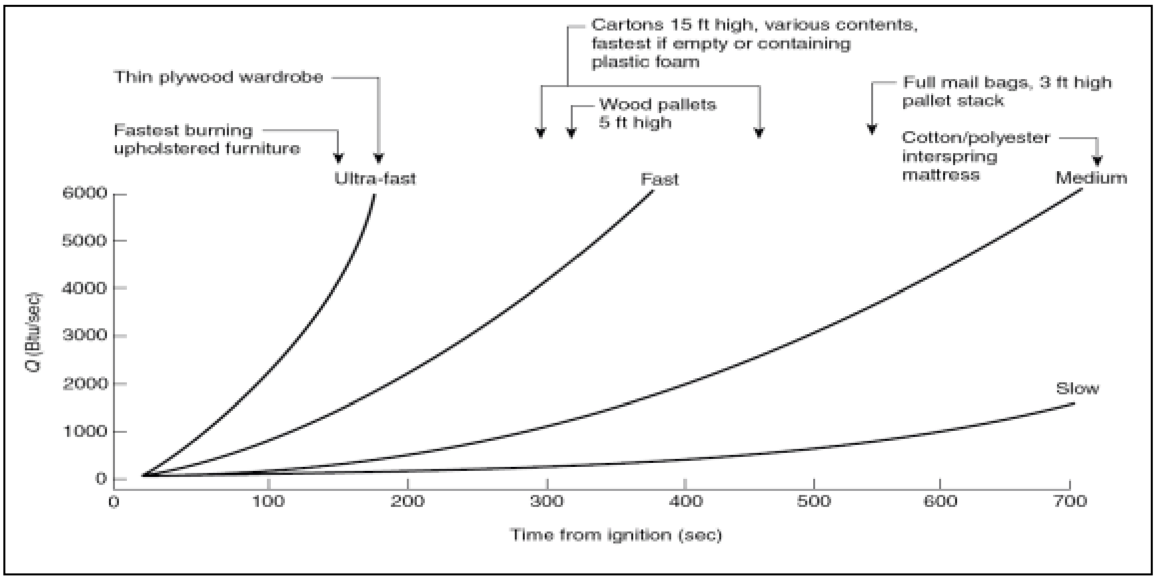


Figure 6-6: NFPA 92B: Relation of t-squared fires to some fire tests

The rate of fire growth can also be estimated from data published in British Standard (BS) 9999:2008 [4] as shown below in Table 6-5, and Table 6-6.

Table 6-5: Summary of Fire Growth Rates per Building Type

BUILDING AREA PROVIDING FUEL	GROWTH RATE	BUILDING AREA PROVIDING FUEL	GROWTH RATE
Reception area	Slow	Restaurant/Canteen	Medium
Office	**Medium**	Teaching Laboratories	Fast
Shop	Fast	Meeting Room	Medium
Warehouse	**Medium – Ultra Fast**	Waiting Room	Slow

The variation in warehouse growth rates can be understood from the following table illustrating the types of stored items.

Table 6-6: Fire Growth Rates as described in BS 9999:2008

FIRE GROWTH RATE	STORED MATERIALS
Slow t^2	Banking hall, limited combustible materials.
Medium t^2	Stacked cardboard boxes, wooden pallets.
Fast t^2	**Baled thermoplastic chips, stacked plastic products, and baled clothing.**
Ultra-Fast t^2	**Flammable liquids, expanded cellular plastics and foam.**

From the above tables (and figures) it is concluded that the likely fire scenarios in the high bay racking may be approximated by an Ultra-Fast standard time-squared fire growth rate curve, while the office areas can be approximated with a Medium time-squared fire growth rate.

6.8 FIRE SOOT YIELD

The materials that make up the fuel load will determine the soot yield of a fire. The fire soot yield should be assessed with respect to hazard due to the following:

Soot yield can affect visibility for occupants trying to escape a fire

Soot yield can be directly related to other products of combustion which may cause untenable conditions.

The NFPA Fire Protection Handbook provides test values of soot yield for some common plastics which vary from 0.012 to 0.23kg/kg [10]. Data for polyurethane is provided in the SFPE handbook which quotes a range between 0.104-0.227kg/kg [9]. As the quantity of fuel in any particular building is expected to be of mixed type, taking the upper value in the range of plastics is considered overly conservative in representing the entire fuel load. The soot yield, quoted by various sources, for wood is 0.015kg/kg which confirms that utilising 0.1kg/kg is a conservative average for fire modelling in pre-flashover conditions where a mixture of plastic and cellulosic fuel is expected.

6.9 FIRE HAZARDS

Subsequent to a review of the relevant fire statistics and hazards presented in Section 6.4, the fire hazards are specific to this building are summarised below.

6.9.1 General Layout

Exits are provided around the buildings' perimeter to allow for multiple alternative egress opportunities. Due to the open nature of the warehouse, there are limited dead end travel routes to exits, however due to the building's large area, extended travel distances to the nearest exit and between alternative exits are present.

No hazards to adjoining buildings have been identified and internal hazards are minimal. Due to the open space and multiple egress opportunities, internal fire exposures are also expected to be minimal as occupants in the area of fire origin are likely to immediately become aware of fire and are likely to commence evacuation.

6.9.2 Activities

The buildings are used as storage and dispatch facilities containing a large number of high piled and racking containing combustibles. These items are only stored temporarily before being dispatched onward, thus there is no degradation of old stock. Notwithstanding the assumed turnover, the storage is assumed to be constantly filled to capacity due to the constant rolling stock.

It is not expected that regular hot work processes, use of highly flammable materials, manufacturing processes or operation of high friction or high temperature machinery will be performed within the buildings.

6.9.3 Ignition Sources

Based on the statistical review contained in Section 6.4 ignition sources relevant to this site, in order of occurrence:

Warehouse

- Intentional
- Electrical distribution / lighting
- Heating equipment
- Shop tools / industrial equipment

6.9.4 Fuel Sources

Quantity of Materials

Warehouse - The racked storage areas are likely to have the densest fire load, with between 200MJ/m^2-1700MJ/m^2 expected depending on the type of items stored.

Office - 800MJ/m^2 with isolated peak values reaching 1600MJ/m^2

Dangerous Goods

Dangerous goods cannot be discounted from being present in the building. However, the quantity will be limited by the space available and relevant workplace health and safety regulations will apply governing storage allowances (quantity) and requirements.

Location of Materials

Products in high storage racking, store room, waste and rubbish containers. The lobbies, stairways and corridors are to be maintained clear of furniture, stored items and the like and constructed with materials and assemblies in accordance with C1.10 to reduce fire spread and smoke production in the event of fire in common areas. Significant fuel loads will therefore be generally limited to the warehouse and offices.

Fire Behaviour

The fire growth rate is expected to approximate an ultra-fast t^2 fire growth rate in warehouse.

Fire growth rates will vary with fuel type and conditions of ventilation and compartmentation. The most likely outcome of any fire outbreak within the building is a sprinkler controlled fire. This would be expected to grow at an ultra-fast time-squared fire growth rate until sprinkler activation in the warehouse areas, at which point the sprinklers are expected to suppress or control the fire.

6.10 PREVENTATIVE AND PROTECTIVE MEASURES

6.10.1 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 building occupants, fire safety systems are provided within the warehouse as listed in the following sections.

6.10.2 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. To that effect, the following systems are design to increase the life safety of occupants:

- The volume of the building acts as a large smoke reservoir to increase the available evacuation time for occupants.
- Manual Smoke Exhaust Fans with turnover rate of 1 enclosure air change per hour.

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

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

- Type C construction
- Sprinkler system documented in Sub System D.

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

The following active systems provided within the buildings to facilitate occupant warning and suppress a potential fire.

- Occupant Warning System
- Storage mode sprinkler system to all areas of the warehouse (including offices)
- Fire Hose Reels
- Fire Extinguishers

6.10.5 Occupant Evacuation and Control (Sub-System E)

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

- Emergency Lighting
- Exit Signage

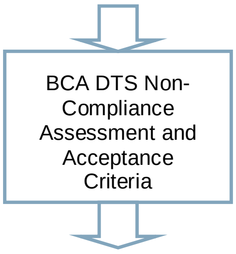
6.10.6 Fire Services Intervention (Sub-System F)

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

- Fire Hydrants
- Automatic Link to Fire Brigade
- 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 Alternative Solutions

BCA DTS PROVISIONS & PERFORMANCE REQUIREMENT	PERFORMANCE BASED SOLUTION
Vehicular Perimeter Access **BCA DTS Provisions** Clause C2.4: Perimeter Vehicle Access **Performance Requirements** CP9	**Relevant BCA DTS Provisions** Clause C2.4 states that the building must be provided with continuous perimeter vehicular access with no part of the roadway less than 6m in width and no more than 18m from the building. The pathway must also permit the passage and operations of fire brigade appliances. **DTS Variation** *Warehouse 3A* • The vehicular access provided to the warehouse is not continuous. • The vehicular access on part of the southern side of the building is greater than 18m from the building (up to 33m). • Vehicular access on the Eastern side of the building is via the adjoining Lot 3B. **Alternative Solution** *Warehouse 3A* • The majority of the access pathway is adjacent the building to allow quick access into the building. • The staff car parking areas will allow smaller vehicles to approach the full southern and western building frontages if required. • Where vehicular access is provided via an adjoining Lot 3B a permanent right of carriageway is to be granted either through an easement or maintaining common ownership of both Lots 3A and 3B **Approaches and Method of Analysis** The assessment methodology follows Clauses A0.5(b)(i), A0.9(b)(ii) and A0.10 of the BCA. An absolute and qualitative approach shall be completed to establish that the design matches the relevant Performance Requirement in facilitating direct, adequate access and entry into the building to undertake fire and emergency intervention activities. **Acceptance Criteria** Access is provided to and around the development to facilitate fire brigade and other emergency services intervention.
BCA DTS Provisions	**BCA DTS Provision** Clause D1.4 requires that travel distances to a point of choice and the nearest exit must not exceed 20m and 40m respectively.

<table>
<tr><th>BCA DTS PROVISIONS & PERFORMANCE REQUIREMENT</th><th>PERFORMANCE BASED SOLUTION</th></tr>
<tr><td>Clause D1.4: Distance to the nearest exit.
Clause D1.5: Distance between alternative exits.
Clause E2.2: Smoke hazard management

Performance Requirement(s)
DP4 & EP2.2</td><td>Clause D1.5 states that travel distance between alternative exits must not exceed 60m.
DTS Non-conformance
The following non-conformances have been identified in the warehouse:
<table><tr><th>LOCATION</th><th>TRAVEL DISTANCE TO NEAREST EXITS</th><th>TRAVEL DISTANCE BETWEEN ALTERNATIVE EXITS</th></tr><tr><td>Warehouse 3A-1</td><td>N/Am</td><td>80m</td></tr><tr><td>Warehouse 3A-2</td><td>45m</td><td>90m</td></tr></table>Alternative Solution
The Alternative Solution will rely upon the volume of the warehouse enclosure to act as a smoke reservoir for hot combustion products with significant reserve so as to provide the population with adequate time to safely evacuate the building prior to the onset of untenable conditions.
Assessment Methodology
The assessment methodology will adhere to Clauses A0.5(b)(i), A0.9(b)(ii), and A0.10 of the BCA. The analysis will be absolute and quantitative where the results of the deterministic assessment are measured directly against the agreed acceptance criteria, with a supporting qualitative argument.
Computational Fluid Dynamic (CFD) programs will be used to simulate the fire development and smoke spread in the warehouse with these results utilised in an ASET/RSET time-line analysis.</td></tr>
<tr><td>BCA DTS Provisions

Clause E4.6 – Direction signs (inter alia AS2293.1: 2005)

Performance Requirement(s)
EP4.2</td><td>BCA DTS Provision
BCA DTS Clause E4.6 (NSW) states that if an exit is not readily apparent to persons occupying or visiting the building, then exit signs must be appropriately provided in accordance with AS2293.1.
AS2293.1 Clause 6.8.1 requires exit signs be mounted not less than 2m and not more than 2.7 above floor level.
DTS Non-conformance
The exit lighting design shall incorporate signage in each warehouse that is positioned above a height of 2.7m to permit the passage of picking machinery below.
Alternative Solution
The Alternative Solution shall rely upon the volume of the warehouse enclosure to provide for adequate time for building population to evacuate prior to the directional exit signs becoming compromised by the hot smoke layer. Further to this, the simplicity of the racking layouts and the familiarity of the occupants within the building shall provide for a rapid evacuation along familiar egress routes.
Assessment Methodology
The assessment methodology will adhere to Clauses A0.5(b)(i), A0.9(b)(ii), and A0.10 of the BCA. The analysis will consist of a qualitative discussion to demonstrate compliance with the relevant Performance Requirements.
Further to the above the deterministic results of the CFD modelling shall demonstrate that the directional exit signage will not be obscured by the descending smoke layer prior to the completion of occupant evacuation, thereby permitting adequate and sufficient way-finding provisions to complete an evacuation.</td></tr>
</table>

8 PROPOSED FIRE SAFETY STRATEGY

8.1 OVERVIEW

The Fire Safety Strategy outlined below has been proposed to satisfy the fire and life safety objectives specified for this project by the relevant stakeholders. In addition, the Fire Safety Strategy 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 it is considered that those items are expected to be deemed-to-satisfy 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 Fire Engineering Report 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 buildings shall be built in accordance with the BCA DTS provisions for Type C fire-resisting construction. These buildings are considered as large-isolated buildings for certification purposes.

8.3 EGRESS PROVISIONS

8.3.1 Evacuation Strategy

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

8.3.2 Egress Provisions

In the warehouse, travel distances to the nearest exit and between alternative exits must be compliant with the BCA DTS requirements with the following exceptions identified and illustrated in Figure 8-1:

LOCATION	TRAVEL DISTANCE TO NEAREST EXITS	TRAVEL DISTANCE BETWEEN ALTERNATIVE EXITS
Warehouse 3A-1	N/A	80m
Warehouse 3A-2	45m	90m

These non-conformances shall be addressed in the fire engineering process.

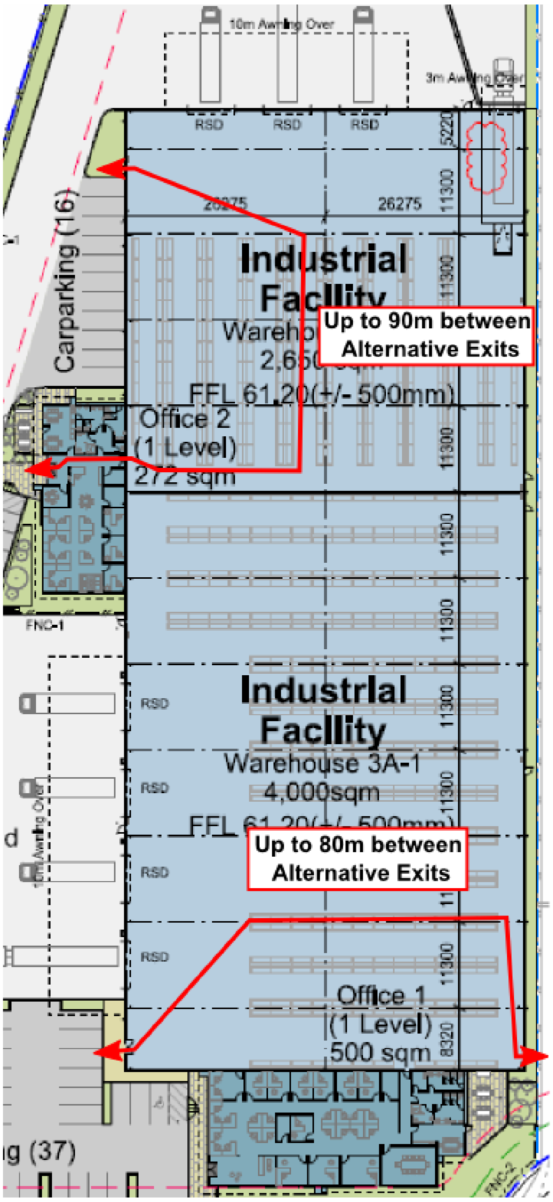


Figure 8-1: DTS Non-Compliant Travel Distances in Warehouse 3A (Tenancies 3A-1 and 3A-2)

8.3.3 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.

8.3.4 Signage and Lighting

Emergency lighting is to be provided throughout each building in accordance with DTS Provisions E4.2 and E4.4 of the BCA 2012 and AS2293.1:2005.

Exit signage is to be provided throughout each building in accordance with the DTS Provisions E4.5, E4.6, E4.8 of the BCA 2012 and AS2293.1:2005 with the directional signage at the end of the racking aisles and above block storage areas permitted to be installed at a height greater than 2.7m.

The final height and location of the directional exit signs shall be determined through the fire engineering analysis.

8.4 ACTIVE FIRE PROTECTION SYSTEMS

8.4.1 Building Occupant Warning System

Building occupant warning systems shall be provided throughout all parts of each warehouse. The system shall be in accordance with the prescriptive requirements of Specification E1.5 and Clause 6 of Specification E2.2a of the BCA 2012 and AS1670.1:2004.

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

8.4.2 Smoke Detection System

Our experience indicates that a smoke detection system may be required throughout the Warehouse 3A parts of the building due to the relatively small area within in each tenancy. This shall be dependent on the maximum travel distances exhibited and will be confirmed subsequent to detailed fire engineering analysis prepared prior to the issuance of the building permit shall confirm this requirement.

Where it is established that smoke detection is required the detectors must form part of a system complying with AS1670.1:2004 (spaced in accordance with BCA Specification E2.2a clause 5 i.e. extended grid spacing 20m x 20m).

The smoke detection system must also activate any electromagnetic devices or locks that are required to fail safe open upon general alarm and the building occupant warning system.

8.4.3 Fire Sprinkler System

A fire sprinkler system shall be provided throughout each building in accordance with the relevant regulatory requirements. Each site shall have an independent system with dedicated fire pump, water supply tanks and booster assemblies on each Lot.

- In the office and beneath the warehouse awnings of each building the sprinkler system shall comply with BCA Specification E1.5 and AS2118.1:1999.
- In each warehouse a storage mode system shall be provided in accordance with BCA Specification E1.5 and AS2118.1:1999, with the sprinkler head location, spacing and design capacity in accordance with Factory Mutual Guidelines 2-0 and 8-9 (or NFPA regulations). Sprinkler activation temperature must be no greater than 101°C and have a Response Time Index (RTI) of less than $50m^{1/2}s^{1/2}$ (i.e. fast response type).

Upon detection of a fire the building occupant warning alarm shall be initiated throughout that building and the direct brigade notification activated.

8.5 FIRST AID FIRE FIGHTING

8.5.1 Fire Hose Reels

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

Locations should be signposted and readily accessible to occupants. Use of facilities should be monitored for abuse, mistreatment and servicing. The fire hose reels shall be located within 4m of an exit and provide coverage to all areas of the building based on a 36m hose length with a 4m water stream (i.e. maximum 40m coverage from the hose location).

8.5.2 Portable Fire Fighting Equipment

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. As a guidance:

• General office areas	Dry Powder (ABE type)	2.5Kg
• Computer/server rooms	CO_2	3.5 Kg
• Plant rooms	Dry Powder (ABE)	2.5 Kg
• Designated exits	Dry Powder (ABE)	4.5 Kg
• Adjacent each fire hose reel cabinet	Dry Powder (ABE)	4.5 Kg

8.6 FIRE BRIGADE INTERVENTION

8.6.1 Fire Indicator Panels

Warehouse 3A shall be provided with a Main Fire Indicator Panel (FIP) within a compliant fire control centre. These shall be located within the main entry to the office or at the main gatehouse (provided adequate room is available to facilitate a fire control centre). In addition to this Mimic FIPs shall be provided in the remaining tenancy office.

Each Main FIP must be installed in accordance with BCA Specification E2.2a and AS1670.1:2004 and have the following capabilities.

- The FIP panel must be capable of isolating, resetting, and determining the fire location within the building for which is serves.
- A red strobe shall be installed at the entry door to the FIP to alert arriving fire brigade of the fire alarm origin and FIP location.

8.6.2 Fire Hydrants

A dedicated hydrant system, with independent booster assembly, must be provided for each site. These shall be fully independent from one another and provide protection to all parts of the building it serves.

The fire hydrant systems shall be in accordance with BCA Clause E1.3 and AS2419.1:2005.

The hydrant system shall incorporate the following minimum design requirements:

- Each system shall incorporate a ring main with isolation valves that are external to the building and numbered with the corresponding numbers indicated on the blockplan at the booster assembly.
- External hydrant connections shall be provided with the heat shields per the requirements of AS2419.1 (i.e. FRL 90/90/90 2m either side, and 3m above the hydrant connection point) or be setback more than 10m from the building.
- All hydrant connection points and the booster assembly must be fitted with Storz hose couplings which comply with Clause 7.1 and 8.5.11 AS2419.1:2005. Further information is available from the FRNSW Guide Sheet No. 4 '*Fire Brigade Hose Couplings*' available at www.fire.nsw.gov.au.
- For large isolated buildings (particularly those with CP9 vehicular access non-compliances), an external hydrant shall be provided adjacent to or within close proximity of each external entry/exit point around the building.
- As far as possible the hydrant system should consist of external hydrant points. Where the size and design of a building require the provision of internal fire hydrants to achieve floor coverage in accordance with the requirements of AS2419.1, such hydrants should be located to allow progressive movement of fire fighters towards the central parts of the building.
  - When working from an external hydrant, the next additional in hydrant should be located into the building not more than 50 metres from the external hydrant.
  - When working from an internal hydrant (either from within a fire isolated exit or passageway, within 4 metres of an exit or another additional hydrant), the next additional hydrant should be located not more than 25 metres from that hydrant.
  - 25 & 50 metre distances have been chosen to make allowance for shorter than standard hoses (repairs etc.) and unknown variables that may occur in building layout and fixtures, etc.
- Hydrants located beneath the warehouse awnings shall have twin connection points, compliant heat shields and may use two hose lengths for coverage.

8.6.3 Vehicular Perimeter Access

The vehicular perimeter access pathway shall be provided around the whole of the building. These shall be designed and constructed in all-weather surface capable of supporting all FRNSW appliances in accordance with BCA Clause C2.4 and NSW Fire Brigade Policy No. 4 '*Guidelines for emergency vehicle access*', available at http://www.fire.nsw.gov.au/gallery/files/pdf/guidelines/vehicle_access.pdf.

The departures from the compliant vehicular perimeter access shall be handled as an Alternative Solution and are indicated below.

Where vehicular access is provided via an adjoining Lot a permanent right of carriageway is to be granted either through an easement or maintaining common ownership of both lots.

Any access or security gates obstructing the perimeter access path shall be unlockable by fire brigade 003 keys or access swipe cards are to be provided to the nearest responding fire stations. Otherwise, all gates are to be programmed to automatically open upon fire alarm.

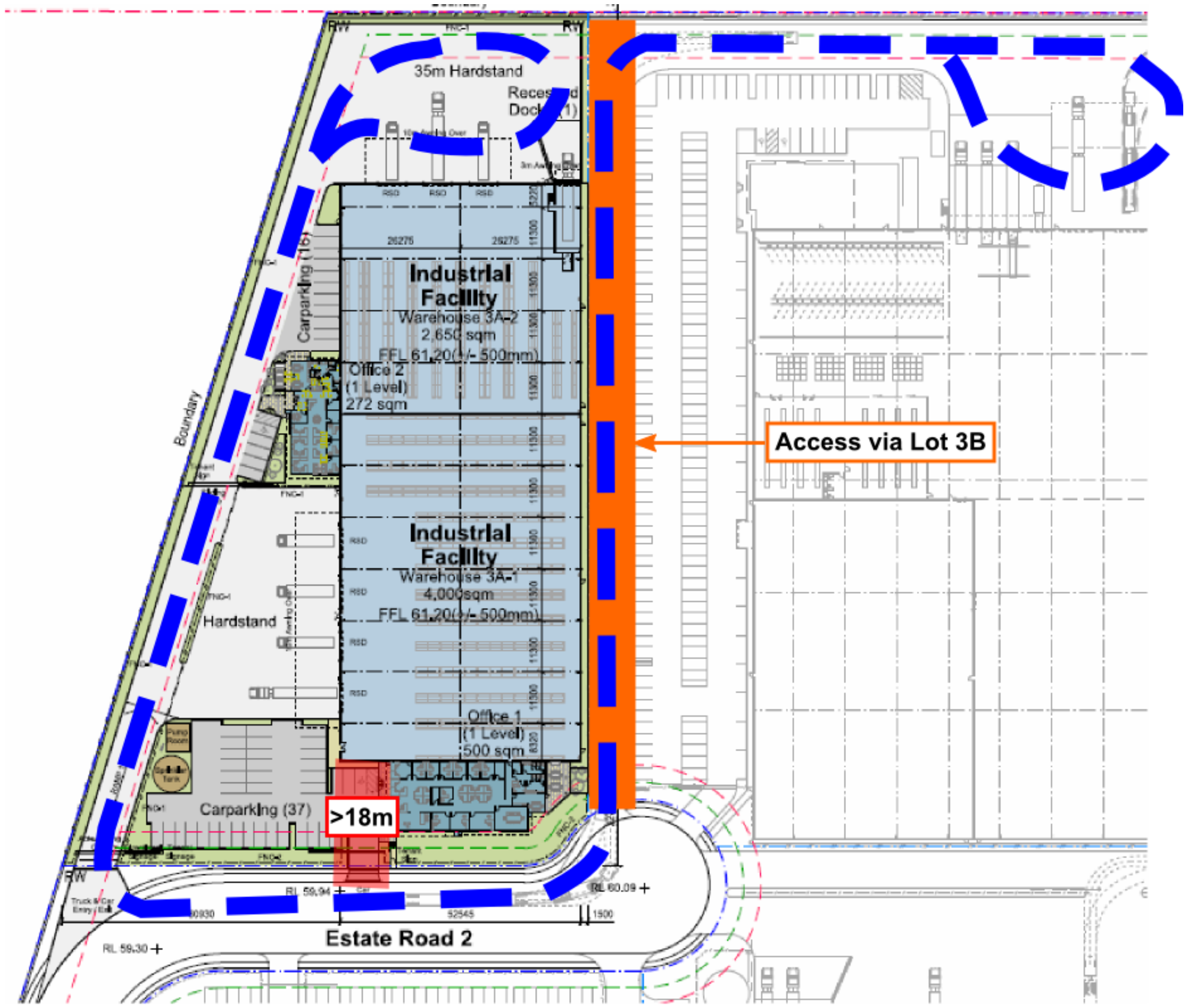


Figure 8-2: Perimeter Access Non-Compliances on Lot 3A

8.7 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.

8.7.1 Maintenance of Fire Safety Equipment

The fire detection systems, fire sprinkler systems, emergency warning systems, fire hydrants, hose reels, portable fire extinguishers, emergency lighting and any other fire safety equipment shall be tested and maintained in accordance with Australian Standard AS1851 or other relevant testing regulatory.

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

8.7.2 Evacuation Plan

An evacuation plan should be developed for each site in accordance with AS3745:2010.

Standard fire orders should be displayed throughout the building.

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