

# Defire

## Review of fire safety engineering issues for section 96 application

Warringah Mall Extension – Stage 1

Client Westfield Design & Construction

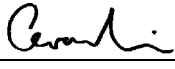
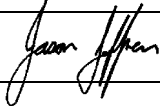
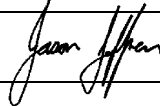
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## Amendment schedule

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			Prepared by	Reviewed by	Approved by
		Name	Aaron Li	Jason Jeffress	Jason Jeffress
		Signature			
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			Prepared by	Reviewed by	Approved by
		Name	Aaron Li	Jason Jeffress	Jason Jeffress
		Signature			
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			Prepared by	Reviewed by	Approved by
		Name	Aaron Li	Jason Jeffress	Jason Jeffress
		Signature			
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		Name	Aaron Li	Jason Jeffress	Jason Jeffress
		Signature			
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			Prepared by	Reviewed by	Approved by
		Name	Aaron Li	Jason Jeffress	Jason Jeffress
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			Prepared by	Reviewed by	Approved by
		Name	Aaron Li	Jason Jeffress	Jason Jeffress
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		Name	Aaron Li	Jason Jeffress	Jason Jeffress

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			Prepared by	Reviewed by	Approved by
		Name	Aaron Li	Jason Jeffress	Jason Jeffress
					

## Executive summary

This report documents the findings of a preliminary fire safety engineering review of the proposed alterations and additions to the existing Warringah Mall shopping complex. The review was undertaken to form part of the section 96 submission.

The intent of the review is to determine whether it is feasible to undertake a fire safety engineering assessment to develop alternative solutions to the deemed-to-satisfy (DTS) provisions of the National Construction Code 2013 Volume One – Building Code of Australia (BCA) for the new works. Defire undertook the review at the request of Westfield Design and Construction.

The existing Warringah Mall shopping centre has a gross lettable area (GLA) of approximately 124,000m<sup>2</sup> located over three storeys and approximately 4500 car spaces. Its main tenants include David Jones, Myer, Target, Big W, Woolworths, Coles, Rebel Sport, JB Hi Fi, Dick Smith Powerhouse and Hoyts Cinema in addition to over 300 specialty stores.

The proposed stage 1 works include alterations to the layout of the existing mall, addition of new specialty tenancies, minor reduction of the existing Myer tenancy and conversion of a portion of the Starfish carpark to retail use. The new works will add approximately 8,000m<sup>2</sup> GLA over three retail storeys and 336 additional carparking spaces over three storeys.

Defire considers that it is possible to develop alternative solutions to the DTS provisions of the BCA related the issues identified within section 5 for the new works demonstrating compliance with the relevant performance requirements of the BCA.

The specific details of the proposed alternative solutions are subject to the development of a comprehensive list of fire safety measures and the outcomes of the required fire safety engineering assessment. These details will be developed as part of the on-going design and development process.

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# 1. Introduction

This report documents the findings of a preliminary fire safety engineering review of the proposed alterations and additions to the existing Warringah Mall shopping complex. The review was undertaken to form part of the section 96 submission.

The intent of the review is to determine whether it is feasible to undertake a fire safety engineering assessment to develop alternative solutions to the deemed-to-satisfy (DTS) provisions of the National Construction Code 2013 Volume One – Building Code of Australia (BCA)<sup>1</sup> for the new works. Defire undertook the review at the request of Westfield Design and Construction.

## 2. Description of building

### 2.1 Building description

The existing Warringah Mall shopping centre has a gross lettable area (GLA) of approximately 124,000m<sup>2</sup> located over three storeys and approximately 4500 car spaces. Its main tenants include David Jones, Myer, Target, Big W, Woolworths, Coles, Rebel Sport, JB Hi Fi, Dick Smith Powerhouse and Hoyts Cinema in addition to over 300 specialty stores.

The proposed stage 1 works include alterations to the layout of the existing mall, addition of new specialty tenancies, minor reduction of the existing Myer tenancy and conversion of a portion of the Starfish carpark to retail use. The new works will add approximately 8,000m<sup>2</sup> GLA over three retail storeys and 336 additional carparking spaces over three storeys.

The proposed works will interface with existing centre on all levels and it is not intended to separate the new works from the existing building.

A description of the main characteristics of the new portions of the centre for the purpose of determining compliance with the BCA is given in Table 1. The proposed use and classification of the building or part in accordance with clause A3.2 of the BCA is described in Table 2.

Characteristic	BCA clause	Description
Effective height	A1.1	Less than 25m
Type of construction required	C1.1	Type A
Rise in storeys	C1.2	Three

Table 1 Main building characteristics

Part of building	Use	Classification (A3.2)
Ground level	Retail and carparking	Classes 6 and 7a
Ground mezzanine level	Carparking	Class 7a
Level 1	Retail and carparking	Classes 6 and 7a
Level 1 mezzanine	Carparking	Class 7a
Level 2	Retail and carparking	Classes 6 and 7a

Table 2 Use and classification

<sup>1</sup> National Construction Code 2013 Volume One – Building Code of Australia, Australian Building Codes Board, Australia, 2013.

## 2.2 Occupant characteristics

A description of the characteristics of the occupants expected to be within the building is given in Table 3.

Characteristic	Description
Familiarity:	Retail – Occupants are expected to be primarily shoppers who may not be familiar with the layout of the building and location of fire exits. A limited number of staff are also expected to be present which are familiar with the layout of the building. Carpark – Occupants are mainly expected to be primarily shoppers and be within the carpark for short periods.
Awareness:	Occupants are expected to be awake and alert to a potential emergency event such as a fire in the building.
Mobility:	Occupants are assumed to have the same level of mobility as the general population. This may include a limited proportion of mobility impaired occupants. These occupants may require crutches, a wheelchair or similar to evacuate on their own or need assistance from other occupants.
Age:	Occupants of all ages may be present within the building.
Language:	Although occupants may have English as their second language, they are expected to understand signs and verbal instructions in English to the degree necessary to not adversely impact upon evacuation.
Occupant load:	Population densities used in this assessment are proposed to be based upon Project 6 report 'Fire Safety in Shopping Centres' <sup>2</sup> – a. 6 m <sup>2</sup> /person in individual retail tenancies b. 6 m <sup>2</sup> /person in mall areas at ground level with direct egress to open space c. 10 m <sup>2</sup> /person in mall areas on other levels

Table 3 Occupant characteristics

## 3. Scope and assumptions

- This report is limited to the new works to the Warringah Mall. This report excludes detailed assessment of existing mall areas, specialty shops, major tenancies and carparks. It is to be shown that the current level of life safety for occupants in these areas is not reduced as a result of the proposed works and fire scenarios within the existing centre are to be considered when assessing the level of safety in the new extension.
- The scope of our works is limited to considering evacuation and fire safety issues for people with disabilities to the same degree as the DTS provisions of the BCA.
- This report is limited to compliance with the performance requirements of the BCA for the new works.
- Fire engineering analysis will be in accordance with standard industry practice and the Society of Fire Safety (SFS) Code of Practice.
- The documentation that forms the basis for this report is listed within Appendix A.
- The existing building complies with the applicable building standard at the time of construction except for the alternative solutions in the reports identified within section 4.2.

<sup>2</sup> Fire Safety in Shopping Centres, Project 6, Fire Code Reform Centre (FCRC), Sydney 1998.

## 4. Preliminary review of design

### 4.1 Proposed fire safety strategy for new works

The new works are proposed to comply with the performance requirements of the BCA. This will be achieved by a combination of compliance with the DTS provisions of the BCA and alternative solutions where appropriate based upon a fire safety engineering assessment of the design. The fire safety systems are to comply with the current BCA and relevant Australian standards.

The main alternative solutions for the new works relate to the smoke hazard management design and evacuation provisions. As the design is still at an early stage further design development is likely to identify additional minor alternative solutions.

The evacuation and smoke hazard management strategy for the new works is to be consistent with the previous fire safety engineering assessments prepared for the existing centre.

### 4.2 Review of existing centre

The interface between new works and the existing centre will be designed so that the new building does not reduce the level of safety of the existing centre. As a result the existing centre is not proposed to be upgraded to comply with today's Australian standards nor the current BCA. It is to be demonstrated that the current level of fire safety afforded will not be decreased as a result of the proposed alterations and additions to the centre.

It is understood the development of the original centre commenced in 1963. It included a three storey shopping centre with a multi-deck carpark, specialty shops and a cinema complex.

Two major redevelopments of the mall have occurred from 1997 to 2002. These are referred to as stage 1 and stage 2. It is understood that these stages of works included the following:

Stage 1: The development comprised an expansion of retail floor space to accommodate a new supermarket, a discount department store, a food court, six additional mini majors and approximately 133 additional specialty shops. A refurbishment of the existing retail facilities was also undertaken.

The existing two storey shopping mall between David Jones and the Starfish carpark was rebuilt as a two storey retail arcade and extended to the northwest. The new Woolworths and Big W major tenancies were located to the northwest and a new food court located at the southern end of the new mall.

Stage 2: The existing buildings in the southeast corner of the shopping centre were demolished – including Woolworths which was relocated to the northern mall – and replaced by retail arcade from the centre court area. A new Coles and a first floor food court were developed. Additional carparking was created and the cinema expanded. In addition, a library and community centre was added on level 2.

The existing building has been the subject of previous fire safety engineering assessments by Scientific Services Laboratory (SSL). The major alternative solution reports prepared for the existing centre are listed as follows:

- Report no XR0074/R4 dated August 1997 prepared by SSL. This report was prepared in relation to the stage 1 works.
- Report no XR0165/R2 dated August 1998 prepared by SSL. This report was prepared in relation to the stage 2 works.
- Report no XR0534/R1 dated November 2001 prepared by SSL. This report was prepared in relation to the proposed addition of fabric canopies over the mall.



- We also understand that several minor fire safety engineering assessments have been compiled since completion of the centre.

In addition to the fire safety engineering assessments, a document was also developed for the existing centre setting out the main fire safety measures for the centre and the associated maintenance procedures. This document is known as the 'Warringah Mall Essential Fire Safety Measures Protocol' which was prepared for AMP Henderson Global Investors Limited. The protocol document is to be updated to include the new extension and the associated fire safety measures that will be required prior to completion of the new works and occupation of the building.

The findings of the previous alternative solution reports and the requirements of the essential fire safety measures protocol are not considered to impact upon the fire safety strategy documented within this report for the following reasons:

- The new works are proposed to be contained in smoke reservoirs separated from the existing parts of the building. The new mall areas and major tenancies are to be provided with independent smoke hazard management systems. The smoke hazard management systems in the new mall and major tenancy are to be designed to maintain tenability for occupants to safely evacuate and to limit smoke spread to the existing centre and adjacent smoke zones. In case of fire in the existing centre the smoke hazard management system in the new mall is to be designed to maintain tenable conditions in the new mall areas.
- Adequate aggregate exit widths are proposed to be provided in the new areas based upon the incremental increase in floor area to cater for the additional population created by the extension and thereby not reducing the existing level of safety. The total exit width serving the new mall and specialty shops is to be designed to be equal to the total width of exits required to serve the altered existing areas plus the width required to serve the additional population resulting from the new retail areas.

#### 4.2.1 Consideration of flood evacuation plan

The existing centre is situated in an area that may be subjected to flooding in the event of a 1 in 100 year flood. A flood intervention plan has been developed for the existing centre to evacuate occupants to a place of relative safety. The overall flood evacuation strategy involves directing occupants to the level 1 carpark areas of the shopping centre away from the flooded areas at ground level. The flood evacuation strategy is not considered to impact upon the fire evacuation strategy. It is noted that the flood evacuation strategy will need to be updated as a result of the proposed new works.

## 5. Review of the main alternative solutions for the new works

### 5.1 Smoke hazard management and evacuation provisions

The smoke hazard management system in the new retail areas of the shopping centre is proposed to be designed from first principles, based on sprinkler controlled fires, to maintain an adequately smoke-free environment and visibility to allow for the mall to be used as an escape route and a place of relative safety. This is considered to be consistent with the strategy adopted in the fire safety engineering assessments for the existing centre. It is intended to treat the new works as separate smoke exhaust zones and provide separation from the existing systems through smoke baffles near the interface between the new and existing works.

The evacuation strategy for the building will be designed upon the premise that the mall is a place of relative safety and most people will evacuate through it. The major tenancies will form separate smoke zones using fixed baffles / downstands or operable shutters at the mall entrance. This will limit the risk of smoke spread to and from these tenancies and allow occupants to move away from a fire to a place of relative safety in the mall.

Computational fluid dynamics (CFD) modelling will be used to design the mall smoke control system. CFD modelling allows the designer to account for the air movements and three-dimensional aspects of the building design to adequately design the smoke control system and determine the required smoke exhaust capacity and location of extract point to achieve the design objectives for the project.

The available safe evacuation time (ASET) is to be estimated from the CFD modelling and be compared with the required safe evacuation time (RSET) for the occupants within the retail areas. An appropriate safety factor will be applied to account for uncertainties in the input data.

### 5.2 Travel distances from specialty tenancies

The sprinkler system is expected to limit fire spread to the area of fire origin and reduced the production of heat and smoke. The provision of a sprinkler system is therefore expected to significantly improve and extend the tenability within a specialty tenancy compared to an unsprinklered building which would have identical DTS requirements in relation to maximum travel distances.

The provisions of an automatic sprinkler system – limiting the growth rate and peak fire size – is also considered to reduce the risk of a fire reaching a critical size blocking the escape path and preventing occupants from safely evacuating past the fire out into the mall.

This beneficial impact of automatic sprinkler systems on occupant safety is acknowledged in a range of building codes and fire safety guidelines around the world by – amongst other – allowing an increase in the travel distance to a point of choice or single exit by 30-50% in sprinkler protected occupancies<sup>3,4,5</sup>.

Although there is no smoke exhaust provided with individual specialty tenancies smaller than 1,000m<sup>2</sup>, the smoke hazard management system in the mall areas is expected to increase the tenability in the mall areas and specialty tenancies by removing heat and smoke produced by a fire.

In addition to this, the open layout of the public sales area of a specialty tenancy – ie no or very limited solid partitions and obstructions – means that the shop entrance is visible from the majority of the tenancy. This will significantly reduce the risk of occupant becoming trapped by a fire before reaching the mall.

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<sup>3</sup> NFPA 101 – Life Safety Code, NFPA, US 2012.

<sup>4</sup> Acceptable solution C/AS1 Part 3: Means of Escape, Compliance Document for New Zealand Building Code Clauses C1, C2, C3, C4: Fire Safety, Department of Building and Housing, NZ, October 2011.

<sup>5</sup> Section 5 – Safety in case of fire, BBR19, BFS 2011-26 (Swedish Building Regulations), 2011.

### 5.3 Travel distances within the carpark areas

The fire hazards associated with carparks are generally low. International and Australian research have demonstrated that carpark occupancies inherently present a low risk to life safety. In a survey conducted by Harris <sup>6</sup> of 1,233 parking buildings and 105 fires in the US and Canada no fatalities were reported. In a more recent study carried out by Denda <sup>7</sup> of 404 fires in US parking buildings over the period from 1986-1988, no fatalities were reported.

Similarly, in Australia no fatalities have been reported from the fire incident data collected by the Melbourne Metropolitan Fire and Emergency Services Board <sup>8</sup> for carparks during the period between 1991-2000. As stated by the BHP research in to fire safety in carparks <sup>9</sup> – ‘Carparks represent little risk to life or of injury, and very low monetary losses, possibly because of a very low frequency of fire starts in this type of building’.

Occupants of the carpark are most likely to be customers of the mall. Although the occupants may be relatively unfamiliar with the carpark, the open layout is considered to significantly simplify the wayfinding required to locate an exit compared to a building with enclosed rooms and corridors.

### 5.4 Fire ratings

In some areas such as separation between carpark and retail areas the requirements for fire separation will be assessed on a performance basis.

It is intended to demonstrate that the separations proposed between areas are sufficient to protect occupants from a fire based on the active systems provided within the building – ie sprinkler and smoke exhaust systems.

## 6. Summary of the review

Defire considers that it is possible to develop alternative solutions to the DTS provisions of the BCA related the issues identified within section 5 for the new works demonstrating compliance with the relevant performance requirements of the BCA.

The specific details of the proposed alternative solutions are subject to the development of a comprehensive list of fire safety measures and the outcomes of the required fire safety engineering assessment. These details will be developed as part of the on-going design and development process.

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<sup>6</sup> LM Harris 1979, ‘Update of the Survey of Fire Experience in Automobile Parking Structures in the United States and Canada’, Marketing Research Associates, American Iron and Steel Institute.

<sup>7</sup> Dale F Denda 1992, Parking Garage Fires – A Statistical Analysis of Parking Garage Fires in the US:1986-1988.

<sup>8</sup> MFB Fire Incidents in Parking Complexes 1991-2000, 2002 MFESB.

<sup>9</sup> Fire Safety in Carparks – BHP – February 1992.

## Appendix A Drawings and information

Drawing title	Dwg no	Date	Drawn
Proposed ground level	Scheme 28d DA 01.5201 C	08/04/2014	Westfield Design & Construction
Proposed ground level mezzanine	Scheme 28d DA 01.5202 C	08/04/2014	Westfield Design & Construction
Proposed level 1	Scheme 28d DA 01.5203 C	08/04/2014	Westfield Design & Construction
Proposed level 1 mezzanine	Scheme 28d DA 01.5204 C	08/04/2014	Westfield Design & Construction
Proposed level 02	Scheme 28d DA 01.5205 C	08/04/2014	Westfield Design & Construction
Proposed roof plan	Scheme 28d DA 01.5206 C	08/04/2014	Westfield Design & Construction