Fire Safety Engineering Report

Galleria Shopping Centre

Redevelopment

284 Collier Road,
Morley WA 6062

Client: Vicinity Centres

Project No: 240380

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A	Issued to building surveyor	15.10.2025	AA
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Executive Summary

This Fire Safety Engineering Report (FSER) documents the findings of a fire safety engineering assessment carried out for the redevelopment of the Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062. The report formulates Performance Solutions for the identified deviations from the Deemed-to-Satisfy (DtS) provisions of the National Construction Code Volume 1, Building Code of Australia 2022, including Amendments 1 and 2 (BCA) [ABCB, 2022; ABCB, 2025-1; ABCB, 2025-2] associated with the project.

The Galleria Shopping Centre (GSC) is being redeveloped in stages. The scope of this stage of redevelopment includes the centre and north part of the Ground Floor and First Floor (Myer Mall).

The works do not comply in full with the BCA DtS provisions; therefore, the design is considered a "performance-based building design". The deviations from the BCA DtS provisions that require assessment, as identified by the building surveyor for the project, are identified in Table 1.

<table>
<tr><th>Perf. Sol.</th><th>Performance Solutions</th><th>DtS Provisions</th><th>Performance Requirements</th></tr>
<tr><td rowspan="2">1</td><td>The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120</td><td>C2D2(2) and Table S5C21e</td><td rowspan="2">C1P1</td></tr>
<tr><td>The loadbearing columns that support the First Floor slab achieve FRL 120/--/-- in lieu of FRL 180/--/--</td><td>C2D2(2) and Table S5C21g</td></tr>
<tr><td rowspan="3">2</td><td>MSSBs that support the operation of smoke exhaust fans in smoke zones SZ-02 and SZ-03 are either not located in fire-rated enclosures or are located in plant rooms that do not achieve DtS compliant fire-separation from the rest of the building</td><td>C3D14(2)(a)</td><td>C1P2(1)(d);
E2P2</td></tr>
<tr><td>Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant are not fire-stopped</td><td>C4D15(2)</td><td>C1P2(1)(d)</td></tr>
<tr><td>Power supply to the AHUs that provide make-up air to the smoke exhaust systems is not fire-rated and is not enclosed in plant rooms that have FRL not less than --/120/120.</td><td>E2D15(2)(a),
Cl. S21C7(7) of Spec. 21,
Cl. 4.10.2.2(a) AS 1668</td><td>E2P2</td></tr>
<tr><td>3</td><td>Travel distances for the non-fire-isolated exits are measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space</td><td>D2D5(3)(a)</td><td>D1P4; E2P2</td></tr>
<tr><td rowspan="2">4</td><td>Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m</td><td rowspan="2">D2D5(3)(a)</td><td rowspan="2">D1P4; E2P2</td></tr>
<tr><td>Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m</td></tr>
</table>

Perf. Sol.	Performance Solutions	DtS Provisions	Performance Requirements
	Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m		
	Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m		
	Travel distances from FF amenities to a point of choice are extended up to 27 m in lieu of 20 m		
	Travel distances from the GF BoH area to the nearest of the alterative exits are extended up to 50 m		
5	Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust are extended up to 61 m in lieu of 40 m	D2D5(3)(a)	D1P4, E2P2
	Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, are extended up to 118 m in lieu of 60 m	D2D6(c)(iii)	
	Smoke exhaust rates are determined on a performance basis in lieu of compliance with the BCA DtS provisions	E2D15(2)(a), Cl. S21C2(2) of Spec. 21	E2P2
	Horizontal length of the Myer retail mall smoke reservoir is extended up to 144 m long in lieu of 60 m	E2D15(2)(a), Cl. S21C4(2) of Spec. 21	
	Horizontal length of the Plaza smoke reservoir is extended up to 66 m long in lieu of 60 m		
	Make-up air velocity through vertical openings exceeds 1 m/s	E2D15(2)(a), Cl. S21C6(3) of Spec. 21	
6	The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03)	D2D12(1)	D1P5, E2P2
7	First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) in lieu of to a road or open space	D2D12(2)(a)	D1P5, E2P2
	Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space	D2D12(2)(b)	

Perf. Sol.	Performance Solutions	DtS Provisions	Performance Requirements
8	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m	E1D2(2) and Cl. 3.5.3.3(b) of AS 2419.1-2021	E1P3
	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.5.3.3(c) of AS 2419.1-2021	
	Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.6.1(e) of AS 2419.1-2021	
	Internal fire hydrants are not located in every fire-isolated exit	E1D2(2) and Cl. 3.6.2(a)(ii) of AS 2419.1-2021	
	Internal fire hydrants installed in retail malls are provided more than 4 m from required exits	E1D2(2) and Cl. 3.6.2(b) of AS 2419.1-2021	
9	In the refurbished and extended parts of the GSC, the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, in lieu of fire hose reels	E1D3(2)(a)	E1P1
10	Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy	Cl. 3.1.2 of AS 2118.1, S17C2(a) of BCA Spec. S17 and E1D4(b)	E1P4
11	The eastern canopies in the North Laneway are protected with vertical sidewall sprinklers on a performance basis	E1D4(b), Cl. S17C2(a) of Spec. 17 and Clauses 3.1.3, 5.5.3(c) and 5.6.10 of AS 2118.1-2017	E1P4
12	Walls between the sprinklered and non-sprinklered parts are provided with glazed sections that are not protected against fire spread	S17C3(a) of Spec. 5 and E1D4(b)	C1P2(1)(d), E1P4
13	After-hours, the make-up air velocity through the Timezone and JB Hi-Fi shopfront openings is increased up to 3.5 m/s in lieu of a maximum 2.5 m/s	S21C6(2) of Spec. 21 and E2D15(2)(a)	E2P2

Perf. Sol.	Performance Solutions	DtS Provisions	Performance Requirements
14	The existing smoke exhaust fans located in the Myer retail mall and Plaza generate noise levels up to 90 dB in lieu of a maximum noise level of 80 dB	Cl. 4.6 of AS 1668.1	E2P2

Table 1: Performance Solutions and relevant BCA provisions

The assessment was carried out in accordance with the process prescribed by BCA Clause A2G2(4) and endorsed by the Government of Western Australia, Department of Local Government, Industry Regulation and Safety (LGIRS) [formerly the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)].

The fire engineering analysis of the performance-based design generally follows the methodology outlined in the Australian Fire Engineering Guidelines [ABCB, 2021], which is produced by the Australian Building Codes Board.

This report provides supporting evidence demonstrating that the performance based design is capable of achieving compliance with the relevant Performance Requirements of the BCA, subject to the following conditions:

1. The provisions listed in Section 9 (Fire Safety Strategy) shall be strictly adhered to and implemented as part of the building design.
2. The requirements listed in Section 9 are *safety measures* and shall be maintained in accordance with Regulation 48A of the Building Regulations 2012 (with amendments).
3. Should a change in use or building alterations and/or additions occur in the future, a re-assessment will be needed to verify consistency with the analysis contained within this report.

Table of Contents

1. Introduction

This Fire Safety Engineering Report (FSER) documents the findings of a fire safety engineering assessment carried out for the redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062. The report formulates Performance Solutions for the identified deviations from the Deemed-to-Satisfy (DtS) provisions of the National Construction Code Volume 1, Building Code of Australia 2022, including Amendments 1 and 2 (BCA) [ABCB, 2022; ABCB, 2025-1; ABCB, 2025-2] associated with the project.

The method of meeting the Performance Requirements of the BCA adopted for this project is in accordance with BCA Clause A2G1(2)(c), i.e. compliance with the Performance Requirements is achieved by a combination of a "*Performance Solution*" and "*Deemed-to-Satisfy Solution*".

The works do not comply in full with the BCA DtS provisions; therefore, the design is considered a "performance-based building design". The deviations from the BCA DtS provisions that require assessment in accordance with BCA Clause A2G2(1), as identified by the building surveyor for the project (BCA Consultants), are detailed in Section 8.

The purpose of this document is to identify the deviations from the BCA DtS provisions; outline the proposed Performance Solutions, acceptance and limiting criteria, design concepts, and fire safety strategy; and generally set down the fire safety engineering philosophy for the approval by the design team. This report is limited to only assessing the deviations from the BCA DtS provisions detailed in Section 8.

BCA Consultants (WA) Pty Ltd (BCA Consultants) developed this report at the request of Vicinity Centres Pty Ltd, who are the owner for the site.

2. Objectives

The fire safety objectives must satisfy the community expectations (legislative objectives) and relevant stakeholders' expectations (design objectives). The fire safety objectives for the project are summarized below.

2.1 Legislative objectives

The following are the fire safety objectives of the BCA:

1. Safeguard people from illness or injury due to a fire in a building.
2. Safeguard occupants from illness or injury while evacuating a building during a fire.
3. Facilitate the activities of emergency services personnel.
4. Avoid the spread of fire between buildings.
5. Protect other property from physical damage caused by structural failure of a building as a result of fire.

2.2 Design objectives

The client requested that a fire safety engineering assessment be provided to support the performance-based building design as outlined in Section 9 of this report.

Objectives such as protection of property; protection of furnishings; protection of reputation and ensuring business continuity; safety other than fire safety; have not been identified as design objectives of this assessment. However, by satisfying the core fire safety objectives some of the above objectives may also be satisfied.

3. Assumptions & Limitations

The following assumptions and limitations apply to this FSER:

a) This FSER formulates Performance Solutions for the redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062, and is limited to the deviations from the BCA DtS provisions as identified in Section 8.

b) This FSER has been produced for review and acceptance by the relevant stakeholders and the approval authorities (permit issuing authority, client, DFES), and provides no guarantee of acceptance. This report provides no guarantee of approval; no action should be taken in respect to this report until such time as full approval has been obtained from the building surveyor or any other relevant approval authorities.

c) This FSER is developed on the assumption that all building works, except for the deviations identified in Section 8 of this report, shall comply with the BCA DtS provisions at the completion of the works.

d) The building fire safety measures shall be completed and maintained to operate as designed. This report does not cover times when the building is incomplete or when fire safety measures are not designed and maintained to be capable of operating in accordance with the requirements set out in this report and/or in the relevant Australian and/or International Standards.

The full list of assumptions and limitations is provided in Appendix A of this report.

4. Principal Building Characteristics

4.1 General

The GSC is an existing regional shopping centre located at 284 Collier Road, the corner of Collier and Walter Roads, Morley, WA 6062, and is proposed to be redeveloped in stages. The location plan is illustrated in Figure 1 below.

Figure 1: Location Plan of Galleria Shopping Centre

The shopping centre consists of major retailers including Woolworths, Coles. Kmart, Aldi, Target, Rebel Sports, Myer, Event Cinemas and facilities including toilets, restrooms, info desk, lost and found, wheelchair hire, payphones, recycling stations, Uber and Taxi bays.

The scope of redevelopment for this stage includes the north part of the Ground Floor and First Floor retail mall areas and the adjacent tenancies, excluding any major tenancies.

In accordance with the DtS provisions of the BCA and based on the advice provided by the building surveyor the building has the following characteristics:

Characteristic	Description
Classification	Class 6 (retail), Class 7a (car park), Class 9b (cinema)
Number of Storeys Contained	3
Effective Height	10 m
Type of Construction Required	Type B
Large Isolated Building	Yes

Table 2: Building Characteristics

4.2 Area of Works

The extent of the proposed refurbishment works is highlighted pink in Figure 2 and Figure 3 below. This report focuses on the areas only. The remaining existing, un-altered parts of the shopping centre will not be assessed.

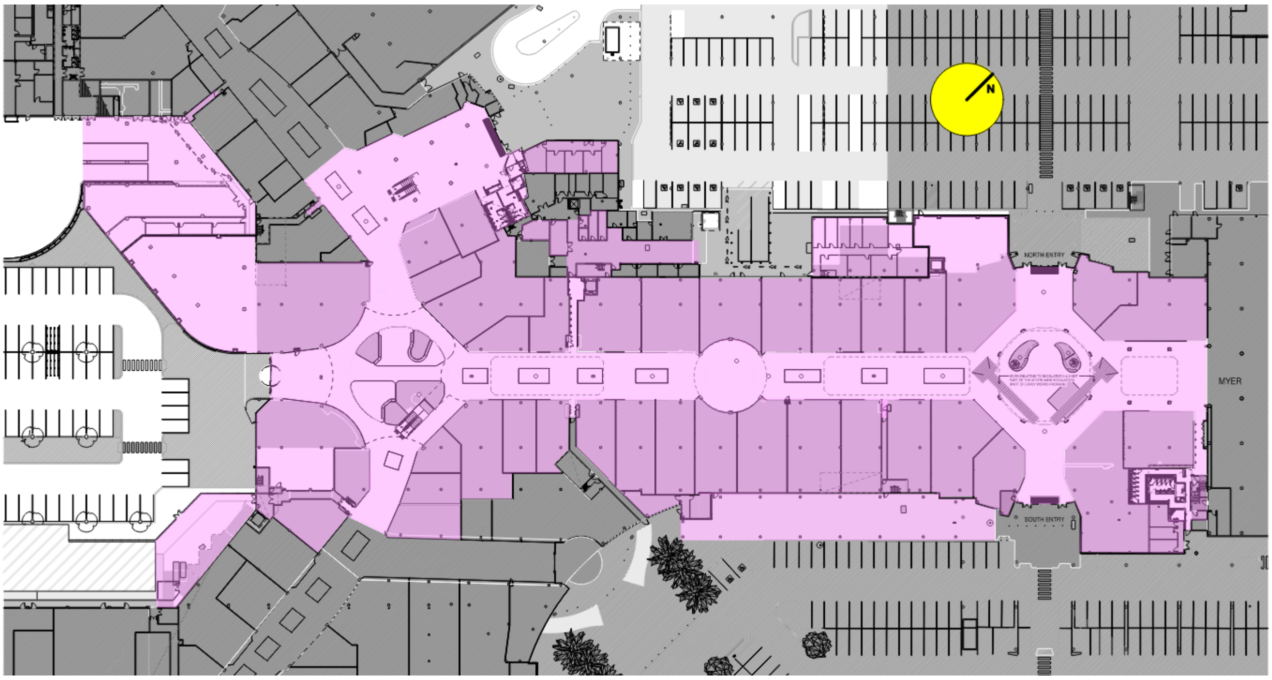

Figure 2: Extend of refurbishment on Ground Floor of GSC

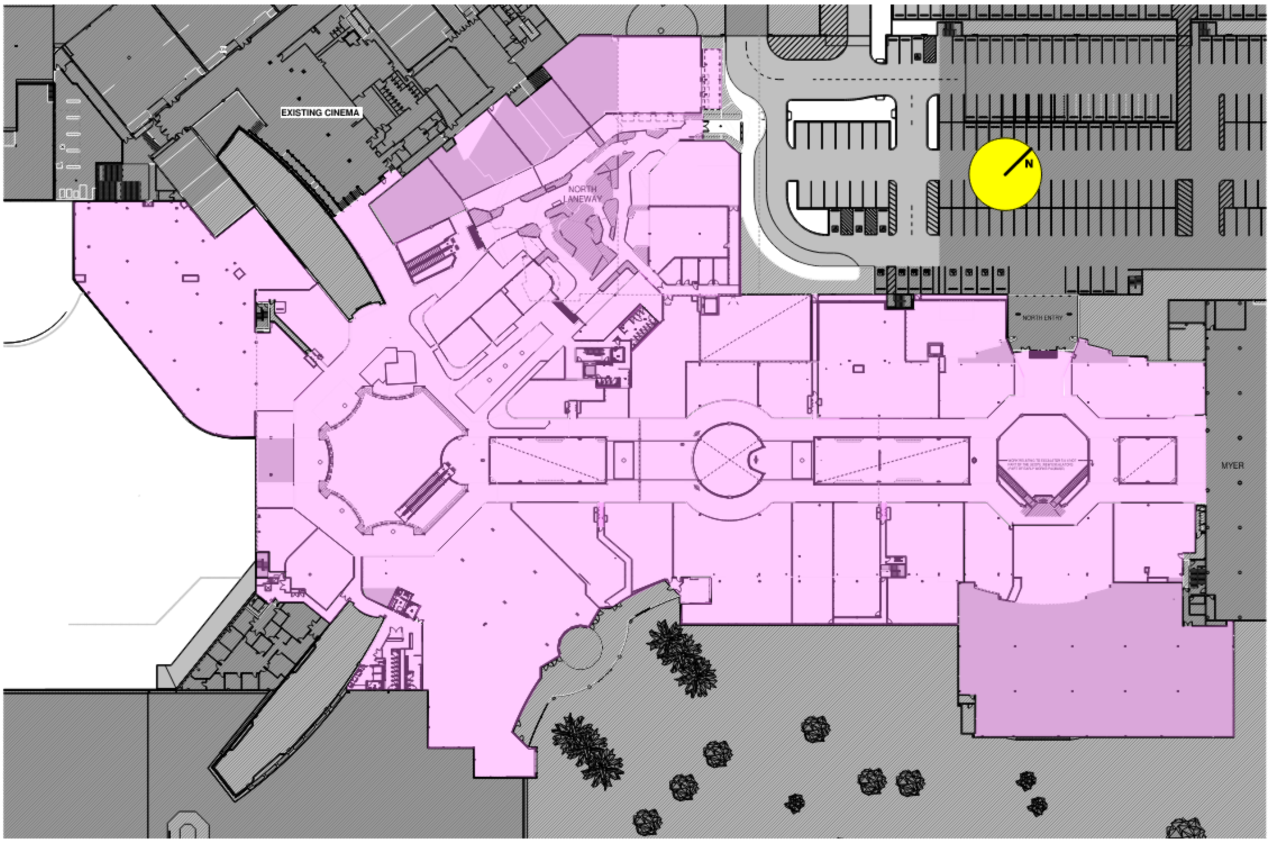

Figure 3: Extend of refurbishment on First Floor of GSC.

4.3 Fire Compartment

The centre is being treated as a large-isolated building and therefore is to be designed as a single fire compartment, except the following existing conditions that are to be retained:

- Myer is currently fire separated from the main centre by fire walls fitted with sliding fire doors
- Kmart, Coles, Woolworths, Target, and the Cinemas are separate smoke zones (i.e. high-level smoke separation and smoke baffles at the shopfronts are provided around these tenancies).

Figure 4 and Figure 5 below show the fire-separated Myer tenancy in red, the smoke-separated tenancies in blue, the remaining tenancies in orange, and the retail mall circulation spaces in green.

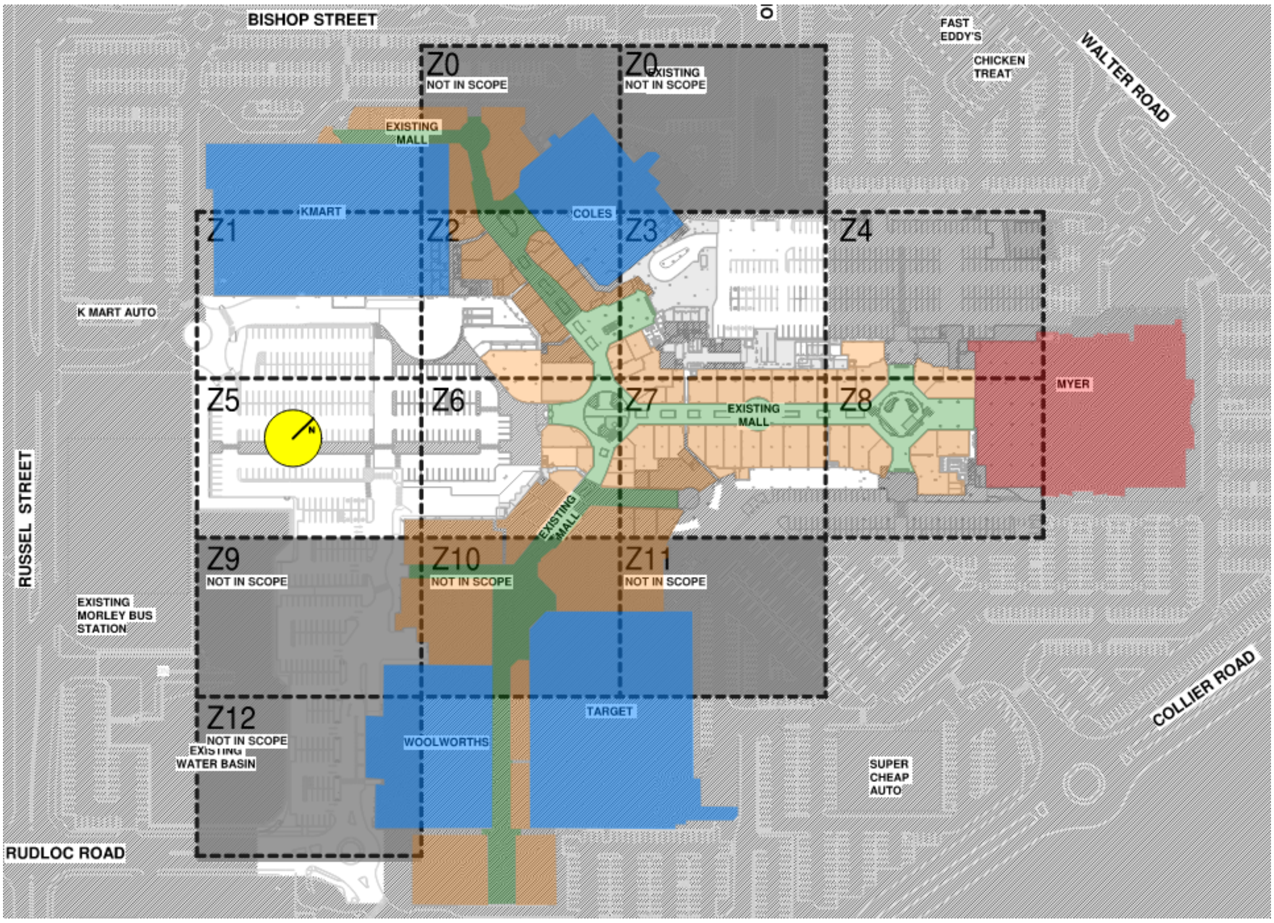

Figure 4: Ground Floor tenancies fire/smoke separated from main shopping centre

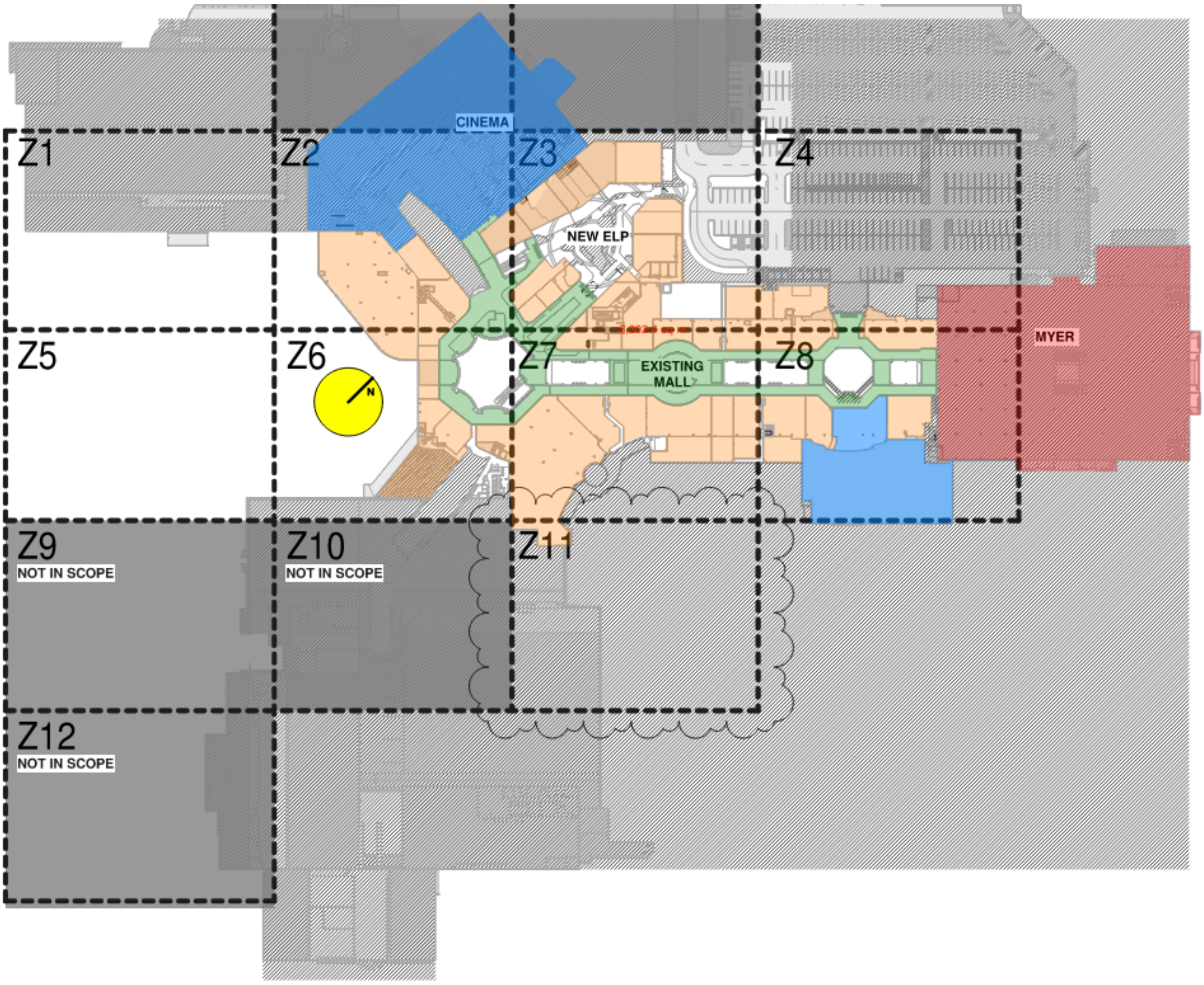

Figure 5: First Floor tenancies fire/smoke separated from main shopping centre

4.4 Smoke Zones

The centre is separated into smoke zones as shown in Figure 6 and Figure 7 below (full size drawings of the smoke zones are provided in Appendix E). Each smoke zone is provided with dedicated smoke exhaust, as outlined in Table 3. Smoke zones SZ-01 and SZ-04 are outside the scope but smoke exhaust fans in these zones may activate during a fire in smoke zone SZ-02.

Smoke zone	Smoke Exhaust Fans	Design SEF capacity, l/s	Actual SEF capacity, l/s
SZ-01	SEF 13.2; SEF 13.3; SEF 13.4; SEF 13.5	64,000	48,352
SZ-02	SEF 13.1; SEF 17.6; SEF 21.5	69,000	63,069
SZ-03(A)	SEF 10.2; SEF 19.2	46,000	50,681
SZ-03(B)	SEF 15.1; SEF 16.2	46,000	51,853
SZ-03(C)	SEF 12.1; SEF 12.2	46,000	50,238
SZ-04	SEF 21.1; SEF 21.2; SEF 21.3; SEF 21.4	64,000	31,613

Table 3: Smoke zones and smoke exhaust capacity per each zone

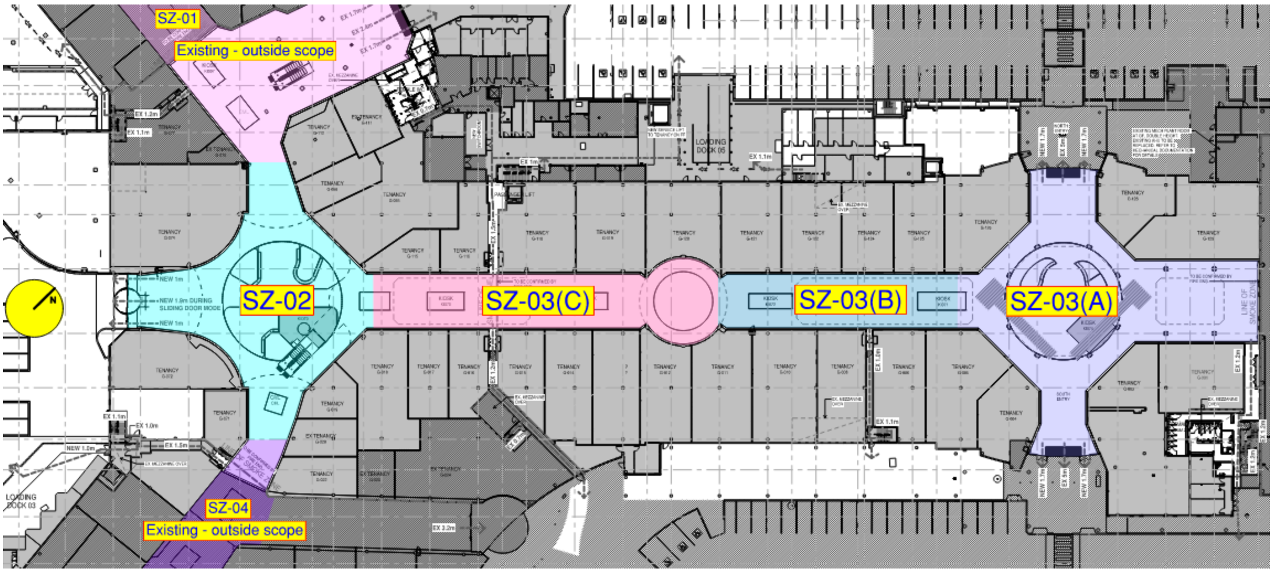

Figure 6: Ground Floor smoke zones

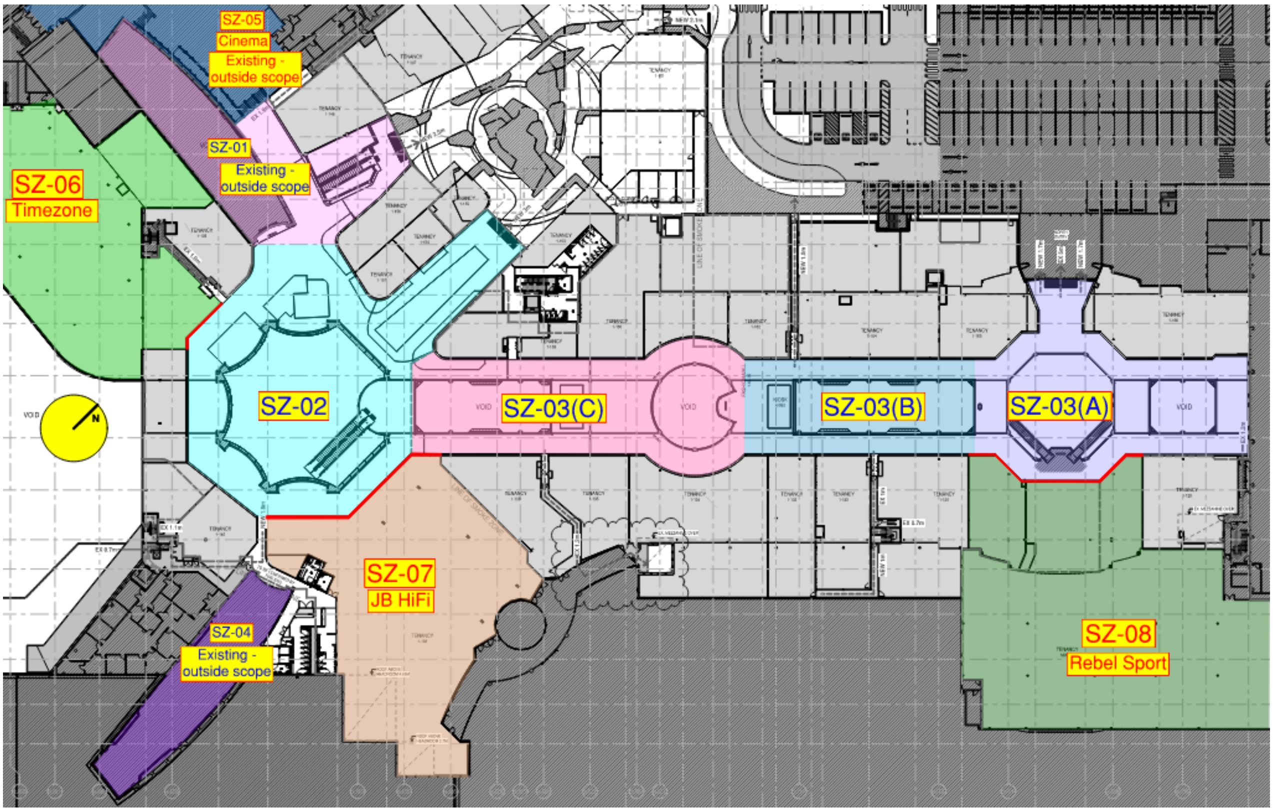

Figure 7: First Floor smoke zones

Make-up air to the smoke exhaust systems shall be provided from AHUs nominated in Table 4 below and via the external retail mall doors that shall automatically open upon fire alarm activation (both during trading hours and after-hours), as nominated in Table 5 below. AHUs shall provide make-up air to the retail malls at Ground Floor only.

Plant Room	Air Handing Units	Design make-up air capacity, l/s
Shall supply make-up air independent of where fire is detected (SZ-01, SZ-02, SZ-03(A-C) or SZ-04)		
AP7	AHU 7.1	1,250
AP Coles	AHU Coles	15,000
	Sub-total:	**16,250**
Shall supply make-up air if fire is detected in smoke zone SZ-01		
AP3	AHU 3.2	1,100
AP4	AHU 4.1; AHU 4.2	10,250
AP6	AHU 6.1	4,000
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500
AP11	AHU 11.1	3,500
	Sub-total:	**34,350**
	Total for smoke zone SZ-01	**50,600**
Shall supply make-up air if fire is detected in smoke zone SZ-02		
AP1	AHU 1.1	5,000
AP3	AHU 3.1	2,200
AP4	AHU 4.3	6,000
AP6	AHU 6.1	4,000
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500
AP11	AHU 11.1	3,500
	Sub-total:	**36,200**
	Total for smoke zone SZ-02	**52,450**
Shall supply make-up air if fire is detected in smoke zone SZ-03(A-C)		
AP1	AHU 1.1	5,000
AP3	AHU 3.1; AHU 3.2	3,300
AP4	AHU 4.1; AHU 4.2; AHU 4.3	16,250
AP6	AHU 6.1	4,000
	Sub-total:	**28,550**
	Total for smoke zone SZ-03(A-C)	**44,800**
Shall supply make-up air if fire is detected in smoke zone SZ-04		
AP1	AHU 1.1	5,000

Plant Room	Air Handing Units	Design make-up air capacity, l/s
AP3	AHU 3.1; AHU 3.2	3,300
AP4	AHU 4.2; AHU 4.3	10,750
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500
AP11	AHU 11.1	3,500
	Sub-total:	**38,050**
	Total for smoke zone SZ-04	**54,300**

Table 4: AHUs thatshall provide make-up air to the smoke exhaust systems

Door	Location	Size, m	Net free open area, m²*
D.EX.01	South-east entrance to Woolworths and Target mall	2.55 x 2.91	6.55
D.EX.02	South-west entrance to Target link mall	2.45 x 2.40	5.16
D.EX.03	South-west entrance to Kmart mall	1.74 x 2.35	3.38
D.EX.04	North-west entrance to Coles mall	1.65 x 2.35	3.17
D.EX.05	North-east entrance to ANZ mall	3.29 x 2.41	7.20
D.EX.06	North entrance to Coles mall	2.06 x 2.41	4.24
1.Z6.01	South entrance to Plaza (new)	2.03 x 2.45	4.24
G.Z4.03	North-west entrance to Myer mall	2.86 x 2.63	6.73
G.Z8.02	South-east entrance to Myer mall	2.35 x 2.27	4.65
		Total:	45.32

Table 5: External doors that shall provide make-up air to the smoke exhaust system

Note *: the effective width of the doors is reduced by 300 mm as sliding doors leave a 150 mm overlap each side of the opening.

All AHUs that are not supplying make-up air to the fire-affected smoke zone shall shut down on fire trip.

4.5 Department of Fire & Emergency Services Access

GSC is provided with three (3) access points (crossovers) from Walter Road, two (2) access points from Collier Road, three (3) access points from Russell Street and one (1) access point from Dewar Street, facilitating vehicle and pedestrian access for the Department of Fire & Emergency Services (DFES).

The DFES response to GSC is expected to come from the Kiara Fire Station located approximately 5.0 km to the north-east, and Malaga Fire Station located approximately 5.9 km to the north. Figure 8 shows the location of the site relative to these fire stations.

The nearest back-up fire stations are Vincent Fire Station, located approximately 6.9 km to the south-west and Osborne Park fire station located approximately 9.6 km to the west.

The nearest aerial appliance is at Perth Fire Station.

The abovementioned fire stations are manned by DFES personnel on a full-time basis.

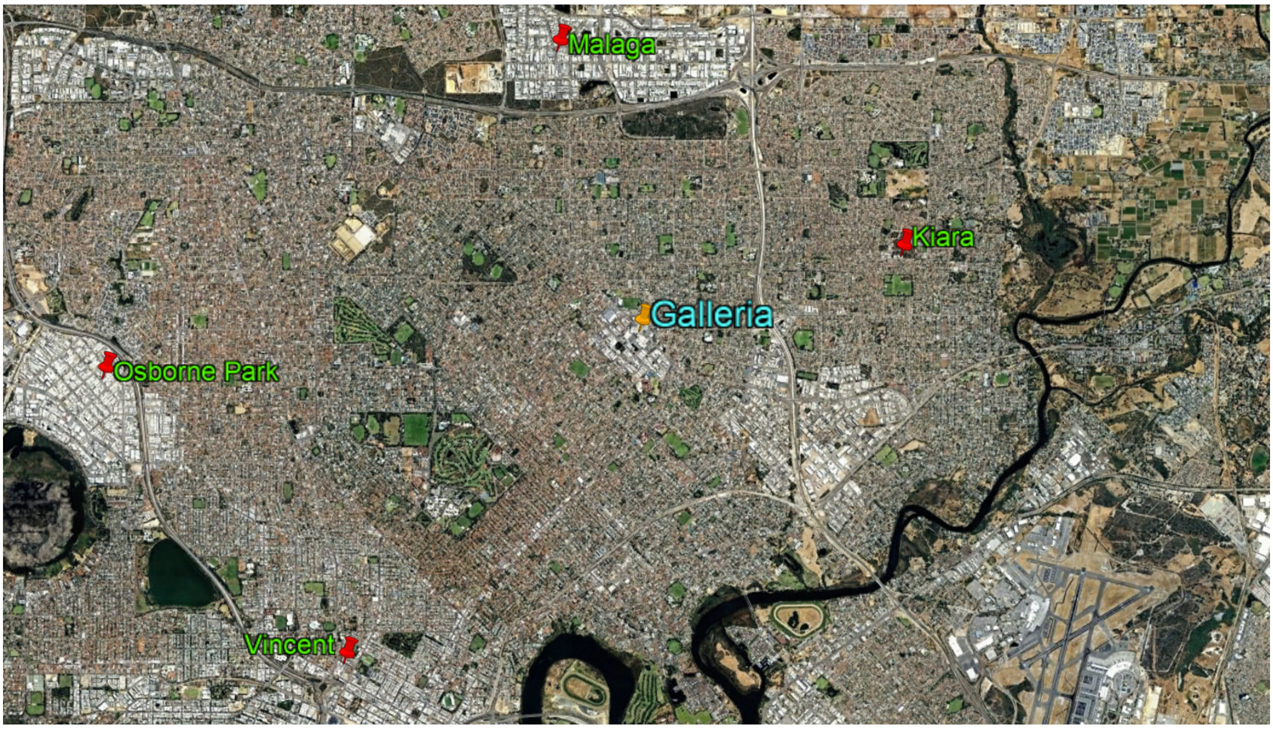

Figure 8: DFES locations relative to the site (image courtesy of Google Earth)

4.6 Egress Provisions

The centre is provided with multiple exits around the perimeter of the centre. The number of exits withstanding, the centre is subject to extended travel distances to a single point of choice from the specialty tenancies and extended travel distances to the nearest of the alternative exits from the centre. The performance-based egress provisions are subject of Performance Solutions No. 3, No. 4 and No. 5.

4.7 Preventive and Protective Measures

The fire preventive and protective measures include various passive and active fire protection measures. The Australian Fire Engineering Guidelines (AFEG) indicate that to assist in analysing a fire safety system, it is convenient to consider the system as comprising six 'sub-systems' [ABCB, 2021a]. Therefore, preventive and protective measures detailed in Table 6 are grouped in accordance with the different 'sub-systems' recommended by the AFEG.

Sub-System	Comment
Sub-System A Fire Initiation and Development and Control	Strict enforcement of a "No-Smoking" policy shall be implemented throughout the building. Strict enforcement of housekeeping measures to ensure rubbish is not accumulated adjacent to potential ignition sources. Regular maintenance and inspection of all electrical equipment and appliances shall be enforced in accordance with the relevant regulations.
Sub-System B Smoke Spread and Control	The GSC is a single fire compartment but is divided into fire- and smoke-separated areas. In the initial stages of fire development smoke spread within smoke-separated areas may be limited by the internal walls. The performance-based smoke exhaust system in the retail malls is expected to control smoke spread in the shopping centre. The performance-based smoke exhaust system is subject of Performance Solution No. 5.
Sub-System C Fire Spread and Impact and Control	The GSC is a single fire compartment but is divided into fire- and smoke-separated areas. Automatic sprinklers installed throughout the building to AS 2118.1 are expected to control a potential fire. In the unlikely event that the sprinkler system fails to operate as designed, non-fire-rated intertenancy walls should provide temporary barriers in the path of spreading fire.
Sub-System D Fire Detection, Warning and Suppression	An automatic fire sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017 shall be provided throughout the area within the scope of this project, except sprinklers may be omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy. Omission of sprinklers is subject of Performance Solution No. 10. (Sprinklers are not prescribed in the open-deck carpark to the north-west of the centre.) A fire detection and alarm system in accordance with Clauses S20C4 and S20C6 of BCA Specification 20 and AS 1670.1-2018 shall be provided throughout the area within the scope of this project. Emergency Warning and Intercommunication System (EWIS) shall be provided in accordance with Clause E4D9(d) of BCA and AS 1670.4-2018 throughout the area within the scope of this project and in the Centre Management Office. Fire hose reels may be omitted throughout the area within the scope of this project. The performance-based omission of fire hose reels is subject of Performance Solution No. 9. Portable fire extinguishers shall be installed in accordance with BCA Clause E1D14 and AS 2444-2001 (where applicable).
Sub-System E Occupant Evacuation	The building is provided with multiple exits; however, extended travel distances are present. These extended travel distances are subject of Performance Solutions No. 3, No. 4 and No. 5. Emergency lighting and exit signage shall be provided in accordance with Part E4 of the BCA.

Sub-System	Comment
Sub-System F Fire Services Intervention	Professional fire service (DFES) is available on a full-time basis. A fire hydrant system shall be provided in accordance with BCA Clause E1D2 and AS 2419.1-2021 throughout the area within the scope of this project, except complete fire hose coverage is achieved with the use of 3 lengths of hose from external attack fire hydrants, in lieu of 2 lengths of hose, and with 2 lengths of hose from internal attack fire hydrants in lieu of a single length of hose. The performance-based fire hose coverage is subject of Performance Solution No. 8.

Table 6: Preventative and protective measures

4.8 Hazards

Identification of hazards that are expected to affect life safety of building occupants is crucial to undertaking a fire safety engineering assessment. Special attention must be paid to those hazards that are not commonly associated with the type of occupancy.

Hazards associated with the general layout and activities as well as the ignition and fuel sources are identified in Table 7 below:

Type	Comment
General Layout	Multiple alternative exits are provided from the building, although some travel distances to exits and distances between the alternative exits exceed the BCA DtS prescribed maximums. This is mitigated by the provision of a performance-based smoke exhaust system in the retail mall and early warning fire detection and alarm system to AS 1670.1-2018 throughout the area within the scope of this project. The general layout of the building is not considered to present an unusual hazard to occupants and is consistent with the building classification and a regional shopping centre.
Activities	The activities within the building are considered to be of low to medium hazard and are not considered to promote any additional hazards to those typical of this type of occupancy. The above notwithstanding, acts of vandalism that could lead to deliberately lit fires cannot be discarded and shall be address through the implementation of adequate security procedures.
Ignition Sources	The main ignition sources throughout the building are expected to be faulty electrical wiring, lighting, or electrical equipment. In areas where food is being prepared or re-heated the kitchen appliances may become an ignition source. The strict enforcement of the “No-Smoking” policy throughout the building shall reduce the likelihood of discarded smoking materials or use of open flames, such as matches and/or lighters; becoming an ignition source.
Fuel Sources	The main fuel source within the building is expected to consist of retail goods for sale, either in the retail areas or in the back-of-house areas.

Table 7: Hazards and ignition source

4.9 Occupant Characteristics

4.9.1 Occupant Groups

The characteristics of the occupant groups expected to be present in the building when a fire starts, are detailed below:

1. Management, support personnel and security – This occupant group is expected to have good familiarity with the building and the fire safety measures and is expected to be fully trained in emergency procedures. This occupant group is 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.

2. Retail Staff – This occupant group is expected to have good familiarity with their respective tenancies and reasonable familiarity with the rest of the centre. Staff should have good familiarity with the fire safety measures. This occupant group is 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 tenancy and is expected to facilitate evacuation in an emergency.

3. Customers – This occupant group may or may not be familiar with the layout of the building. Occupants in this group are expected to have mobility, hearing and visual abilities in line with the general population. This occupant group may require assistance with walking and may have mobility, hearing, and visual impairments in line with the general public.

4. External maintenance contractors – This occupant group is expected to have reasonable familiarity with the building. This occupant group is also 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. Contractors are expected to be awake and aware of their surroundings at all times when inside the tenancy.

In addition to the above, in an emergency DFES are expected to enter the building as part of their fire brigade intervention activities.

4.9.1 Number of Occupants

BCA Clause D2D18 states that the number of persons accommodated in a building must be determined with consideration of the purpose for which it is used and the layout of the floor area. It also states that the number of persons accommodated in a building may be determined using either BCA Clause D2D18(a) and Table D2D18, or by using BCA Clause D2D18(c) which utilises "*any other suitable means of assessing its capacity*".

In determining the population of the GSC relevant to this assessment the following assumptions were made:

1. Occupant numbers for the GSC were based on the "Fire Safety in Shopping Centres" research report, also known as Project 6 [FCRRP, 1998a], i.e. as permitted by BCA Clause D2D18(c), i.e. 6 m²/person for trading floor and specialty shops, and 10 m²/person for the retail mall.

2. Customers can access the trading floors of the Major and Mini-Major Stores, but not the back-of-house (BoH) areas; therefore, only the floor area of the trading floors were used to determine occupant numbers.

3. Occupant numbers for the BoH were based on BCA Table D2D18 provisions for "storage space" (30 m²/person). Occupant numbers for the offices were based on BCA Table D2D18 provisions for "office" (10 m²/person).

4. 60% of the selling floor occupants are assumed to evacuate via the main entrance to the store with the rest of the population evacuating via all available exits [FCRRP, 1998b].

5. Customers can access all areas of Specialty Shops, Food Tenancies, or retail mall; therefore, the gross floor area of the shops and retail malls was used to determine the occupant numbers.

6. Occupants from specialty shops that open directly to outside and do not have alternative escape paths via the retail mall are not competing for the same exits with occupants from within the retail mall and specialty shops that open onto the retail mall; hence they are not included in the assessment.

7. Where a specialty shop is provided with an exit directly to outside and an alternative escape path via the mall, the total population of the tenancy was divided by the number of exits and was evacuated accordingly, e.g. if there is one exit directly to outside and one alternative escape path via the retail mall, ½ of the population is evacuated directly to outside and ½ via the retail mall.

For the purposes of this fire engineering analysis, the number of occupants evacuating via the retail malls from the area of scope was calculated to be 3,707 people during the design egress scenario (occupant numbers based on the provisions of Project 6) and 7,352 people during the sensitivity egress scenario (occupant numbers based on the provisions of BCA Table D2D18).

5. Assessment Data

The following data was examined during the production of this FSER:

1. The project architectural drawings listed in Table 8 below prepared by the architect (Buchan; project no.: 19049A).

Drawing No.	Title/Description	Revision	Date
00004	Location Plan	C	06.06.2025
00005	GA Ground Floor – Zones Map 1 of 2	D	06.06.2025
00006	GA First Floor – Zones Map 2 of 2	D	06.06.2025
00007	GA Ground Floor – Scope of Work	D	06.06.2025
00008	GA First Floor – Scope of Work	D	06.06.2025
01000	MLP Ground Floor – With Name	E	06.06.2025
01002	MLP First Floor – With Name	E	06.06.2025
16000	Ground Floor Control Plan	E	06.06.2025
16100	First Floor Control Plan	E	06.06.2025
20001	Ground Floor Plan Z1	E	06.06.2025
20002	Ground Floor Plan Z2	E	06.06.2025
20003	Ground Floor Plan Z3	E	06.06.2025
20004	Ground Floor Plan Z4	E	06.06.2025
20005	Ground Floor Plan Z5	E	06.06.2025
20006	Ground Floor Plan Z6	E	06.06.2025
20007	Ground Floor Plan Z7	E	06.06.2025
20008	Ground Floor Plan Z8	E	06.06.2025
20102	First Floor Plan Z2	E	06.06.2025
20103	First Floor Plan Z3	E	06.06.2025
20104	First Floor Plan Z4	F	06.06.2025
20105	First Floor Plan Z5	E	06.06.2025
20106	First Floor Plan Z6	E	06.06.2025
20107	First Floor Plan Z7	E	06.06.2025
20108	First Floor Plan Z8	C	06.06.2025
20111	First Floor Plan Z11	E	06.06.2025
20202	Roof Plan Z2	E	06.06.2025
20203	Roof Plan Z3	E	06.06.2025
20204	Roof Plan Z4	E	06.06.2025

Drawing No.	Title/Description	Revision	Date
20205	Roof Plan Z5	E	06.06.2025
20206	Roof Plan Z6	E	06.06.2025
20207	Roof Plan Z7	E	06.06.2025
20208	Roof Plan Z8	E	06.06.2025
30002	Ground Floor RCP Z2	E	06.06.2025
30003	Ground Floor RCP Z3	E	06.06.2025
30004	Ground Floor RCP Z4	E	06.06.2025
30005	Ground Floor RCP Z5	E	06.06.2025
30006	Ground Floor RCP Z6	E	06.06.2025
30007	Ground Floor RCP Z7	E	06.06.2025
30008	Ground Floor RCP Z8	E	06.06.2025
30102	First Floor RCP Z2	E	06.06.2025
30103	First Floor RCP Z3	E	06.06.2025
30104	First Floor RCP Z4	E	06.06.2025
30105	First Floor RCP Z5	C	06.06.2025
30106	First Floor RCP Z6	D	06.06.2025
30107	First Floor RCP Z7	D	06.06.2025
30108	First Floor RCP Z8	D	06.06.2025
30111	First Floor RCP Z11	C	06.06.2025
18001	Ground Floor FRL Egress Plan	F	06.06.2025
18002	Ground Floor Mezzanine FRL Egress Plan	F	06.06.2025
18003	First Floor FRL Egress Plan	F	06.06.2025
18004	First Floor Mezzanine FRL Egress Plan	A	06.06.2025
40001	Elevations North & South Entrances 2&3	A	06.06.2025
40002	Elevations Plaza	A	06.06.2025
40003	Elevations Terrace	A	06.06.2025
50001	Sections 1	C	06.06.2025
50002	Sections 2	D	06.06.2025
50003	Sections 3	D	06.06.2025
50004	Sections 4	D	06.06.2025
50005	Sections 5	D	06.06.2025

Table 8: Project architectural drawings schedule

2. The structure drawings listed in Table 9 below prepared by HERA Engineering (project no.: 24077).

Drawing No.	Title/Description	Revision	Date
0L-1-001	Ground Level General Arrangement – Zone 1	B	23.05.2025
0L-2-002	Ground Level General Arrangement – Zone 2	F	21.07.2025
0L-3-003	Ground Level General Arrangement – Zone 3	G	21.07.2025
0L-4-004	Ground Level General Arrangement – Zone 4	F	21.07.2025
0L-6-006	Ground Level General Arrangement – Zone 6	E	21.07.2025
0L-7-007	Ground Level General Arrangement – Zone 7	E	21.07.2025
0L-8-008	Ground Level General Arrangement – Zone 8	G	21.07.2025
1L-1-001	Level 1 General Arrangement – Zone 1	B	23.05.2025
1L-2-002	Level 1 General Arrangement – Zone 2	E	21.07.2025
1L-3-003	Level 1 General Arrangement – Zone 3	G	21.07.2025
1L-4-004	Level 1 General Arrangement – Zone 4	F	21.07.2025
1L-6-006	Level 1 General Arrangement – Zone 6	F	21.07.2025
1L-7-007	Level 1 General Arrangement – Zone 7	F	21.07.2025
1L-8-008	Level 1 General Arrangement – Zone 8	G	21.07.2025
RF-2-002	Roof Awning Level General Arrangement – Zone 2	D	23.05.2025
RF-2-102	Roof Level General Arrangement – Zone 2	D	23.05.2025
RF-2-202	Upper Roof Level General Arrangement – Zone 2	E	13.06.2025
RF-3-003	Roof Awning Level General Arrangement – Zone 3	E	13.06.2025
RF-3-103	Roof Level General Arrangement – Zone 3	F	16.06.2025
RF-4-004	Roof Awning Level General Arrangement – Zone 4	D	23.05.2025
RF-4-104	Roof Level General Arrangement – Zone 4	E	13.06.2025
RF-6-006	Roof Awning Level General Arrangement – Zone 6	E	13.06.2025
RF-6-106	Roof Level General Arrangement – Zone 6	D	23.05.2025
RF-6-206	Upper Roof Level General Arrangement –Zone 6	D	23.05.2025
RF-7-007	Roof Awning Level General Arrangement – Zone 7	D	23.05.2025
RF-7-107	Roof Level General Arrangement – Zone 7	E	13.06.2025
RF-8-008	Roof Awning Level General Arrangement – Zone 8	D	23.05.2025
RF-8-108	Roof Level General Arrangement – Zone 8	E	13.06.2025

Table 9: Structures drawings schedule

3. The fire services drawings listed in Table 9 below prepared by Firesafe Group Pty Ltd (project no.: WCS25009). A copy can be found in Appendix D of this report.

Drawing No.	Title/Description	Revision	Date
0L-0-401	Fire Wet – Main Works Fire Hydrant Coverage Layout – Level 00	D	13.06.2025
1L-0-401	Fire Wet – Main Works Fire Hydrant Coverage Layout – Level 01	E	13.06.2025

Table 10: Fire services drawings schedule

6. Relevant Stakeholders

This FEB was prepared by BCA Consultants in collaboration and consultation with the relevant stakeholders identified in Table 11 below:

Name	Organisation	Role	Email Address
Brendan O'Regan	DFES	Fire Engineer	Brendan.O'Regan@dfes.wa.gov.au
Alexis Wake	DFES	Fire Safety Officer	Alexis.Wake@dfes.wa.gov.au
James Fudge	Vicinity Centres	Client	james.fudge@vicinity.com.au
Nikola Stojanovic	Built Plus	Project manager client	nik.stojanovic@buildplusgroup.com
Chris West	Built Plus	Project manager client	chris.west@buildplusgroup.com
Rebecca Creamer	Multiplex	Design manager	Rebecca.Creamer@multiplex.global
Kylie Judd	Multiplex	Project manager	Kylie.Judd@multiplex.global
Vincent Chi	Buchan	Architect	Vincent.Chi@buchan.au
Chris Bright	Link Engineering	Mechanical engineer	chris@linkengineering.com.au
Rebecca Boston	Firesafe	Fire services engineer	rebecca.boston@firesafegroup.com.au
Mark Viska	BCA Consultants	Building surveyor	mviska@bcagroup.com.au
Chris Meisinger	BCA Consultants	Fire services peer review	cmeisinger@bcagroup.com.au
Amy Chao	BCA Consultants	Fire safety engineer	achao@bcagroup.com.au
Alex Alexandrovski	BCA Consultants	Fire safety engineer	aalexandrovski@bcagroup.com.au

Table 11: Relevant stakeholders

7. Fire Engineering Brief Process

The FEB process to date has consisted of the following stages:

1) Briefing by Buchan with regard to the project details and objectives.
2) E-mail correspondence and telephone conversations with the relevant stakeholders to confirm the extent of the deviations from the BCA DtS provisions and the proposed fire safety strategy.
3) A DRAFT FEB report (Revision A) was issued for stakeholders review on 17 April 2025.
4) An FEB meeting was held with the DFES Built Environment Branch (BEB) to discuss the project on 22 April 2025. A copy of the meeting minutes is provided in Appendix B of this report.
5) The FEB report (Revision B) was submitted to DFES for review and comments on 29 April 2025.
6) Since the submission of FEB Revision B to DFES, the design has changed with new Performance Solutions identified. The FEB was revised accordingly.
7) Revision C of the FEB report was issued for tender on 27 May 2025.
8) An FEB meeting was held with the DFES Built Environment Branch (BEB) on 3 June 2025 to discuss the changes to the fire safety strategy that was discussed in the first FEB meeting on 22 April 2025. A copy of the meeting minutes is provided in Appendix C of this report.
9) Revision D of the FEB report was issued for tender and submitted to DFES on 6 June 2025.
10) BCA Consultants received a peer review report prepared by Fire Engineering Professionals Pty Ltd (ref. no.: 2025 / 2019PBDB-R1.0, dated 2 July 2025) for Revision C of the FEB report that was issued to the design team on 27 May 2025. A copy of the report and BCA Consultants' response are provided in Appendix N and Appendix O, respectively.
11) The configuration of the smoke exhaust system was modified to achieve an optimal performance. The FEB was revised accordingly.
12) Revision E of the FEB report was issued to the design team for review and comments on 11 August 2025.
13) The design team provided their comments, and the FEB was revised accordingly.
14) Revision F of the FEB report was issued to DFES for review and comments on 22 August 2025.

15) DFES were afforded over 3 weeks to provide comments on the FEB report, however, DFES feedback was not received as of 15 October 2025. The timeline of the project does not allow for extended period consultation period, therefore, the FSER was completed without addressing potential DFES comments.

16) Revision A of the FSER was issued for stakeholders' review on 15 October 2025.

17) DFES provided comments on revision F of the FEB report in "Performance-based Design Brief / Fire Engineering Brief FES Commissioner's Preliminary Advice" letter dated 23 October 2025. A copy of the letter and BCA Consultants' response are provided in Appendix P and Appendix Q, respectively.

18) Revision B of the FSER was issued to the building surveyor on 8 December 2025.

8. Summary of Performance Solutions and Relevant BCA Criteria

Table 12 provides a description of the Performance Solutions, the BCA Performance Requirements and the proposed assessment methods for the Performance Solutions that are addressed in this report.

Perf. Sol.	Description of Performance Solutions	DtS Provisions	Perform. Req's	Assess. Method
1	The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120	C2D2(2) and Table S5C21e	C1P1	A2G2(2)(b)(ii); A2G2(2)(d)
	The loadbearing columns that support the First Floor slab achieve FRL 120/--/-- in lieu of FRL 180/--/--	C2D2(2) and Table S5C21g		
2	MSSBs that support the operation of smoke exhaust fans in smoke zones SZ-02 and SZ-03 are either not located in fire-rated enclosures or are located in plant rooms that do not achieve DtS compliant fire-separation from the rest of the building	C3D14(2)(a)	C1P2(1)(d); EP2.2	A2G2(2)(b)(ii)
	Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant are not fire-stopped	C4D15(2)	C1P2(1)(d)	
	Power supply to the AHUs that provide make-up air to the smoke exhaust systems is not fire-rated and is not enclosed in plant rooms that have FRL not less than --/120/120.	E2D15(2)(a), Cl. S21C7(7) of Spec. 21, Cl. 4.10.2.2(a) AS 1668	E2P2	
3	Travel distances for the non-fire-isolated exits are measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space	D2D5(3)(a)	D1P4; E2P2	A2G2(2)(b)(ii)
4	Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m	D2D5(3)(a)	D1P4, E2P2	A2G2(2)(d)
	Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m			
	Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m			

Perf. Sol.	Description of Performance Solutions	DtS Provisions	Perform. Req's	Assess. Method
	Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m			
	Travel distances from FF amenities to a point of choice are extended up to 27 m in lieu of 20 m			
	Travel distances from the GF BoH area to the nearest of the alterative exits are extended up to 50 m			
5	Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust are extended up to 61 m in lieu of 40 m	D2D5(3)(a)	D1P4, E2P2	A2G2(2)(b)(ii)
	Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, are extended up to 118 m in lieu of 60 m	D2D6(c)(iii)		
	Smoke exhaust rates are determined on a performance basis in lieu of compliance with the BCA DtS provisions	E2D15(2)(a), Cl. S21C2(2) of Spec. 21	E2P2	
	Horizontal length of the Myer retail mall smoke reservoir is extended up to 144 m long in lieu of 60 m	E2D15(2)(a), Cl. S21C4(2) of Spec. 21		
	Horizontal length of the Plaza smoke reservoir is extended up to 66 m long in lieu of 60 m			
	Make-up air velocity through vertical openings exceeds 1 m/s	E2D15(2)(a), Cl. S21C6(3) of Spec. 21		
6	The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03)	D2D12(1)	D1P5, E2P2	A2G2(2)(b)(ii)
7	First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) in lieu of to a road or open space	D2D12(2)(a)	D1P5, E2P2	A2G2(2)(b)(ii)
	Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space	D2D12(2)(b)		

Perf. Sol.	Description of Performance Solutions	DtS Provisions	Perform. Req's	Assess. Method
8	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m	E1D2(2) and Cl. 3.5.3.3(b) of AS 2419.1-2021	E1P3	A2G2(2)(b)(ii)
	Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.5.3.3(c) of AS 2419.1-2021		
	Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m	E1D2(2) and Cl. 3.6.1(e) of AS 2419.1-2021		
	Internal fire hydrants are not located in every fire-isolated exit	E1D2(2) and Cl. 3.6.2(a)(ii) of AS 2419.1-2021		
	Internal fire hydrants installed in retail malls are provided more than 4 m from required exits	E1D2(2) and Cl. 3.6.2(b) of AS 2419.1-2021		
9	In the refurbished and extended parts of the GSC, the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, in lieu of fire hose reels	E1D3(2)(a)	E1P1	A2G2(2)(b)(ii)
10	Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy	Cl. 3.1.2 of AS 2118.1, S17C2(a) of BCA Spec. S17 and E1D4(b)	E1P4	A2G2(2)(b)(ii)
11	The eastern canopies in the North Laneway are protected with vertical sidewall sprinklers on a performance basis.	E1D4(b), Cl. S17C2(a) of Spec. 17 and Clauses 3.1.3, 5.5.3(c) and 5.6.10 of AS 2118.1-2017	E1P4	A2G2(2)(b)(ii)

Perf. Sol.	Description of Performance Solutions	DtS Provisions	Perform. Req's	Assess. Method
12	Walls between the sprinklered and non-sprinklered parts are provided with glazed sections that are not protected against fire spread	S17C3(a) of Spec. 5 and E1D4(b)	C1P2(1)(d), E1P4	A2G2(2)(b)(ii)
13	After-hours, the make-up air velocity through the Timezone and JB Hi-Fi shopfront openings is increased up to 3.5 m/s in lieu of a maximum 2.5 m/s	S21C6(2) of Spec. 21 and E2D15(2)(a)	E2P2	A2G2(2)(b)(ii)
14	The existing smoke exhaust fans located in the Myer retail mall and Plaza generate noise levels up to 90 dB in lieu of a maximum noise level of 80 dB	Cl. 4.6 of AS 1668.1	E2P2	A2G2(2)(b)(ii)

Table 12: Performance Solutions, relevant BCA provisions and the assessment methods

9. Fire Safety Strategy

9.1 General

1. The redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062, shall comply with the "Deemed-to-Satisfy" (DtS) Provisions of the National Construction Code Volume One (NCC), Building Code of Australia 2022 (BCA), except for the specific deviations from the BCA DtS identified in Section 8.

2. The fire safety strategy for the GSC outside of the area affected by the redevelopment works shall comply with the provisions of the building codes current at the time of construction of these parts.

3. Should a change in use or building alterations and/or additions occur in the future, a reassessment will be needed to verify consistency with the analysis contained within this report.

4. The requirements listed in this Section are *safety measures* and shall be maintained as per Regulation 48A of the Building Regulations 2012 (with amendments).

9.2 Fire Resistance and Stability, Compartmentation and Separation, Protection of Openings

5. The parts of the GSC within the scope of this project have been assessed by the building surveyor as a 2-storey mixed-use development of Type B construction containing Class 6 (retail) and Class 7a (open-deck carpark) parts. The Class 9b (cinemas) part is not within the scope of this project and is specifically excluded from the scope of this Fire Safety Strategy.

6. Fire resistance and stability, compartmentation and separation, and protection of openings provisions within the scope of this project shall comply with the DtS provisions of BCA Part C2, Part C3 and Part C4, except:

    a. The loadbearing lift shaft in Tenancy 1-165 may achieve FRL 120/120/120 in lieu of FRL 180/120/120.

    b. The loadbearing columns and walls that support the First Floor slab may achieve FRL 120/--/-- in lieu of FRL 180/--/--.

    c. MSSBs that support the operation of smoke exhaust fans in smoke zones SZ-02 and SZ-03 may be located outside fire-rated enclosures and may be located in plant rooms that do not achieve DtS compliant fire-separation from the rest of the building

    d. Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant may not be fire-stopped.

7. Areas where the FRL of the loadbearing structure is reduced to nominal 2 hours are highlighted red in Figure 9 below.

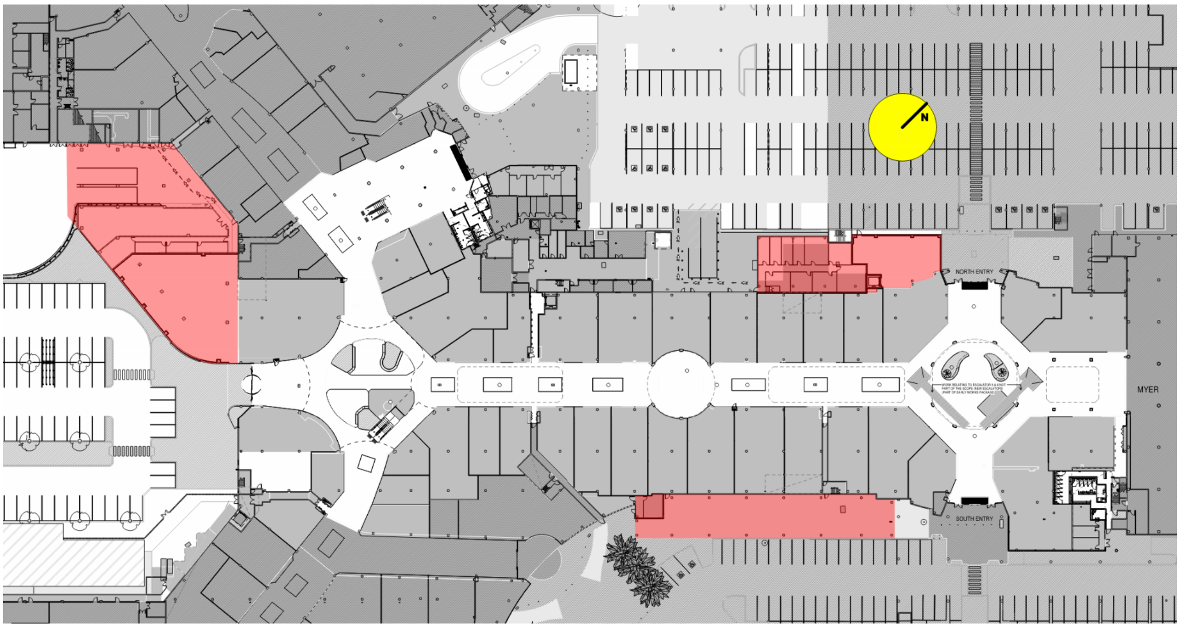

Figure 9: Ground Floor areas where load bearing structure has performance-based reduced FRL

8. The existing Myer tenancy is fire separated from the rest of the centre with fire walls and the openings to the Myer mall are protected with sliding fire doors. This existing condition shall remain unaltered.

9. The existing Kmart tenancy, Coles tenancy, Woolworths tenancy, Target tenancy and the Cinemas, except for the shopfronts, are smoke separated from the rest of the centre. This existing condition shall remain unaltered.

10. The new Timezone (tenancy 1-141) and JB Hi-Fi (tenancy 1-138) that are provided with automatic smoke exhaust shall be separated from the rest of the centre with walls that shall prevent the free passage of smoke constructed in accordance with Clause S11C3 of Specification 11 of the BCA (refer to Figure 10 where the smoke-proof walls are highlighted with solid blue lines). The shopfront openings and external walls of these tenancies do not need to prevent the free passage of smoke.

11. The modified Rebel tenancy (MM-004) that is provided with automatic smoke exhaust shall be separated from the rest of the centre with walls that shall prevent the free passage of smoke constructed in accordance with Clause S11C3 of Specification 11 of the BCA (refer to Figure 11 below where the smoke-proof walls are highlighted with solid blue lines). The shopfront opening and external walls of this tenancy do not need to prevent the free passage of smoke.

12. The new required non-fire-isolated stairwell adjacent to external balcony 1.BO.03 shall be bound with walls that shall prevent the free passage of smoke constructed in accordance with Clause S11C2 of Specification 11 of the BCA (refer to Figure 12 and Figure 13 below where the smoke-proof walls are highlighted with solid blue lines).

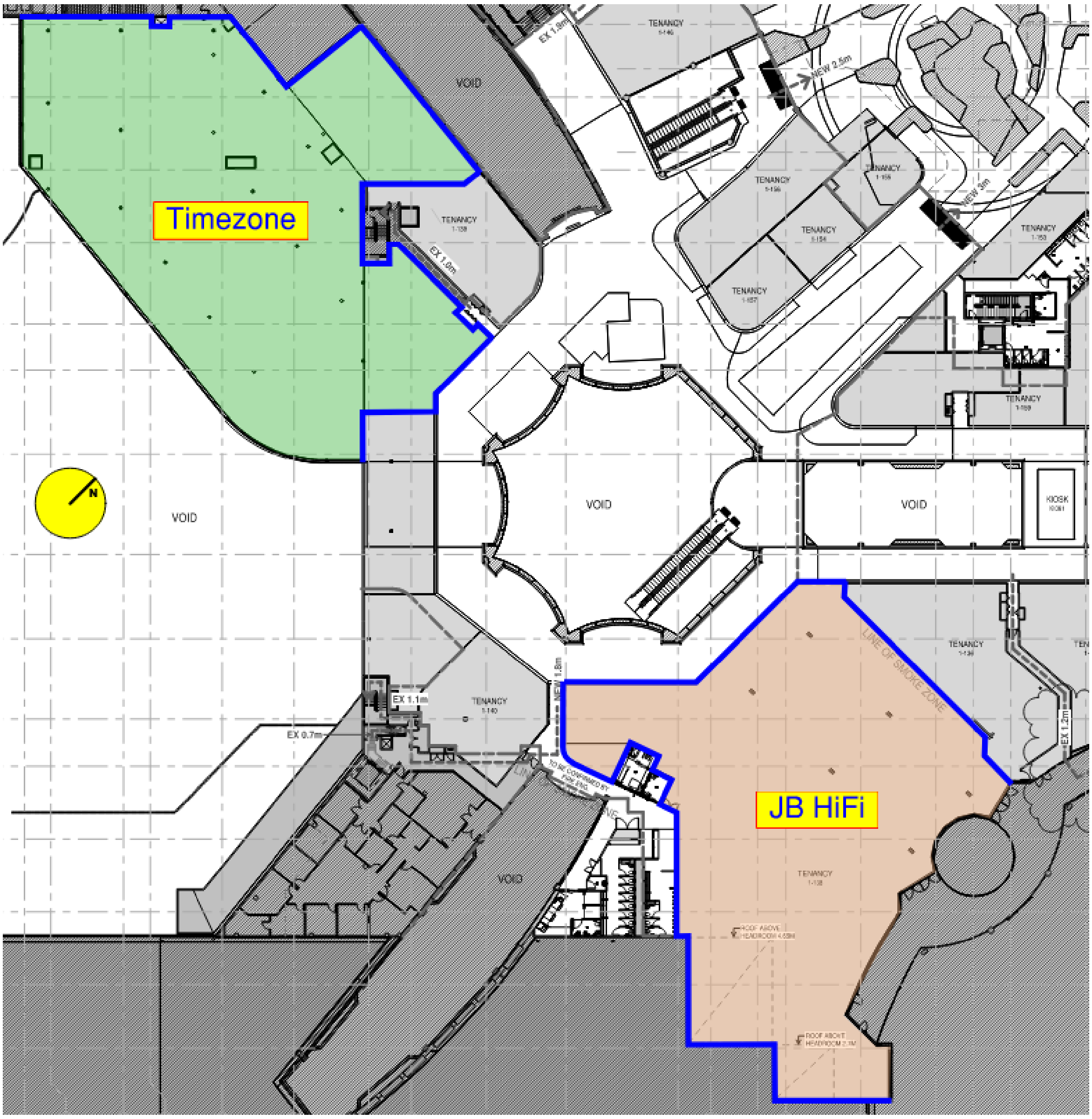

Figure 10: Walls that shall prevent the free passage of smoke around Timezone and JB Hi-Fi

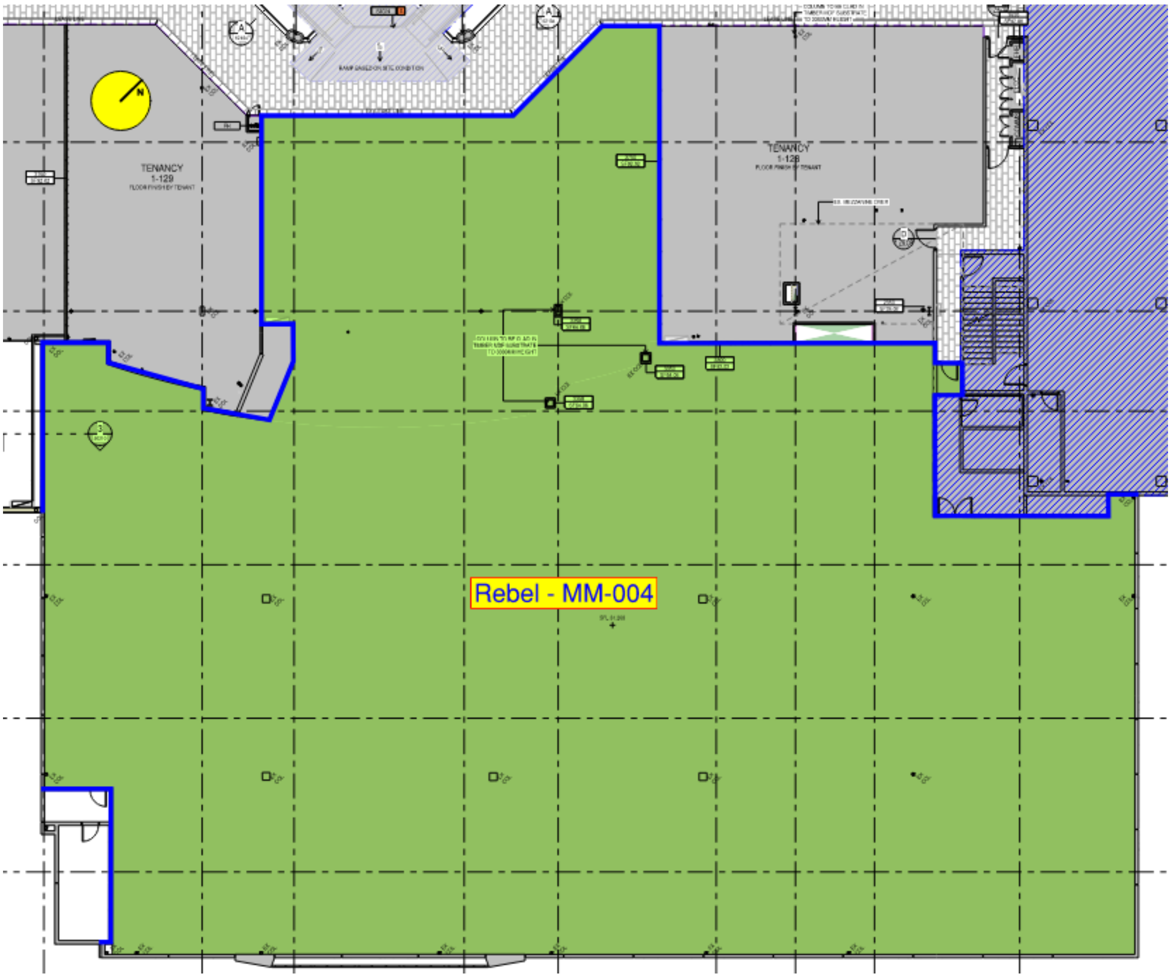

Figure 11: Walls that shall prevent the free passage of smoke around Rebel

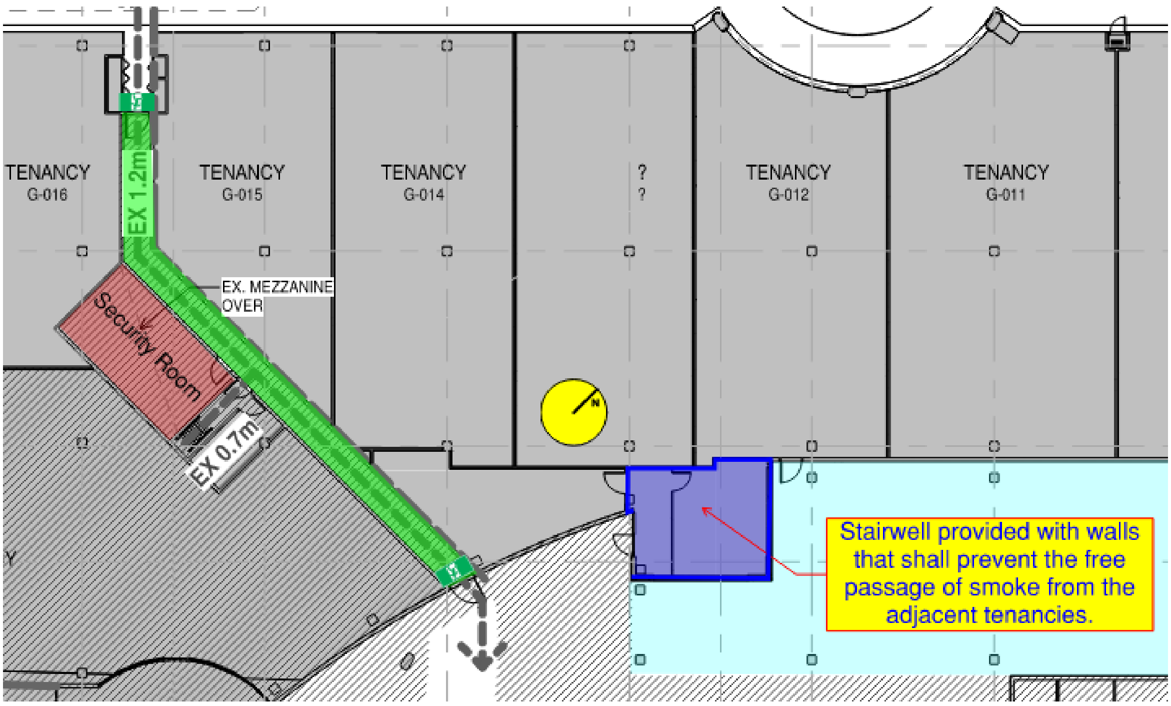

Figure 12: Walls that shall prevent the free passage of smoke on Ground Floor

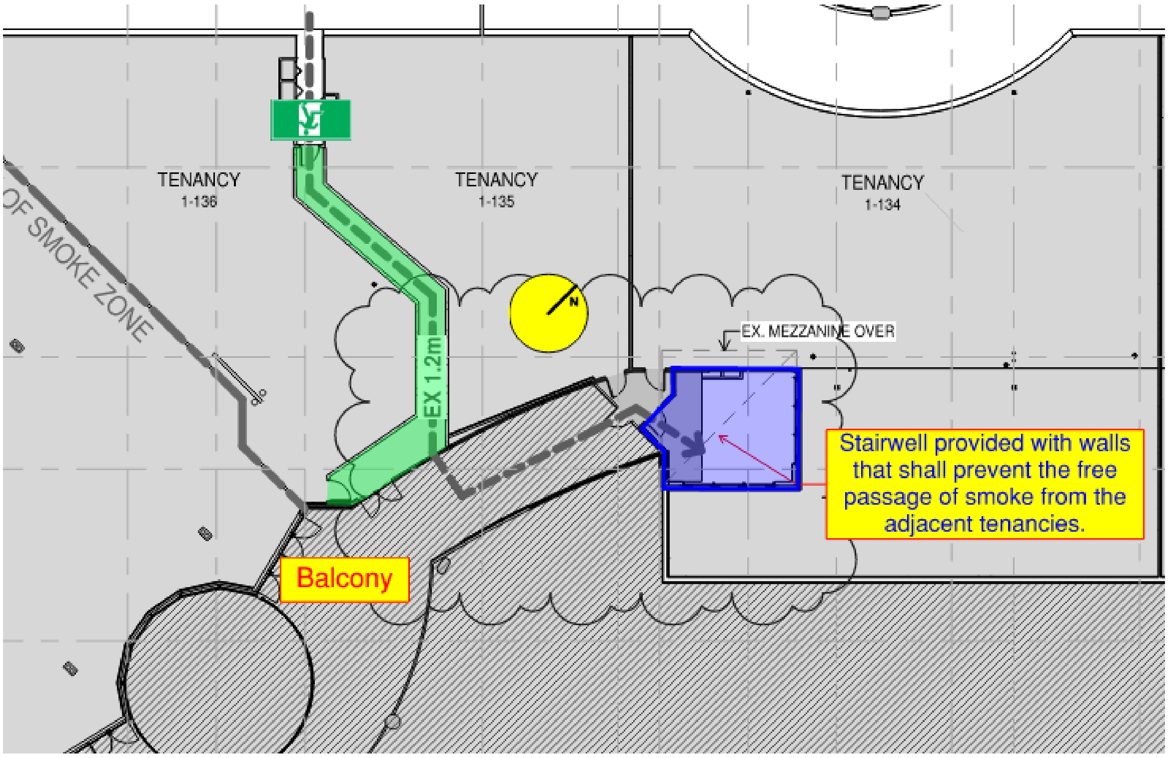

Figure 13: Walls that shall prevent the free passage of smoke on First Floor

13. The walls that shall prevent the free passage of smoke may be penetrated by services and ducts. While the penetrations around the services and ducts shall be smoke-sealed in accordance with Clause S11C3(f) of Specification 11 of the BCA, the ducts need not be provided with smoke dampers.

14. External façades within the scope of this project (including any insulation materials and vapour membranes) shall be non-combustible materials when tested to AS 1530.1-2014.

9.3 Provisions for Escape, Construction of Exits

15. Travel distances within the scope of this project shall comply with the DtS provisions of BCA Part D2 and Part D3, except:

    a. Travel distances for the non-fire-isolated exits may be measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space.

    b. Travel distances from some specialty shops to a point of choice may be extended up to 30 m in lieu of 20 m.

    c. Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m.

    d. Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m.

    e. Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m.

f. Travel distances from FF amenities to a point of choice may be extended up to 29 m in lieu of 20 m.

g. Travel distances from the GF BoH area to the nearest of the alterative exits may be extended up to 50 m.

h. Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust may be extended up to 61 m in lieu of 40 m.

i. Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, may be extended up to 118 m in lieu of 60 m.

16. Other egress provisions within the scope of this project shall comply with the DtS provisions of BCA Part D2 and Part D3, except:

    a. The existing security room that does not occupy the whole of a storey may open directly into the Ground Floor fire-isolated corridor 03 (G.BO.03).

    b. First floor fire-isolated corridor 19 (1.BO.19) may discharge to an external balcony (1.BO.03) in lieu of to a road or open space.

    c. Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) may discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space.

17. Tenancies within the scope of this project where travel distances to a point of choice exceed 30 m shall be provided with an alternative exit.

18. Existing door (circled red in Figure 14) shall unlock upon fire alarm activation in loading dock 04 fire alarm zones (FAZ-03 and FAZ-04) to facilitate occupant evacuation via the existing fire-isolated corridor 06 (G.BO.06).

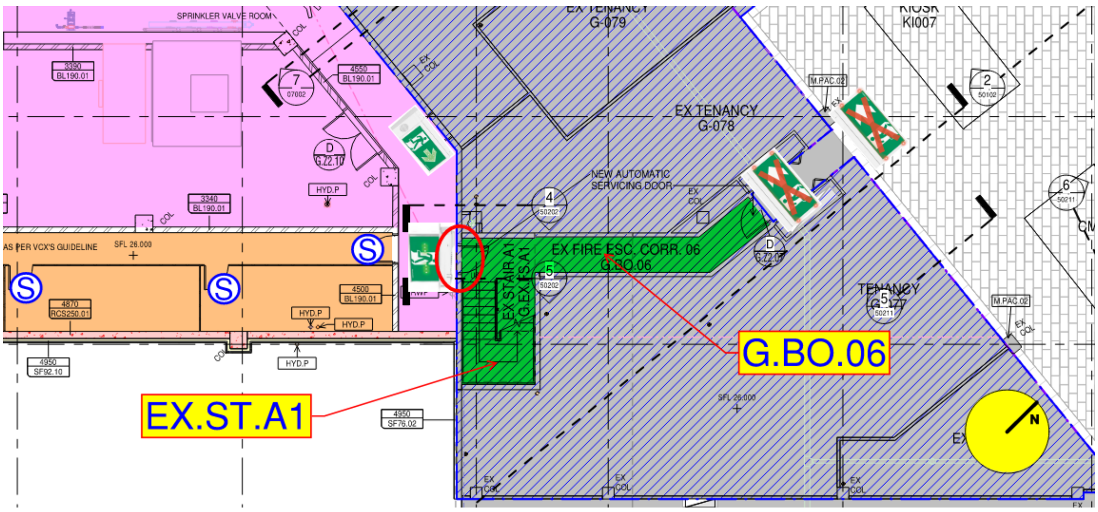

Figure 14: Door to unlock upon fire alarm activation in loading dock 04 fire alarm zone

19. Door 1.Z6.01 leading to the Centre Management Office on First Floor, if provided with access control from the retail mall, shall unlock upon fire alarm activation anywhere in the centre to facilitate access to fire-isolated Stair A2 (1.FS.A2).

20. Door 1.Z7.11 leading from external balcony 1.BO.03 on First Floor to the lobby in front of the new required non-fire-isolated stairway shall swing in the direction of egress, i.e. in the direction of travel to door 1.Z7.14.

21. Door G.Z2.07 leading from the Coles mall on Ground Floor to fire-isolated corridor 06 (G.BO.06) upon fire alarm activation shall be provided with re-entry from the corridor side to facilitate the evacuation of occupants who may be working in plantrooms AP4 and AP.ENT and the storage area during a potential fire in Loading Dock 04.

22. The existing door leading from lift lobby G.LL.02 on Ground Floor to the western BoH area (refer to Figure 15 where the door is circled red) upon fire alarm activation shall be provided with re-entry from the BoH side to facilitate the evacuation of occupants who may be working in the existing storerooms and switch rooms during a potential fire in this BoH.

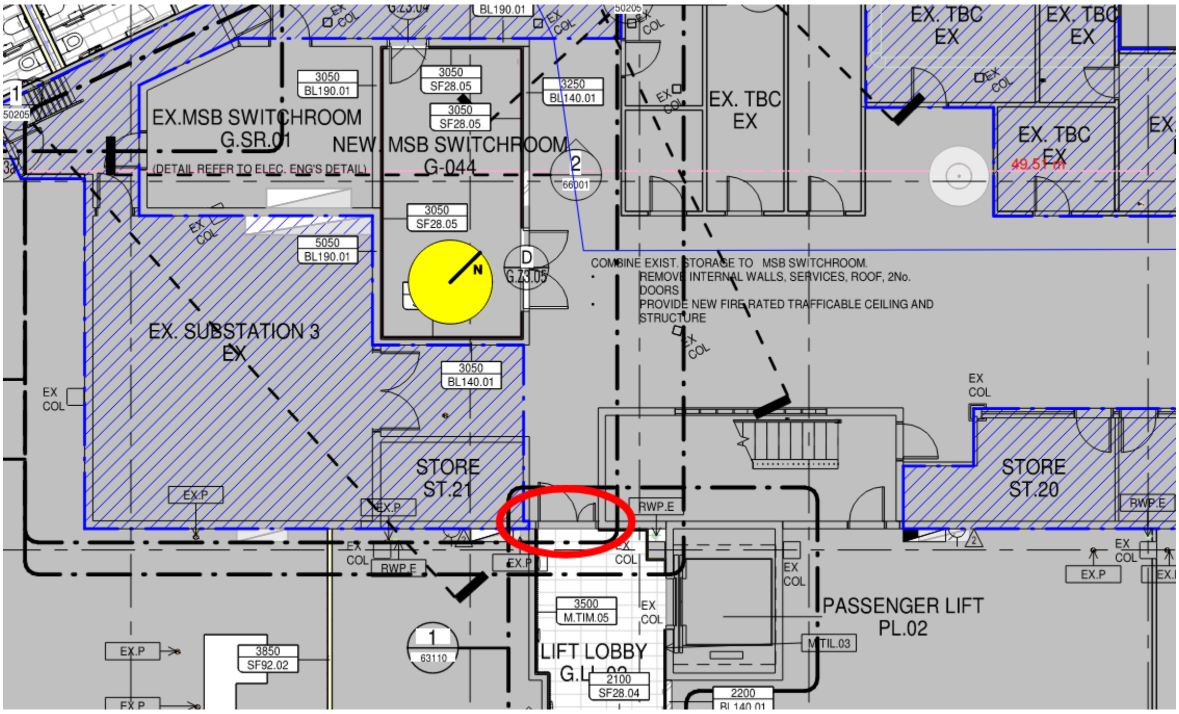

Figure 15: Existing door leading to the western BoH that shall be provided with re-entry

23. Doors opening from the required exits into areas where they can be blocked by parked vehicles or other obstructions (garbage bins, skips, etc.) shall be protected with bollards in accordance with Clause D2D15(1) of the BCA.

24. Door hardware shall maintained or altered in accordance with Clause D3D26 of the BCA.

25. Egress from the existing fire-isolated Stair A2 (G.EX.FS.A2) directly to the outside at Ground Floor shall be retained.

26. Paths of travel from the point of discharge from the required exits to a road or open space shall be unobstructed and shall comply with Clause D2D15(2) of the BCA. Where paths of travel can be blocked by parked vehicles or other obstructions (garbage bins, skips, etc.) they shall be protected with appropriate barriers all the way to the point of discharge to a road or open space.

9.4 Fire Fighting Equipment

27. The existing fire hydrant system within the scope of this project shall be extended to include new internal fire hydrants. The system shall comply with the DtS provisions of BCA Clause E1D2(2) and AS 2419.1-2021, except:

    a. Fire hose coverage may be achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m.

    b. Fire hose coverage may be achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m.

    c. Fire hose coverage may be achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m.

    d. Internal fire hydrants need not be located in every fire-isolated exit.

    e. Internal fire hydrants installed in retail malls may be provided more than 4 m from required exits.

28. Fire hose reels may be omitted from the refurbished and extended parts of the centre as highlighted pink (refurbished areas) and cyan (extended areas) in Figure 16 and Figure 17 below.

Figure 16: Areas on Ground Floor where hose reels may be omitted

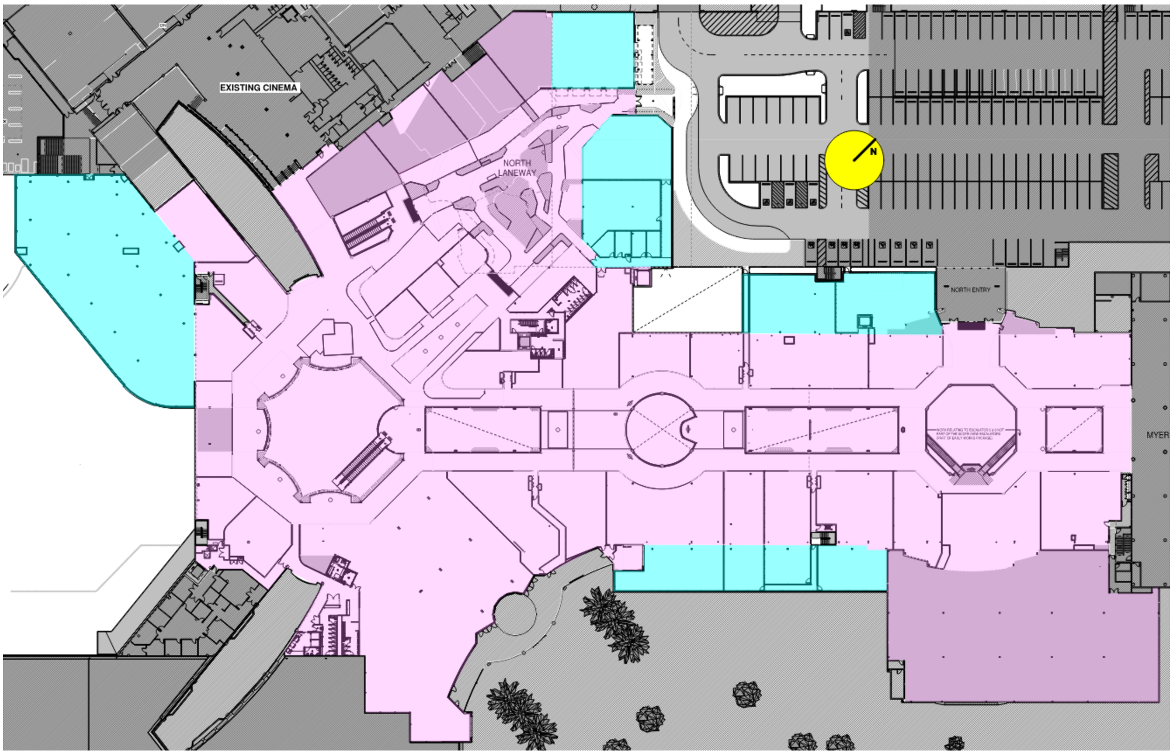

Figure 17: Areas on First Floor where hose reels may be omitted

29. The existing automatic fire sprinkler system within the scope of this project shall be modified and/or expanded where required, and shall comply with the DtS provisions of BCA Clause E1D4, Specification 17 and AS 2118.1-2017, except:

    a. Sprinklers may be omitted from the skylights above the Plaza and Myer retail mall (the areas highlighted red in Figure 18).

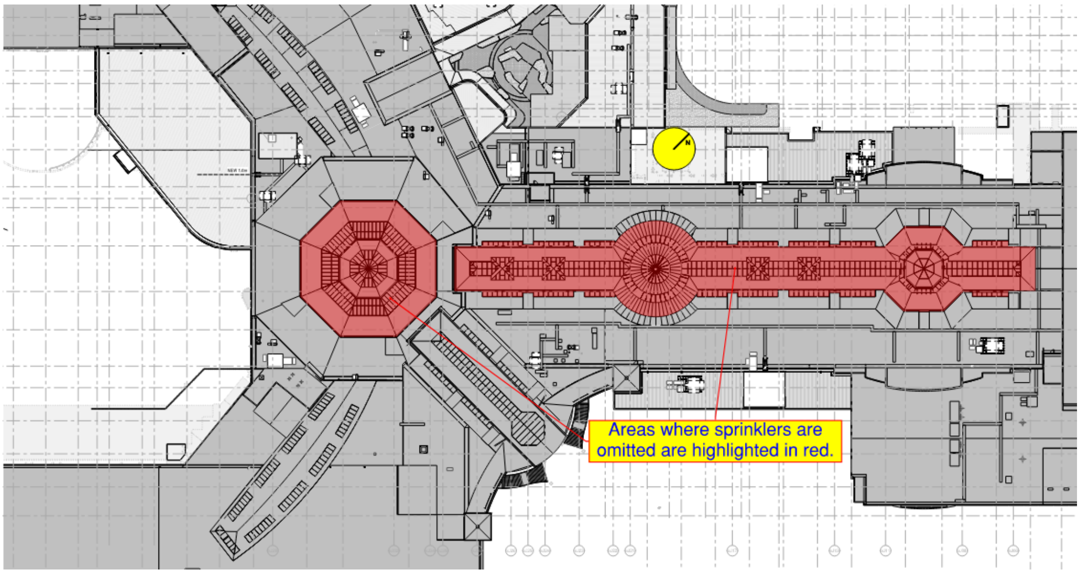

Figure 18: Omission of sprinkler protection from Plaza and Myer mall skylights

    b. Sprinklers may be omitted from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy (the area highlighted red in Figure 19 below).

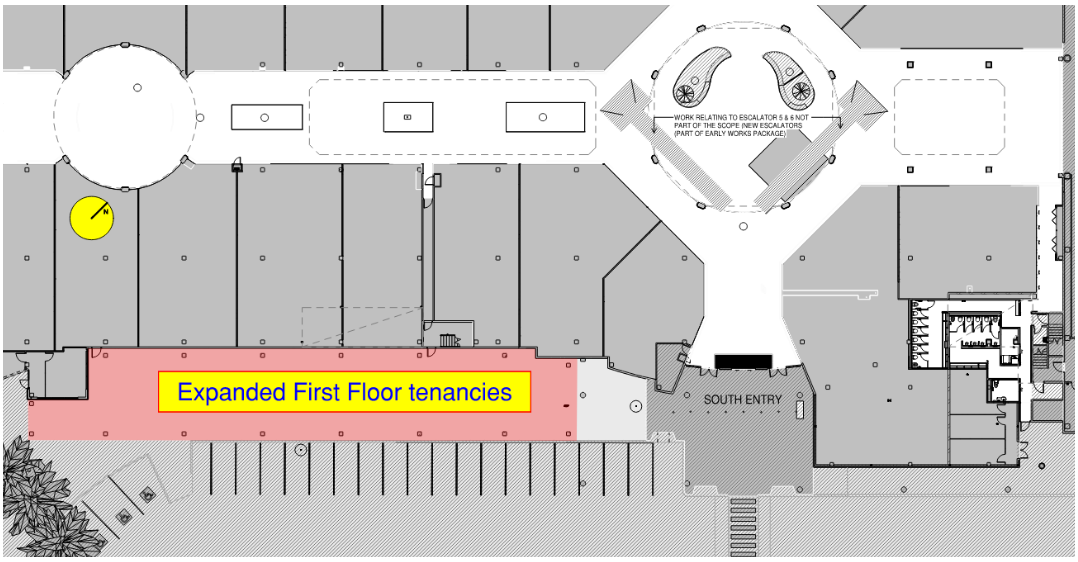

Figure 19: Omission of sprinkler protection below new extended tenancies on First Floor

c. The eastern canopies in the North Laneway (the canopies highlighted light green in Figure 20 below) may be protected with a single row of vertical sidewall sprinklers installed along the external walls of the tenancies in lieu of 2 rows of sidewall sprinklers for canopies that are between 3.7 m and 7.4 m wide and a combination of sidewall sprinklers and conventional sprinklers in the middle of the canopies for canopies that are between 7.4 m and 9.0 m wide.

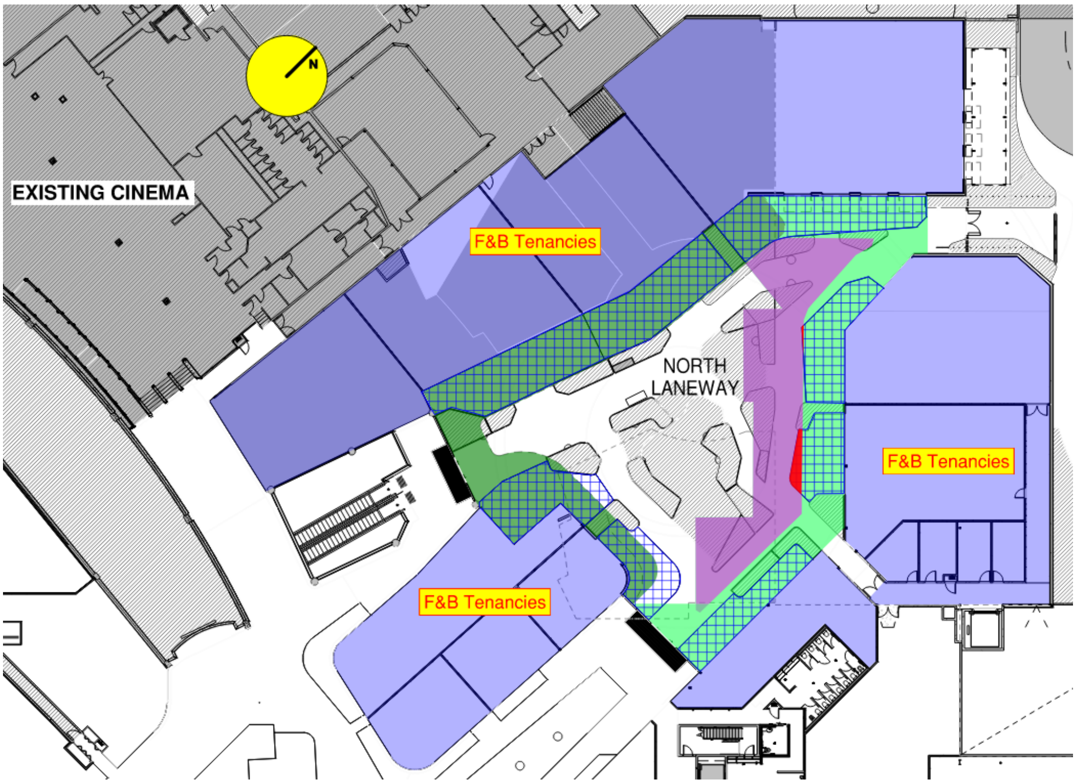

Figure 20: North Laneway layout and extent of sprinkler protection to canopies

d. Walls between the sprinklered and non-sprinklered parts may be provided with glazed sections that are not protected against fire spread (the glazed sections of the walls are clouded red in Figure 21).

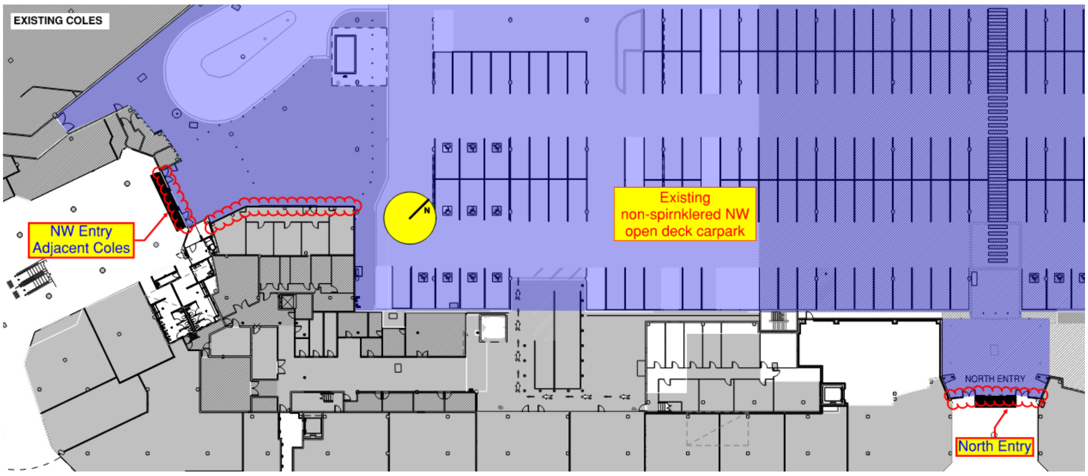

Figure 21: Locations where the walls between the sprinkler protected retail parts of the centre and the open-deck carpark that is not sprinkler protected have glazed sections

30. Additional to item 29, to achieve an appropriate level of fire safety, sprinkler protection shall be extended into the existing Stair M6 (G.ST.M6) located between Rebel (MM-004) and Myer that is no longer considered a fire-isolated stair and into the existing stair located north of passenger lift PL.02. Stair M6 is highlighted cyan in Figure 22 and Figure 23 below. The existing stair is highlighted cyan in Figure 22 and Figure 23 below. The extended sprinkler system shall comply with the DtS provisions of BCA Clause E1D4, Specification 17 and AS 2118.1-2017.

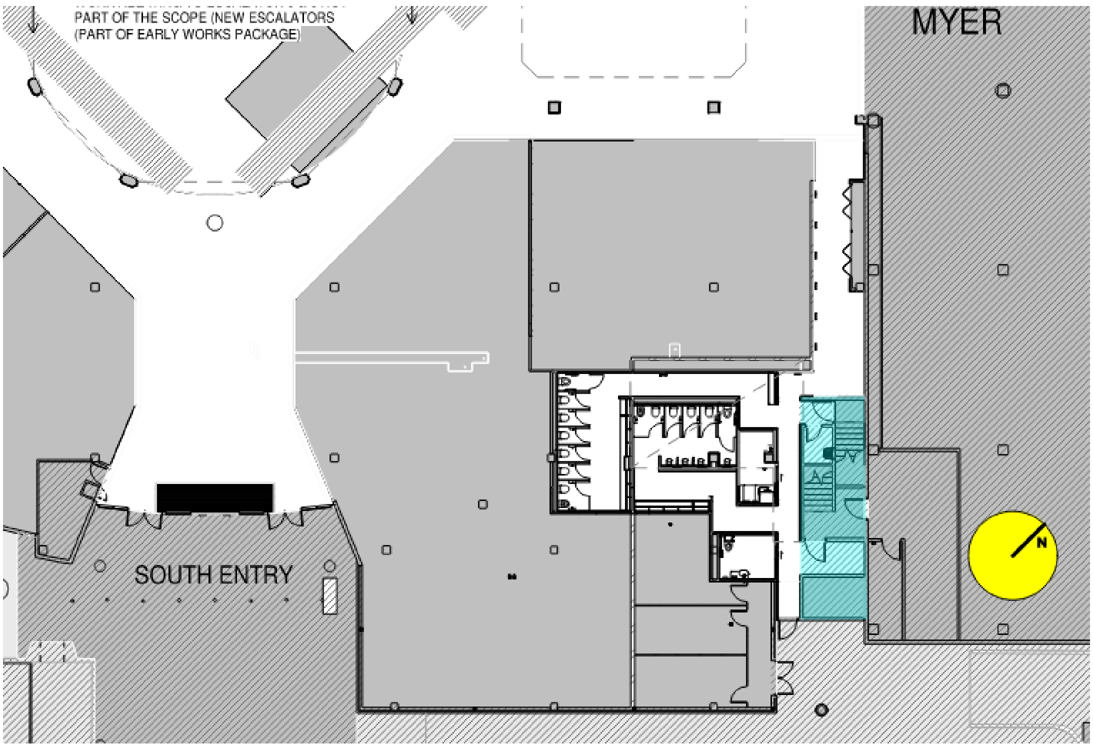

Figure 22: Stair M6 – Ground Floor

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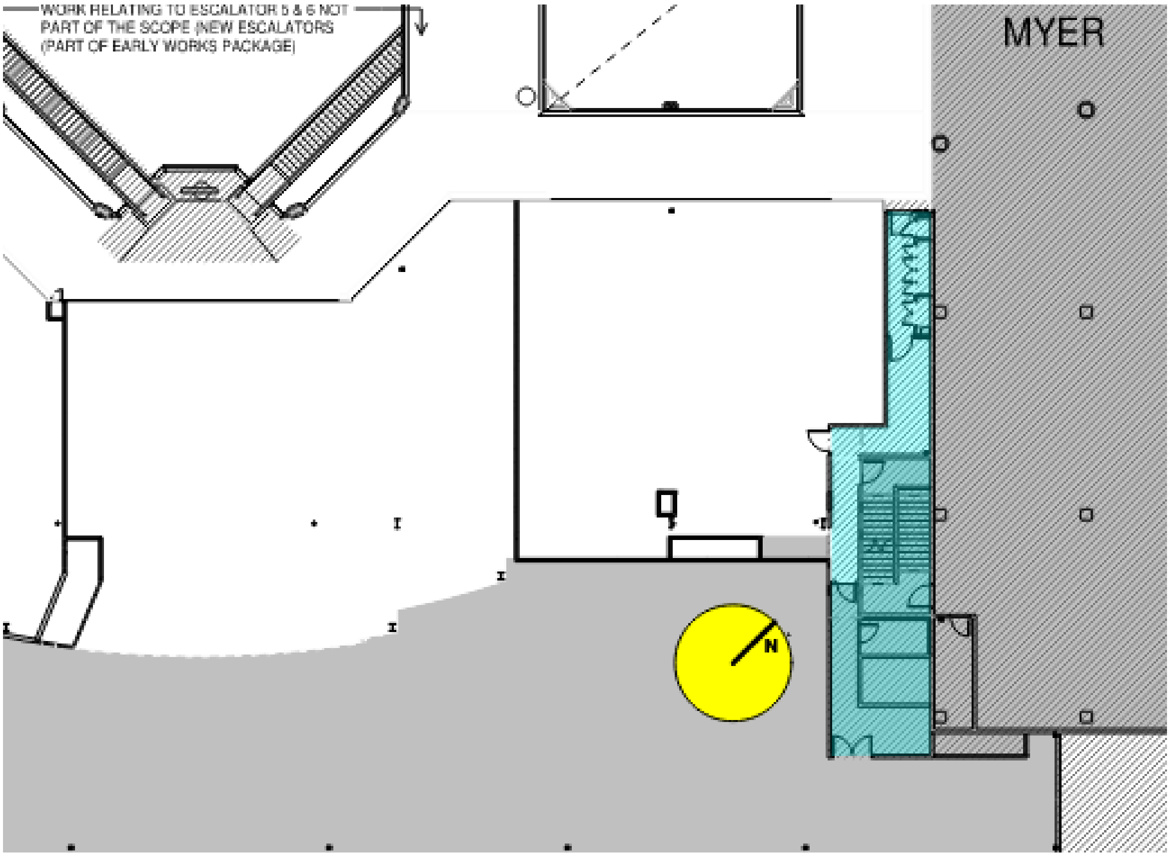

Figure 23: Stair M6 – First Floor

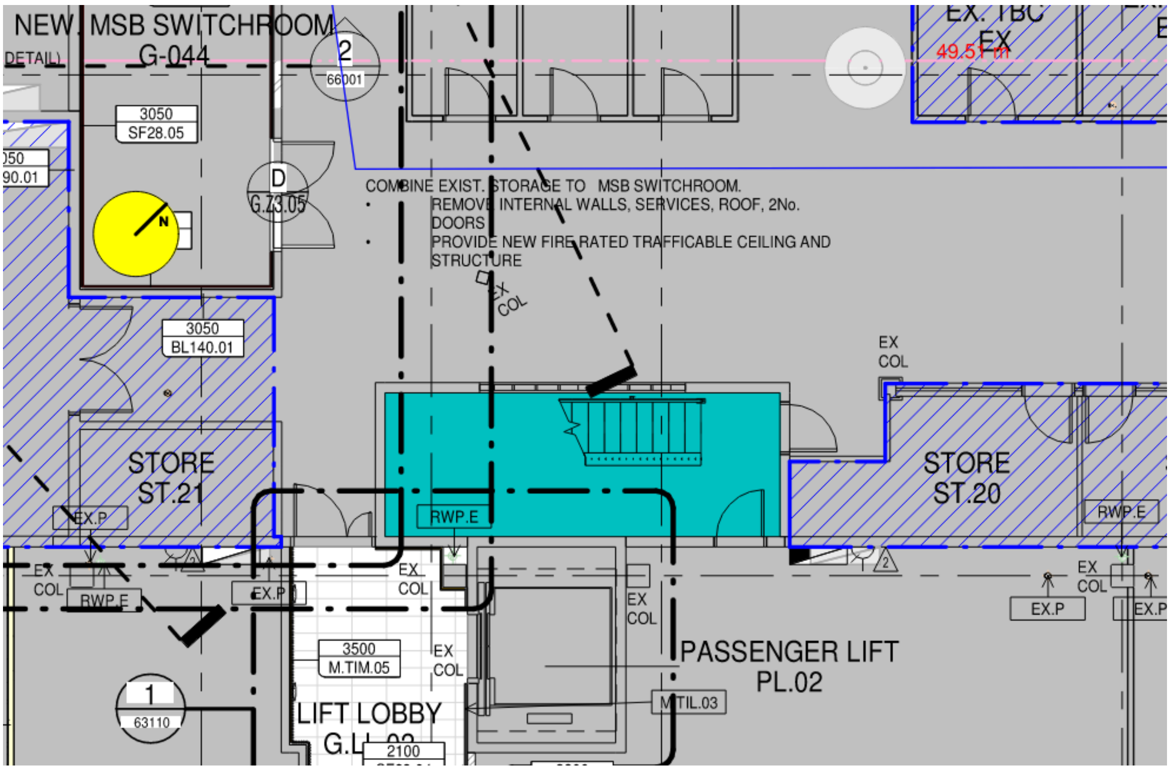

Figure 24: Existing stair north of passenger lift PL.02 – Ground Floor

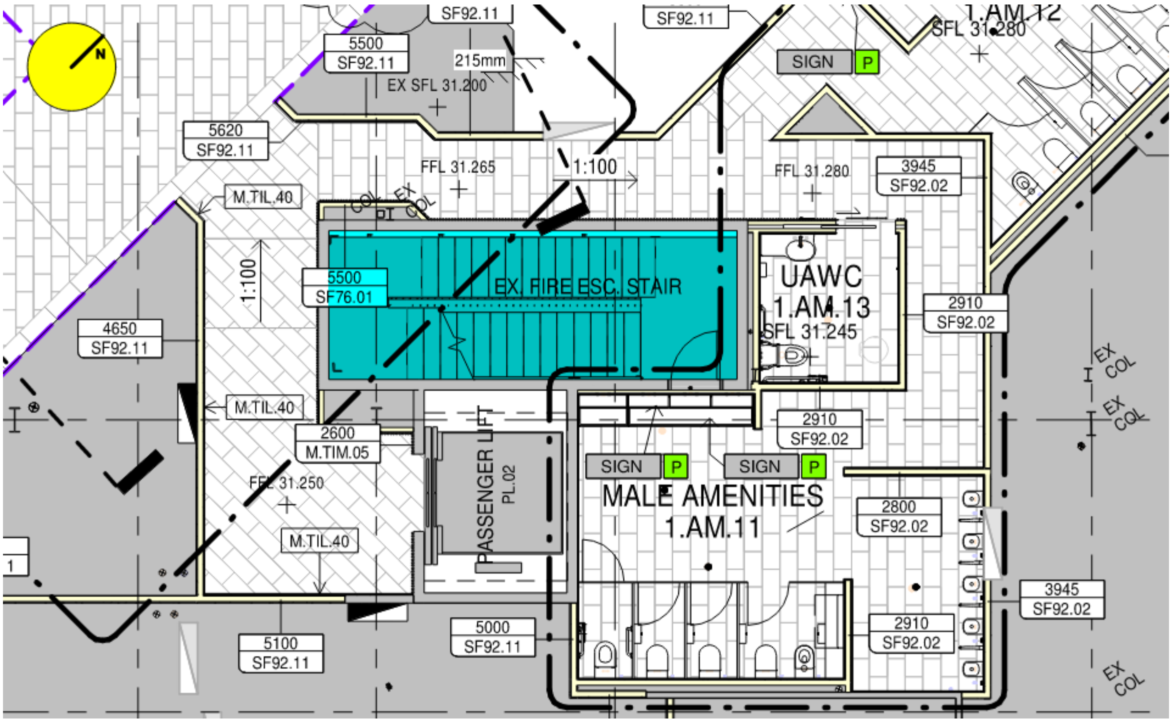

Figure 25: Existing stair north of passenger lift PL.02 – First Floor

31. The fire sprinkler heads within the scope of this project shall:

    a. All below ceiling sprinkler heads shall be fast response, i.e. the sprinkler Response Time Index (RTI) shall not exceed 50 $ms^{-1/2}$ and the conduction factor shall not exceed 0.65 $m/s^{-1/2}$.

    b. The temperature rating of sprinkler heads shall be 68°C for below ceiling sprinklers throughout the retail and BoH areas.

    c. The temperature rating of the sprinkler heads shall be 93°C for sprinkler heads located under uninsulated roofing and in loading docks and BoH areas that are not enclosed with external walls and where temperatures in excess of 40 C could occur in summer.

32. Vertical sidewall sprinklers shall be Reliable Model F1 or F1FR or similar sprinklers that at 207 kPa (30 PSI) pressure can protect an area up to 5.7 m (19 feet) wide.

33. Portable fire extinguishers (PFEs) suitable for Class AB(E) fire risks shall be provided within the scope of this project in accordance with BCA Clause E1D14 and the applicable parts of AS 2444-2001, where required.

34. Additional to Item 32, PFEs shall be provided in lieu of fire hose reels in accordance with Table 4.1 of AS 2444-2001 and the following:

    a. Each PFE shall be 4.5 kg agent capacity ABE PFE (rating 6A) and may protect up to 675 m².

    b. The travel distance from the most remote point on the floor to the nearest PFE shall not exceed 30 m.

c. Each specialty tenancy shall be provided with at least one PFE.

d. Where combustible kiosks and/or displays (including vehicle displays) are provided under voids in the Plaza and Myer retail mall, at least one 2.5 kg agent capacity ABE PFE (rating 4A) shall be provided in each kiosk or at each display to facilitate the initial attack on the fire.

9.5 Smoke Hazard Management

35. Within the scope of this project, to enhance the detection time and facilitate safe occupant evacuation, a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018 shall be provided in the areas identified below. The below ceiling smoke detectors shall be installed on a 10 m x 10 m nominal grid and smoke detectors in the concealed space shall be installed in accordance with the provisions of AS 1670.1-2018 (except where specifically modified by the provisions of item 37 below). The below ceiling heat detectors shall be installed on a 7 m x 7 m nominal grid in accordance with the provisions of AS 1670.1-2018 where provision of smoke detectors could cause spurious alarms.

    a. Throughout specialty shops and mini-major not provided with automatic smoke exhaust.

    b. Throughout enclosed BoH areas and loading docks.

36. Additional to item 35, specific fire alarm zones shall be created to facilitate safe occupant evacuation. The specific alarm zones are summarised in Table 13 below and the extent of these zones is shown in Figure 27, Figure 28 and Figure 30 in Section 54.

Fire alarm zones associated with dynamic exit signs	Detection mechanism
Fire alarm zone 01 (FAZ-01) – Existing western BoH – areas highlighted orange in Figure 27 in Section 54	Smoke detectors
Fire alarm zone 02 (FAZ-02) – Existing western BoH – areas highlighted pink in Figure 27 in Section 54	Heat detectors
Fire alarm zone 03 (FAZ-03) – Loading Dock 04 – areas highlighted orange in Figure 28 in Section 54	Smoke detectors
Fire alarm zone 04 (FAZ-04) – Loading Dock 04 – areas highlighted pink in Figure 28 in Section 54	Heat detectors
Fire alarm zone 05 (FAZ-05) – Tenancies 1-134 and 1-135 – areas highlighted orange in Figure 30 in Section 54	Smoke detectors

Table 13: Specific fire alarm zones

37. In fire alarm zones FAZ-01 and FAZ-03 smoke detectors in the BoH areas only need to be installed not more than 1.5 m horizontally from the doorway opening into the external circulation spaces. The approximate locations of smoke detector are marked with ‘S’ symbols in Figure 27 and Figure 28 in Section 54.

38. In fire alarm zones FAZ-01 and FAZ-05 smoke detectors in tenancies G-055, G-118, 1-134 and 1-135 shall be installed on a 10 m x 10 m nominal grid in accordance with the provisions of AS 1670.1-2018.

39. In fire alarm zones FAZ-02 and FAZ-04 heat detectors shall be installed on a 7 m x 7 m nominal grid in accordance with the provisions of AS 1670.1-2018.

40. A fire detection and alarm system in accordance with Clause S20C6(3) of BCA Specification 21 shall be provided throughout the following areas:

    a. Rebel tenancy (MM-004).

    b. JB Hi-Fi (tenancy 1-138).

    c. Timezone (tenancy 1-141).

    d. Myer retail mall & Plaza

41. The automatic fire sprinkler system and fire detection and alarm systems shall be interfaced with the Fire Brigade Panel (FDCIE) and shall be linked to DFES via the Direct Brigade Alarm (DBA) provided in accordance with Clause S20C8 of BCA Specification 20.

9.6 Smoke Exhaust in Mini-major Tenancies

42. Automatic smoke exhaust systems in accordance with BCA Clause E2D15 and Specification 21 shall be provided in Timezone (SZ-06), JB Hi-Fi (SZ-07) and Rebel (SZ-08), as shown in Figure 26 below, except:

    a. The make-up air velocity through the Timezone and JB Hi-Fi shopfront openings after-hours may be increased up to 3.5 m/s in lieu of a maximum 2.5 m/s prescribed by Clause S21C6(2).

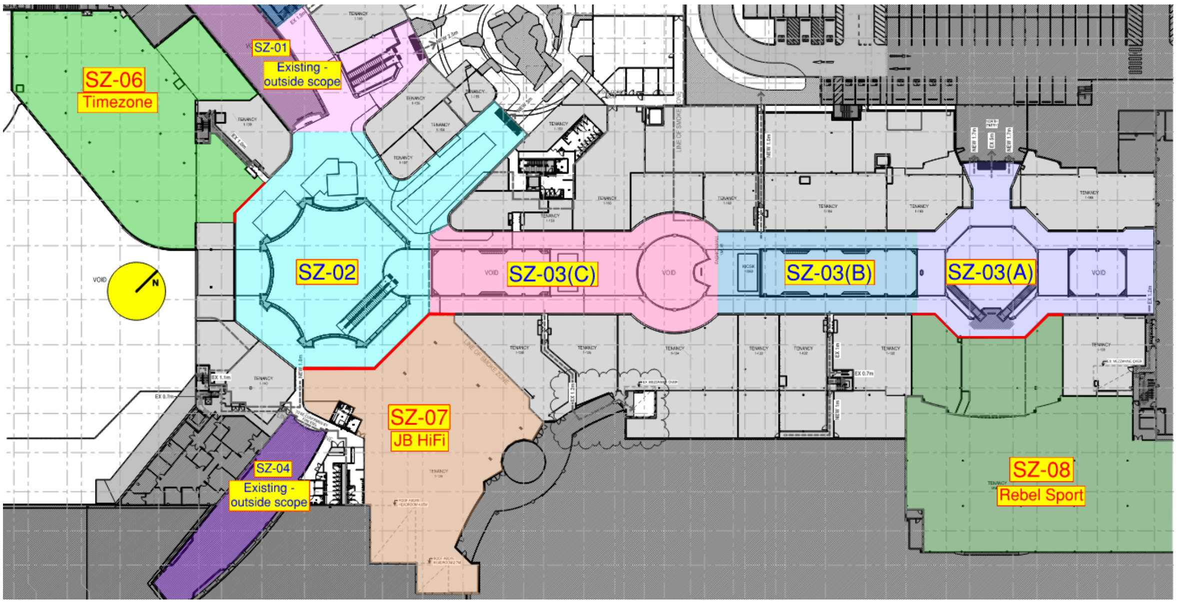

Figure 26: Smoke zones – First Floor

43. The smoke exhaust systems in the tenancies nominated in item 42 above shall activate only if smoke is detected in the tenancy first. The smoke exhaust system in the tenancy shall not activate if smoke is detected in the retail mall first and then spreads and activates smoke detection in the tenancy. Similarly, smoke exhaust in the retail malls shall not activate if smoke is detected in a tenancy nominated in item 42 above and then spreads and activates smoke detection in the retail mall.

44. Make-up air to the smoke exhaust systems nominated in item 42 above shall be provided from the retail malls via the shopfront openings (the characteristics of the make-up air are nominated in Section 9.8 below). The configuration of the shopfront openings shall be as follows:

    a. During trading hours, the roller-shutter(s) in the shopfront shall descend to 2.4 m above floor level upon activation of the smoke detection system installed in the tenancy to create smoke baffles between the tenancy and the retail mall. The bottom section of the roller-shutters (between the bottom of the baffle and the underside of the bulkhead above) shall be solid. The make-up air velocity through the shopfront opening shall not exceed 2.5 m/s.

    b. After-hours, the roller-shutter(s) in the shopfront shall remain closed upon activation of the smoke detection system installed in the tenancy. The roller-shutters shall be provided with openings that shall not extend beyond 2.4 m above floor level. The net free open area of the openings shall be such that the make-up velocity does not exceed 2.5 m/s for the Rebel shopfront and 3.5 m/s for the Timezone and JB-Hi Fi shopfronts.

9.7 Smoke Exhaust in Retail Malls

45. The Plaza (SZ-02) and Myer mall (SZ-03(A), SZ-03(B) and SZ-03(C)) within the scope of this project and the Coles link mall (SZ-01) and the Target link mall (SZ-04) outside the scope of this project are provided with existing smoke exhaust systems. The smoke exhaust fans (SEF) and the design and actual SEF capacities for each smoke zone are summarised in Table 14.

Smoke zone	Smoke Exhaust Fans	Design SEF capacity, l/s	Actual SEF capacity, l/s
SZ-01	SEF 13.2; SEF 13.3; SEF 13.4; SEF 13.5	64,000	48,352
SZ-02	SEF 13.1; SEF 17.6; SEF 21.5	69,000	63,069
SZ-03(A)	SEF 10.2; SEF 19.2	46,000	50,681
SZ-03(B)	SEF 15.1; SEF 16.2	46,000	51,853
SZ-03(C)	SEF 12.1; SEF 12.2	46,000	50,238
SZ-04	SEF 21.1; SEF 21.2; SEF 21.3; SEF 21.4	64,000	31,613

Table 14: Smoke zones and smoke exhaust capacity per each zone

46. Even though smoke zones SZ-01 and SZ-04 are outside the scope of this project, they are referenced because smoke from SZ-02 may spread to these smoke zones. Without accounting for an adequate volume of make-up air, the effective operation of the smoke exhaust systems in the affected smoke exhaust zones may not be achieved.

47. The configuration of the existing smoke exhaust zones, should remain unchanged; however, the following deviations from the DtS provisions of Clause E2D15(2)(a) and BCA Specification 21 are addressed within the scope of this project:

    a. Smoke exhaust rates in Plaza and Myer mall smoke exhaust zones may be determined on a performance basis in lieu of compliance with the BCA DtS provisions.

    b. The horizontal length of the Myer retail mall smoke reservoir may be extended up to 144 m long in lieu of 60 m.

    c. The horizontal length of the Plaza smoke reservoir may be extended up to 66 m long in lieu of 60 m.

48. Power supply to the smoke exhaust fans in smoke zones SZ-01 (Coles link mall) and SZ-04 (Target link mall) shall comply in full with the BCA DtS provisions.

49. The existing smoke baffles throughout the retail malls shall be retained and shall be rectified where gaps have formed between the edges of the baffles and the adjacent walls.

50. Smoke baffles between smoke zone SZ-01 and SZ-02; SZ-04 and SZ-02; and SZ-02 and SZ-03(A-C) need not be provided.

9.8 Make-up Air Provisions

51. Make-up air to the smoke exhaust systems in the retail malls and in tenancies nominated in item 42 above shall be provided in accordance with Clause E2D15(2)(a) and BCA Specification 21, and AS 1668.1-2015, except:

    a. Power supply to the AHUs that provide make-up air to the smoke exhaust systems may not be fire-rated.

    b. Make-up air velocity through vertical openings may exceed 1 m/s.

52. Make-up air to the smoke exhaust systems shall be provided from AHUs nominated in Table 15 below and via the external retail mall doors that shall automatically open upon fire alarm activation (both during trading hours and after-hours), as nominated in Table 16 below.

Plant Room	Air Handing Units	Design make-up air capacity, l/s
Shall supply make-up air independent of where fire is detected (SZ-01, SZ-02, SZ-03(A-C) or SZ-04)		
AP7	AHU 7.1	1,250
AP Coles	AHU Coles	15,000
	Sub-total:	**16,250**

Plant Room	Air Handing Units	Design make-up air capacity, l/s
Shall supply make-up air if fire is detected in smoke zone SZ-01		
AP3	AHU 3.2	1,100
AP4	AHU 4.1; AHU 4.2	10,250
AP6	AHU 6.1	4,000
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500
AP11	AHU 11.1	3,500
	Sub-total:	**34,350**
	Total for smoke zone SZ-01	**50,600**
Shall supply make-up air if fire is detected in smoke zone SZ-02		
AP1	AHU 1.1	5,000
AP3	AHU 3.1	2,200
AP4	AHU 4.3	6,000
AP6	AHU 6.1	4,000
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500
AP11	AHU 11.1	3,500
	Sub-total:	**36,200**
	Total for smoke zone SZ-02	**52,450**
Shall supply make-up air if fire is detected in smoke zone SZ-03(A-C)		
AP1	AHU 1.1	5,000
AP3	AHU 3.1; AHU 3.2	3,300
AP4	AHU 4.1; AHU 4.2; AHU 4.3	16,250
AP6	AHU 6.1	4,000
AP ENT	AHU ENT.3	8,000
	Sub-total:	**36,550**
	Total for smoke zone SZ-03	**56,800**
Shall supply make-up air if fire is detected in smoke zone SZ-04		
AP1	AHU 1.1	5,000
AP3	AHU 3.1; AHU 3.2	3,300
AP4	AHU 4.2; AHU 4.3	10,750
AP8	AHU 8.1	8,000
AP9	AHU 9.1	7,500

Plant Room	Air Handing Units	Design make-up air capacity, l/s
AP11	AHU 11.1	3,500
	Sub-total:	**38,050**
	Total for smoke zone SZ-04	**54,300**

Table 15: AHUs that shall provide make-up air to the smoke exhaust systems

Door	Location	Size, m	Net free open area, m²
D.EX.01	South-east entrance to Woolworths and Target mall	2.55 x 2.91	6.55
D.EX.02	South-west entrance to Target link mall	2.45 x 2.40	5.16
D.EX.03	South-west entrance to Kmart mall	1.74 x 2.35	3.38
D.EX.04	North-west entrance to Coles mall	1.65 x 2.35	3.17
D.EX.05	North-east entrance to ANZ mall	3.29 x 2.41	7.20
D.EX.06	North entrance to Coles mall	2.06 x 2.41	4.24
1.Z6.01	South entrance to Plaza (new)	2.03 x 2.45	4.24
G.Z4.03	North-west entrance to Myer mall	2.86 x 2.63	6.73
G.Z8.02	South-east entrance to Myer mall	2.35 x 2.27	4.65
		Total:	45.32

Table 16: External doors that shall provide make-up air to the smoke exhaust system

53. AHUs nominated in Table 15 shall provide make-up air to the retail malls at Ground Floor only.

54. All AHUs that are not supplying make-up air to the fire-affected smoke zone shall shut down on fire trip.

9.9 Emergency Lighting, Exit Signs

55. Emergency lighting within the scope of this project shall be located and installed in accordance with Clauses E4D2, E4D3 and E4D4 of the BCA and AS/NZS 2293.1-2018.

56. Exit signs within the scope of this project shall be located and installed in accordance with Clauses E4D5 and E4D6 of the BCA and AS/NZS 2293.1-2018.

57. Additional to item 56 above, dynamic RED exit signs shall be installed above the doors nominated in Table 17, as shown in Figure 27 to Figure 31 below.

Doors/openings provided with dynamic exit signs		Fire alarm zones associated with the dynamic exit signs
Level	**Doors/openings**	
Ground Floor	Opening from the Myer retail mall leading to corridor 04 (G.BO.04) and Lift Lobby G.LL.02	Fire alarm zone FAZ-01,

Doors/openings provided with dynamic exit signs		Fire alarm zones associated with the dynamic exit signs
Level	Doors/openings	
	Door leading from Lift Lobby G.LL.02 to the western BoH area	Fire alarm zone FAZ-02
	Door leading from Tenancy G-055 to the western BoH area	
	Door leading from Tenancy G-118 to the western BoH area	
Ground Floor	Door leading from the Coles retail mall to fire-isolated corridor 06 (G.BO.06)	Fire alarm zone FAZ-03, Fire alarm zone FAZ-04
	Door leading from fire-isolated corridor 06 (G.BO.06) and Stair A1 (G.EX.FS.A1) to Loading Dock 04	
	Door leading from the Coles retail mall to fire-isolated corridor 20 (G.BO.20)	
First Floor	Door D.3155 leading from Plaza to fire-isolated corridor 15 (1.BO.15)	
	Door D.3957 leading from Tenancy 1-144 to fire-isolated corridor 19 (1.BO.19)	
First Floor	Door leading from the Myer retail mall to fire-isolated corridor 19 (1.BO.19)	Fire alarm zone FAZ-05

Table 17: Doors provided with dynamic RED exit signs and the associated fire alarm zones

58. Additional to item 56 above, a dynamic GREEN direction exit sign (refer to Figure 33 below) with sounder shall be installed in the path of travel and a dynamic GREEN exit sign (refer to Figure 34 below) shall be installed above the door nominated in Table 18, as shown in Figure 28 below.

Doors/openings provided with dynamic exit signs		Fire alarm zones associated with the dynamic exit signs
Level	Path of travel / door	
Ground Floor	In path of travel from plantroom AP.ENT to door leading from loading dock 04 to fire-isolated corridor 06 (G.BO.06)	Fire alarm zone FAZ-03, Fire alarm zone FAZ-04
	Door leading from loading dock 04 to fire-isolated corridor 06 (G.BO.06)	

Table 18: Door provided with dynamic GREEN exit signs and the associated fire alarm zones

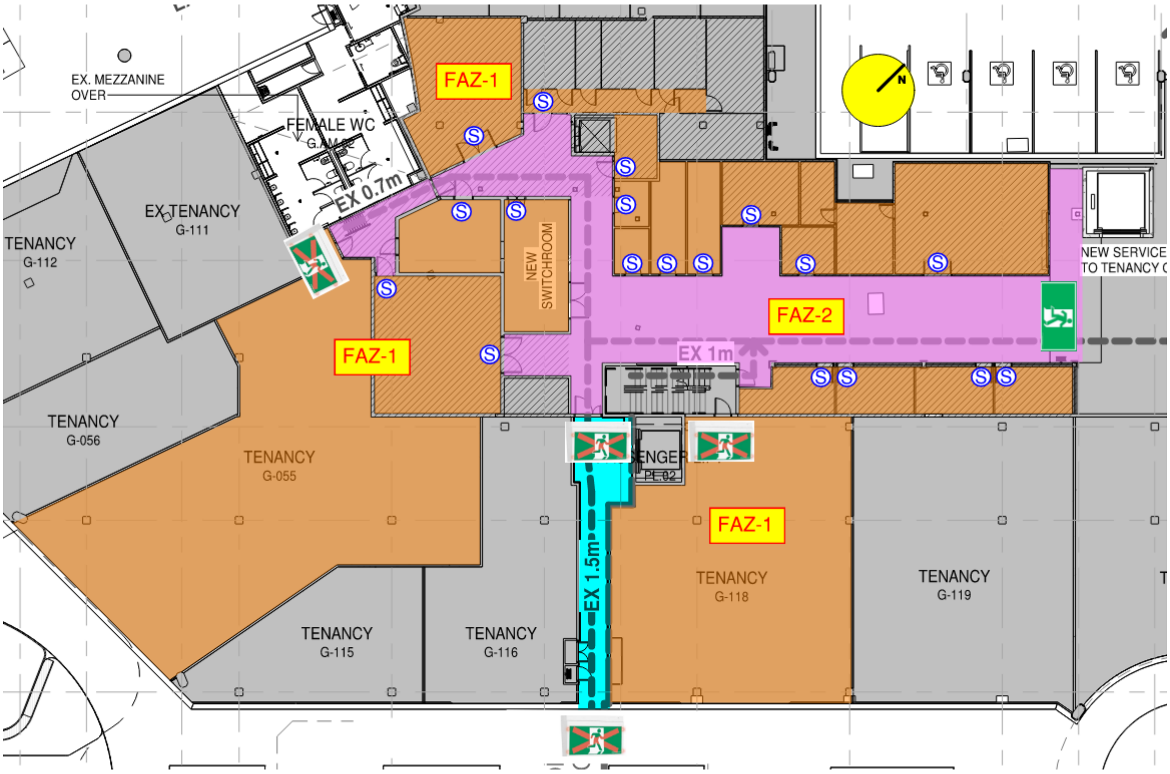

Figure 27: Location of dynamic exit signs interfaced with fire alarm zones FAZ-1 and FAZ-2

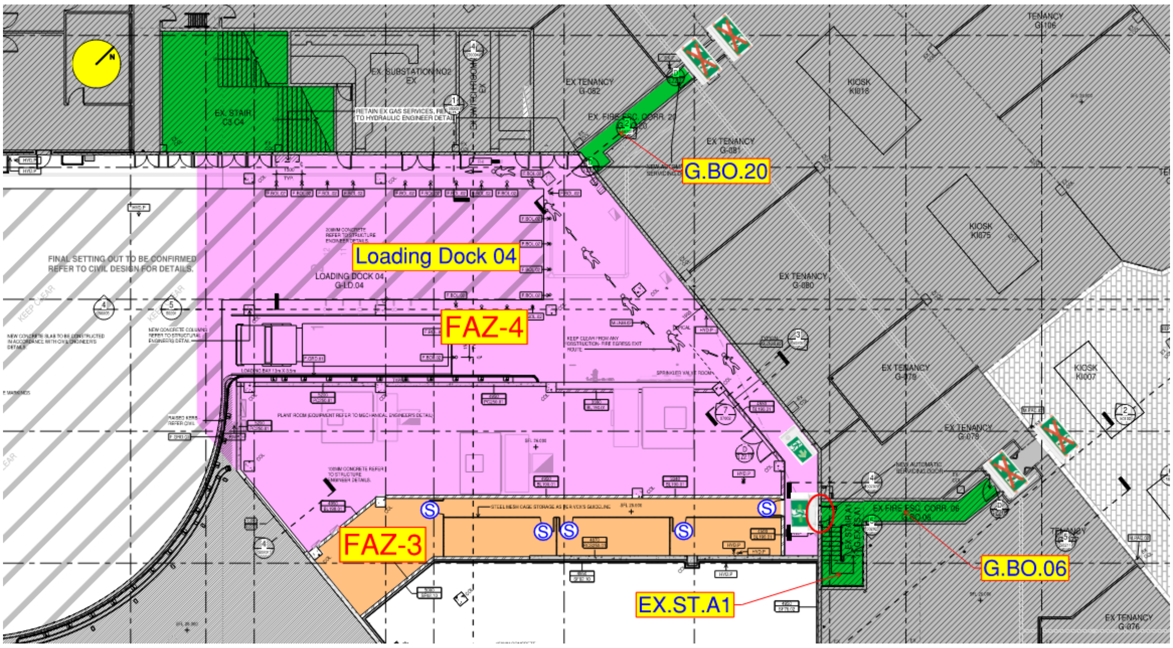

Figure 28: Location of dynamic exit signs interfaced with fire alarm zones FAZ-3 and FAZ-4 – Ground Floor

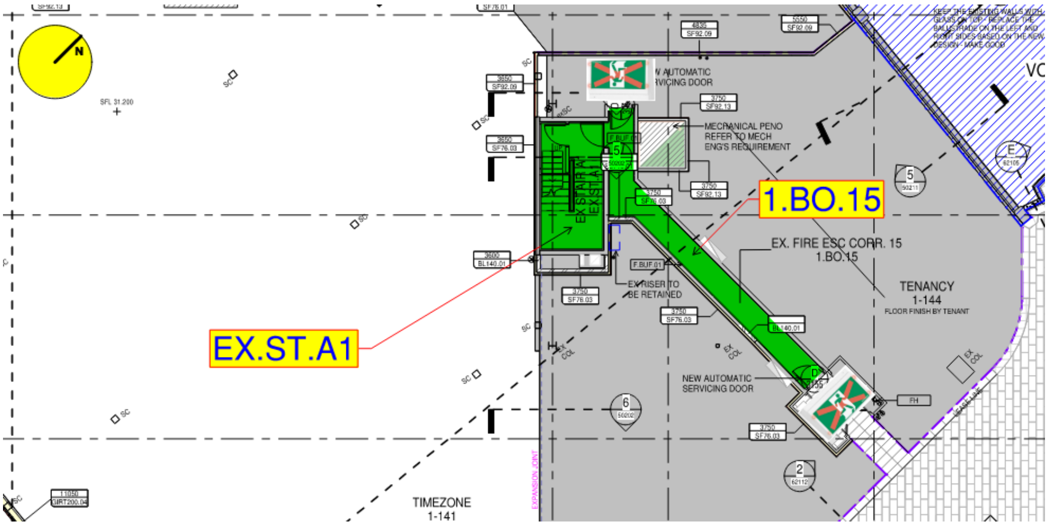

Figure 29: Location of dynamic exit signs interfaced with fire alarm zones FAZ-3 and FAZ-4 – First Floor

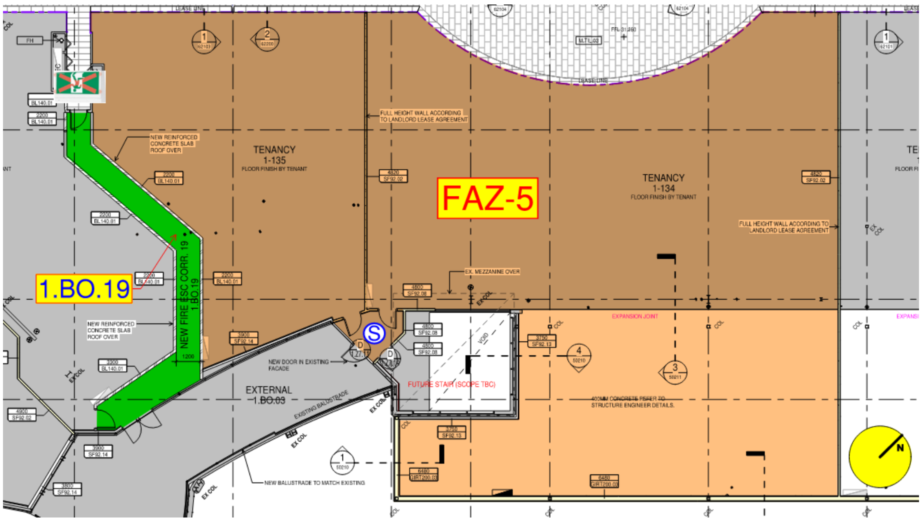

Figure 30: Location of dynamic exit signs interfaced with fire alarm zone FAZ-5

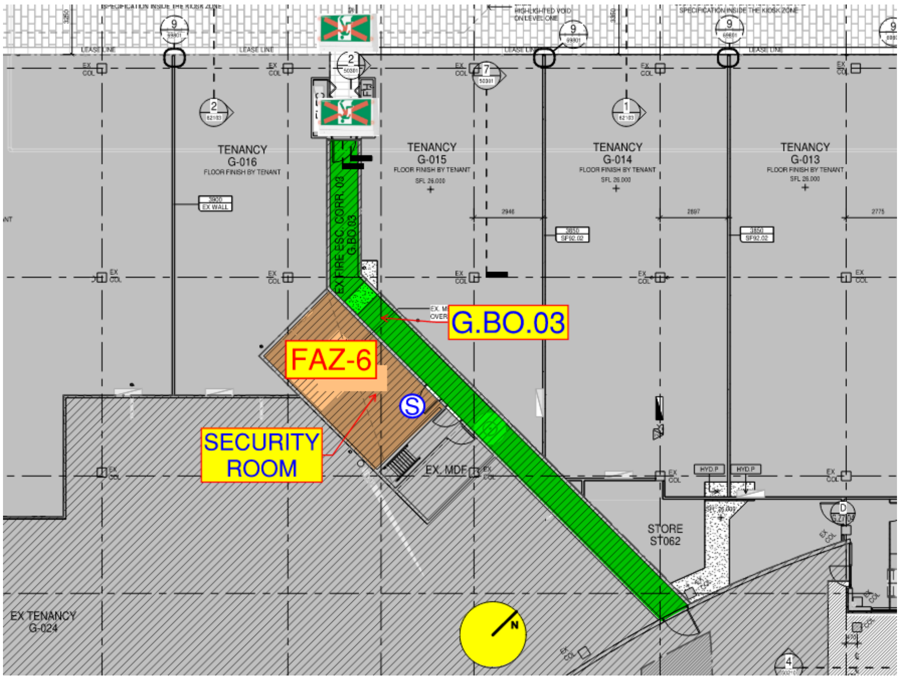

Figure 31: Location of dynamic exit signs interfaced with fire alarm zone FAZ-6

59. The dynamic RED exit signs shall be as shown in Figure 32 or similar.

Figure 32: Dynamic RED X sign

60. During the normal mode of operation, the dynamic RED exit signs shall show the running man pictogram. Upon fire alarm activation in a fire alarm zone, as nominated in item 36 above, the dynamic RED exit signs above the doors associated with the fire-affected fire alarm zone, as nominated in Table 17 above, shall activate and shall display a red cross.

61. The dynamic GREEN exit sign with sounder shall be as shown in Figure 33 or similar.

Figure 33: Dynamic GREEN exit sign with sounder

62. The dynamic GREEN exit sign shall be as shown in Figure 34 or similar.

Figure 34: Dynamic GREEN exit sign

63. During the normal mode of operation, the dynamic GREEN exit signs shall not be illuminated. Upon fire alarm activation in fire alarm zones FAZ-03 or FSZ-04, as nominated in item 36 above, the dynamic GREEN exit signs in the path of travel to and above the door above the door leading into fire-isolated corridor 06 (G.BO.06), shall activate and shall display running green dots. The dynamic direction exit sign with sounder shall produce a message stating: EVACUATE HERE.

64. Emergency Warning and Intercommunication System (EWIS) shall be provided throughout the areas within the scope of this project (areas highlighted pink in Figure 35 and Figure 36 below) in accordance with Clause E4D9(d) and AS 1670.4-2018. Activation of the automatic fire sprinkler system and of the smoke detection system shall activate the EWIS.

65. Addition to item 63 above, the EWIS shall be extended into the Centre Management Office (the area highlighted cyan in Figure 36 below). The extended EWIS shall be installed in accordance with Clause E4D9(d) and AS 1670.4-2018.

66. The EWIS shall be configured such that compliance with the provisions of Clause AS 1670.4-2018 is achieved in the Plaza and Myer retail malls where the noise levels generated by the existing smoke exhaust fans may be elevated.

Figure 35: Extent of the EWIS system upgrade – Ground Floor.

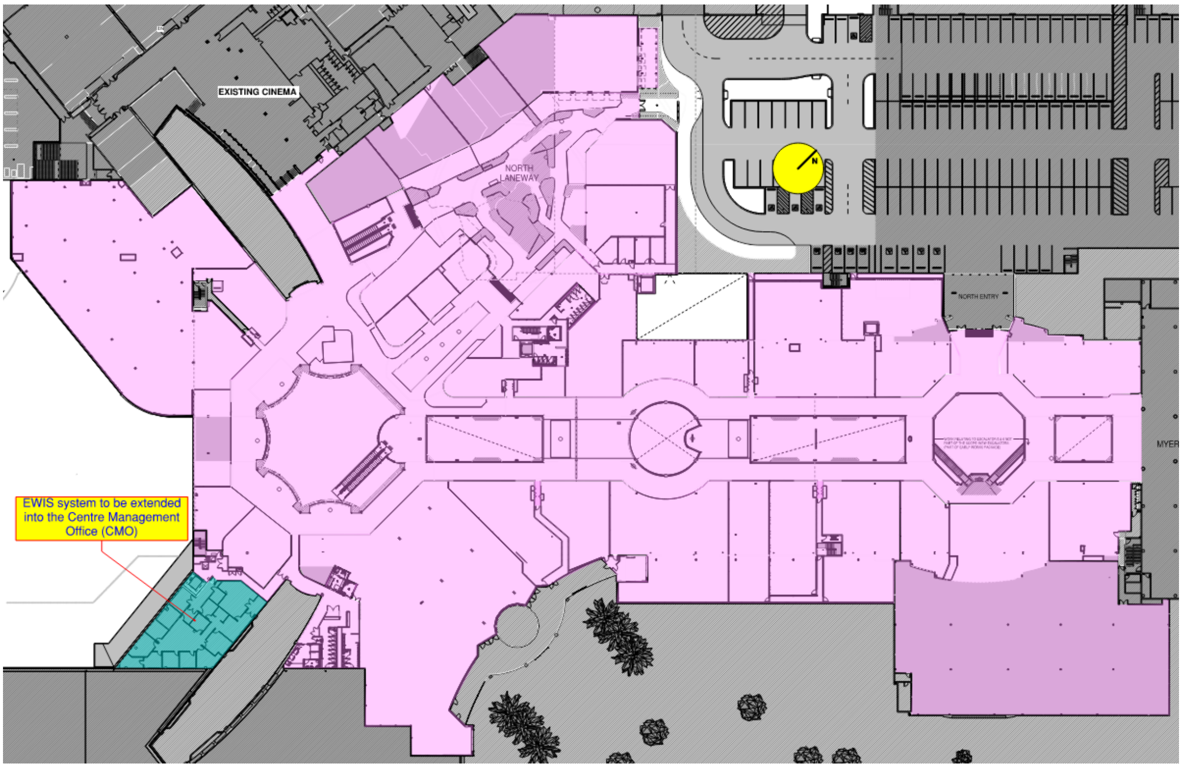

Figure 36: Extent of the EWIS system upgrade – First Floor

9.10 Fire Safety Signage

67. Signage shall be provided at the fire hydrant booster assembly, at the onsite fire hydrants, at the Fire Brigade Panel (FDCIE) and on the fire hydrant system block plans. The signs shall be fade resistant.

    a. The sign shown in Figure 37 shall be provided at the booster assembly, at the FDCIE and on the fire hydrant system block plans.

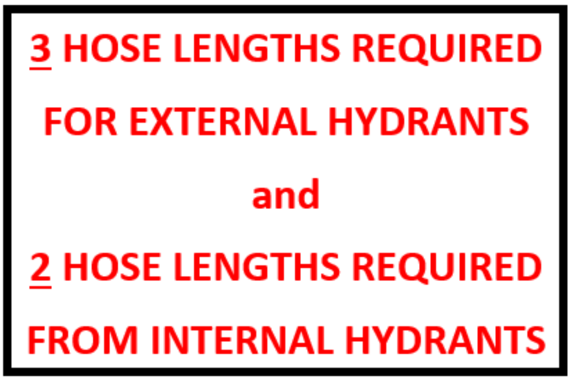

Figure 37: Extra lengths of hose sign at the booster assembly and at the FDCIE

    b. The sign at the booster assembly shall be in capital letters not less than 50 mm high in a colour contrasting with the background.

    c. The sign at the FDCIE shall be of a minimum A3 size sheet and shall be installed in a prominent location where it is immediately apparent to the responding DFES personnel.

d. The sign on the fire hydrant system block plans shall be appropriate to the size of the block plan and shall be immediately apparent.

e. The sign shown in Figure 38 shall be provided at the on-site external fire hydrants, including those on the open-deck carpark roof. The sign shall be in capital letters not less than 30 mm high in a colour contrasting with the background in accordance with the provisions of DFES Guideline GL-03.

3 HOSE LENGTHS REQUIRED

Figure 38: Sign identifying the requirement for 3 lengths of hose from external hydrants

9.11 Management in Use Procedures

1. Management in Use procedures shall be developed to ensure that:

    a. The complete fire safety system is maintained and tested in accordance with Regulation 48A of the Building Regulation 2012 (with amendments) and AS 1851-2012 and all building occupants are appropriately informed and trained (where appropriate) in the correct implementation and use of the approved fire safety measures.

    b. "No-Smoking" policy shall be implemented and enforced throughout the facility.

    c. Housekeeping measures shall be implemented to ensure rubbish is not accumulated adjacent to potential ignition sources.

    d. Regular maintenance and inspection of all plant, electrical equipment and appliances shall be enforced in accordance with the relevant regulations.

    e. Exits shall be kept clear of obstructions at all times.

    f. A minimum 1.8 m wide egress path shall be maintained through Loading Dock 04 (refer to Figure 39) and Loading Dock 05/BoH (refer to Figure 40). This path shall clearly delineated using weather-resistant, high-contrast floor markings to indicate areas where storage is not permitted. Refer to Figure 39 and Figure 40 for the no-storage zones, which are highlighted in yellow.

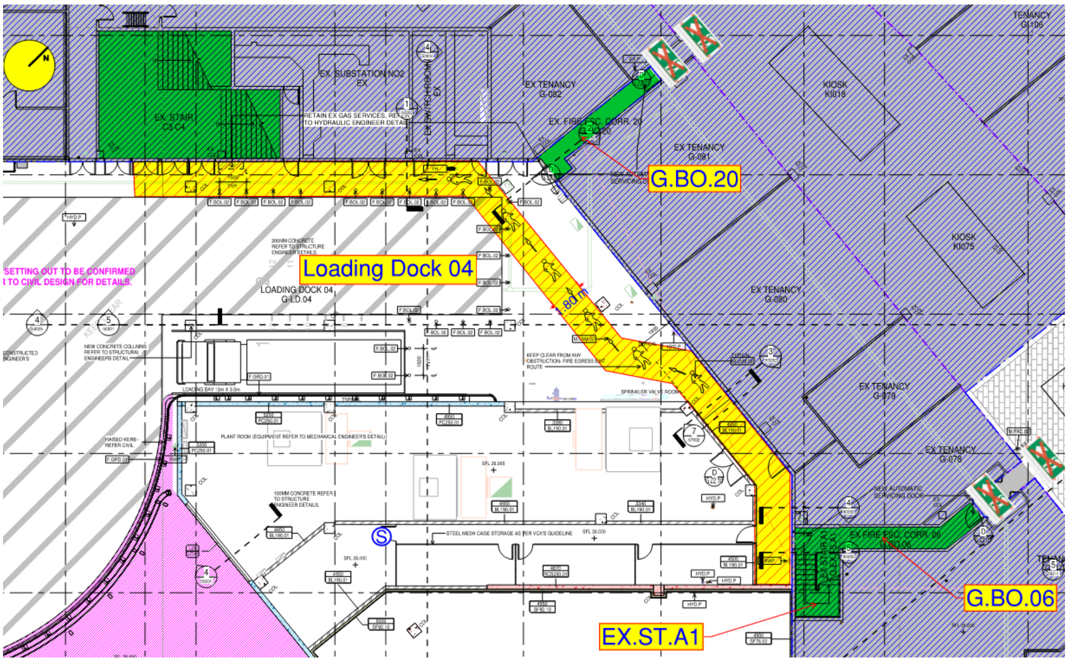

Figure 39: Floor markings for occupant egress through the Loading Dock 04

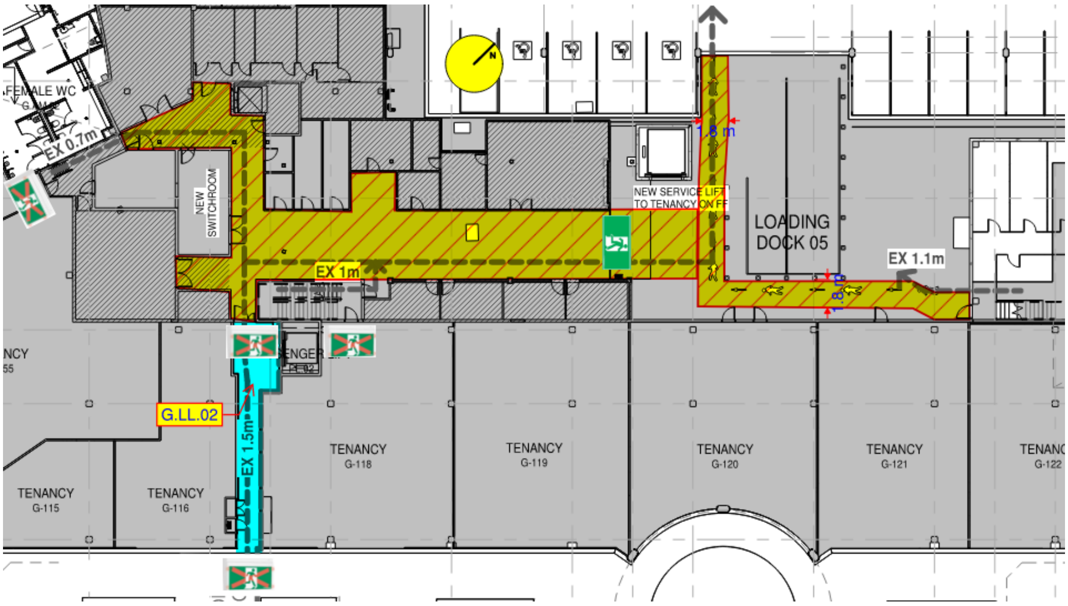

Figure 40: Floor markings for occupant egress through BoH and Loading Dock 05

g. Signage stating: **"KEEP CLEAR – NO STORAGE ALLOWED"**, shall be provided on the wall adjacent to the floor markings. The signs shall be in capital letters not less than 30 mm high in a colour contrasting with the background.

9.12 Building Subject to FSER Notice

68. A “Building Subject to FSER” notice (a copy of the notice will be provided in the FSER) shall be mounted adjacent to the FDCIE. The notice shall be of a minimum A4 size sheet, mounted within a permanent frame and securely fastened to the wall, and shall be in accordance with the DFES “Direct Brigade Alarm (DBA) Technical Bulletin – July 2014 (Advice 4)” and DFES DBA Connection Code. The notice shall be black lettering on a white background and shall meet the following minimum requirements for size:

    a. BUILDING SUBJECT TO FSER – Times New Roman – 15 mm high capital letters.

    b. Body of the sign – Times New Roman – 12 mm high small letters.

9.13 Maintenance

69. The *safety measures* outlined above shall be maintained and tested in accordance with Regulation 48A of the Building Regulation 2012 (with amendments) and the following:

    a. AS 1851-2012, or the latest edition, if the fire safety system is within the scope of AS 1851.

    b. AS 2293.2-2019, or the latest edition, for emergency lighting and exit signage.

    c. The manufactures’ instructions and recommendations for each product.

10. Quantitative Engineering Tools and Parameters

10.1 Required Safe Egress Time versus Available Safe Egress Time Concept

The performance-based travel distances are addressed based on the determination and comparison of the time for occupants to evacuate and the time available for the evacuation to be completed safely. This form of analysis is known as a timeline analysis; or the Required Safe Egress Time (RSET) versus Available Safe Egress Time (ASET) analysis.

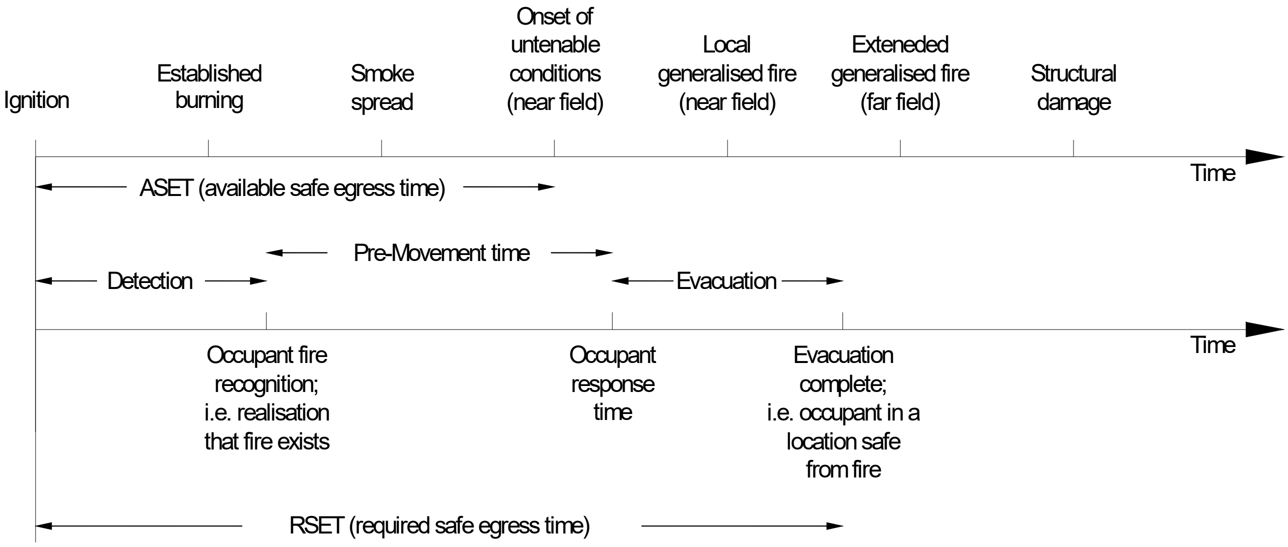

Figure 41: ASET versus RSET timeline diagram

Parameters required to undertake this assessment are defined in the following sections of this report.

10.2 Required Safe Egress Time (RSET) Modelling

The RSET is the sum of times incurred during the following three stages of the evacuation process:

- ***Cue time*** – time taken from effective ignition to the receipt of a cue by the occupants regarding the presence of a fire. In open plan areas occupants can also receive a cue upon development of a visible smoke layer under the ceiling.
- ***Response (pre-movement) time*** – time which extends from the cue to the time when occupants decide to evacuate. The degree of training and familiarity with the surroundings, as well as the general nature of the population, has an impact on the response time, together with the type of cue received. This period covers the time for occupants to assimilate the cue, resolve any ambiguity, undertake pre-evacuation actions and commence evacuation.
- ***Egress time*** – occupant evacuation time, which can be calculated on the basis of movement time to an exit and potential queuing time at the exit before reaching a place of relative safety.

$$T_R = t_d + t_{pm} + t_e$$

where :

T_R is the total time of evacuation to a place of safety.
t_d is the time of occurence for an automatic or intrinsic fire cue.
t_{pm} is the pre - movement t ime.
t_e is the time necessary for occupants to move to a safe place.

Equation 1: Total time for evacuation to a place of safety

10.2.1 Cue Times (t_d)

The cue time in the performance-based design is based on the time it takes smoke of sufficient optical density to cover the distance between the axis of the fire plume and to activate the nearest smoke detector. The cue time in a BCA DtS compliant design is based on the time it takes occupants to become aware of the fire due to exposure to combustion products (see flames, smell smoke, hear fire related noises, such as cracking, popping, things falling downs, etc.) or due to an alarm being raised by others.

Where smoke detectors are provided in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018 on a nominal 10 m grid, the maximum radial distance from the axis of the fire plume to the nearest detector should not exceed 7.1 m (refer to Figure 42 below).

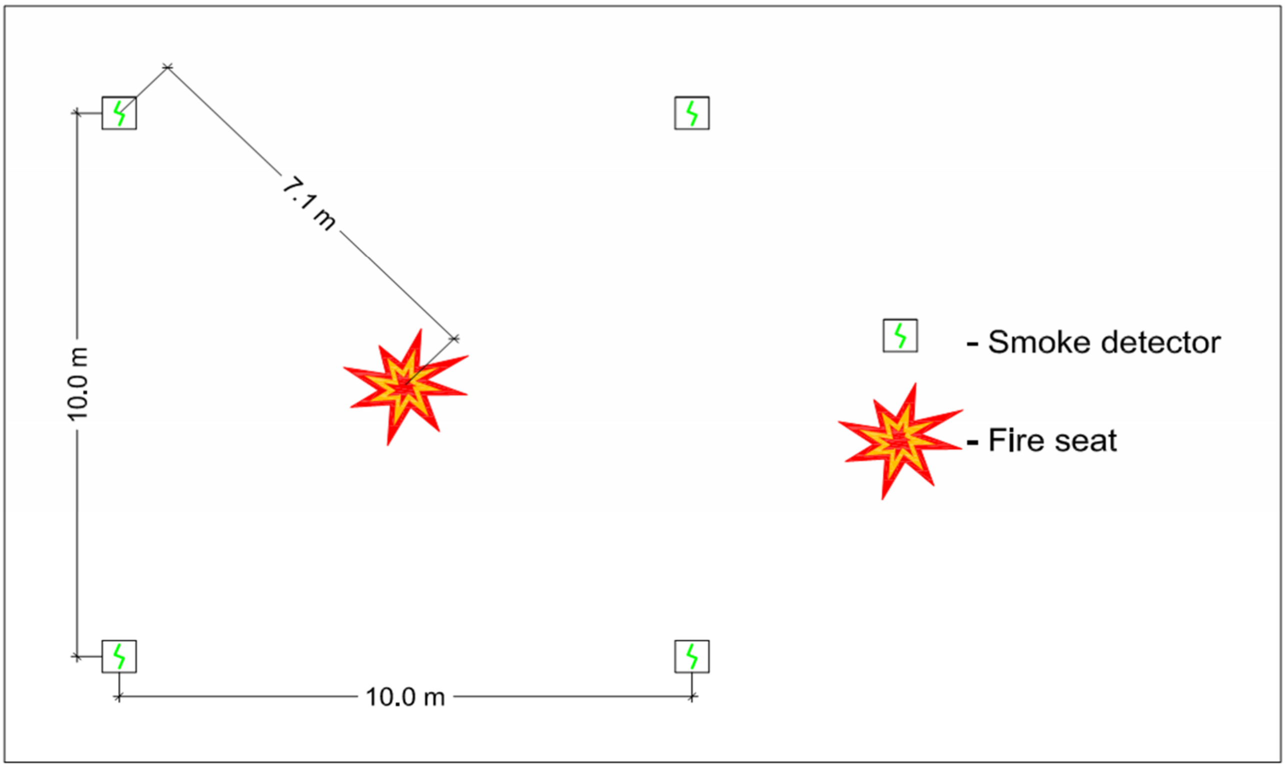

Figure 42: Distance from the axis of a fire plume to the nearest smoke detector installed on a 10 m x 10 m grid to Clause S20C4 of BCA Spec. 20 and AS 1670.1-2018

Where smoke detectors are provided in accordance with Clause S20C6 of BCA Specification 21 and AS 1670.1-2018 a on a nominal 20 m grid, the maximum radial distance from the axis of the fire plume to the nearest detector should not exceed 14.1 m (refer to Figure 43 below).

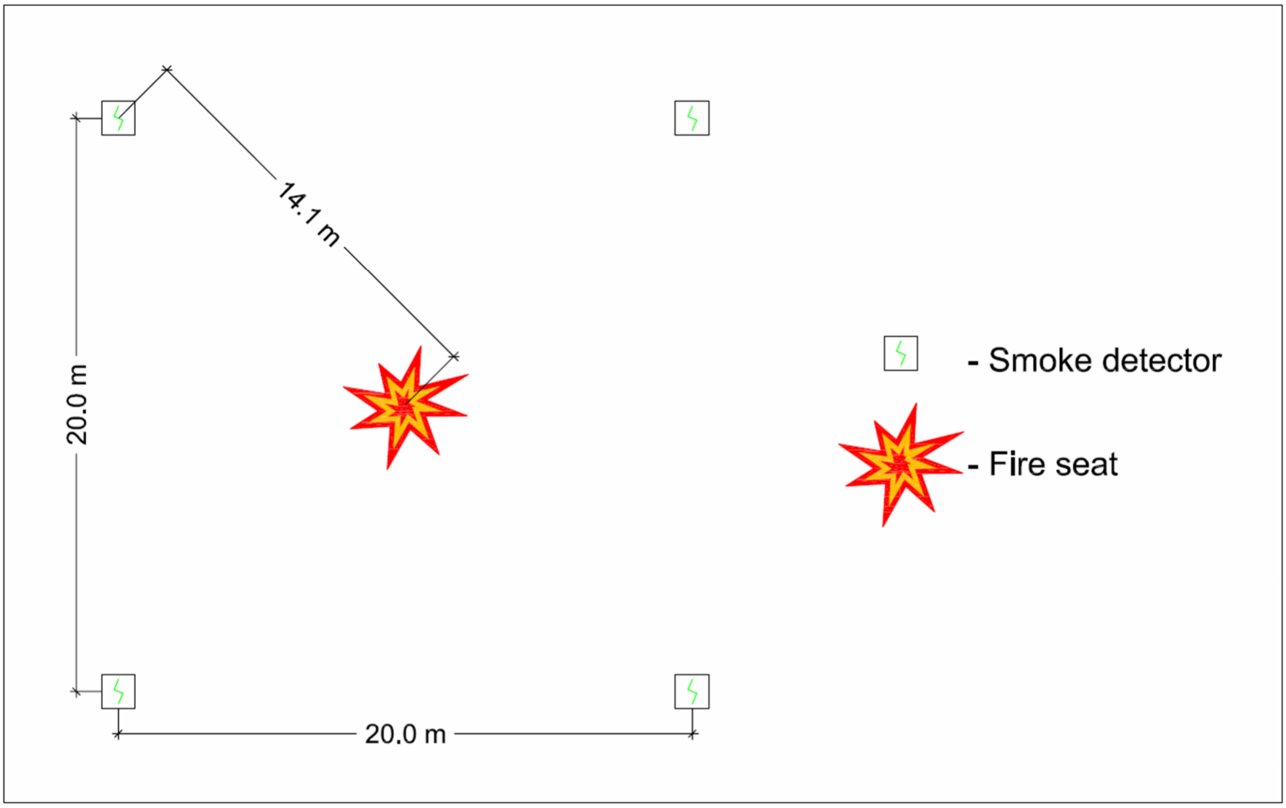

Figure 43: Distance from the axis of a fire plume to the nearest smoke detector installed on a 20 m x 20 m nominal grid

On site, detectors may be located closer than in the nominal grids; however, to provide a conservative estimate, the calculations were carried out using the nominal detector spacing.

One relatively crude method of predicting smoke detector activation times at different spacings and heights is identified in the *International Fire Engineering Guidelines* (IFEG) [ABCB, 2005a]. This method was developed by Heskestad [1981] and it suggests that once the temperature at the detector has reached approximately 13°C above ambient the detector is likely to have activated. More recent research however indicates that 13°C is an overly conservative value for most applications, with 4°C to 5°C temperature rise closely replicating experimentally observed smoke detector activation times [Bukowski, 1998].

This report adopts this method in comparative assessments and uses computer model CFAST [Peacock, 2023] to calculate detector activation times.

The smoke detection algorithm from the computer model FDS was used in the absolute assessment of the GSC, as an assessment carried out with the use of computer model CFAST may not provide an adequate estimation of smoke detector activation times under sloping ceilings/roofs.

The FDS algorithm is based on work by William Grosshandler and Tom Cleary from NIST, who developed an enhancement to the smoke detector activation algorithm, originally conceived by Heskestad and Steve Olenick of Combustion Science and Engineering (CSE), and implemented this model in FDS [McGrattan, 2023]. In FDS the activation of smoke detectors is modelled using simple correlations of transport lag.

The alarm verification time for smoke detectors can be up to 20 seconds (Clause 2.11 of AS4428.1-1998, Amendment No.1 - 2004). This time is added to all calculated activation times of smoke detectors.

Where sprinklers are provided in accordance with AS 2118.1-2017 on a nominal 3 m x 4 m grid, the maximum radial distance from the axis of the fire plume to the nearest sprinkler should not exceed 2.5 m (refer to Figure 44).

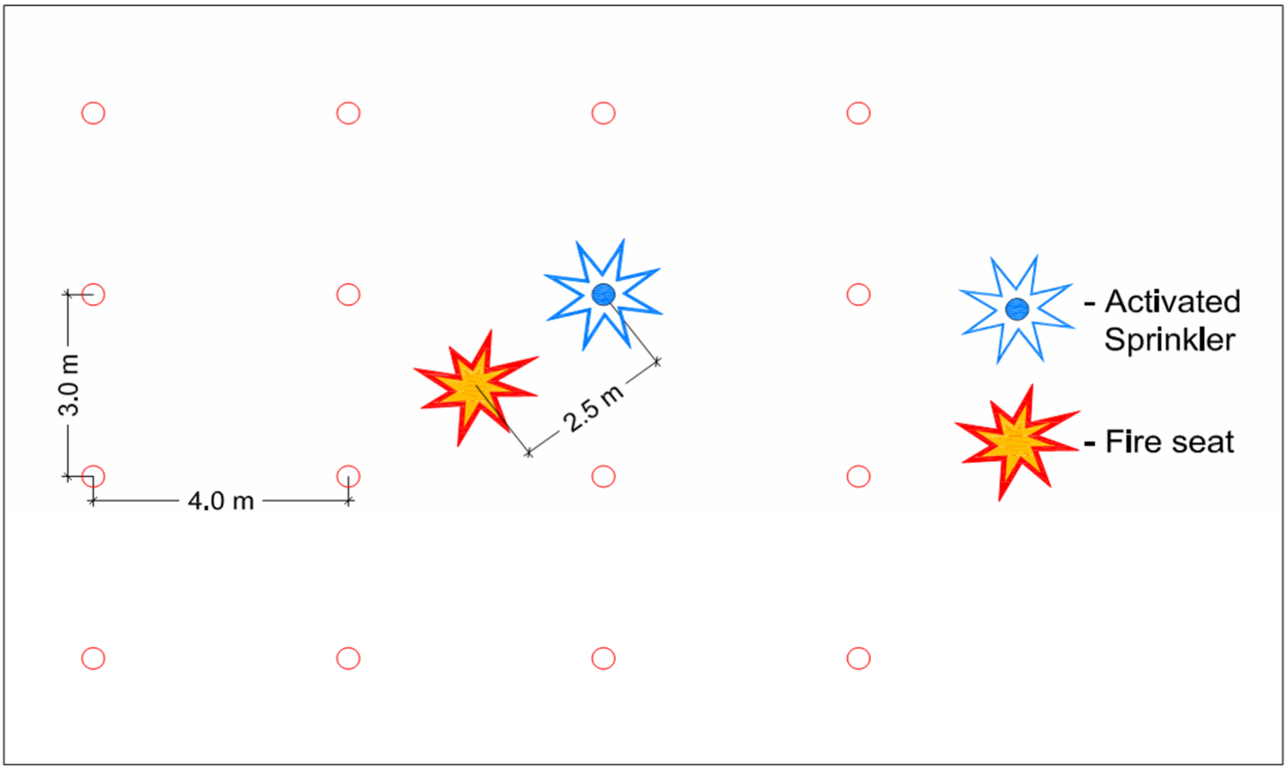

Figure 44: Distance from the axis of a fire plume to the nearest sprinkler installed on a nominal 3 m x 4 m grid in accordance with AS 2118.1-2017

The assessment uses module Sprinkler from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013] to calculate sprinkler activation times in the comparative assessment where sprinklers are the primary detection system.

An additional delay in detection time is created by the depressurisation time of the sprinkler system.

On a small sprinkler system the depressurisation time is considered to be at least 30 seconds; however, on larger systems, the depressurisation time can be as high as 3 minutes [Table 2.4.1.2, Item No. 2.2(b) of AS 1851-2005]. Conservatively, for the purpose of the comparative assessment a 30 second depressurisation time is assumed.

10.2.2 Response Time (t_{pm})

Response time (or pre-movement time) is the time taken between the moment when the cue is first received and the moment when movement to a place of safety begins.

Occupant response time involves the process of interpreting automatic and/or intrinsic cues and identifying them as a cause for evacuation. The response time is dependent upon the type of a cue. For the primary fire/smoke zone the cues may be in the form of:

- Alarm caused by smoke detection system activation.
- Sight or smell of smoke (based on a smoke depth which is 10% of the floor-to-ceiling height).
- Activation of the Building Occupant Warning System (BOWS).
- Notification and evacuation assistance by building management staff.
- Movement of a substantial number of occupants from the primary fire affected zone to an adjacent zone during evacuation.

Occupants close to the fire seat are expected to respond quicker than occupants remote from the fire seat due to the sight of fire and the strong smell of smoke.

Previous investigations in the occupant behaviour reveal that all occupants do not respond to a fire emergency at the same time. It has been observed in emergency evacuations in shopping centres that the staff assistance plays a critical role in the evacuation of occupants, which results in a reduction of the response time and a more efficient evacuation.

Table 3-13.1 of the SFPE Handbook [Proulx, 2002] provides suggested response times for various occupancies based on the type of warning system within the occupancies. These suggested times for retail occupancies range between less than 2 minutes (with live directives from staff) to more than 6 minutes (with fire alarm signal with no staff training). The basis of these estimates is not made clear, i.e. a link to recent experimental data or other justification is not clearly provided.

The above notwithstanding, research carried out in Sweden and the UK [Sandberg, 1997] indicates that pre-movement times less than 60 seconds may be appropriate based on real, unannounced, evacuation drills.

FCRC Project 6 [FCRRP, 1998c] suggests a pre-movement time of 60 seconds from the first sight of dense smoke may be appropriate in shopping centres in a serious fire scenario, and in less serious fire scenarios the pre-movement time may be extended, however there will be more time to evacuate.

Many occupants, especially those in the vicinity or direct line of sight from the fire are expected to respond to a fire cue much quicker and are likely to start movement soon after the cue is received. However, to provide an additional level of conservatism during evacuation scenarios it is assumed that all occupants would start moving at the same time.

A pre-movement time of 120 seconds is therefore considered suitably conservative and is adopted in the analysis.

10.2.3 Occupant Egress Time (t_e)

Occupant egress time is the time taken for the occupants to walk to the exits, queue at the exits and eventually travel to a place of ultimate safety such as an open road.

Egress calculations in the comparative analysis that has a relatively simple architectural layout are based on the hand calculation methods presented in the SFPE Handbook (refer to Equation 2) [Gwynne, 2016a].

$$t = \frac{P}{F_s W_e}$$

Where:

- t the queuing time, sec.
- P the population in persons.
- F_s specific flow, persons/s/m.
- W_e effective width, m.

Equation 2: Queuing time at exit

The assumed travel speed is 0.8 m/s and a specific flow rate of 1.0 persons/s/m of effective width [DFES, 2021].

The effective width of an exits is determined by subtracting the boundary layer width of 304 mm from the width of the exit [Gwynne, 2016b]. For example, the effective width of a single 1.0 m door is 0.696 m.

Evacuation modelling of large occupant numbers from the GSC is carried out using computer model Pathfinder [TE, 2024]. The results are conservative because the modelling process assumes that the first person starts to move towards an exit after the cue and response times have elapsed, whereas in fact some people may commence moving towards the nearest available exit earlier due to direct visual contact with the fire and smoke.

It is hard to predict the exact occupant mix for a shopping centre; however, if it is based on a general population mix, it is considered to be an appropriate assumption. Based on the 2011 Australian Census 67.6% of Australian population are aged between 15 and 64 years old. Children under 15 comprise 18.9% and people over 65 years old – 13.5%. The outcomes of the Census indicate that 18.5% of the population have a disability.

To determine the movement speed of the building population it was assumed that people with a disability or otherwise physically impaired, people over 65 years old and children under 15 years old would be moving at 0.8 m/s. The rest of the population would be moving at 0.93 m/s [DFES, 2021a]. Assuming that 18.5% of the 15 to 64 years old age group is disabled (12.5% of the total population), the percentage of the total occupants moving at 0.93 m/s is approximately 55%.

The Pathfinder input parameters were adjusted accordingly to reflect that 55% of the population have a movement speed of 0.93 m/s and 45% of the population have a movement speed of 0.8 m/s.

It is assumed that contractors who may be present in the plantrooms are all able-bodied people and would have a movement speed of 0.93 m/s.

10.2.4 Safety Factors

The International Fire Engineering Guidelines state that ASET should be greater than RSET x λ_{esc}, where λ_{esc} is a factor of safety incorporated to ensure conservatism in the analysis of the reasonable worst credible fire scenario. There should be a margin incorporated in this to account for uncertainty and the potential consequence of any deficiencies in the analysis. The safety factor λ_{esc} is usually taken to be between 1 and 2.

The main uncertainties with the RSET are associated with the cue, pre-movement and egress times. Given that considerable conservatism is built into the quantification of these variables as detailed above, it is not considered appropriate to add significantly to this conservatism by requiring a high safety margin.

A margin of 50% (i.e., 1.5) greater than that calculated for cue, pre-movement and egress times is considered appropriate for the base case design fire scenarios.

Hence the criterion for acceptability of an outcome from a time-line analysis for the credible worst case design fire scenarios is:

ASET $\geq$1.5 x RSET

Redundancy and sensitivity fire scenarios normally attract a safety factor of 1, as these scenarios are less likely to happen and generally are assessed only to establish the robustness of the fire safety strategy.

ASET $\geq$1.0 x RSET

The IFEG also state that "*in a comparative evaluation, it should not be necessary to include explicit factors of safety because the same methods and assumptions for the analysis would be used for both the deemed-to-satisfy or prescriptive design and the proposed design*". The comparative analysis therefore does not include a safety factor.

10.3 Available Safe Egress Time (ASET) Modelling & FDS Input Parameters

The ASET is determined through smoke development and movement modelling of the design and redundancy fire scenarios using computational fluid dynamics computer model FDS-6.8.0.

10.3.1 Mesh Size

In FDS the approximate form of the conservation equation for mass, momentum, and energy is solved on a numerical grid. The size of the grid cells will determine how accurate the output results are. A coarse grid can provide reasonable predictions of certain quantities, especially those that can be traced directly to conservation equations of mass and energy, like temperature and visibility. However, with coarser grids the results are generally less reliable than those obtained with finer grids, and certain results cannot be obtained at all.

With any grid resolution study, a point of diminishing returns is reached when the improvement in the quality of the results is outweighed by the "cost" of the computation. When this point is reached depends on the application. It also depends on the quantities that are of interest. Some quantities, like hot smoke layer temperature or height, do not typically require as fine a numerical grid as quantities such as the heat flux to targets near the fire [McGrattan, 2023].

The “FDS User Guide” indicates that there is an alternative method of determining the appropriate grid cell size. It suggests that for simulations involving buoyant plumes, the cell size (δx) can be correlated to the characteristic fire diameter (D^*) [McGrattan, 2007]. A validation study sponsored by the US Nuclear Regulatory Committee [Stroup, 2013] indicates that the $D^*/\ \delta x$ values in the range between 4 and 16 achieve good agreement with the experimental data for various fire scenarios.

The characteristic fire diameter can be determined using the following equation [McGrattan, 2007]:

$$D^* = \left(\frac{Q}{\rho_\infty c_p T_\infty \sqrt{g}} \right)^{\frac{2}{5}}$$

Equation 3: Characteristic fire diameter

Where:

D^* - characteristic fire diameter;

Q - total heat release rate of the fire (kW);

ρ_∞ - air density at ambient temperature ρ_∞ = 1.204kg/m³;

c_p - specific heat at ambient temperature c_p = 1.005kJ/kg.K;

T_∞ - ambient temperature T_∞ = 23°C (296K);

g - the acceleration due to gravity g = 9.81m/s²

10.3.2 Fire Reaction Parameters

In computational fluid dynamics (CFD) modelling where the smoke layer is generally not stratified, as opposed to zone modelling, it is also paramount to establish parameters (input data) that would correctly reflect the amount of toxic volatiles of smoke produced during the combustion process, as these will determine the tenability of the environment through which occupants may have to evacuate.

The contents of the retail mall present a mix of plastics, cellulosic materials and hydrocarbons. The fuel composition is therefore based on the following parameters: CO_2 – 1.9 g/g; CO yield – 0.04 g/g; soot yield – 0.07 g/g; heat of combustion – 20 MJ/kg; and radiative fraction – 0.35 [MBIE, 2020].

It should be noted that the above values are more conservative than the values suggested in the Society of Fire Safety “Practice Note for Design Fires” [SFS, 2012].

10.3.3 Heat Release Rate per Unit Area

The heat release rate per unit area (HRRPUA) in sprinklered shopping centres can vary between 270 kW/m² and 1,200 kW/m² [Hopkin, 2019]. "Verification Method: Framework for Fire Safety Design" [MBIE, 2020] suggests HRRPUA values that range between 500 kW/m² and 1,000 kW/m² for "*all buildings including storage with a stack height of less than 3.0 m*".

It is conservatively assumed that the HRRPUA is 750 kW/m², as a lower HRRPUA is expected to result in a cooler fire and less buoyant smoke.

10.4 Occupant Evacuation Limiting Criteria

To establish the point in time at which the ASET is reached the following limiting criteria have been adopted to evaluate the performance-based egress.

10.4.1 Visibility and Temperature Limits

It is widely accepted that occupants can evacuate safely if the visibility through the smoke stays at above 10 m in large spaces, and above 5 m in smaller spaces, and the smoke temperature does not exceed 60°C. Familiarity with the environment plays an important role as well [Purser, 2002].

The above notwithstanding, in experiments conducted by Jin it was determined that people would still walk through non-irritant smoke if the visibility was reduced down to 2.3 m [Purser, 2002]. However, in other experiments [Proulx, 2002] it was established that people would generally turn back if the visibility was around 3 m.

Therefore, the adoption of a visibility limit of 10 m and a temperature limit of 60°C is considered appropriate.

10.4.2 Availability of Exits

The hot smoke layer height and its temperature are typically used as limiting criteria to determine the ASET for occupant evacuation in simulations using zone fire models. Typically, when the hot smoke layer descends below a defined height (e.g. 2.1 m), tenability is deemed to be lost across the entire compartment.

This concept however is too simplistic an approach when using field (CFD) fire models. CFD models can consist of hundreds of thousands of cells to simulate geometrical and spatial characteristics of a fire environment that could not be simulated in a zone fire model and the output data is correspondingly complex and detailed, and as such, more refined limiting criteria are considered appropriate.

For the purposes of this assessment the visibility and temperature limits are applied at a height of 2.1 m, however, some loss of tenability at this height may not be considered to result in ASET being reached.

For example, when using CFD models smoke may descend below the 2.1 m benchmark in different parts of the model environment without impeding safe evacuation of the occupants, i.e. one of the alternative exits can become obscured or even blocked by smoke; however, other exits are not compromised and are available (this concept is in line with the BCA DtS provisions – if one exit is blocked, an alternative exit must be available). Therefore, strictly using the 2.1 m benchmark across the entire domain may be inappropriate and the analysis may consider the specific building configuration where multiple exits are available and transient areas of low visibility that may not pose a significant risk to occupants.

10.4.3 Summary

For the purpose of this assessment, it is assumed that it is acceptable for smoke during a fire simulation to descend below the 2.1 m benchmark above the finished floor level. However, smoke below this benchmark must satisfy the following limiting criteria:

- Visibility along required exit travel paths does not reduce to less than 10 m and the temperature does not exceed the 60°C benchmark at 2.1 m above the finished floor level [Purser, 2002]; or
- If travel paths to alternative exits are available from a point of choice, some localised loss of tenable conditions may be acceptable, only if alternative travel paths to an exit are available.

10.4.4 Fire Brigade Intervention Limiting Criteria

The limiting criteria for DFES internal intervention are outlined in Table 19 below. The values indicated in Table 19 are described in the Australasian Fire Authorities Councils Fire Brigade Intervention Model (FBIM) as the limiting conditions for fire-fighters in full turnout gear.

Tenability Criteria	**Limiting Value for Fire-fighters (relative to 1.5 m above floor level)**	
	Air Temperature (°C)	**Radiation (kW/m²)**
Routine Conditions (25 minutes maximum exposure)	100	1
Hazardous Conditions (10 minutes maximum exposure)	120	3
Extreme Conditions (1 minutes maximum exposure)	160	4.0 – 4.5

Table 19: Maximum critical radiant heat flux allowed for fire brigades personnel in their protective clothing

DFES recommends a maximum radiant heat flux for all calculations to be no greater than 2.5 kW/m² [DFES, 2021b], as snatch rescue situations cannot be predicted and should not be modelled. For conservatism, routine conditions, based on a maximum temperature of 100°C at a height of 1.5 m above floor level, are considered the limiting criteria for fire fighters.

10.5 Design Fires

There is a large amount of data concerning the burning rates of items and materials; however, rarely is this information sufficiently generic to be universally adopted and applied to specific buildings. Also, what can be representative of current fuel loading for an enclosure may not be the case in the future. 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.

Much experimental work has been carried out on the burning rates. These have been closely examined and translated into a simplified mathematical expression relating heat release to time after commencement of the flaming stage of the fire growth [Buchanan, 2001]. The unpredictable incubation phase (incipient stage) of fire development is not included. The basis of the mathematical simplification arises from the fact that the fire growth during the flaming stage can be approximated by a smooth curve that can be expressed mathematically.

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. As noted, the times of fire incubation are not included in the t-squared growth fire models.

Figure 45 illustrates the five typical fire growth rates. The design fire curve represents the initial stage of the fire. There is no or very little reliable data for fires where the rate of heat released exceeds 10 MW. This fire size represents the approximate limit for current test facilities.

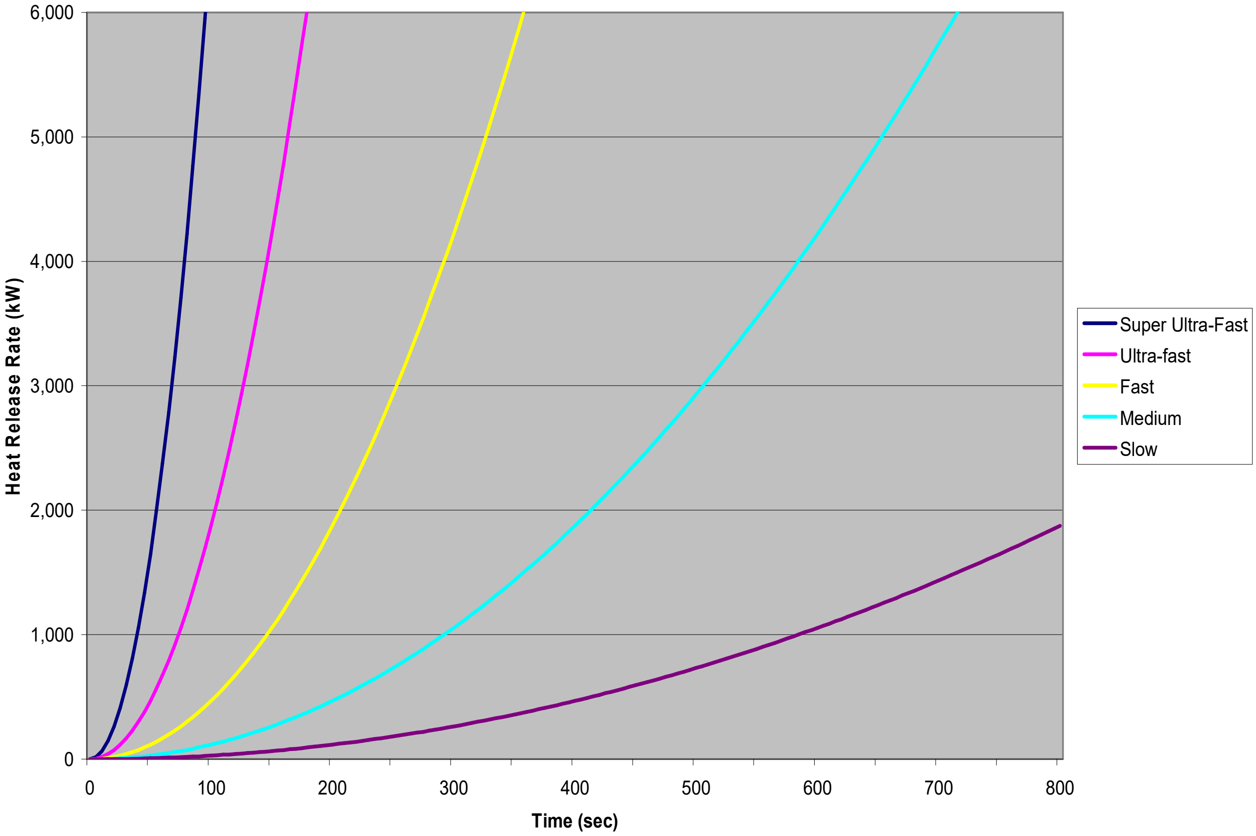

Figure 45: t-squared growth rate fires based on test data

Considering that it is impossible to predict with complete accuracy what fire will occur, it is reasonable to use a t-squared growth rate.

10.5.1 Fire Growth Rates

The heat release rate (HRR) of a t-squared (t^2) growth rate fire at any given time can be determined using the following equation [Buchanan, 2001]:

$$Q = \alpha \times t^2$$

Equation 4: Heat release rate of a t-squared fire

where:

Q - the heat release rate of the fire, kW.

α - fire intensity coefficient, kW/s^2.

t - time, s.

The heat release rate vs. time relationship for a range of t^2 growth rate fires is illustrated in Table 20 below [Buchanan, 2001]:

Time (s)	Heat Release Rate (kW)				
	Slow (K-600)	Medium (K-300)	Fast (K-150)	Ultra-fast (K-75)	Super Ultra-fast (K-40)
α	0.0029	0.0117	0.0469	0.1876	0.6594
0	0	0	0	0	0
25	2	7	29	117	412
50	7	29	117	469	1,649
100	29	117	469	1,876	6,594
150	66	264	1,055	4,221	14,837
200	117	469	1,876	7,504	26,376
250	183	733	2,931	11,725	41,213
300	264	1,055	4,221	16,884	59,346
350	359	1,436	5,745	22,981	80,777
400	469	1,875	7,504	30,016	105,504
450	593	2,373	9,497	37,989	133,529
500	733	2,931	11,725	46,900	164,850
550	886	3,545	14,187	56,749	199,469
600	1,055	4,221	16,884	67,536	237,384

Table 20: Time vs. Heat Release Rate for a range of t^2 growth rate fires

Retail occupancies in general are comprised of a variety of stores that contain mixed types of commodities and have different types of storage configurations. Some areas could have a specific line of products, but most have a mix of cellulosic, plastic, and non-combustible materials. Combustibles displayed and/or stored in vertical configurations are expected to create the worst fire growth rates.

A lot of research has gone into determining the appropriate fire growths rates for different occupancies. While some researchers indicate that for retail occupancies ‘ultra-fast’ t-squared growth rate fires would be appropriate for design fire scenarios [Karlsson, 1999], the majority of publications [SFS, 2012; MBIE, 2020] indicate that the most appropriate t-squared growth rate fire for retail areas is ‘fast’. The sensitivity fires however are assessed using an ‘ultra-fast’ t-squared growth rate.

10.5.2 Fire Size

The design fire curve represents the initial stage of the fire. For a nominated fire scenario, the design fire is modified to take into account either the action of the fire suppression measures, or the reduction of the available fuel load, or lack of ventilation. These design fires are used in computer models to determine the smoke spread throughout or between the enclosures.

Occupant intervention and its impact on the fire size is usually ignored, as it cannot be relied upon (except for industrial fire brigades) and generally cannot be quantified.

The maximum fire size in a building that is not fitted with an automatic fire sprinkler system is either ventilation or fuel controlled and can be determined using appropriate equations.

It is also possible to establish the maximum fire size in a building that is provided with an automatic fire sprinkler system. Sprinkler activation could result in three possible outcomes (refer to Figure 46 below) [ABCB, 2005b; Staffansson, 2010]:

(A) Sprinkler activation does not have any effect on the fire growth rate – red line in Figure 46. This outcome is highly unlikely; however, under certain conditions (the sprinkler system is not designed for the fire load present; inadequate water supply; abnormal fire growth rate; etc.) it is possible; or

(B) Sprinkler activation controls the fire growth rate – blue line in Figure 46. Generally, this is a conservative assumption; or

(C) Sprinkler activation results in the fire being extinguished – green line in Figure 46. Upon activation, appropriately designed; installed and maintained fire sprinkler systems are highly likely to reduce the heat release rate of a fire and potentially extinguish it; however, this approach is not considered sufficiently conservative for most applications.

There are different ways of determining the HRR versus time curve during a sprinkler-controlled fire scenario.

Based on research carried out in Sweden, Nystedt [2011] suggests that for heat release rates below 5 MW at the time of sprinkler system activation (Q_{act}), the HRR could remain constant for 60 seconds and then be reduced to 1/3 of the Q_{act}, after which time the HRR should remain constant for the duration of evaluation. For Q_{act} of greater than 5 MW, Nystedt suggests that upon sprinkler activation the HRR shall remain constant for the rest of the evaluation and be equal to $Q_{act.}$

This approach suggests that Q_{act} can be equal to Q_{ctrl}. However, fire tests replicating an office environment that were carried out in China [Chow, 2005], indicate that an increase of HRR after sprinkler system activation could be as high as 50% (refer to Figure 47 below), however, the fire size then quickly reduces compared to a similar fire with no sprinkler activation.

To make sure that a conservative assessment is provided, the following approach has been adopted to determine the HRR versus time curve for the design and sensitivity fire scenarios:

i. Fire grows with a given t-squared growth rate (e.g. ‘medium’, ‘fast’, or ‘ultra-fast’) until activation of a sprinkler on the first row of sprinkler heads. The axis of the fire plume is assumed to be located in the middle of a rectangular array of four (4) sprinkler heads as illustrated in Figure 49.

ii. Upon activation of the first sprinkler, the growth rate of the fire is reduced to the next lower growth rate, e.g. ‘fast’ is reduced to ‘medium’ growth rate.

iii. Thereafter, the fire keeps growing at the reduced t-squared growth rate until at least five (5) sprinklers are activated, i.e. at least one (1) sprinkler has activated on the second row of sprinkler heads.

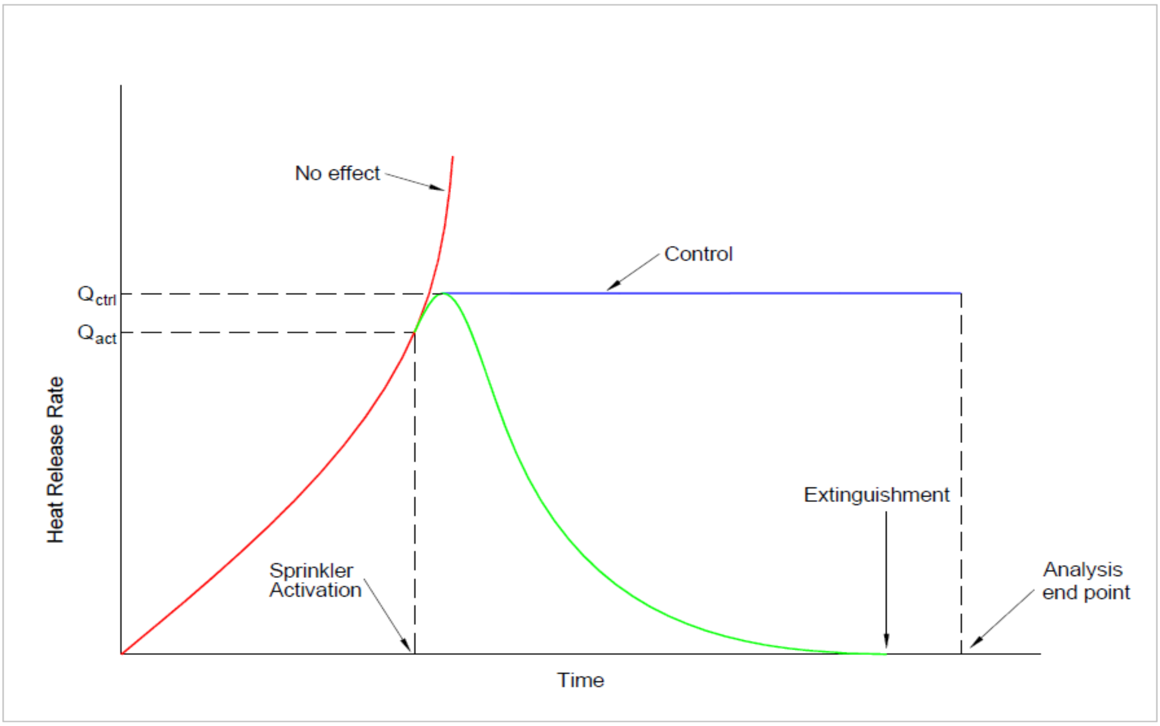

Figure 46: Possible effects of sprinkler system activation on the fire heat release rate

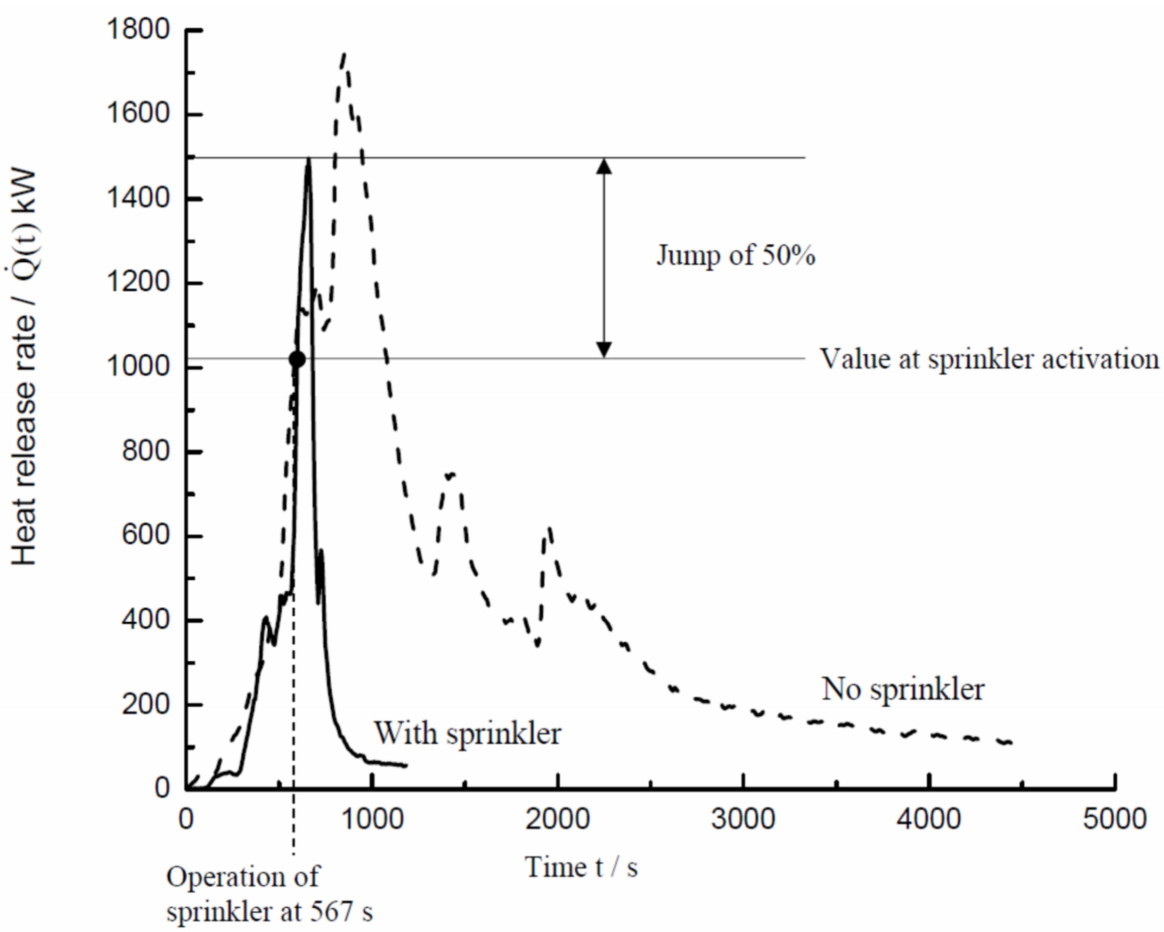

Figure 47: Heat release rate observed in experiment carried out at Chinese Assembly Calorimeter

The above approach results in a schematic fire design curve illustrated in Figure 48 below.

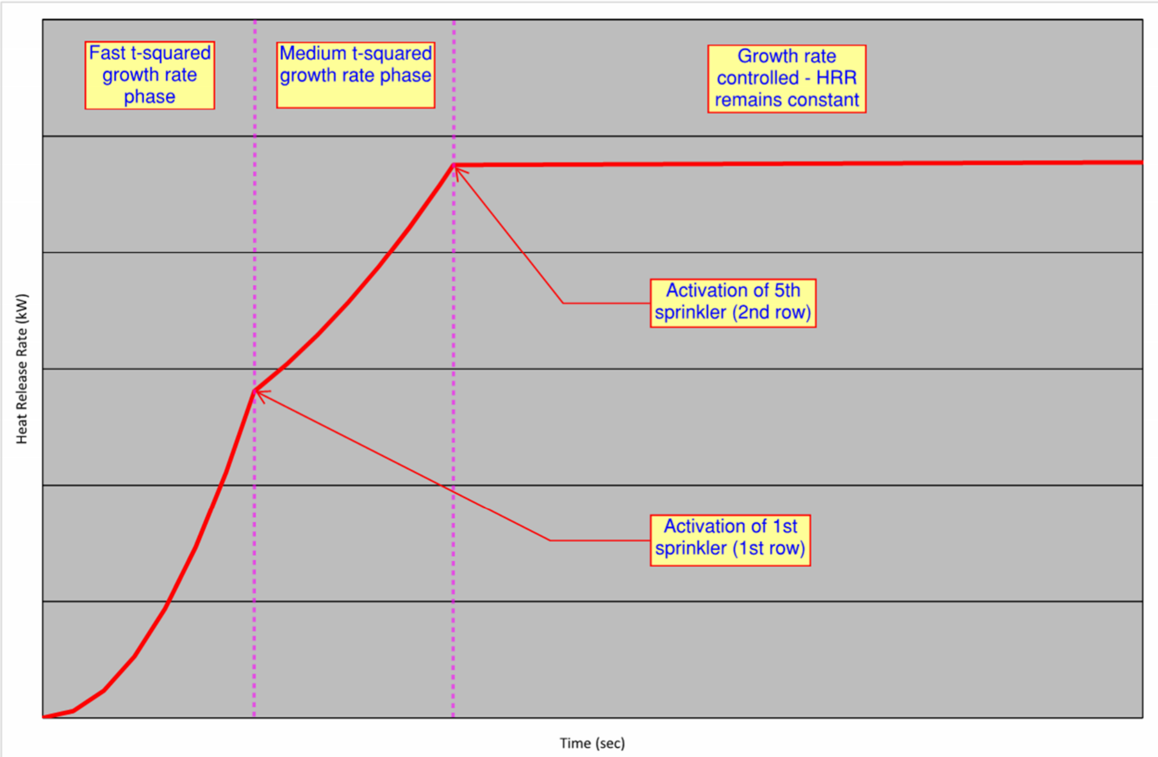

Figure 48: Schematic fire design curve for design fire scenarios

Module Sprinkler from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013a] is used to calculate sprinkler activation times.

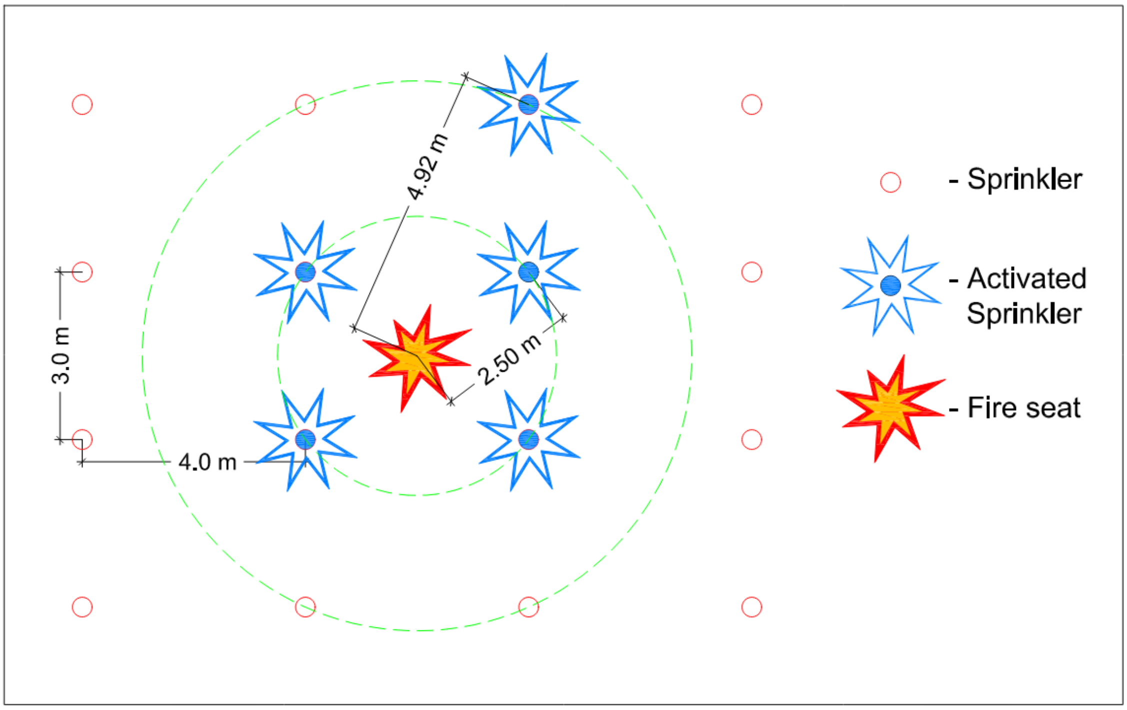

Figure 49: Distance from the axis of a fire plume to the first and fifth sprinklers installed on a nominal 3 m x 4 m grid in accordance with AS 2118.1-2017

11. Performance Solution No. 1 – Performance-based FRL of Loadbearing Structure

11.1 Relevant BCA DtS Provisions

BCA Clause C2D2(1) states that the fire-resisting construction of a building must be that specified in Table C2D2, i.e. a 3-storey building containing Class 6 and Class 9b parts, where Class 6 is the top floor, shall be of Type B construction.

BCA Clause C2D2(2) states that each building element must comply with Specification 5 as applicable.

Table S5C21e of BCA Specification 5 states that loadbearing fire-resisting lift and stair shafts in a Class 6 and Class 9b building of Type B construction where different classifications are not fire separated shall achieve FRL180/120/120.

Table S5C21g of BCA Specification 5 states that loadbearing internal walls and columns in a Class 6 and Class 9b building of Type B construction where different classifications are not fire separated shall achieve FRL180/--/--.

11.2 Performance Solution

The GSC is an existing 3-storey mixed use development that contains Class 6 (retail) and Class 9b (cinema) parts that are not fire-separated (Class 6 is the top floor); therefore, the prescribed construction type is Type B.

The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120, which does not comply with the DtS provisions of Table S5C21e of BCA Specification 5.

The loadbearing columns that support the First Floor slab in areas highlighted red in Figure 50 achieve FRL 120/--/-- in lieu of FRL 180/--/--, which does not comply with the DtS provisions of Table S5C21g of BCA Specification 5.

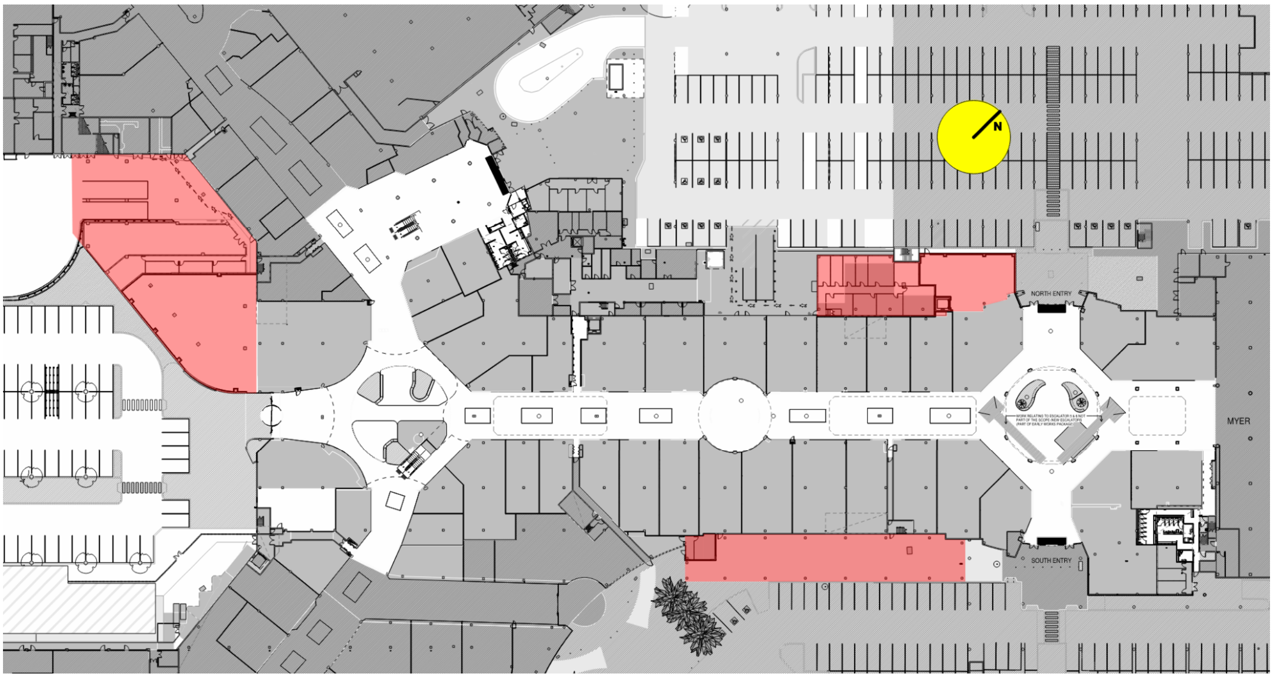

Figure 50: Ground Floor areas where loadbearing structure has performance-based reduced FRL

11.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as C1P1.

11.4 Assessment Method

The assessment methods adopted are BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*" and BCA Assessment Method A2G2(2)(d), i.e. "*comparison with the Deemed-to-Satisfy Provisions*".

11.5 Intent of the BCA

The intent of Performance Requirement C1P1 (formerly CP1), in accordance with the Guide to the BCA, which provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020-2], is to ensure that the building has a structure that, "*to the degree necessary*", should withstand the impact of a fire and should not have localised or catastrophic collapse as a result of it.

The Guide to the BCA states that the use of words "*to the degree necessary*" means that the "*BCA recognises that different building elements require differing degrees of structural stability during a fire. The expression is intended to allow the appropriate authority to determine the degree of compliance necessary in each particular case*".

The above notwithstanding, the Guide states that "*while assessment of a building proposal must have regard to the differing needs of each building element, the proposal must make sure that the elements have an appropriate structural stability during a fire so that*:

- "*the fire does not endanger the occupants by entering escape routes*; and
- "*the fire does not endanger fire fighters while they are undertaking search and rescue operations*".

It is evident that the reduced FRL of the loadbearing structure may contribute to premature structural failure, which may compromise safe occupant evacuation and fire brigade intervention.

11.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based reduced FRL of the loadbearing structure (columns and the lift shaft) would not increase the risk of structural collapse.

If it can be demonstrated that an uncontrolled fire during a sprinkler failure scenario in areas provided with ample ventilation (tenancies, plant room AP.ENT, loading dock 04 and external area along the south-east façade – areas highlighted green in Figure 51 below) and without relying on fire brigade intervention burns out before the nominal FRL of the loadbearing structure is reached, it is considered that compliance with Performance Requirement C1P1 is achieved.

The level of fire safety inherent in a BCA DtS compliant design represents an acceptable community standard for new building works in Australia.

Figure 51: Areas subject of performance-based FRL assessment

If it can be demonstrated that the fire safety performance of the performance-based design in areas with restricted ventilation (store rooms – areas highlighted orange in Figure 51) is better or at least equal to that afforded by a BCA DtS compliant design, it is considered that compliance with Performance Requirement C1P1 is achieved on a comparative basis.

The methodology adopted for the assessment of areas provided with ample ventilation is an absolute quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify fire scenarios that potentially could cause collapse of the loadbearing structure.
2. Identify fire loads and ventilation conditions for areas where a fire could cause collapse of the performance-based loadbearing structure.
3. Undertake burn-out calculations using the Eurocode formula [EC1, 2002] to establish the equivalent fire severity during a total burnout.
4. Determine whether burnout of the critical areas is expected to occur before the nominal FRL is reached, without relying on fire brigade intervention.

The methodology adopted for the assessment of areas with restricted ventilation is an absolute qualitative comparative analysis in accordance with the following:

1. Identify fire scenarios that potentially could cause collapse of the loadbearing structure.
2. In consultation with the building surveyor develop and document a hypothetical reference BCA DtS compliant base case design and document the performance-based design. These designs are detailed in Table 21 below.

3. Compare the fire safety performance of the performance-based design with that of the BCA DtS compliant design. The Australian Fire Engineering Guidelines indicate that to assist in analysing a fire safety system, it is convenient to consider the system as comprising six 'sub-systems': "Fire Initiation and Development and Control"; "Smoke Development and Spread and Control"; "Fire Spread and Impact and Control"; "Fire Detection, Warning and Suppression"; "Occupant Evacuation and Control"; and "Fire Services Intervention". The comparative performance analysis of the BCA DtS compliant design and the performance-based building design will be carried out for each of the 'sub-systems' recommended by the AFEG.

4. If it can be demonstrated that the fire safety performance of the performance-based design is better or equal to that afforded by a BCA DtS compliant design, then compliance with the relevant Performance Requirements of the BCA is achieved on a comparative basis.

11.7 Comparative Characteristics

The comparative characteristics of the BCA DtS compliant design and the performance-based design are summarised in the table below:

Parameter	BCA DtS compliant design	Performance-based design
Building classification	Class 6 (retail)	Class 6 (retail) and Class 9b (cinemas)
Rise-in-storeys	2	
Type of Construction	Type C	Type B
Occupancy	BoH storage	
Building classification supported by columns	Class 6	
Affected area	300 m²	Area 1 – 247 m² Area 2 – 100 m²
Floor-to-soffit height	4.5 m	
FRL of the loadbearing structure	--/--/--	120/--/--
Fire hose coverage	Fire hose coverage to the fire affected areas is provided with 2 lengths of hose from external attack fire hydrants	
Fire suppression system	Automatic fire sprinkler system to AS 2118.1, provided with standard response sprinklers	Automatic fire sprinkler system to AS 2118.1, provided with fast response sprinkler heads
Fire detection and alarm system	Nil	Fire detection and alarm system to Clause S20C4 of BCA Specification 20 and AS 1670.1
Building Occupant Warning System	BOWS in accordance with Clause S20C7 of BCA Specification 20 and AS 1670.1	EWIS in accordance with Clause E4D9(d) of BCA and AS 1670.4

Table 21: Comparative characteristics for the BCA DtS compliant design and performance-based design

11.8 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Design fire scenario (sprinkler system performs as designed): the loadbearing structure with performance-based reduced FRL shall not fail.*

2. *Redundancy fire scenario (sprinklers fail to operate as designed):*

   a. *For areas provided with ample ventilation: a potential fire in the areas where loadbearing structure with performance-based reduced FRL is present shall burn out in not more than 120 minutes.*

   b. *For areas with restricted ventilation: the fire safety performance of the performance-based design must be better or at least equal to that afforded by a BCA DtS compliant design.*

11.9 Fire Scenarios Selection

An important factor of a fire safety engineering assessment is identifying appropriate fire scenarios. These scenarios are identified by considering fire hazards present and their potential consequences. The process of fire scenario selection is based around identifying those fire scenarios which might be considered “worst-credible” that is having the following aspects:

1. The most likely; and

2. Having the worst impact or consequence; and/or

3. Highlighting the performance of the identified areas of non-compliance during a fire emergency.

The following fire scenarios were considered in the assessment:

1. Design fire scenario – occupants extinguish a potential fire in the incipient stages of its development.

2. Design fire scenario – sprinklers suppress, or control fire spread.

3. Redundancy fire scenario – sprinklers fail to operate as designed; staff are not available to extinguish the fire or cannot control the fire; the fire spreads uncontrolled and reaches flashover.

The above scenarios are discussed in the following sections.

11.9.1 Fire Extinguished by Occupants

Staff are present in the GSC during trading hours and security are present 24/7. These occupants may have basic firefighting training. It is therefore reasonable to assume that a routine fire may be extinguished by staff and/or security before the sprinkler system activates.

A fire extinguished by occupants does not pose any threat to the loadbearing structure with performance-based reduced FRL, which satisfies the nominated acceptance criterion; hence further discussion of this fire scenario is not required.

11.9.2 Fire Extinguished or Controlled as a Result of Sprinkler Activation

The GSC is protected with a sprinkler system that is expected to control or extinguish a potential fire that was not controlled by the occupants. The potential for successful sprinkler operation and the fire being either extinguished or controlled is considered to be high (refer to the sprinkler performance discussion in Section 11.9.4 below).

The impact on the loadbearing structure is expected to be negligible when the installed fire sprinkler system extinguishes the fire. During such scenario the fire would grow until sprinklers activate, and thereafter the fire would cease to grow in intensity, i.e. the fire would have a constant heat release rate until extinguished by the attending fire brigade, or all fuel load is consumed. The temperature of the ceiling jet prior to sprinkler operation could reach approximately 250°C. Upon sprinkler activation, even if the fire is not extinguished, the temperatures within the area of operation generally should be below 200°C, except in the immediate vicinity of the flames. Outside the area of operation, the temperature should be below 100°C [BCC, 2000a].

When sprinklers operate, the exposed structure is expected to be cooled by the water spray. Tests conducted as part of the Fire Code Reform Research Program indicated that even lightweight members were not significantly affected by exposure to a sprinkler-controlled fire [FCRRP, 1998b]. Therefore, the impact on the loadbearing structure during a sprinkler-controlled fire is expected to be negligible due to the comparatively low temperatures, which satisfies the nominated acceptance criterion, and further discussion of this fire scenario is not warranted.

11.9.3 Sprinkler Performance

A scenario in which occupants fail to extinguish the fire and fire sprinklers fail to operate as designed is not likely, however possible. In this scenario the fire could grow to reach flashover, depending on the fire load in the affected area and the ventilation conditions.

Flashover is expected to occur when the hot layer temperature reaches between 500°C and 600°C [Thomas, 1981]. In the event of total sprinkler failure, this could occur before fire brigade arrival, especially in relatively small spaces.

It is useful to demonstrate that the probability of a total sprinkler failure is extremely low, before examining an uncontrolled fire scenario in detail.

11.9.4 Sprinkler Performance

An assessment of sprinkler performance in Australia between 1886 and 1986 showed that sprinkler operation was unsatisfactory in 0.54% of the 9,022 fires reported [Marryatt, 1988].

A similar assessment of sprinkler performance in the USA between 1897 and 1969, carried out by Richardson, showed that sprinkler performance was unsatisfactory in 3.85% of the 81,425 fires reported [Richardson, 1983].

Richardson also lists the causes of unsatisfactory sprinkler performance; with the percentages prepared by Rohr [2003], where the 100% total reflects the 3.85% of unsatisfactory cases (refer to Table 22 below):

Problem	Percentage of Cases
Water shut off	35.4*
System not adequate for level of hazard	13.5
Inadequate water supplies	9.9
Inadequate maintenance	8.4
Obstruction to water distribution	8.2
System designed for partial protection only	8.1
Faulty building construction	6.0
Antiquated system	2.1
Slow Operation	1.8
Defective dry-pipe valve	1.7
Exposure fire	1.7
System frozen	1.4
Other unknown	1.9
Total	**100.0**

Table 22: Summary of sprinkler systems failure analysis

Note *: Anecdotal evidence suggests that this value is very high and skewed due to the number of fires in empty/derelict buildings in which the sprinklers have been turned off.

In addition to the above statistics, a recent analysis of data for fires in premises in the UK in which sprinkler systems were fitted over the period of 2011 to 2016 [NFSN/NFCC, 2017] suggests that sprinklers worked as intended in 94% of cases and controlled or extinguished fire in 99% of cases when activated.

A reliable performance of a sprinkler system is dependent on adequate design, sound maintenance and good management of the system.

The GSC is protected throughout with an automatic fire sprinkler system that shall be installed in accordance with AS 2118.1 and shall be appropriate for the hazard protected. The system shall be soundly maintained in accordance with AS 1851-2012 and appropriately managed, which eliminates the majority of the causes for unsatisfactory sprinkler performance listed above.

In view of the above statistics sprinkler failure is not a likely event; however, full sprinkler failure fire scenarios were considered to adequately address the resilience of the performance-based design.

11.10 Equivalent Fire Severity (Burnout) Assessment Basis

The fire resistance level of a building element, as detailed in AS 1530.4, is derived by exposing the element to a “standard fire curve” and determining when the element has failed based on a number of failure criteria. The standard fire curve however is at best an approximation of the conditions that may be expected during a real fire.

A number of methodologies have been developed to determine the fire severity in a post-flashover fire, i.e. empirical relationships (also known as time-equivalence formulae) that attempt to relate the performance of a building element exposed to a compartment fire to the performance when exposed to the standard fire curve.

The Law formula [BCC, 2000b] does not consider the impact of the room lining materials on the severity of the fire and the CIB W14 formula [Thomas, 1986] does not account for horizontal ventilation openings. Both these formulae are considered outdated and were not used in this assessment.

The method adopted for this analysis is the Eurocode formula that allows to carry out calculations for spaces with both vertical (doors and windows) and horizontal (ceiling or roof vents) openings [EC1, 2002]. Although the Eurocode formula is based on the thermal performance of insulated steel members, it is widely used for structural performance of concrete and many other materials. The formula contains a number of assumptions and approximations but is generally accepted as capable of providing a first-order estimate of the required performance.

The equivalent fire severity, determined using the Eurocode formula (refer to Equation 5), depends on the fuel load density in the room of fire origin and the ventilation conditions.

$$t_e = k_b * w_f * \mathrm{e}$$

Equation 5: Eurocode formula

where:

t_e – equivalent fire severity (min).

k_b – conversion factor for wall thermal properties – 0.09 min*m²/MJ (plasterboard walls and ceiling).

w_f – dimensionless ventilation factor.

e – fuel load density (MJ/m²).

The dimensionless ventilation factor is dependent on the number and dimensions of openings, as well as the floor area and the height of the room, and can be expressed using the following equation:

$$\mathrm{w} = \left(\frac{6.0}{\mathrm{H_r}}\right)^{0.3} * \left[0.62 + \frac{90 * (0.4 - \alpha_v)^4}{1 + \mathrm{b_v} * \alpha_h}\right] > 0.5$$

Equation 6: Dimensionless ventilation factor

where:

$\mathrm{H_r}$ – height of the room (m).

α_v – $^{A_v}/_{A_f}$, 0.025 ≤ α_v ≤ 0.25.

α_h – $^{A_h}/_{A_f}$, α_h ≤ 0.20.

$\mathrm{b_v}$ – $12.5 * (1 + 10\alpha_v - \alpha_v{}^2)$.

$\mathrm{A_f}$ – floor area of the fire room (m²).

A_v – area of vertical vents (doors and windows) (m²).

A_h – area of horizontal openings in the ceiling (m²).

It is considered for the purpose of this assessment that during redundancy fire scenarios (sprinklers fail to operate as designed) 75% of the glazing in the retail shopfronts fails. In the retail tenancies, a 95% fractile fire load is used (1,300 MJ/m² based on 'shops' mean value as per Table 3.4.1b of the IFEG [ABCB, 2005c]). The fractile fire loads in plant room AP.ENT and loading dock 04 are 400 MJ/m² [MBIE, 2020].

The above assumptions result in multiple levels of concurrent redundancies: sprinklers fail to operate; the fire load is 95% fractile of the mean value for the retail tenancies; and fire brigade does not commence attack on the fire for 2 hours. It is unlikely that all these conditions would happen concurrently in a real fire emergency; therefore, it is acceptable to assume that during redundancy fire scenarios 75% of the glazing in the retail shopfronts fails.

A room that is not provided with windows and has the door closed is not expected to support combustion for an extended period of time, as oxygen supply to the fire will be limited.

11.11 Assessment

11.11.1 Burnout Calculation

The analysis was carried out for all areas on the Ground Floor located beneath the new First Floor extension, all of which are provided with ample ventilation. These areas include:

- GF Loading Dock 04
- GF New Mechanical Plant Room (located adjacent Loading Dock 04)
- GF Tenancy G-074 (Mecca)
- GF Tenancy G-125 (Sketchers)
- GF Tenancy 1.165 (JD Sports)
- 1F Tenancy 1.165 (JD Sports)

The floor area, height, the size of ventilation openings and the fire load density [MBIE, 2020] for the areas assessed is provided in Table 23 below.

Functional Area	Area, A_f (m²)	Height, H_r, average (m)	Vertical openings area, A_v (m²)	Opening size free area, (m²)*
Loading Dock 04	351.40	4.80	64.32	64.32
Mech Plant Room	202.20	4.80	17.92	4.48
Tenancy G-074	800.00	3.65	127.07	95.30
Tenancy G-125	129	3.65	30.3	22.72
GF Tenancy 1.165	371.10	3.65	91.62	68.71
1F Tenancy 1.165	391.00	3.70	91.87	68.90
Combined Ground Floor and First Floor Tenancy 1.165				
Tenancy GF + 1F 1.165	762.10	7.35	183.49	137.61

Table 23: Characteristics of rooms assessed

Note *: It is assumed that during a potential fire 75% of the glazed openings falls out and non-glazed doors are closed, which is a conservative assumption.

The results of the equivalent fire severity calculations carried out using Eurocode formula are summarised in Table 24. A sample of the calculations is provided in Section 33 (Appendix G).

Tenancy / Area	Fuel load density, e (MJ/m²)	Conversion factor, k_b (min*m²/MJ)	Vertical opening to floor ratio, α_v *	Free open area factor, b_v	*Ventilation factor, w_f*	Equivalent fire severity (min)
Loading Dock 04	1,200	0.065	0.183	34.96	0.88	68
Mech Plant Room	400	0.065	0.022	15.26	2.62	68
Tenancy G-074	1,300	0.09	0.471	68.64	0.72	85
Tenancy G-125	1,300	0..09	0.176	34.13	0.98	115
GF Tenancy 1.165	1,300	0.09	0.185	35.22	0.94	110
1F Tenancy 1.165	1,300	0.09	0.176	34.14	0.98	114
Combined Ground Floor and First Floor Tenancy 1.165						
Tenancy GF + 1F 1.165	1,300	0.09	0.181	34.66	0.96	113

Table 24: Equivalent fire severity

Tenancy 1.165 on the ground floor is connected to Tenancy 1.165 on the first floor via a lift. As a result, a sensitivity analysis was undertaken using the combined floor area of both levels, along with the total ventilation area across the ground and first floors. This was conducted to ensure that the increased combined floor area does not adversely impact fire severity.

It is evident from Table 24 that the equivalent fire severity for the worst case scenario should not exceed 115 minutes; therefore, it is reasonable to conclude that a total burnout of the Ground Floor loading dock 04, mechanical plant room, and tenancies without DFES intervention should not result in structural failure of the loadbearing structure rated to 2 hours (120 minutes).

11.11.2 Comparative Assessment

The comparative characteristics of a BCA Deemed-to-Satisfy (DtS) compliant design and the performance-based design for areas with restricted ventilation (store rooms – areas highlighted orange in Figure 51) are summarised in Section 11.7, Table 21.

The International Fire Engineering Guidelines (IFEG) indicate that to assist in analysing a fire safety system it is convenient to consider the system as comprising six 'sub-systems'. Therefore, the comparative performance analysis of a BCA DtS compliant design and the performance-based building design was carried out for each of the 'sub-systems' recommended by the IFEG.

In Table 25, where applicable, the green colour means that the performance-based design has a superior fire safety performance, the red colour means that the BCA DtS compliant design has a superior fire performance, and the blue colour means that both designs have similar/equivalent fire safety performance.

Performance Criteria	Performance-based Design	BCA DtS Compliant Design
Sub-System A Fire Initiation and Development	This IFEG sub-system is used to *"define design fires in the enclosure of fire origin as well as enclosures to which the fire has subsequently spread."* The ignition sources for both designs are considered similar, i.e. light fittings, GPO's, occupant activities, etc. may result in a fire initiating, and these sources are considered similar between the designs. The combustible materials and goods stored in both designs are assumed to have similar characteristics. The type of a potential fire, as well as heat release rate, toxic species yield and smoke yield in the initial stage of fire development (prior to sprinkler system activation in the performance based building design), are assumed to be similar in both designs.	
	A fire is expected to be controlled by the sprinkler system with fast response heads and should not spread beyond the storage cell of fire origin. The fire should not result in flashover. The heat release rate is expected to be capped off at the time of the first sprinkler activation or soon thereafter and is not expected to exceed 5 MW (the heat release rate at the time of fifth sprinkler activation during a 'fast' t-squared growth rate fire in a fire compartment with 4.8 m high soffit (247 sec) is expected to be approximately 2.5 MW). Depending on the configuration and type of the combustibles involved, the fire may even be extinguished.	A fire is expected to be controlled by the sprinkler system with standard response heads. The delay in sprinkler response may result in fire spreading beyond the storage cell of fire origin before being controlled, however the fire should not result in flashover. The heat release rate is expected to be capped off at the time of the first sprinkler activation or soon thereafter and is not expected to exceed 5 MW (the heat release rate at the time of fifth sprinkler activation during a 'fast' t-squared growth rate fire in a fire compartment with 4.8 m high soffit (309 sec) is expected to be approximately 3.5 MW).
	In the performance-based design, the fire is not expected to spread beyond the storage unit of origin due to the provision of a sprinkler system fitted with fast-response sprinkler heads. Additionally, the heat release rate, compartment temperature, and the production of smoke and toxic species are expected to be less severe, owing to the sprinkler's ability to control the fire in its early stages. In comparison, the BCA Deemed-to-Satisfy (DtS) compliant design is expected to control the fire approximately 62 seconds later than the performance-based design. This delay in sprinkler activation may allow the fire to spread beyond the storage unit of origin. As a result, the heat release rate, compartment temperature, and the yields of smoke and toxic species may be more severe than in the performance-based design. In the context of the fire resistance of the load-bearing elements, the overall fire safety performance of both designs for sub-system A may be considered equal.	

<table>
<tr><th>Performance Criteria</th><th>Performance-based Design</th><th>BCA DtS Compliant Design</th></tr>
<tr><td rowspan="3"><u>Sub-System B</u>
Smoke Spread</td><td colspan="2">This IFEG subsystem is used to “analyse the development of smoke in an enclosure, its spread within the building and the properties of the smoke at locations of interest.”
The combustible materials and goods stored and ventilation conditions in both designs are considered similar, and therefore the smoke and toxic species yields are considered to be similar for both designs in the initial stages of fire development.
Both designs are provided with automatic sprinkler system. The installed fire sprinkler system is expected to control a fire in the initial stage of its development, which is expected to result in reduced smoke and toxic species yields.
Smoke may spread throughout the storage room, but it is not expected to compromise the escape routes outside of the storage room, as the smoke generated by a sprinkler controlled fire is expected to be less toxic and should not cause the onset of untenable conditions.</td></tr>
<tr><td>ll storage cages are constructed from steel mesh; therefore, the smoke reservoir is considered to encompass the entire storage room, which has a smaller floor area than that in the BCA DtS compliant design. The fast-response sprinkler system in the performance-based design is expected to control the fire earlier than the standard-response system used in the BCA DtS design.
As a result, the smoke layer depth is anticipated to be similar to that of the BCA DtS design. Although the smoke reservoir is smaller, the earlier activation of the sprinkler system is expected to offset this difference.</td><td>All storage cages are constructed from steel mesh; therefore, the smoke reservoir is considered to encompass the entire storage room, resulting in a larger reservoir area compared to that in the performance-based design. However, the standard-response sprinkler system is expected to activate later, leading to a delay in fire control compared to the performance-based design.
Despite the larger smoke reservoir, the overall smoke layer depth is expected to be similar to that in the performance-based design, as the delayed sprinkler activation offsets the benefit of the increased reservoir volume.</td></tr>
<tr><td colspan="2">In the performance-based design, activation of the fast-response sprinkler system is expected to result in the production of less toxic smoke. This is anticipated to maintain extended tenable conditions within the escape routes, particularly in more remote areas, even if smoke spreads into those spaces.
In contrast, the BCA Deemed-to-Satisfy (DtS) compliant design incorporates a standard-response sprinkler system, which is expected to activate later. This delay may lead to the generation of more toxic smoke. However, the larger smoke reservoir in the BCA DtS design is expected to result in a similar smoke layer thickness, thereby maintaining a comparable level of tenable conditions within the escape routes and compensating for the increased smoke toxicity.
In the context of the fire resistance of the load-bearing elements, the overall fire safety performance of both designs for sub-system B may be considered equal.</td></tr>
</table>

Performance Criteria	Performance-based Design	BCA DtS Compliant Design
<u>Sub-System C</u> Fire Spread and Impact	This IFEG subsystem is used to "*analyse the spread of fire beyond an enclosure, the impact a fire might have on the structure*". Both designs incorporate tenant storage rooms constructed with concrete/block walls, with each individual storage unit separated by steel mesh cages. Both designs are provided with automatic fire sprinkler system. A fire is expected to be controlled to the storage unit of fire origin. The nominal FRL of the load-bearing structure is 2 hours, except for the load-bearing columns that generally achieve 3 hours FRL. Research indicates that in sprinkler controlled fires the temperature of the hot smoke layer in the vicinity of the fire is unlikely to exceed 200°C, except for inside the fire plume or immediately adjacent to it, and the temperature of the hot smoke layer away from the fire seat should not exceed 100°C [BCC, 2000]. Research also indicates that there should not be significant impact on the compressive and tensile strength of concrete before temperatures reach 300°C [Kodur, 2014], and the Eurocode suggests that the minimal tabulated critical temperature of reinforcement (the temperature of reinforcement at which failure of the member in fire situation is expected to occur at a given steel stress level is 500°C for simply supported beams and slabs, and 350°C for prestressing tendons [EN, 2004]. It is therefore reasonable to conclude that a sprinkler controlled fire should not spread beyond the storage unit of fire origin, and the fire should not have an adverse impact on the reinforced concrete load-bearing structure.	
	Each storage area is protected with fire detection and alarm system with automatic fire sprinkler system with fast response sprinkler heads. A fire is expected to be controlled faster compared to DtS design.	Each storage area is protected with automatic fire sprinkler system with standard response sprinkler heads. A fire is expected to be controlled to the storage unit of fire origin.
	In both DtS design and performance-based design, automatic fire sprinkler system is expected to control a potential fire to the area of fire origin and there should not be an adverse impact of the load-bearing structure. A sprinkler controlled fire may result in an indefinite available safe egress time for the occupants and indefinite internal intervention time for the fire brigade. The performance-based design with fast response sprinkler heads may control the fire sooner compared to the DtS design. In the context of the fire resistance of the load-bearing elements, the overall fire safety performance of both designs for sub-system C may be considered equal.	
<u>Sub-System D</u> Fire Detection, Warning and Suppression	This IFEG subsystem is used to "*analyse detection, warning and suppression for fires. This process enables estimates to be made of times of critical events and the effectiveness of suppression*". Both designs are provided with automatic sprinkler system.	

Performance Criteria	Performance-based Design	BCA DtS Compliant Design
	Fire detection is provided by means of smoke detectors installed in accordance with AS 1670.1 and an automatic fire sprinkler system installed to AS 2118.1 and fitted with fast response sprinkler heads. The detection system is interfaced with the Emergency Warning and Intercommunication System. Fire detection is expected to occur in the early stage of fire development and alarm should be transmitted throughout the building. The fast-response automatic sprinkler system is expected to activate more quickly and transmit an alarm to DFES via the Direct Brigade Alarm (DBA), thereby reducing DFES response and intervention time.	Fire detection is provided by means of an automatic fire sprinkler system installed to AS 2118.1 and fitted with standard response sprinkler heads. The detection system is interfaced with the Building Occupant Warning System. Fire detection is expected to occur when the fire reaches a heat release rate that can activate the sprinkler system and the sprinkler system has depressurised. The detection time may be increased significantly due to extra time that it takes for a sprinkler to activate and the additional depressurisation time, which may be up to 3 minutes long. After the sprinkler system activates, and most likely prior to the alarm being transmitted, the fire is expected to be controlled.
	In the performance-based design fire detection is expected to occur in the early stages of fire development and the automatic fire sprinkler with fast response heads is expected to control a potential fire to the area of fire origin. Provision of the DBA is expected to provide early notification to DFES, which should reduce their intervention time. This is particularly important if the sprinkler system is not successful in controlling a potential fire. In the BCA DtS compliant design the installed automatic fire sprinkler system with standard response sprinkle heads may increase the detection time and delay fire alarm transmission, however it is expected to control a potential fire to the area of fire origin. It is worth noting that an automatic sprinkler system is considered an acceptable detection system in the BCA, hence safe occupant evacuation should not be compromised. Provision of the DBA is expected to provide early notification to DFES. In the context of the fire resistance of the load-bearing elements, the overall fire safety performance of both designs for sub-system D may be considered equal.	
<u>Sub-System E</u> Occupant Evacuation	This IFEG subsystem is used to "*analyse the evacuation of the occupants of a building*". Both designs have BCA DtS complaint egress provisions. The number of occupants and staff is considered to be similar in both designs.	
	Occupant notification is expected to occur when smoke detectors installed throughout the building activate.	Occupant notification is expected to occur only when standard sprinklers activate and the sprinkler system has de-pressurised sufficiently to activate the alarm.

<table>
<tr><th>Performance Criteria</th><th>Performance-based Design</th><th>BCA DtS Compliant Design</th></tr>
<tr><td></td><td colspan="2">Smoke detection is expected to occur earlier in the performance-based design, prompting earlier occupant evacuation. However, in both the DtS and performance-based designs, occupants should be able to evacuate safely, as both smoke detection systems and sprinkler systems are considered acceptable forms of fire detection.

In the context of the fire resistance of the load-bearing elements, the overall fire safety performance of both designs for sub-system E may be considered equal.</td></tr>
<tr><td rowspan="3"><u>Sub-System F</u>
Fire Services Intervention</td><td colspan="2">This IFEG subsystem is used to "analyse the effects of the intervention activities of fire services on a fire".

Both designs are provided with a fire hydrant system fitted with external 'attack' fire hydrants.</td></tr>
<tr><td>The building is provided with a fire detection and alarm system as well as automatic fire sprinkler system with fast response sprinkler heads that is monitored via the DBA.

Fire brigade notification is expected to occur upon sprinkler system activation which will activate faster in comparison to the standard response sprinkler heads. The sprinkler system is expected to control the fire at a earlier stage and limit its spread to the area of fire origin.

It is worth noting that during a sprinkler controlled fire DFES are not expected to need additional resources and their intervention may be limited to a "mop up", which can be carried out with a smaller diameter hose.</td><td>The building is protected with an automatic fire sprinkler system with standard response sprinkler heads that is monitored via the DBA.

Fire brigade notification is expected to occur upon sprinkler system activation. The sprinkler system is expected to control the fire and limit its spread to the area of fire origin.

It is worth noting that during a sprinkler controlled fire DFES are not expected to need additional resources and their intervention may be limited to a "mop up", which can be carried out with a smaller diameter hose.</td></tr>
<tr><td colspan="2">In the performance-based design, the installed automatic fire sprinkler system incorporates fast-response sprinkler heads, which are expected to control a potential fire at its point of origin earlier than a BCA Deemed-to-Satisfy (DtS) compliant design. This early activation facilitates faster automatic notification to DFES, which is expected to reduce their response and intervention time.

In contrast, the BCA DtS compliant design includes a standard-response sprinkler system. As a result, a potential fire may grow and spread further within the compartment of origin before sprinkler activation occurs, leading to a delayed notification and DFES response.

In the context of fire resistance for load-bearing elements, the overall fire safety performance of the performance-based design for Sub-System F is considered superior to that provided by a BCA DtS compliant design. This is attributed to the fast-response sprinkler system, which is expected to limit fire severity and its impact on structural elements, as well as the inclusion of the Direct Brigade Alarm (DBA), which supports earlier DFES intervention.</td></tr>
</table>

Table 25: Comparative fire safety performance of the performance-based and BCA DTS compliant designs

The comparative analysis provided in Table 25 demonstrates that the reduced performance-based FRL of the loadbearing structure does not present an additional fire risk and the overall fire safety performance of the performance-based design should be better than that afforded by a BCA DtS compliant design.

11.12 Conclusion

This assessment demonstrates that the acceptance criteria for the analysis are met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements, as outlined in Section 25.

12. Performance Solution No. 2 – Non-fire-rated Plant Rooms and Cabling to AHUs

12.1 Relevant BCA DtS Provisions

BCA Clause C3D13(1)(c) states that central smoke control plant must be separated from the remainder of the building with construction complying with (4).

BCA Clause C3D13(4)(a)(i) states that separating construction must have an FRL as required by Specification 5, but not less than 120/120/120.

Specification 5 does not prescribe an FRL for non-loadbearing internal walls bounding plant rooms in a building of Type B construction. Therefore, the walls bounding plant rooms that contain central smoke control plant shall achieve FRL 120/120/120.

BCA Clause C3D14(2) states that a main switchboard located within the building which sustains emergency equipment operating in the emergency mode must— (a) be separated from any other part of the building by construction having an FRL of not less than 120/120/120; and (b) have any doorway in that construction protected with a self-closing fire door having an FRL of not less than --/120/120.

BCA Clause C4D15(1) states that the requirements of (2) apply where an electrical, electronic, plumbing, mechanical ventilation, air-conditioning or other service penetrates a building element (other than an external wall or roof) that is required to have an FRL with respect to integrity or insulation or a resistance to the incipient spread of fire.

BCA Clause C4D15(2) states that the installation mentioned in C4D15(1) must comply with any of the following: (a) tested systems; (b) in the case of ventilation or air-conditioning ducts or equipment, the installation is in accordance with AS 1668.1; (c) compliance with Specification 13.

Clause E2D15(2)(a) states that a building "*containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit*" in a fire compartment with a floor area greater than 2,000 m² must be provided with "*an automatic smoke exhaust system complying with Specification 21*".

Clause S21C7(7) of BCA Specification 21 states that "*power supply wiring to exhaust fans together with detection, control, and indication circuits (and where necessary to automatic make-up air supply arrangements) must comply with AS 1668.1*".

Clause 4.10.2.1 of AS 1668.1-2015 in part states that wiring systems required to function in fire mode shall meet the fire resistance and mechanical protection requirements of Table 4.1, Appendix D and AS /NZS 3013.

Clause 4.10.2.2 of AS 1668.1-2015 states that apart from wiring systems that serve fire-isolated exit pressurisation systems, any wiring systems serving smoke control equipment listed in Clause 4.10.3 is not required to comply with the fire resistance and mechanical protection requirements of AS/NZS 3013 provided the following cases apply:

(a) When installed entirely within a plantroom that is fire-isolated from the occupied spaces by construction having FRL not less than --/120/120

(b) Where loss of voltage cannot adversely affect the operation of the smoke-control system.

Clause 4.10.3 of AS 1668.1-2015 states that electrical components (such as switchgear, control gear, accessories, variable speed drives) associated with smoke control systems (excluding fire-isolated exit systems) shall be fire-isolated from occupied spaces with construction having an FRL not less than --/120/120.

12.2 Performance Solution

The Plaza (SZ-02), the Myer retail mall (SZ-03), the Coles wing mall (SZ-01 – not part of this project but may activate during a fire in SZ-02) and the Target wing mall (SZ-04 – not part of this project but may activate during a fire in SZ-02) are provided with dedicated automatic smoke exhaust systems. The layout of smoke exhaust zones is illustrated in Figure 52 below.

The operation of the smoke exhaust systems is supported by multiple existing plant rooms that contain Air Handling Units (AHU) and mechanical service switchboards (MSSB) for smoke exhaust fans (SEF). Also, some MSSBs are located outside plantrooms.

The plant rooms are enclosed with pre-cast concrete panels and reinforced concrete slabs; hence the bounding construction is expected to achieve FRL 120/120/120. The above notwithstanding, some cabling penetrations through the walls are not fire-stopped and the AHU ductwork is not provided with fire dampers where it penetrates fire-rated walls, which does not comply with the DtS provisions of Clause C4D15(2).

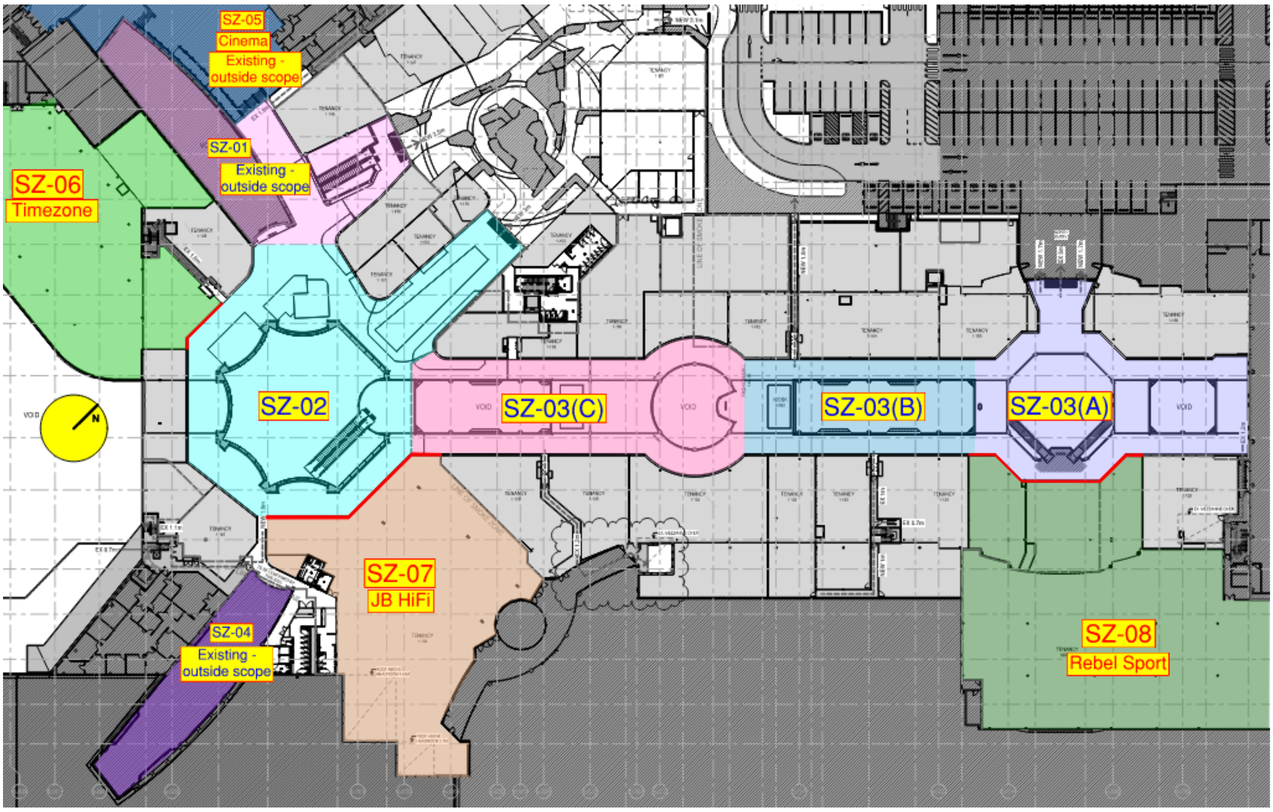

Figure 52: Layout of the smoke exhaust zones on First Floor

The MSSBs located both inside and outside the above plantrooms are not separated from the rest of the building with construction that achieves FRL 120/120/120, which does not comply with the DtS provisions of Clause C3D14(2)(a).

Power supply to the AHUs that provide make-up air to the smoke exhaust systems is provided from the non-essential chassis of the MSSBs and is not fire-rated, which does not comply with the provisions of Clause 4.10.2.2(a) of AS 1668.1-2015 and the DtS provisions of Clause E2D15(2)(a) and Clause S21C7(7) of BCA Specification 21.

12.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as C1P2(1)(d) and EP2.2.

12.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

12.5 Intent of the BCA

The intent of Performance Requirement C1P2(1)(d) (formerly CP2(a)(iv)) is to "*minimise the risk of fire spreading through a building that could endanger the occupants, and impede the actions of the fire brigade*".

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that the main objective of fire rating plant rooms that contain central smoke control plant, including mechanical services switchboards (MSSBs) and power cables to the AHUs that provide make-up to the smoke exhaust system, as well as the MSSBs located external to the plant rooms, is to ensure that during a potential fire the smoke exhaust system operates to a level that facilitates safe occupant evacuation and fire brigade intervention.

12.6 Assessment Methodology

The purpose of this assessment is to demonstrate that if a fire compromises one or more plant rooms and/or MSSBs and/or disables one or more AHUs due to non-fire-rated cabling the operation of the smoke exhaust system is not compromised to a point where it would not be able to support safe occupant evacuation and fire brigade intervention.

If it can be demonstrated that a fire that could compromise plant rooms, MSSBs and/or AHUs would not reduce the operational capability of the smoke exhaust system below the critical level, i.e. a level where safe occupant evacuation and fire brigade intervention cannot be facilitated, then compliance with Performance Requirements C1P2(1)(d) and E2P2 is achieved.

The methodology adopted for the assessment is an absolute quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify plant rooms that cannot be considered fire-rated due to service penetrations that are not fire-stopped.
2. Identify where MSSBs supporting the operation of the automatic smoke exhaust system in smoke exhaust zones SZ-02 and SZ-03 are located and to what degree they are fire-separated from the rest of the building.

3. Identify AHUs that are serviced by non-fire-rated cabling.
4. Identify worst-case fire scenarios that could compromise the maximum number of plant rooms, MSSBs and/or AHUs simultaneously.
5. Determine the make-up air volume and smoke exhaust volume that could be lost during the worst-case scenario.
6. Undertake fire and smoke modelling for the worst-case (redundancy) fire scenarios in the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria (refer to Performance Solution No. 5).
7. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters (refer to Performance Solution No. 5).
8. Compare the derived ASET and RSET to determine if the design is acceptable.
9. If occupant evacuation and fire brigade intervention with a reduced capacity smoke exhaust system can be facilitated, then compliance with the relevant Performance Requirements is achieved.

12.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *If plant rooms that contain smoke control plant, MSSBs and/or AHUs providing make-up air to the smoke exhaust system are compromised by the fire, the ASET calculated for the redundancy fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

12.8 Assessment

The redundancy fire scenarios presented in Performance Solution 5 (refer to Section 15) model conditions in which plant rooms housing smoke control equipment, MSSBs, and AHUs supplying make-up air to the smoke exhaust system are compromised by fire. The modelling results indicate that the Available Safe Egress Time (ASET) exceeds the Required Safe Egress Time (RSET). This confirms that safe occupant evacuation and effective fire brigade intervention can still be achieved, even when the smoke exhaust system operates at reduced capacity.

12.9 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements on a comparative basis, as outlined in Section 25.

13. Performance Solution No. 3 – Performance-based Non-fire-isolated Exits

13.1 Relevant BCA DtS Provisions

BCA Clause D2D5(3)(a) states that in a Class 6 building "*no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*".

The BCA Glossary defines an exit as:

(a) Any, or any combination of the following if they provide egress to a road or open space: (i) an internal or external stairway; (ii) a ramp; (iii) a fire-isolated passageway; (iv) a doorway opening to a road or open space; or

(b) A horizontal exit or a fire-isolated passageway leading to a horizontal exit.

13.2 Performance Solution

The GSC is provided with multiple non-fire-isolated exits that discharge either into covered carparks or into open spaces from where occupants need to travel either via covered carparks on Ground Floor (refer to Figure 53) or under a roofed area on First Floor (refer to Figure 54 below) before they reach a road or open space.

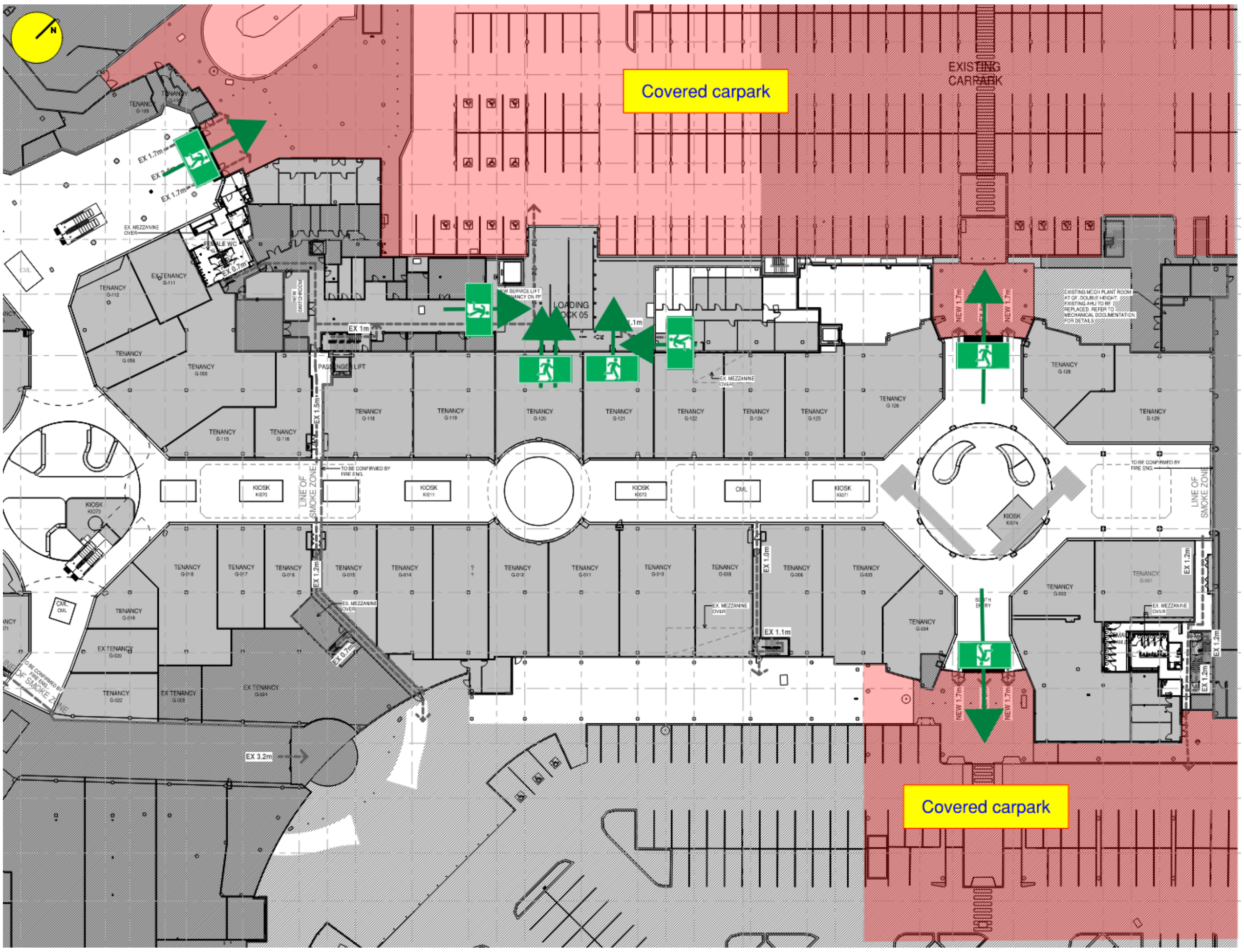

Figure 53: Performance-based non-fire-isolated exits discharging from Ground Floor

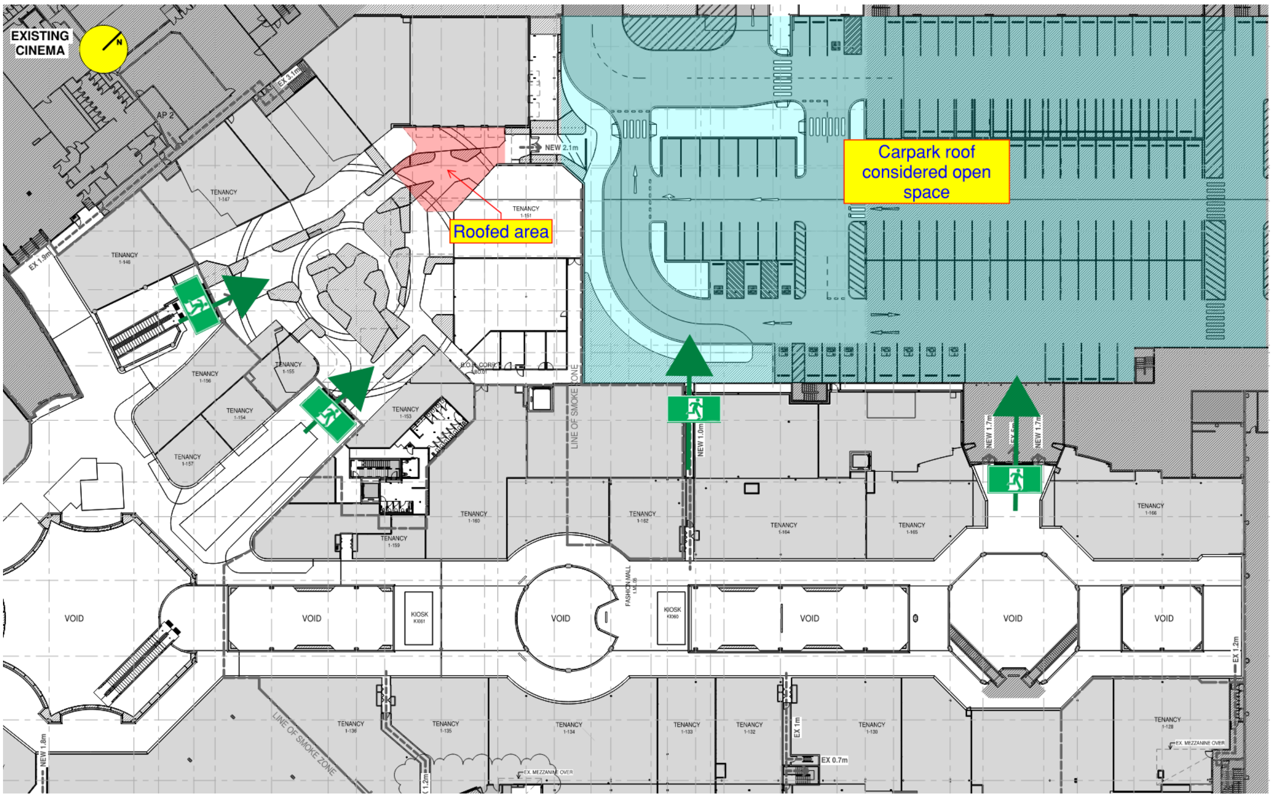

Figure 54: Performance-based non-fire-isolated exits discharging from First Floor

Travel distances in this assessment are measured either to internal stairways, fire-isolated passageways and to performance-based non-fire-isolated exits.

The performance-based non-fire-isolated exits are doorways opening into the covered carparks and into open spaces from where occupants need to travel either via covered carparks on Ground Floor or under a roofed area on First Floor before they reach a road or open space in lieu of directly to a road or open space, which does not comply with the DtS provisions of Clause D2D5(3)(a).

Performance-based discharge from internal stairways and fire-isolated passageways is subject of Performance Solution No. 7.

13.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P4 and E2P2.

13.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

13.5 Intent of the BCA

The intent of Performance Requirement D1P4 (formerly DP4), in accordance with the Guide to the BCA that provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020], is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is reasonable to conclude that once a person reaches an exit they should no longer be exposed to dangerous products of combustion and can safely reach a road or open space.

13.6 Assessment Methodology

The purpose of this assessment is to demonstrate that doorways that do not discharge directly to a road or open space may be considered performance-based non-fire-isolated exits and that travel distances can be measured to these doors instead of to the edge of the covered carparks on Ground Floor and the roofed area on First Floor.

If it can be demonstrated that during a fire in the retail (Class 6) or entertainment (Class 9b – cinemas) parts of the GSC once occupants leave the fire-affected part they would not be exposed to dangerous products of combustion and can safely evacuate through the covered carparks or under the roofed area, then compliance with Performance Requirements D1P4 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute, qualitative deterministic analysis in accordance with the following:

1. Identify the non-fire-isolated exits that discharge into the covered carparks and into open spaces from where occupants need to travel either via covered carparks on Ground Floor or under a roofed area on First Floor before they reach a road or open space.
2. Determine whether the spaces where occupants discharge could be compromised by a potential fire in Class 6 or Class 9b parts.
3. Identify fire scenarios that could compromise safe occupant evacuation through the covered carparks and the roofed area on First Floor and determine whether occupants need to evacuate via the fire-affected areas.
4. Determine whether fire brigade is facilitated, i.e. firefighters can connect to external fire hydrants safely before entering the fire-affected areas.

13.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Safe occupant evacuation through the covered carparks on Ground Floor and under the roofed area on First Floor shall not be compromised during a potential fire in the Class 6 or Class 9b parts of the GSC.*
2. *Fire brigade intervention shall be facilitated, i.e. shall not be exposed to dangerous products of combustion when they connect to external attack fire hydrants installed in or adjacent to the covered carparks.*

13.8 Fire Scenarios

Tenability in the performance-based fire-escape corridor may be compromised if a fire starts in the areas that are connected to or are adjacent to the corridor; therefore, the following fire scenarios were identified as requiring assessment:

1. Fire scenario 3.1 – A vehicle fire starting in the Coles Click & Collect area adjacent the GF NW Entrance.
2. Fire scenario 3.2 – A vehicle fire starts in the carpark space closest to the GF North Entrance.
3. Fire scenario 3.3 – A vehicle fire starts near GF Loading Dock 05.
4. Fire scenario 3.4 – A fire starts in the GF west BoH
5. Fire scenario 3.5 – A fire starts under the unsprinklered canopy within the 1F North Laneway

13.9 Assessment

The carpark consists of two levels, with a concrete slab separating the ground floor and first floor carparks. The ground floor carpark has a floor-to-slab height of 5.0 m, while the first floor carpark is open to air.

13.9.1 Fire inside the GSC

Any fire occurring within the GSC is not expected to compromise the covered ground floor carpark. Smoke escaping through the entrance door of the GSC will dissipate into the carpark, travel along the underside of the concrete slab, and ventilate to the outside air through openings along the carpark perimeter. It is not anticipated that the smoke layer will descend below 2.1 m above ground level— the height at which occupants' visibility could be significantly reduced. Therefore, although the ground floor carpark is covered, it can be considered a place of intermediate safety, allowing occupants to evacuate safely toward open space beyond the carpark perimeter.

13.9.2 Fire in the Carpark

As there are no detection or sprinkler systems in the northwest (NW) carpark on the ground floor or in the rooftop carpark on the first floor, a fire in these areas will not trigger a building-wide evacuation in the GSC. Patrons will only become aware of a fire in these locations if they are notified by staff or if they personally detect signs of the fire—such as smoke, heat, or visual cues.

If a patron identifies the fire, they are likely to notify GSC staff. The staff may attempt to extinguish the fire or, if unsuccessful, contact DFES. In such cases, staff are expected to guard the entrances closest to the fire's origin to prevent patrons from walking past the affected area and to redirect them to alternative exits. A building-wide evacuation is unlikely to be initiated if the fire is contained and managed until DFES arrives.

Fire Scenarios 3.1, 3.2, and 3.3 explore situations where a fire starts in the NW carpark on the ground floor before staff have arrived to provide instructions to patrons. Fire Scenario 3.4 addresses a fire originating in the NW rooftop carpark near the north laneway, also in the absence of staff intervention.

13.9.2.1 Fire Scenario 3.1 – Fire in the Ground Floor Coles Click & Collect

A vehicle fire occurring in the Ground Floor Coles Click & Collect area would likely be visible to patrons approaching the northwest (NW) glazing entrance of the GSC. Upon noticing the fire, patrons may choose to turn back, notify staff, or exit the building through an alternative entrance.

If patrons attempted to exit via the NW entrance, the radiation assessment presented in Performance Solution 11 (Section 21) indicates that the maximum radiant heat at the northwest entrance glazing to the GSC is 2.1 kW/m² at a distance of 11.6 m. This radiation level is below the threshold required to cause pain to occupants attempting to egress via that entrance. According to Table 48 in Section 22.7, a minimum of 4 kW/m² is required to cause pain after 10 to 20 seconds of exposure. Therefore, if occupants insist on exiting the GSC via the NW entrance near the vehicle fire, the radiant heat at that point is not expected to pose a danger.

Once outside, if occupants perceive that conditions are no longer tenable for safe egress past the fire, they can re-enter the GSC and exit via alternative routes. An illustration of the egress paths is provided in Figure 55 below.

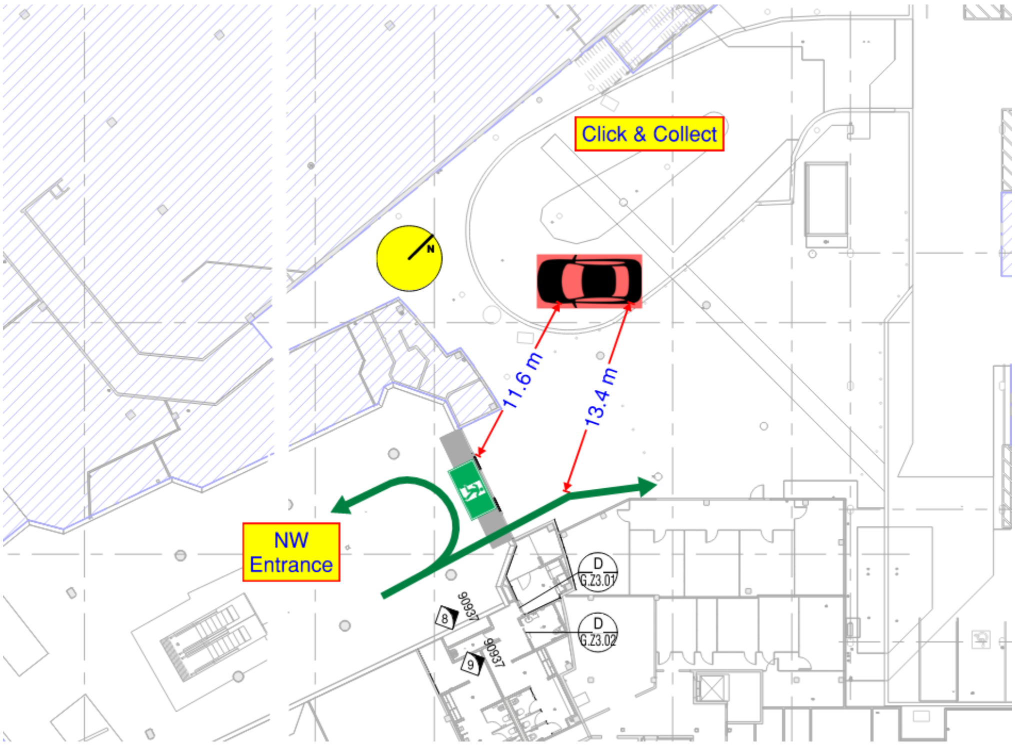

Figure 55: Illustration of travel path at NW Entrance

The radiation assessment showed that a vehicle fire in this location should not expose fire fighters to dangerous products of combustion when they connect to external attack fire hyrdants, which satisfies the nominated acceptance criteria and facilitates DFES intervention.

13.9.2.2 Fire Scenario 3.2 – Vehicle fire near the GF North Entrance

Fire scenario 3.2 is similar to fire scenario 3.1. The radiation assessment in radiation assessment in Performance Solution 11 (Section 21) determined that the maximum radiant heat at the north entrance glazing of the GSC is 1.7 kW/m². This level is below the threshold that would cause pain to occupants attempting to exit through that entrance as per Table 48 in Section 22.7.

Therefore, even if occupants are unaware of the fire's exact location and choose to exit the GSC via the North Entrance near the vehicle fire, the radiant heat at that point will not pose a danger.

If at any point occupants perceive that conditions are unsafe—such as encountering visible flames or intense heat—they can re-enter the GSC and exit through alternative routes. Figure 56 below illustrates the available egress paths.

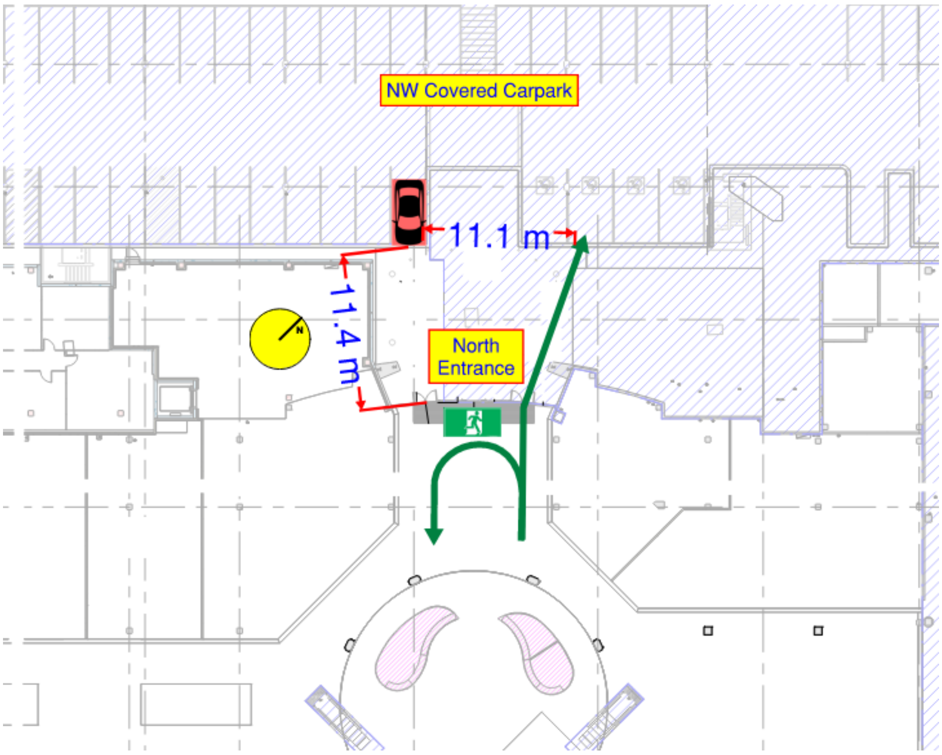

Figure 56: Illustration of travel path at North Entrance

The radiation assessment showed that a vehicle fire in this location should not expose fire fighters to dangerous products of combustion when they connect to external attack fire hyrdants, which satisfies the nominated acceptance criteria and facilitates DFES intervention.

13.9.2.3 Fire Scenario 3.3 – Vehicle fire in Loading Dock 05

Loading Dock 05 is accessible from tenancies G-120 and G-121, the tenant stores, and the Back of House (BoH) area. It is an open-to-air space, with the open area indicated in cyan in Figure 57 below and the egress path shown by the green arrows.

As Loading Dock 05 is open to air, a vehicle fire occurring in this location is not required to be addressed under the BCA NCC 2022. In the event of a vehicle fire in the northwest (NW) covered carpark, smoke may spill into the loading dock and be vented to the outside air.

Since a vehicle fire in the NW carpark will not initiate a building-wide evacuation of the GSC, the occupants accessing Loading Dock 05 via the rear doors of tenancies G-120 and G-121 are expected to be staff only. If staff open the back doors and observe the vehicle fire, they can return into their respective tenancies. Similarly, staff located in the BoH area can return to the GSC via Lift Lobby G.LL.02. Refer to Figure 57 for the egress path indicated by the green arrows.

Staff accessing the tenant stores are not expected to remain there for extended periods. Therefore, if a vehicle fire starts near the tenant stores while staff are inside, the fire should still be in its early stages, and conditions should remain tenable. If the fire grows and tenability within the NW covered carpark is lost, staff in the tenant stores can evacuate through Loading Dock 05 and proceed to the BoH area, re-entering the GSC via Lift Lobby G.LL.02 as shown in Figure 57.

As demonstrated in Fire Scenario 3.1, a vehicle fire located 11.6 m from an entrance with the vehicle side facing the entrance—thus presenting the largest radiant surface—produced a maximum radiant heat of 2.1 kW/m². Therefore, a vehicle fire located 17.4 m from the egress path is not expected to emit more than 4 kW/m², which is the threshold for causing pain after 10 to 20 seconds of exposure.

Additionally, Fire Scenario 3.2 shows that a vehicle fire 11.4 m from the entrance emitted a maximum radiant heat of 1.6 kW/m². By comparison, a parked vehicle on fire located 12.9 m from the egress path is also expected to remain below the 4 kW/m² threshold.

These assessments demonstrate that staff evacuating from the tenant stores should be able to safely egress past Loading Dock 05 and into the BoH area.

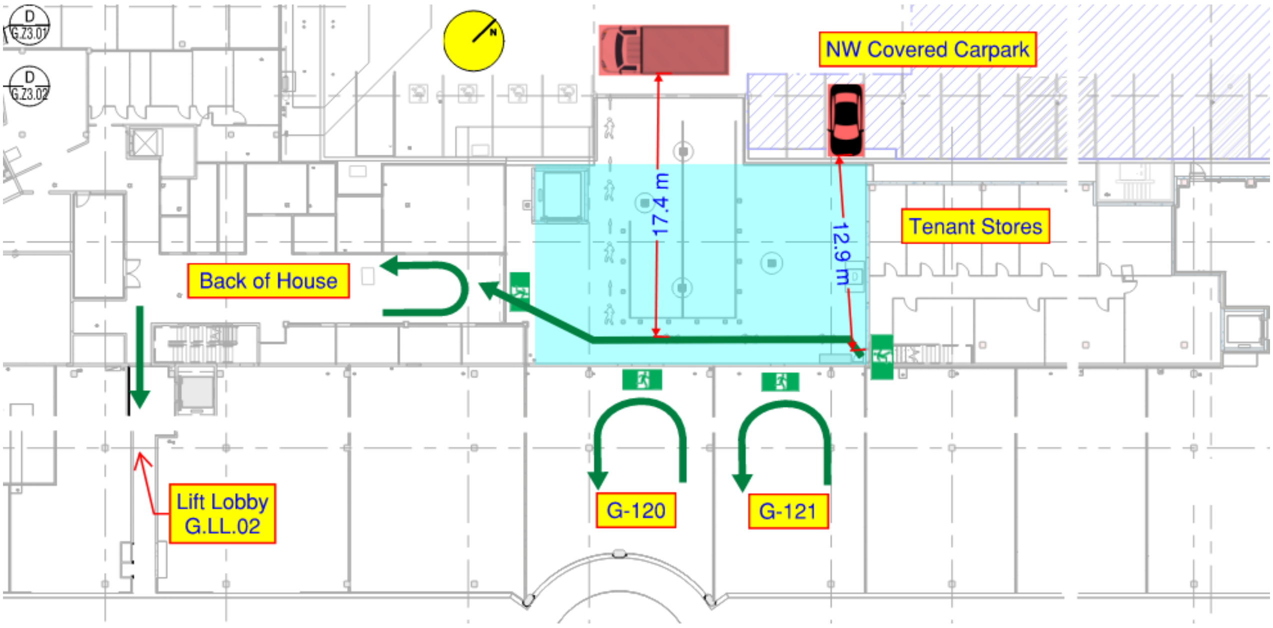

Figure 57: Illustration of travel path at Loading Dock 05

The radiation assessment showed that a vehicle fire in this location should not expose fire fighters to dangerous products of combustion when they connect to external attack fire hyrdants, which satisfies the nominated acceptance criteria and facilitates DFES intervention.

13.9.2.4 Fire Scenario 3.4 – Fire in the west BoH

The west Back-of-House (BoH) area is accessed via corridor G.LL.02 and comprises tenant storage rooms and switch rooms, leading to Loading Dock 05. Although the area is roofed, it remains open to air along the north-east elevation, which connects to Loading Dock 05. All tenant stores and switch rooms open directly into the BoH; therefore, smoke detectors—identified by the symbol 'S'—are installed in front of each doorway and the area is designated as Fire Alarm Zone FAZ-01.

Adjacent tenancies G-055 and G-118 have back doors that open directly into the BoH and are also equipped with smoke detectors to Clause S20C4 of BCA Specification 20 and AS 1670.1-2018. These tenancies are included in FAZ-01, as highlighted in orange in Figure 58. The BoH common areas are provided with heat detectors and are designated as Fire Alarm Zone FAZ-02, highlighted in pink in Figure 58.

Both FAZ-01 and FAZ-02 are linked to dynamic RED exit signage located at the non-fire-isolated corridor G.LL.02 and at the back doors of tenancies G-055 and G-118, as shown in Figure 58. In the event of a fire within either FAZ-01 or FAZ-02, activation of the smoke or heat detectors will trigger the dynamic RED signs to display a red cross in place of the green running man symbol. This indicates that the BoH area is no longer safe and discourages occupants from the retail mall or from tenancies G-055 and G-118 from entering the BoH.

The door from the BoH to Lift Lobby G.LL.02 is designed to allow re-entry from the BoH side during a fire emergency in FAZ-01 or FAZ-02. This design ensures that occupants within the storage or switch rooms can retreat back into the retail mall if tenable conditions within the BoH common area deteriorate, or if continuing toward Loading Dock 05 is perceived to pose an increased risk.

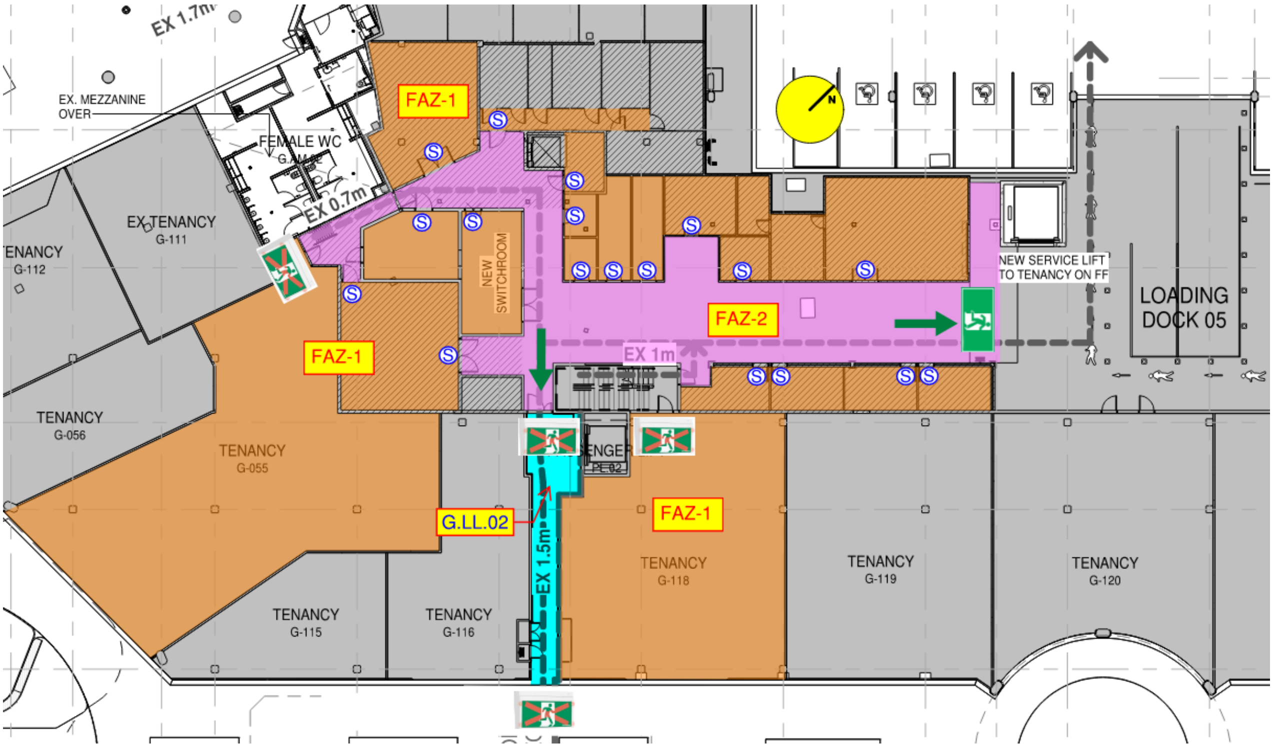

Figure 58: West BoH fire alarm zones FAZ-1 and FAZ-2

13.9.2.5 Fire Scenario 3.5 –Fire under the 1F North Laneway unsprinklered canopy

The north laneway is located directly outside the north-west entrance of the shopping mall. Occupants may exit the building via this entrance and proceed through the laneway to reach the first-floor carpark.

The laneway is partially covered by a sprinkler-protected canopy along the tenancies and is open to the air in the centre, as shown in Figure 59. In this figure, the sprinklered canopy is highlighted in blue, and the open-to-air section is highlighted in cyan. The laneway has a single exit that leads to the open carpark, which is considered a place of safety. However, before reaching this final exit, occupants pass under a section of non-sprinklered canopy, highlighted in red in Figure 59. In the event of a fire occurring under this non-sprinklered canopy, the fire may remain undetected and uncontrolled until discovered by staff or until the fire spread into adjacent sprinlered areas.

The north-west entrances are fitted with glazed automatic sliding doors. Patrons attempting to exit via this entrance may visually identify a fire under the non-sprinklered canopy and choose to re-enter the mall. Similarly, occupants already within the laneway or in adjacent tenancies retain the ability to egress back into the retail mall upon noticing the fire. As the laneway is open to air, smoke accumulation is limited, and occupants moving from adjacent food tenancies back into the mall via the laneway are not expected to be affected by smoke. An illustration of the egress paths is provided in Figure 59 below by the green arrows.

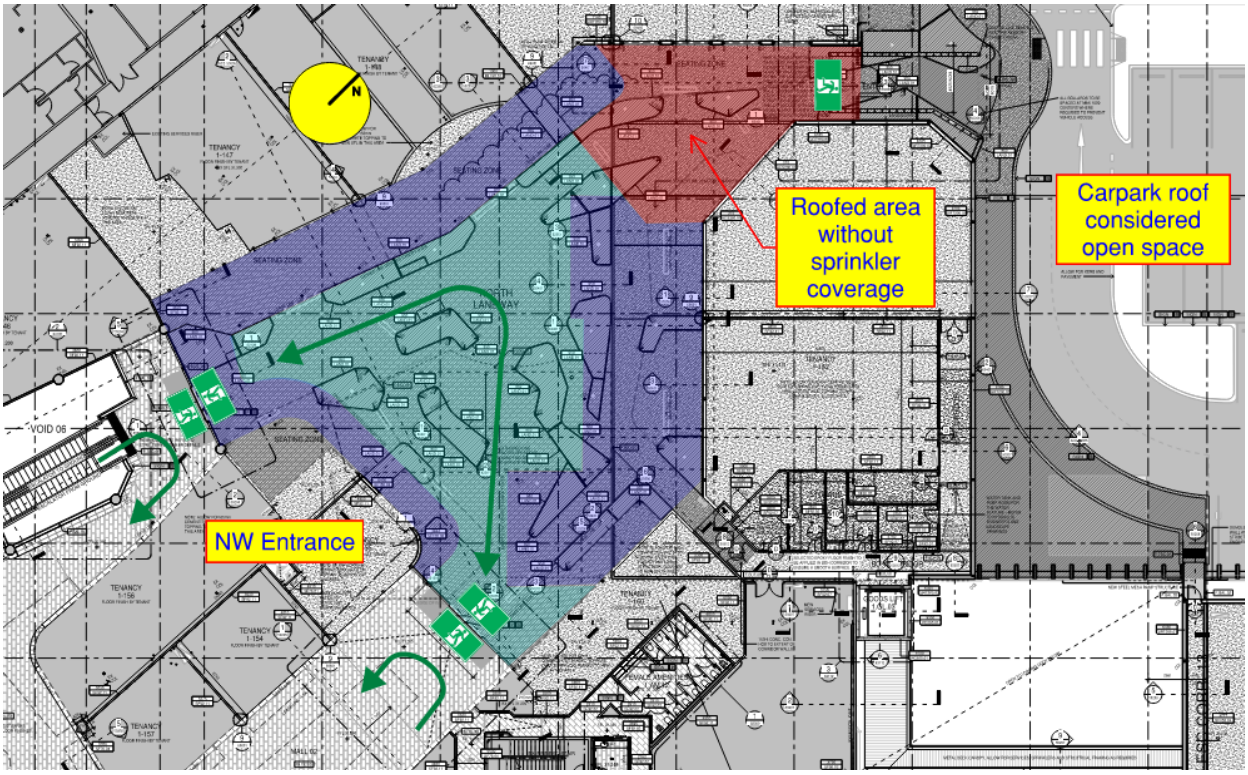

Figure 59: Illustration of travel path at First Floor North Lanyway

13.10 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements on a comparative basis, as outlined in Section 25.

14. Performance Solution No. 4 – Extended Travel Distances from Areas not Provided with Automatic Smoke Exhaust

14.1 Relevant BCA DtS Provisions

BCA Clause D2D5(3)(a) states that in a Class 6 building "*no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*".

14.2 Performance Solution

The following areas within the GSC that are not prescribed to be provided with automatic smoke exhaust have extended travel distances:

1. Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m.
2. Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m.
3. Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m.
4. Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m.
5. Travel distances from FF amenities (Male Amenities 1.AM.11, Parent Room 1.AM.03, Female Amenities 1.ST.03 and Male Amenities 1.ST.24) to a point of choice are extended up to 29 m in lieu of 20 m.
6. Travel distances from the GF BoH area to the nearest of the alterative exits are extended up to 50 m.

The dead-end travel distances therefore do not comply with the DtS provisions of Clause D2D5(3)(a).

14.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as D1P4 and E2P2.

14.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(d), i.e. "*comparison with the Deemed-to-Satisfy Provisions*".

14.5 Intent of the BCA

The intent of Performance Requirement D1P4 (formerly DP4), in accordance with the Guide to the BCA that provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020], is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that time plays a crucial role in safe occupant evacuation. The overall evacuation time consists of three (3) main components: detection time, pre-movement (response) time and egress (movement) time. Generally, if the egress time is increased due to extended travel distances, the detection and/or pre-movement times must be reduced to facilitate safe occupant evacuation.

14.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design with extended travel distances to a point of choice or a single exit should not compromise safe occupant evacuation and should not adversely affect fire brigade intervention.

The level of fire safety inherent in a BCA DtS compliant design represents an acceptable community standard for new building works in Australia.

If it can be demonstrated that in the performance-based design the RSET is shorter than in a BCA DtS complaint design, compliance with Performance Requirements D1P4 and E2P2 is achieved on a comparative basis.

The methodology adopted for the assessment is a quantitative and qualitative comparative analysis in accordance with the following:

1. In consultation with the building surveyor develop and document a hypothetical reference base case design that complies with the BCA DtS provisions and document the characteristics of the performance-based design. These designs are detailed in Table 26 below.

2. Calculate the detection time for the BCA DtS compliant design using module 'Sprinkler' from the FireWind 3.6 suite of fire safety engineering software. The detection time is based on the activation of automatic fire sprinkler system installed to AS 2118.1 and fitted with standard response sprinkler heads installed on a 3.0 m x 4.0 m grid.

3. Calculate the detection time for the performance-based design (areas where provision of smoke detectors may cause spurious alarms) using module Sprinkler from the FireWind 3.6 suite of fire safety engineering software. The detection time is based on the activation of automatic fire sprinkler system installed to AS 2118.1 and fitted with fast response sprinkler heads installed on a 3.0 m x 4.0 m grid.

4. Calculate the detection time for the performance-based design (specialty shops, amenities and "clean" BoH areas) using program CFAST. The detection time is based on the activation of fire detection and alarm system installed to AS 1670.1 and fitted with smoke detectors installed on a 10.0 m x 10.0 m grid.

5. Calculate travel times for the BCA DtS compliant design and the performance-based design.

6. Determine RSET for the BCA DtS compliant design and the performance-based design.

7. Compare RSET for the BCA DtS compliant design and the performance-based design. If the RSET for the performance-based design is less than or equal to that of the BCA DtS compliant design, then the relevant Performance Requirements of the BCA are satisfied.

14.7 Comparative Characteristics

The comparative characteristics of the BCA DtS compliant design and the performance-based design are summarised in Table 26 below:

Item	BCA DtS compliant design	Performance-based design
Building classification	Class 6 (Retail)	
Floor-to-ceiling height	3.6 m to 9.4 m	
Maximum travel distance to a point of choice or to a single exit	20 m	30 m
Maximum travel distance to the nearest of the alternative exits	40 m	50 m
Fire suppression	Automatic sprinkler system to AS 2118.1-1999	
	Standard response sprinkler heads on a 3.0 m x 4.0 m grid	Fast response sprinkler heads on a 3.0 m x 4.0 m grid (where smoke detectors could cause spurious alarms)
Fire detection and alarm in specialty shops, amenities and BoH areas	Automatic fire sprinkler system to AS 2118.1-1999 with standard response sprinkler heads	Smoke detectors to Clause S20C4 of BCA Specification 20; and Automatic fire sprinkler system to AS 2118.1-1999 with fast response sprinkler heads (where smoke detectors could cause spurious alarms)
Smoke exhaust	Not prescribed and not provided	
Building occupant warning	Building occupant warning to Clause 6 of BCA Spec. 20 and AS 1670.1-2018	EWIS to Clause E4D9(d) and AS 1670.4-2018

Table 26: Comparative characteristics for the BCA DtS compliant design and the performance-based design

14.8 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *RSET for the performance-based design shall be less or equal to the RSET for the BCA DtS compliant design:*

RSET (performance-based design) ≤ RSET (BCA DtS compliant design).

14.9 Fire Scenarios

An important factor of a fire safety engineering assessment is identifying appropriate fire scenarios.

Extended travel distances are present in areas that may have different fire growth rates that may vary from ‘medium’ in amenities to ‘ultra-fast’ in some stores. Therefore, ‘medium’ and ‘ultra-fast’ t-squared growth fire rates are considered.

For the purpose of this comparative analysis the fire scenarios detailed in Table 27 were assessed.

Fire Scenario	Location of Fire	Fire Description
BCA DtS compliant designs		
BCD-11	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
BCD-12	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
BCD-21	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
BCD-22	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by standard response sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid
Performance-based designs – sprinkler detection / smoke detection		
PBD-11-Spkl	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-12-Spkl	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-21-Spkl	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-22-Spkl	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by fast response sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid
PBD-11-SD	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1-2015 on a 10 m by 10 m grid
PBD-11-SD	Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid
PBD-21-SD	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Medium' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid
PBD-22-SD	Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height)	'Ultra-fast' t-squared growth rate fire. Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid

Table 27: Summary of the fire scenarios

14.10 Assessment

The following sections detail the comparative assessment carried out for the areas with extended travel distances that are not provided with automatic smoke exhaust.

14.10.1 Cue Time (t_d)

In the BCA DtS compliant design, the cue time is based on the combined standard response sprinkler activation time and sprinkler system depressurisation time of 30 seconds (refer to Section 10.2.2). Sprinkler activation time modelling for the BCA DtS compliant design was carried out using module Sprinkler from the FireWind 3.6 suite of fire safety engineering software (refer to Section 34.1 in Appendix H of this report). The modelling results are summarised in Table 28 below.

Fire scenario	Sprinkler activation time (sec)	Sprinkler system depressurisation time (sec)	Cue time (sec)
BCD-11	297	30	327
BCD-12	103	30	133
BCD-21	430	30	460
BCD-22	138	30	168

Table 28: Summary of detection times for the BCA DtS compliant design fire scenarios

In the performance-based design, the cue time is based on the combined fast response sprinkler activation time and sprinkler system depressurisation time of 30 seconds (refer to Section 10.2.2). Sprinkler activation time modelling for the performance-based design was carried out using module Sprinkler from the FireWind 3.6 suite of fire safety engineering software (refer to Section 34.2 in Appendix H of this report). The modelling results are summarised in Table 26 below.

Fire scenario	Sprinkler activation time (sec)	Sprinkler system depressurisation time (sec)	Cue time (sec)
PBD-11-Spkl	246	30	276
PBD-12-Spkl	78	30	108
PBD-21-Spkl	378	30	408
PBD-22-Spkl	109	30	139

Table 29: Summary of fast sprinkler detection times for the performance-based fire scenarios

In the performance-based design the cue time is based on the combined smoke detector activation time and an alarm verification time of 20 second (refer to Section 10.2.2). Smoke detector activation time modelling was carried out using computer program CFAST (refer to Section 34.3 in Appendix H of this report). The modelling results are summarised in Table 30 below.

Fire scenario	Smoke detector activation time (sec)	Alarm verification time (sec)	Cue time (sec)
PBD-11-SD	42	20	62
PBD-12-SD	16	20	36
PBD-21-SD	53	20	73
PBD-22-SD	17	20	37

Table 30: Summary of smoke detection times for the performance-based fire scenarios

14.10.2 Pre-movement Time (t_{pm})

The BCA DtS compliant design are provided with BWOS while the performance-based design are provided with EWIS, however, the type of occupant alarm notification will be the same in both designs; therefore, the pre-movement time may be ignored for the purpose of this comparative assessment.

14.10.3 Egress Time (t_e)

Occupant egress time was calculated using hand calculation methods presented in the SFPE Handbook [Gwynne, 2016a], as detailed in Section 10.2.3.

Egress time consists of the time to walk to an exit and the time to queue at the exit. The time to walk to an exit depends on the distance that a person needs to travel and the travel speed of occupants. The queue time dependents on the width of the exit and the number of people evacuating via the exit.

The largest tenancy has a floor area of 366 m², with a calculated occupant load of 61 people, based on 6 m² per person in accordance with BCA Clause D2D18(a) and Table D2D18. This occupant load has been conservatively applied to all tenancies. Accordingly, the analysis considers the evacuation of 61 persons from the largest tenancy—without the provision of smoke exhaust—to a point of choice.

The largest Back of House (BoH) area has a floor area of 387 m², with a calculated occupant load of 13 people, based on 30 m² per person in accordance with BCA Clause D2D18(a) and Table D2D18. This occupant load has also been conservatively applied to all BoH, storage areas, and plant rooms. The analysis therefore assumes the evacuation of 13 occupants from these areas to a point of choice located 30 m away (in lieu of the prescribed 20 m) and 50 m to the nearest alternative exit (in lieu of the prescribed 40 m).

For the amenities, the largest combined group—comprising Female Amenities 1.ST.03, Male Amenities 1.ST.24, and Parent Room 1.AM.03—has a calculated occupant load of 27 people, based on the number of cubicles and urinals. The analysis assumes evacuation of these 27 occupants to a point of choice located 29 m away (in lieu of 20 m).

Male Amenities 1.AM.11 has a calculated occupant load of 5 people, with a travel distance to a point of choice of 22 m (in lieu of 20 m). As the combined amenities scenario represents the worst-case condition, the same assessment and conclusions are considered applicable to 1.AM.11.

The following assumptions apply to this assessment:

1. The minimum unobstructed width of a path of travel to a point of choice is 1.0 m.
2. The maximum distance occupants may need to travel to reach the point of choice is up to 20 m in the BCA DtS compliant design and up to 30 m in the performance-based design.
3. The maximum travel distance to the nearest exit/place of intermediate safety is up to 40 m in the BCA DtS compliant design and up to 50 m in the performance-based design.
4. The travel speed for all occupants is 0.80 m/s.

5. The nearest person is located 5 m from the point of choice or from an exit/place intermediate safe (an arbitrary assumption – not a BCA DtS requirement).

6. All occupants commence movement at the same time. This is a conservative assumption, as it is expected to result in the longest queueing time.

Table 31 summarises the egress time calculations for travel to a point of choice from the largest tenancy. Table 32 summarises the egress time calculations for travel to a point of choice from the largest Back of House (BoH) area. Table 33 summarises the egress time calculations for travel to the nearest exit or place of intermediate safety. Table 34 summarises the egress time calculations for travel to a point of choice from the largest amenities area.

Parameter	BCA DtS compliant design	Performance-based design
Number of occupants	Largest Tenancy - 61 occupants	
Number of exits	1	1
Boundary layer for the exits	0.304 m	0.304 m
Exit width	1.000 m	1.000 m
Effective egress width	0.696 m	0.696 m
Maximum distance to exit	20 m	30 m
Minimum distance to exit	5 m	5 m
Walking speed	0.8 m/s	0.8 m/s
Specific flow	1.0 p/s/m	1.0 p/s/m
Effective flow through exit	0.696 p/s/m	0.696 p/s/m
Travel time for nearest person from the door to target room	7 sec	7 sec
Travel time for the furthest person from the door to target room	25 sec	38 sec
number of people that may clear the point of choice before the furthest person arrives	up to 13	up to 22
Number of people queueing at the door	48	39
Queueing time	70 sec	57 sec
Total egress time	**95 sec**	**95 sec**

Table 31: Egress time from the largest tenancy to a point of choice

Parameter	BCA DtS compliant design	Performance-based design
Number of occupants	Largest BoH - 13 occupants	
Number of exits	1	1
Boundary layer for the exits	0.304 m	0.304 m
Exit width	1.000 m	1.000 m
Effective egress width	0.696 m	0.696 m

Parameter	BCA DtS compliant design	Performance-based design
Maximum distance to exit	20 m	30 m
Minimum distance to exit	5 m	5 m
Walking speed	0.8 m/s	0.8 m/s
Specific flow	1.0 p/s/m	1.0 p/s/m
Effective flow through exit	0.696 p/s/m	0.696 p/s/m
Travel time for nearest person from the door to target room	7 sec	7 sec
Travel time for the furthest person from the door to target room	25 sec	38 sec
number of people that may clear the point of choice before the furthest person arrives	up to 13	up to 22
Number of people queueing at the door	0	0
Queueing time	1 sec	0 sec
Total egress time	**26 sec**	**38 sec**

Table 32: Egress time from the largest BoH to a single point of choice

Parameter	BCA DtS compliant design	Performance-based design
Number of occupants	Largest BoH - 13 occupants	
Number of exits	2	2
Boundary layer for the exits	0.304 m	0.304 m
Exit width	1.000 m	1.000 m
Effective egress width	1.392 m	1.392 m
Maximum distance to exit	40 m	50 m
Minimum distance to exit	5 m	5 m
Walking speed	0.8 m/s	0.8 m/s
Specific flow	1.0 p/s/m	1.0 p/s/m
Effective flow through exit	1.392 p/s/m	1.392 p/s/m
Travel time for nearest person from the door to target room	7 sec	7 sec
Travel time for the furthest person from the door to target room	50 sec	63 sec
number of people that may clear the point of choice before the furthest person arrives	up to 13	up to 22

Parameter	BCA DtS compliant design	Performance-based design
Number of people queueing at the door	0	0
Queueing time	1 sec	0 sec
Total egress time	**51 sec**	**63 sec**

Table 33: Egress time from the largest BoH to the nearest exit/place of intermediate safety.

Parameter	BCA DtS compliant design	Performance-based design
Number of occupants	Largest FF amenities - 27 occupants	
Number of exits	1	1
Boundary layer for the exits	0.304 m	0.304 m
Exit width	1.000 m	1.000 m
Effective egress width	0.696 m	0.696 m
Maximum distance to exit	20 m	29 m
Minimum distance to exit	5 m	5 m
Walking speed	0.8 m/s	0.8 m/s
Specific flow	1.0 p/s/m	1.0 p/s/m
Effective flow through exit	0.696 p/s/m	0.696 p/s/m
Travel time for nearest person from the door to target room	7 sec	7 sec
Travel time for the furthest person from the door to target room	25 sec	37 sec
number of people that may clear the point of choice before the furthest person arrives	up to 13	up to 22
Number of people queueing at the door	14	5
Queueing time	21 sec	8 sec
Total egress time	**46 sec**	**45 sec**

Table 34: Egress time from the largest FF amenities to a single point of choice

Calculations provided in the above table clearly demonstrate that if the same number of occupants travel to an exit of the same width, occupants that have to travel longer to reach the exit are expected to queue for a shorter period of time (if at all), as more occupants are expected to clear the exit before the last occupant joins the cue.

The above notwithstanding, the benefits of a shorter queueing time may be cancelled by a longer travel time due to a longer travel distance.

14.10.4 Summary

The results of the comparative RSET analysis are summarised below in Table 35 to Table 38.

Specialty tenancies are provided with smoke detections while all BoH areas, storage areas plant rooms and amenities are provided with fast response sprinkler system.

Table 35 present a comparison between the BCA DtS design and a performance-based design incorporating smoke detections for the specialty tenancies with extended travel distances to a point of choice.

Table 36 and Table 37 present a comparison between the BCA Deemed-to-Satisfy (DtS) design and a performance-based design incorporating fast-response sprinklers. The comparison considers extended travel distances from BoH to a point of choice and to the nearest exit or place of intermediate safety, respectively.

Table 38 present a comparison between the BCA DtS design and a performance-based design incorporating fast-response sprinklers. The comparison similarly considers extended travel distances from the amenities to a point of choice.

Fire scenario	Cue time (t_d), sec	Pre-movement time (t_{pm}), sec	Egress time (t_e), sec	RSET, sec	RSET margin
BCD-11	327	Ignored	95	422	+ 265 sec
PBD-11-SD	62	Ignored	95	157	
BCD-12	133	Ignored	95	228	+ 97 sec
PBD-12-SD	36	Ignored	95	131	
BCD-21	460	Ignored	95	555	+ 387 sec
PBD-21-SD	73	Ignored	95	168	
BCD-22	168	Ignored	95	263	+ 131 sec
PBD-22-SD	37	Ignored	95	132	

Table 35: Comparative RSET summary for BCD vs PBD (smoke detection) – travel from specialty tenancies to a point of choice

Fire scenario	Cue time (t_d), sec	Pre-movement time (t_{pm}), sec	Egress time (t_e), sec	RSET, sec	RSET margin
BCD-11	327	Ignored	26	353	+ 39 sec
PBD-11-Spkl	276	Ignored	38	314	
BCD-12	133	Ignored	26	159	+ 13 sec
PBD-12-Spkl	108	Ignored	38	146	
BCD-21	460	Ignored	26	486	+ 40 sec
PBD-21-Spkl	408	Ignored	38	446	
BCD-22	168	Ignored	26	194	+ 17 sec
PBD-22-Spkl	139	Ignored	38	177	

Table 36: Comparative RSET summary for BCD vs PBD (sprinklered) – travel from BoH to a point of choice.

Fire scenario	Cue time (t_d), sec	Pre-movement time (t_{pm}), sec	Egress time (t_e), sec	RSET, sec	RSET margin
BCD-11	327	Ignored	51	378	**+ 39 sec**
PBD-11-SD	62	Ignored	63	339	
BCD-12	133	Ignored	51	184	**+ 13 sec**
PBD-12-SD	36	Ignored	63	171	
BCD-21	460	Ignored	51	511	**+ 40 sec**
PBD-21-SD	73	Ignored	63	93	
BCD-22	168	Ignored	40	535	**+ 17 sec**
PBD-22-SD	37	Ignored	43	123	

Table 37: Comparative RSET summary for BCD vs PBD (sprinkleredr) – from BoH to the nearest exit/place of intermediate safety

Fire scenario	Cue time (t_d), sec	Pre-movement time (t_{pm}), sec	Egress time (t_e), sec	RSET, sec	RSET margin
BCD-11	327	Ignored	46	373	**+ 52 sec**
PBD-11-SD	62	Ignored	45	321	
BCD-12	133	Ignored	46	179	**+ 26 sec**
PBD-12-SD	36	Ignored	45	153	
BCD-21	460	Ignored	46	506	**+ 53 sec**
PBD-21-SD	73	Ignored	45	453	
BCD-22	168	Ignored	46	214	**+ 30 sec**
PBD-22-SD	37	Ignored	45	184	

Table 38: Comparative RSET summary for BCD vs PBD (sprinklered) – travel from amenities to a single point of choice

Note: The '+' sign indicates that the performance-based design affords extra time to complete the evacuation than a BCA DtS compliant design.

The comparative analysis in Table 35 to Table 38 demonstrates that in the event of the identified reasonable worst credible fire scenarios the performance-based design is capable of achieving an improved RSET to that afforded by a BCA DtS compliant design, i.e. in the performance-based design occupants should reach the point of choice or to the nearest of the alternative exit quicker.

Extended travel distances do not create areas within the tenancies that cannot be reached with 3 lengths of hose from an external attack fire hydrant or 1 lengths of hose from internal attack fire hydrant, which satisfies the nominated acceptance criteria and facilitates DFES intervention.

14.11 Conclusion

This assessment demonstrates that the acceptance criteria for the analysis are met. Therefore, the Performance Solution achieves compliance with the relevant BCA Performance Requirements on a comparative basis, as outlined in Section 25.

15. Performance Solution No. 5 – Performance-based Egress and Smoke Hazard Management Provisions in the Retail Malls

15.1 Relevant BCA DtS Provisions

The BCA sets out the following DtS requirements regarding travel distances and smoke hazard management systems:

1. Clause D2D5(3)(a) states that in a Class 5 to 9 building "*no point on the floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*".

2. Clause D2D6(c)(iii) states that in a Class 6 building the maximum distance between the alternative exits must not exceed 60 m.

3. Clause E2D15(2)(a) states that a building "*containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit*" in a fire compartment with a floor area greater than 2,000 m² must be provided with "*an automatic smoke exhaust system complying with Specification 21*".

4. Clause S21C2(2) of BCA Specification 21 state that smoke "*exhaust rates must be determined in accordance with Figure S21C2, with the height measurement taken from the lowest floor level to the underside of the smoke layer and the fire load determined in accordance with Table S21C2*".

5. Clause S21C4(2) of BCA Specification 21 states that "*the horizontal area of a smoke reservoir must not exceed 2,000 m^2 and in enclosed walkways or malls of a Class 6 building must not exceed 60 m in length*".

6. Clause S21C6(3) of BCA Specification 21 states that "*within a multi-storey fire compartment, make-up air must be provided across each vertical opening from a building void to the fire-affected storey at an average velocity of 1 m/s so as to minimise the spread of smoke from the fire-affected storey to other storeys*".

15.2 Performance Solution

The GSC is provided with multiple exits around the perimeter of the building. The multiple escape paths notwithstanding, egress provisions from parts of the centre that are prescribed to be provided with automatic smoke exhaust and from tenancies with paths of travel via areas that are prescribed to be provided with automatic smoke exhaust, and some smoke hazard management provisions, do not achieve full compliance with the BCA DtS provisions as outlined below.

1. Travel distances to the nearest of the alternative exits in multiple areas are extended up to 61 m in lieu of 40 m (refer to Figure 60 and Figure 61 below, with DtS compliant fire-isolated corridors highlighted in green and areas with extended travel distances highlighted in red), which does not comply with the DtS provisions of BCA Clause D2D5(3)(a).

2. Distances between the alternative exits, when measured through a point of choice, are extended up to 118 m in lieu of 60 m (refer to Figure 62 and Figure 63 below with DtS compliant fire-isolated corridors highlighted in green), which does not comply with the DtS provisions of BCA Clause D2D6(c)(iii). When distances are measured between an exit and a “place of intermediate safety” or between “places of intermediate safety” they are extended only up to 86 m.

Figure 60: Travel distances to the nearest of alternative exits on Ground Floor

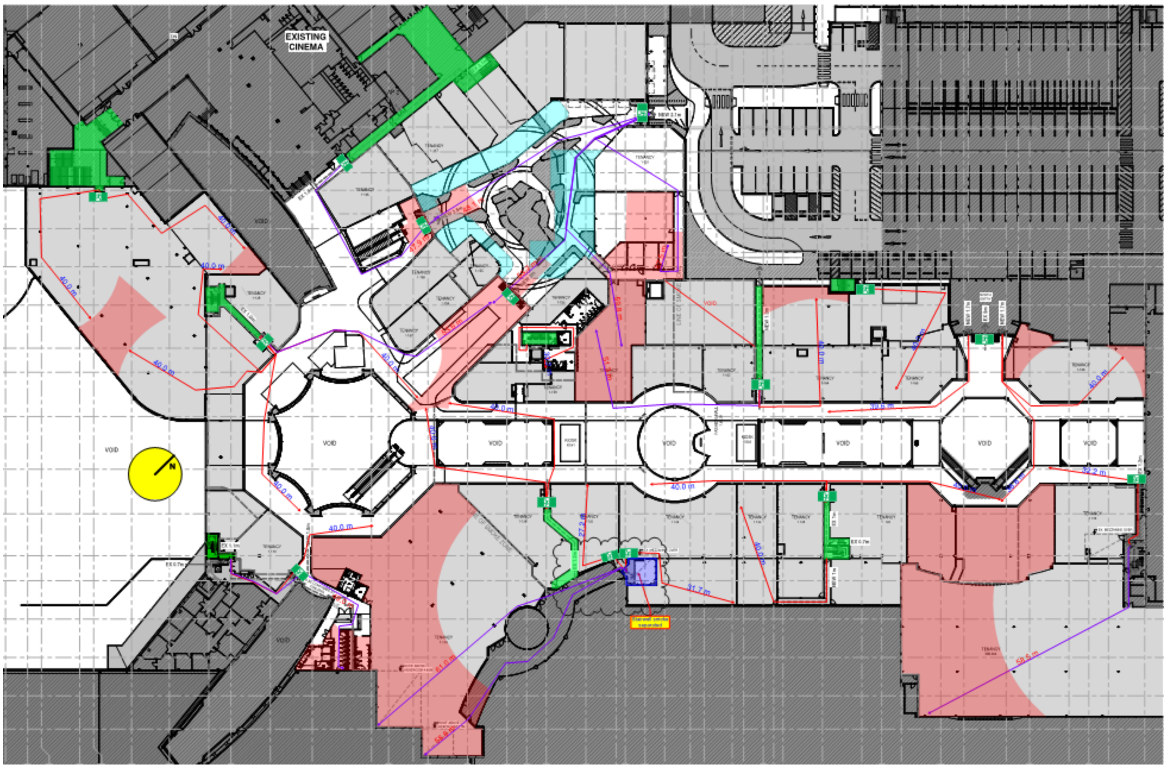

Figure 61: Travel distances to the nearest of alternative exits on First Floor

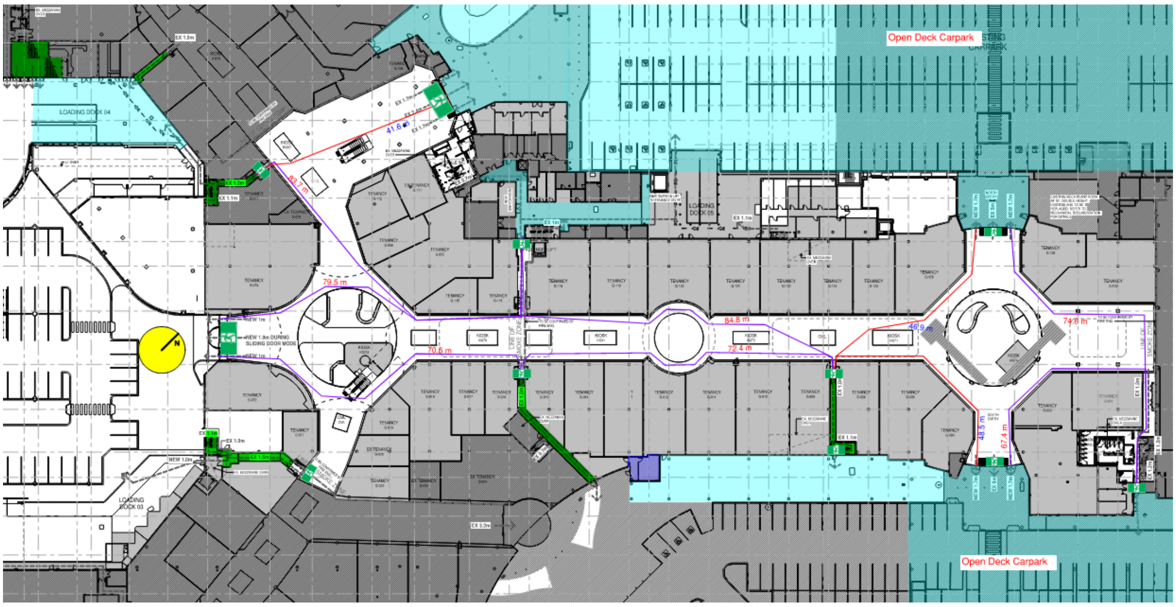

Figure 62: Distances between alternative exits when measured through a point of choice on Ground Floor

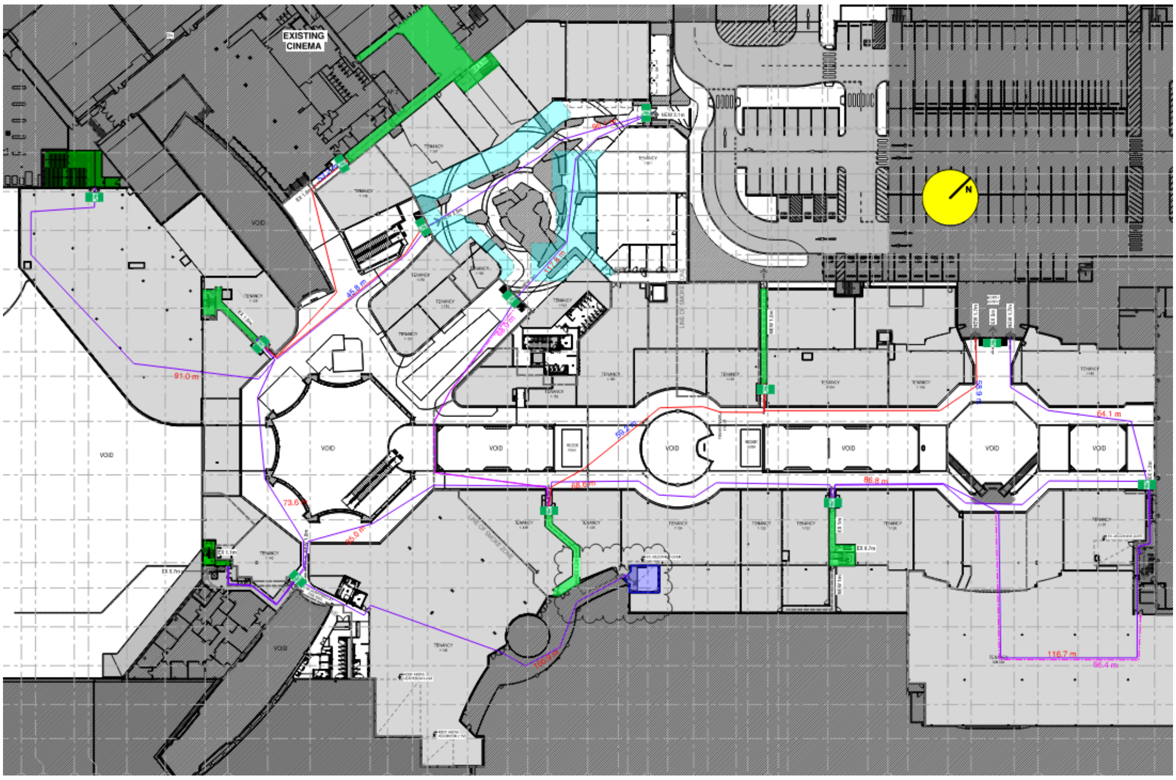

Figure 63: Distances between alternative exits when measured through a point of choice on First Floor

3. The smoke exhaust rates for the Myer retail mall and the Plaza (refer to the configuration of smoke zones as shown in Figure 64 below) are determined on a performance basis in lieu of compliance with Figure S21C2, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C2(2) of BCA Specification 21.

4. The Myer retail mall (smoke zones SZ-03(A), SZ-03(B) and SZ-03(C)) forms a single smoke reservoir with a horizontal length of 144 m in lieu of 60 m, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C4(2) of BCA Specification 21.

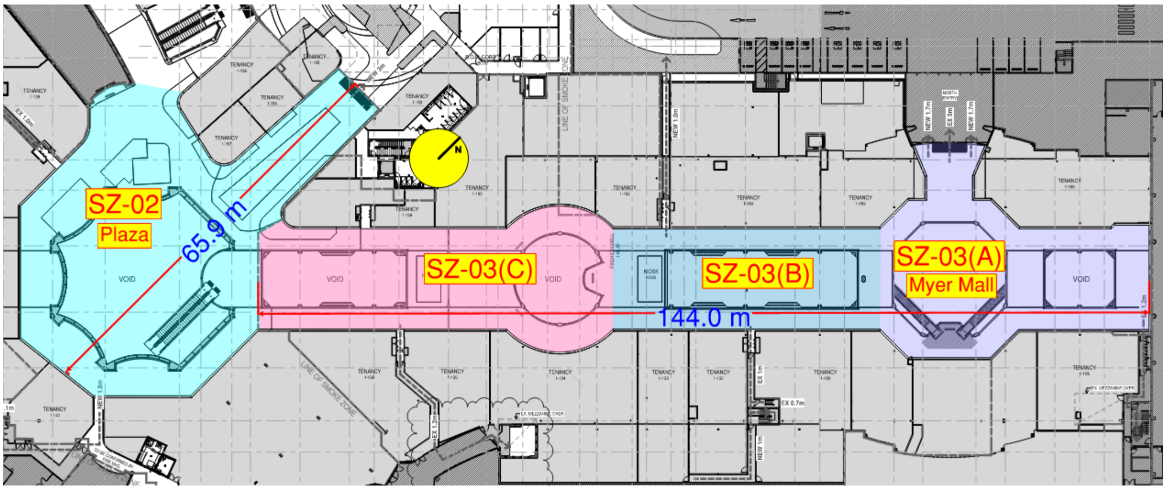

Figure 64: Extended length of smoke reservoirs

5. The Plaza and the associated retail mall (smoke zone SZ-02) form a single smoke reservoir with a horizontal length of 66 m in lieu of 60 m, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C4(2) of BCA Specification 21.

6. Make-up air velocities through vertical openings are determined on a performance basis in lieu of achieving an average velocity of 1 m/s, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C6(3) of BCA Specification 21.

15.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P4 and E2P2.

15.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e., "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

15.5 Intent of the BCA

The intent of Performance Requirement D1P4 is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that for a successful completion of an emergency evacuation a building must be provided with a smoke hazard management system that is appropriately sized and exits that are adequately located, sized and designed so as to provide occupants with safe means of egress from the fire affected areas.

The Guide states regarding the smoke reservoir size that the purpose of specifying maximum smoke reservoir size is because "*smoke reservoirs are necessary to contain the hot layer in the upper levels of compartments, thus preventing the lateral spread of smoke resulting in excessive cooling and downward mixing of the smoke with the relatively clear layer below*" and that in doing so, the design:

- *"enables occupants to make their way through the comparatively clear air below the hot smoke layer; and*
- *"maintains the smoke above any openings between compartments, thus minimising the risk that smoke will migrate to other areas."*

The Guide further states that "*to maximise the effectiveness of smoke reservoirs, the horizontal area formed by a reservoir is limited by Clause S21C4(2) to 2,000 m*^{2}" and that "*the maximum length of a smoke reservoir in a shopping mall is limited by Clause S21C4(2) to 60 metres, due to the distance people would be expected to travel below a smoke layer while evacuating to a safe place, having regard to the potential for smoke, from a fire in a mall or adjacent specialty shop, to flow into more than one reservoir.*"

The relevant BCA DtS provisions are intended to maintain tenable conditions so that occupants can evacuate and therefore if a building is provided with fire safety measures designed to maintain conditions tenable in the evacuation routes for the duration of the evacuation, including adequate safety factors, occupants should be able to leave the building safely, which satisfies the relevant Performance Requirements.

15.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design with extended travel distances to the nearest of the alternative exits and extended distances between the alternative exits in the parts of the GSC that are prescribed to be provided with automatic smoke exhaust, and a performance-based smoke hazard management system in the retail malls should not compromise safe occupant evacuation and should not adversely affect fire brigade intervention.

If it can be demonstrated that during a fire in the retail mall or in a specialty shop not provided with smoke exhaust the installed fire safety measures are capable of maintaining tenable conditions in the escape paths for a period of time sufficient for all occupants to leave the GSC, and fire brigade intervention is facilitated, compliance with Performance Requirements D1P4 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute quantitative deterministic assessment in accordance with the following:

1. Analyse the proposed egress provisions for the GSC identifying all exits, including exits directly to the outside of the building; fire-isolated stairways and corridors; etc.
2. Analyse the smoke hazard management systems in the retail malls, including the type of automatic fire sprinkler and fire detection and alarm systems, and the mechanical smoke exhaust and make-up air supply systems.
3. Identify reasonable worst-credible design fire scenarios, specifying the locations of fires that are expected to have the worst impact on occupant evacuation and fire brigades' intervention.

4. Identify reasonable worst credible sensitivity and/or redundancy fire scenarios. Fire brigade intervention for the sensitivity and redundancy fire scenarios is not considered, as the size of an uncontrolled fire could be beyond the extinguishing capacity of the first arriving units and would require multiple alarms transmitted to be brought under control. DFES operations in the early stages of sensitivity and redundancy fire scenarios are expected to be limited to search and rescue (if conditions permit) and/or protection of exposures.

5. Undertake fire and smoke modelling for the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria.

6. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters.

7. Compare the derived ASET and RSET to determine if the design is acceptable.

15.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *ASET calculated for the design fire scenarios must be equal to or greater than the RSET for the design fire scenarios incorporating a safety factor of 1.5:*

$$ASET \geq 1.5 \times RSET$$

2. *ASET calculated for the redundancy and sensitivity fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

3. *Routine conditions for fire fighters must be maintained up until fire brigade apply water to the fire for the design fire scenarios.*

15.8 Fire Scenarios Selection

The ASET is dependent on the fire characteristics, such as the fire growth rate, the heat release rate, the soot yield, the species concentrations, and the location of a fire. Therefore, an important factor in a fire safety engineering assessment is identifying appropriate fire scenarios.

The derivation of fire parameters (such as soot yield and heat release rate) is discussed in Section 10.3. It is recognised that modelling every possible fire location is not practical, however, the fire locations chosen are considered worst credible locations and appropriate for the analysis. The fire locations are discussed in Table 39 and are shown in Figure 65 below.

Fire Location		Comment
1	DF-01/RF-01 In the Plaza atrium	A fire located under the Plaza atrium is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread.
2	DF-02/RF-02 In the Myer Mall GF circulation space under the void	A fire located in the Myer Mall circulation space under the void is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread.

Fire Location		Comment
3	DF-03/RF-03 In the Myer Mall atrium	A fire located under the Myer Mall atrium is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread.

Table 39: Fire locations

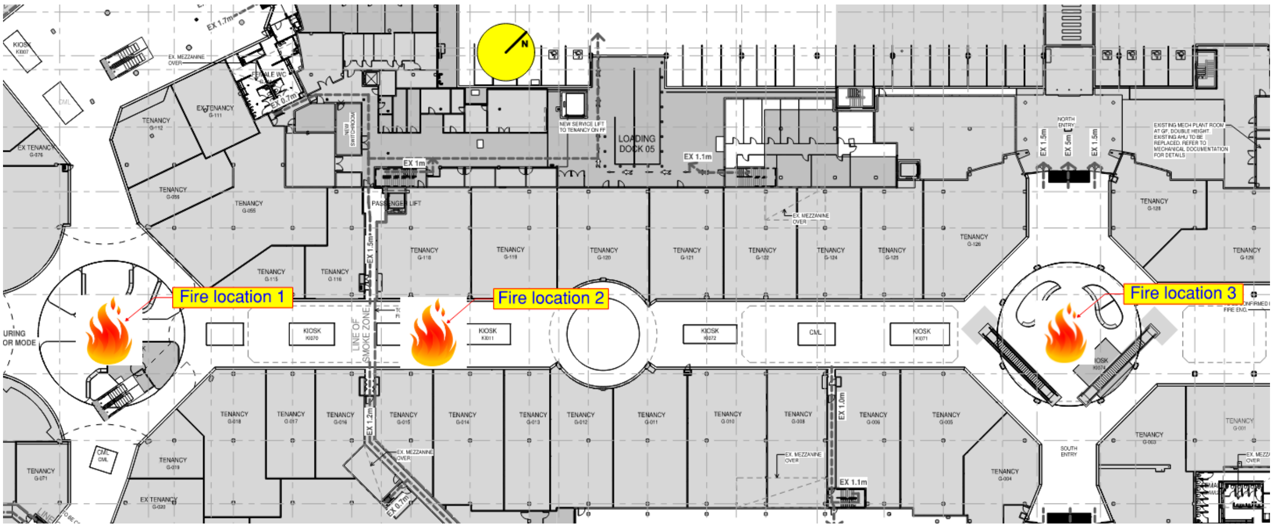

Figure 65: Fire locations

Based on the above fire locations, the discussion provided in Section 10.5 and accounting for the redundancy and sensitivity fire scenarios, the summary of fire scenarios that are assessed as part of this Performance Solution are provided in Table 40.

Fire scenario	Fire Location	Fire growth rate	Comment
PL-DF-01	In the Plaza Atrium – under 20.6 m high roof	Fast t^2 to medium t^2	Design fire scenario
PL-RF-01		Fast t^2 to medium t^2	Redundancy scenario – single plant room failure
MM-DF-02	In the Myer Mall GF circulation space – under 8.8 m high roof	Fast t^2 to medium t^2	Design fire scenario
MM-RF-02		Fast t^2 to medium t^2	Redundancy scenario – single plant room failure
MM-DF-03	In the Myer Mall Atrium – under 25.5 m high roof	Fast t^2 to medium t^2	Design fire scenario
MM-RF-03		Fast t^2 to medium t^2	Redundancy scenario – single plant room failure
SP222-DF			
SP222-RF			
SP222-DF			
SP222-RF			

Table 40: Fire scenarios for the assessment

15.9 Sprinkler Activation Times and Fire Sizes

In this assessment sprinkler activation times were modelled based on the following parameters:

Protected to	Spacing	Temperature rating of the sprinkler heads	Response Time Index (RTI)	C-factor
AS 2118.1-2017; OH-3 (fast response sprinklers)	3 m x 4 m	68ºC	50 $ms^{-1/2}$	0.65 $m/s^{-1/2}$

Table 41: Input parameters for determining time to sprinkler system activation

Sprinkler activation times were based on the ceiling height in the vicinity of each fire location. Modelling was carried out using the module 'Sprinkler' from the FireWind 3.6 suite of fire safety engineering software (refer to Appendix I, Section 35). A summary of sprinkler activation times and the heat release rate of the fire for each fire scenario is provided in Table 42 below:

Fire Scenario	Roof height (m)	First sprinkler activation time (sec)	Fifth sprinkler activation time (sec)	HRR (MW)
PL-DF-01	20.6	501	593	12.95
PL-RF-01				
PL-SF-01		257	304	13.63
MM-DF-02	8.8	242	346	3.46
MM-RF-02				
MM-SF-02		129	182	3.89
MM-DF-03	25.5	645	682	20.09
MM-RF-03				
MM-SF-03		330	348	21.00

Table 42: Sprinkler activation times and heat release rates

15.10 Available Safe Egress Time

The ASET is based on the analysis of the output data from FDS modelling provided in Appendix J (Section 36) of this report.

Fire scenario	ASET due to visibility	ASET due to temperature	ASET for DFES
PL-DF-GF-01a	> 1,200	> 1,200	> 1,200
PL-DF-1F-01a	650	> 1,200	> 1,200
PL-DF-GF-01b	> 1,200	> 1,200	> 1,200
PL-DF-1F-01b	650	> 1,200	> 1,200
PL-RF-GF-01	> 600	> 600	N/A
PL-RF-1F-01	500	> 600	N/A
MM-DF-GF-01a	> 1,200	> 1,200	> 1,200
MM-DF-1F-01a	650	> 1,200	> 1,200
MM-DF-GF-01b	> 1,200	> 1,200	> 1,200
MM-DF-1F-01b	650	> 1,200	> 1,200
MM-RF-GF-01	> 600	> 600	N/A
MM-RF-1F-01	500	> 600	N/A
MM-DF-GF-02a	> 1,200	> 1,200	> 1,200
MM-DF-1F-02a	650	> 1,200	> 1,200

Fire scenario	ASET due to visibility	ASET due to temperature	ASET for DFES
MM-DF-GF-02b	> 1,200	> 1,200	> 1,200
MM-DF-1F-02b	650	> 1,200	> 1,200
MM-RF-GF-02	> 600	> 600	N/A
MM-RF-1F-02	500	> 600	N/A

Table 43: ASET summary

15.11 Required Safe Egress Time

As detailed in Section 10.2.3, the RSET is the sum of the cue time, pre-movement time and egress time. The sections below detail how these times were derived.

15.11.1 Cue Time (t_d)

The detection times for the GSC were calculated using computer program FDS and are based on the results provided in Appendix K (Section 37). Table 44 below summarises the cue times for each fire scenario.

Fire scenario	Roof Height (m)	Smoke detector activation time (sec)	Alarm verification time (sec)	Cue Time (sec)
PL-DF-01	20.6	47	20	67
PL-RF-01		47	20	67
MM-DF-02	8.8	47	20	67
MM-RF-02		47	20	67
MM-DF-03	25.5	47	20	67
MM-RF-03		47	20	67

Table 44: Cue times

15.11.2 Pre-movement Time (t_{pm})

The A pre-movement time of 120 seconds was adopted in the analysis, as detailed in Section 10.2.2.

15.11.3 Occupant Evacuation Time (t_e)

The egress time was calculated using Pathfinder as detailed in Section 10.2.3.

The egress time, which consists of the time to walk to an exit and the time to queue at the exit, is dependent on the number of people evacuating a room or part of a building, as well as the width of the escape routes.

Three egress scenarios were modelled:

1. Design egress scenario (GSC-ES-01) – occupant numbers in areas accessible to customers are based on Project 6 occupant density of 6 m²/person – 3,707 people evacuate.
2. Sensitivity egress scenario (GSC-ES-02) – occupant numbers in F&B or entertainment tenancies areas accessible to customers are based on the BCA DtS compliant occupant

density of 1 m²/person with other areas accessible to customers based on Project 6 occupant density of 6 m²/person – 7,352 people evacuate.

The analysis of the modelling results indicates that all occupants should be able to leave the centre in 232 seconds during the design egress scenario and in 420 seconds during the sensitivity egress scenario.

Screenshots from the Pathfinder egress modelling are provided in Appendix G (Section 37) of this report.

15.11.4 RSET Summary

Table 45 summarises the RSET for the design and sensitivity egress scenarios.

Fire scenario	Cue Time (sec)	Pre-movement time (sec)	Evacuation time (sec)	RSET (sec)
PL-DF-GF-01a	67	120	232	419
PL-DF-1F-01a	67	120	224	411
PL-DF-GF-01b	67	120	420	607
PL-DF-1F-01b	67	120	308	495
PL-RF-GF-01	67	120	232	419
PL-RF-1F-01	67	120	224	411
MM-DF-GF-01a	67	120	232	419
MM-DF-1F-01a	67	120	224	411
MM-DF-GF-01b	67	120	420	607
MM-DF-1F-01b	67	120	308	495
MM-RF-GF-01	67	120	232	419
MM-RF-1F-01	67	120	224	411
MM-DF-GF-02a	67	120	232	419
MM-DF-1F-02a	67	120	224	411
MM-DF-GF-02b	67	120	420	607
MM-DF-1F-02b	67	120	308	495
MM-RF-GF-02	67	120	232	419
MM-RF-1F-02	67	120	224	411

Table 45: RSET summary

15.12 ASET vs RSET Assessment

The ASET vs RSET assessments for the GSC is summarised in Table 46. As discussed in Section 10.2.4, a safety factor of 1.5 is applied to the design fire scenarios and a safety factor of 1.0 is applied to the sensitivity and redundancy fire scenarios.

The design fire scenarios were assessed both against the design and sensitivity egress scenarios; however, for the sensitivity egress scenarios a safety factor of 1.5 was not applied to the RSET.

The ASET for the design, sensitivity, and redundancy fire scenarios were based on the limiting criteria as outlined in Section 10.4. Based on the analysis of the CFD modelling output data, it is considered reasonable to conclude that the RSET for the fire scenarios are smaller or at least equal to the ASET values. It is noted that ASET was assessed at the RSET x Safety Factor times, and therefore ASET may be further extended, and the safety factors achieved are therefore greater than the minimum required, although this is not quantified.

Fire scenario	RSET (s)	Safety Factor	RSET x Safety Factor (sec)	ASET (sec)	Acceptable?
PL-DF-GF-01a	419	1.5	629	> 1,200	YES
PL-DF-1F-01a	411	1.5	617	650	YES
PL-DF-GF-01b	607	1.0	607	> 1,200	YES
PL-DF-1F-01b	495	1.0	495	650	YES
PL-RF-GF-01	419	1.0	419	> 600	YES
PL-RF-1F-01	411	1.0	411	500	YES
MM-DF-GF-01a	419	1.5	629	> 1,200	YES
MM-DF-1F-01a	411	1.5	617	650	YES
MM-DF-GF-01b	607	1.0	607	> 1,200	YES
MM-DF-1F-01b	495	1.0	495	650	YES
MM-RF-GF-01	419	1.0	419	> 600	YES
MM-RF-1F-01	411	1.0	411	500	YES
MM-DF-GF-02a	419	1.5	629	> 1,200	YES
MM-DF-1F-02a	411	1.5	617	650	YES
MM-DF-GF-02b	607	1.0	607	> 1,200	YES
MM-DF-1F-02b	495	1.0	495	650	YES
MM-RF-GF-02	419	1.0	419	> 600	YES
MM-RF-1F-02	411	1.0	411	500	YES

Table 46: ASET vs RSET assessment

Based on the ASET versus RSET comparison presented above, it is reasonable to conclude that in a fire emergency, occupants should be able to evacuate the GSC safely.

Review of the slice files provided in Appendix J (Section 36) demonstrates that untenable conditions in the retail mall are not lost at any time during the simulations; therefore, as soon as occupants reach the retail mall may be considered to be in a place of intermediate safety, which further increases the safety margin.

Based on the discussion above, the analysis demonstrates that the relevant acceptance criteria have been satisfied.

15.13 FBIM Assessment

FDS simulations were run for 1,200 seconds (20 minutes) for the design fire scenarios. At that time, the temperature at 1.5 m AFFL was less than 100°C.

As shown in Appendix H (Section 38), DFES intervention (application of water) is expected to occur approximately 19 minutes after fire initiation, at which time the tenability conditions for fire brigade intervention should not be compromised.

Based on the outcomes of the FDS modelling and FBIM analysis, DFES are considered to be provided with tenable conditions sufficient to commence an attack on a fire.

15.14 Conclusion

This assessment demonstrates that the acceptance criteria for the analysis are met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements, as outlined in Section 25.

16. Performance Solution No. 6 – Performance-based Access to Fire-Isolated Corridor 03

16.1 Relevant BCA DtS Provisions

BCA Clause D2D12(1) states that "*a doorway from a room must not open directly into a passageway that is required to be fire-isolated unless it is from: a public corridor, public lobby or the like; a sole-occupancy unit occupying all of a storey; or a sanitary compartment, airlock or the like*".

16.2 Performance Solution

The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03), as shown in Figure 66, which does not comply with the DtS provisions of Clause D2D12(1).

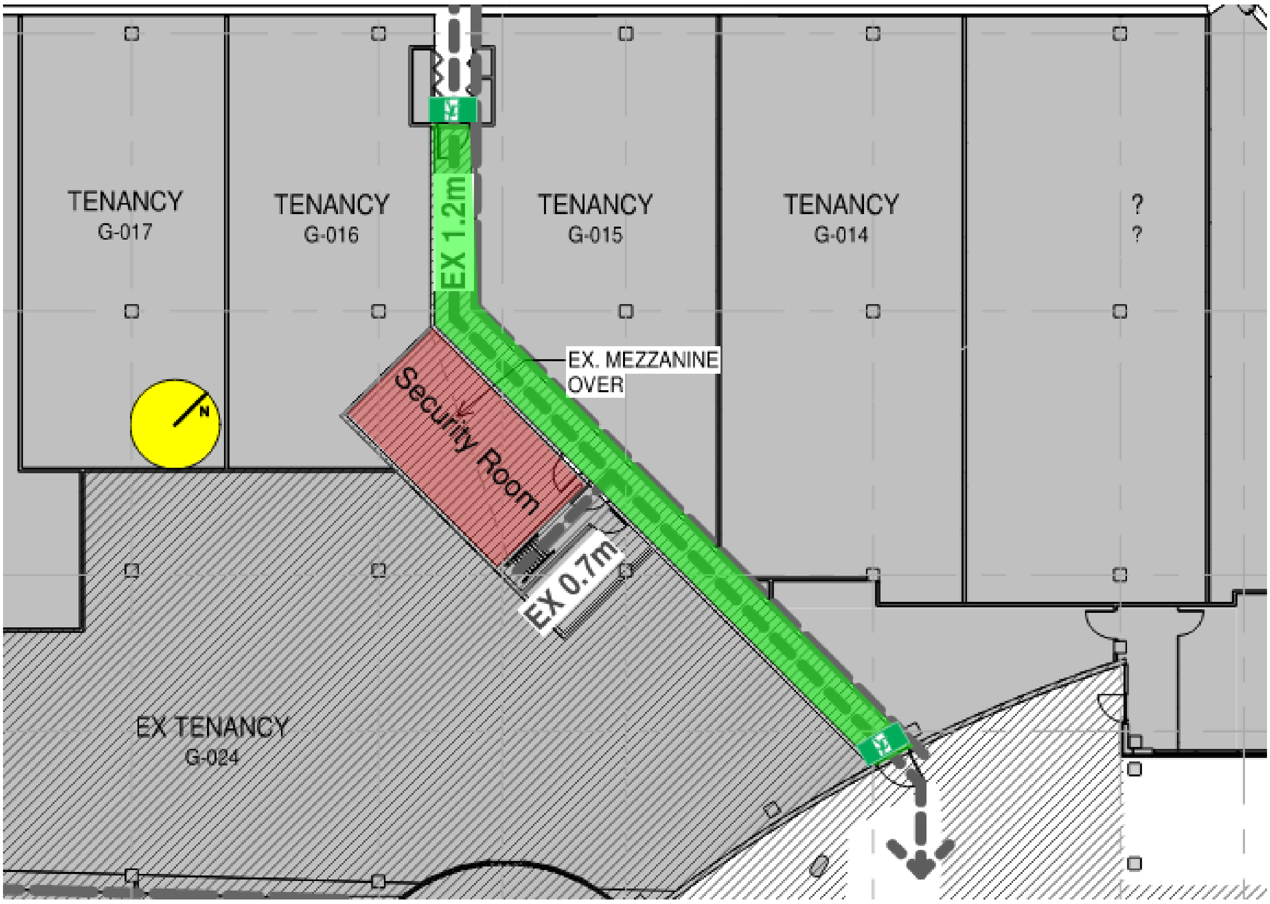

Figure 66: Security room open directly into fire-isolated corridor 03

16.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P5 and E2P2.

16.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

16.5 Intent of the BCA

The intent of Performance Requirement D1P5 (formerly DP5) is to provide fire-isolated exits, where necessary, to facilitate safe evacuation of occupants and fire brigade intervention. The Guide to BCA states that fire-isolated exits are used to:

- "*Enable people to evacuate safely past a storey on fire*;
- *"Facilitate fire brigade access to carry out operations such as search and rescue and fire-fighting*;
- *"Minimise the distance people need to travel in a fire affected area before they are able to access a "safe place", such as a fire-isolated stairway*."

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident from the above that fire-isolated exits are required to provide occupants with safe means of egress while reducing the time they might have to travel through the fire affected areas, as well as facilitating fire brigade's personnel fast and safe access to these areas. However, to understand how doorways opening directly into a fire-isolated exit from a room that does not occupy the whole storey could impact safe evacuation of the occupants the intent of Clause D2D12(1) (formerly D1.7(a)) must be understood.

The Guide to the BCA indicates that the intent of Clause D1.7 is "*to enable occupants to safely enter a fire-isolated exit which discharges to a safe location*", and the intent of sub-clause (a) is "*to limit the number of entry points into a fire-isolated exit to retain its fire resisting performance*".

The BCA DtS provisions allow a public corridor, public lobby [smoke lobby], or the like, as well as a "*sole-occupancy unit occupying all of a storey*" to open directly into a fire-isolated exit. It is reasonable to assume that a public corridor and to a lesser degree a retail mall in a shopping centre should have a performance that is not dissimilar to that of a smoke lobby, as they are reasonably free of combustible materials and create a buffer between the fire affected area and a fire-isolated exit. However, it is not clear why a "*sole-occupancy unit occupying all of a storey*" can open directly into a fire-isolated exit and one that does not, cannot provide direct access. The Guide to the BCA remains silent on this issue.

It is understood that independent of a floor/storey configuration the main intent of the BCA in relation to access to fire-isolated exits is to protect occupants using these exits from dangerous combustion products, so the building can be evacuated safely. This can be achieved only if the doors to fire-isolated exits remain closed and an effective barrier to smoke spread is provided.

It is understood that the main concern of the BCA, as reflected in Clause D1.7(a), is that sole-occupancy units that do not occupy the whole of a storey are generally smaller tenants, who may not be concerned with keeping the door to the fire-isolated exit closed, as they may use it regularly to move stock, access other parts of the building, or even use it for ventilation. Hence with several smaller tenants occupying the same floor/storey the risk of a door being left open multiplies.

Sole-occupancy units occupying the whole of a storey are generally major tenants who take particular care of their security arrangements. In such tenancies the likelihood of a door opening into a fire-isolated exit being left open is significantly reduced, as keeping a door properly closed becomes self-regulatory due to security reasons.

16.6 Assessment Methodology

The purpose of this assessment is to demonstrate that safe occupant evacuation of building occupants and fire brigade intervention should not be compromised due to a room that does not occupy the whole of a storey opening directly into a fire-isolated corridor.

If it can be demonstrated that during a potential fire occupants from the existing security room and MDF room on Ground Floor and from the existing plant room AP7 on Ground Floor Mezzanine can evacuate safely via fire-isolated corridor 03 and occupants elsewhere in the GSC are provided with adequate warning that evacuation via fire-isolated corridor 03 should be avoided, and fire brigade personnel are provided with alternative access routes to the fire affected area, then compliance with Performance Requirements D1P5 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute qualitative deterministic analysis in accordance with the following:

1. Identify the doorway that opens into fire-isolated corridor 03 directly from a room that does not occupy a whole storey.
2. Identify occupants who have to or may be evacuating via fire-isolated corridor 03.
3. Develop a fire safety strategy that would limit the potential for smoke spread into fire-isolated corridor 03 in the initial stages of fire development and would also enable occupants from other rooms and parts of the GSC either to evacuate via the corridor safely or avoid evacuation via this corridor altogether.
4. Identify alternative access routes for fire brigade and determine whether their intervention is facilitated.
5. If the adopted fire safety strategy limits the potential for smoke spread into fire-isolated corridor 03, provides an adequate warning to occupants that would enable them to evacuate safely and facilitates fire brigade intervention, then compliance with the relevant Performance Requirements of the BCA is achieved.

16.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *Smoke from security room shall not spread into fire-isolated corridor 03 in the initial stages of fire development.*
2. *Occupants who have to evacuate via fire-isolated corridor 03 shall be provided with timely and adequate warning that tenability conditions in the corridor may be quickly compromised due to a fire in the security room.*
3. *Occupants in other parts of the GSC shall be provided with adequate warning that evacuation via fire-isolated corridor 03 may not be safe and alternative escape routes shall be used.*

4. *Fire brigade shall be provided with alternative access routes to the GSC that do not involve travel via fire-isolated corridor 03.*

16.8 Fire Scenarios

Tenability in the performance-based fire-escape corridor may be compromised if a fire starts in the areas that are connected to or are adjacent to the corridor; therefore, the following fire scenarios were identified as requiring assessment:

1. Fire scenario 4.1 – fire starts in security Room

16.9 Assessment

The Security Room has one (1) doorway that opens directly into fire-isolated corridor G.BO.03. Smoke detector —identified by the symbol 'S'—is installed in front of this doorway and this room is designated as Fire Alarm Zone FAZ-06, as highlighted in orange in Figure 67 below.

This smoke detector is connected to the dynamic RED exit signage located at fire-isolated corridor G.BO.03 (refer to Figure 67 below).

In the event of a fire within FAZ-06, the smoke detector will activate the dynamic RED signs, displaying a red cross in place of the green running man. This signals that corridor G.BO.03 is no longer safe to enter, and prevents occupants from the retail mall from egressing via this corridor.

Based on the above, it is considered that the alternative building design—incorporating a doorway from the Security Room opening directly into the fire-isolated corridor—adequately facilitates occupant evacuation.

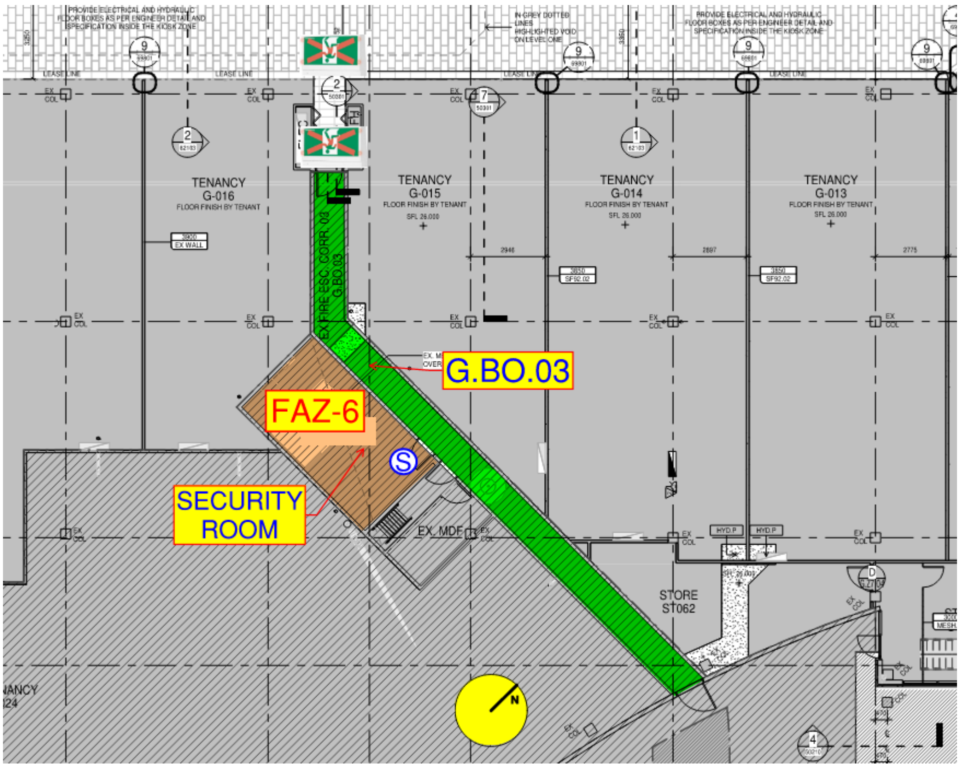

Figure 67: Ground Floor fire alarm zone FAZ-6

16.10 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements on a comparative basis, as outlined in Section 25.

17. Performance Solution No. 7 – Performance-based Discharge from Fire-Isolated Exits

17.1 Relevant BCA DtS Provisions

BCA Clause D2D12(2) in part states that "*each fire-isolated stairway or fire-isolated ramp must provide independent egress from each storey served and discharge directly, or by way of its own fire-isolated passageway— (a) to a road or open space; or (b) to a point— (i) in a storey or space, within the confines of the building, that is used only for pedestrian movement, car parking or the like and is open for at least 2/3 of its perimeter; and (ii) from which an unimpeded path of travel, not further than 20 m, is available to a road or open space*".

17.2 Performance Solution

First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) from where occupants need to use a required non-fire-isolated stairway to leave the building (refer to Figure 68) in lieu of to a road or open space, which does not comply with the DtS provisions of Clause D2D12(2)(a).

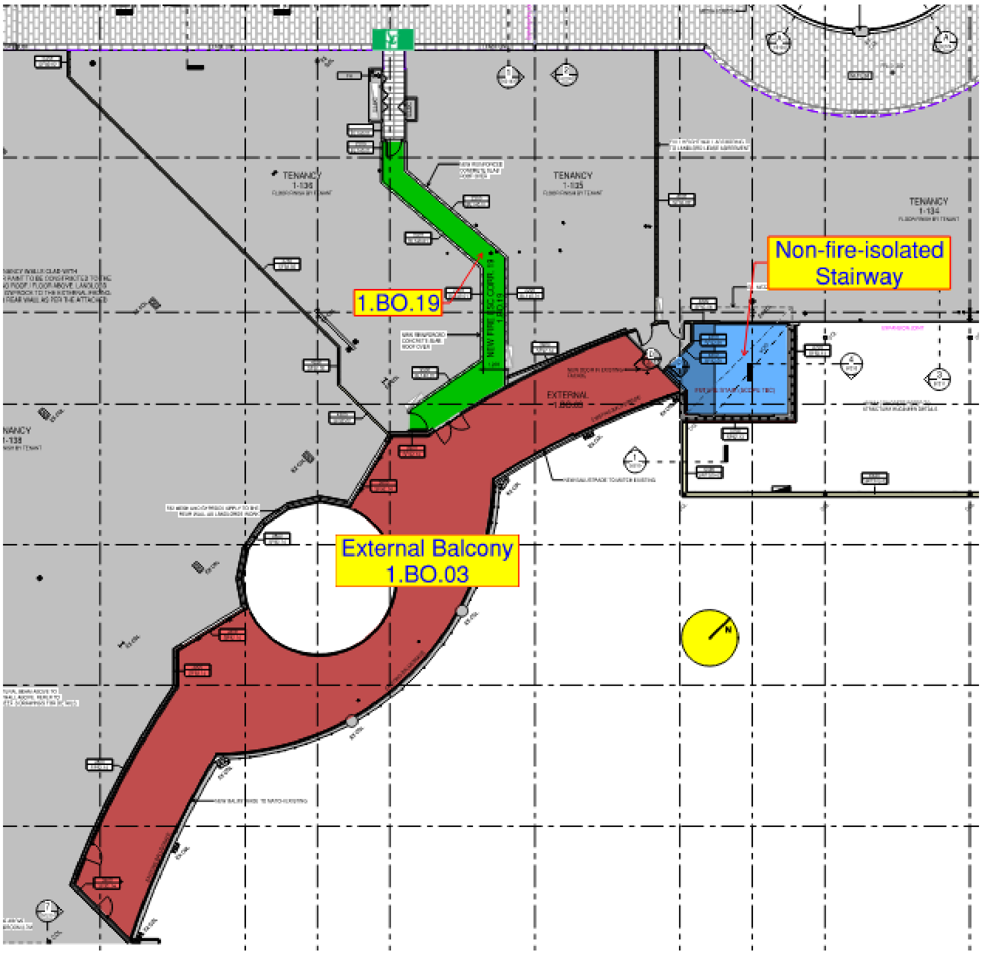

Figure 68: Fire-isolated corridor 19 that discharges onto an external balcony

Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space (refer to Figure 69, where the extent of the loading dock is highlighted red, and Figure 70 below), which does not comply with the DtS provisions of Clause D2D12(2)(b).

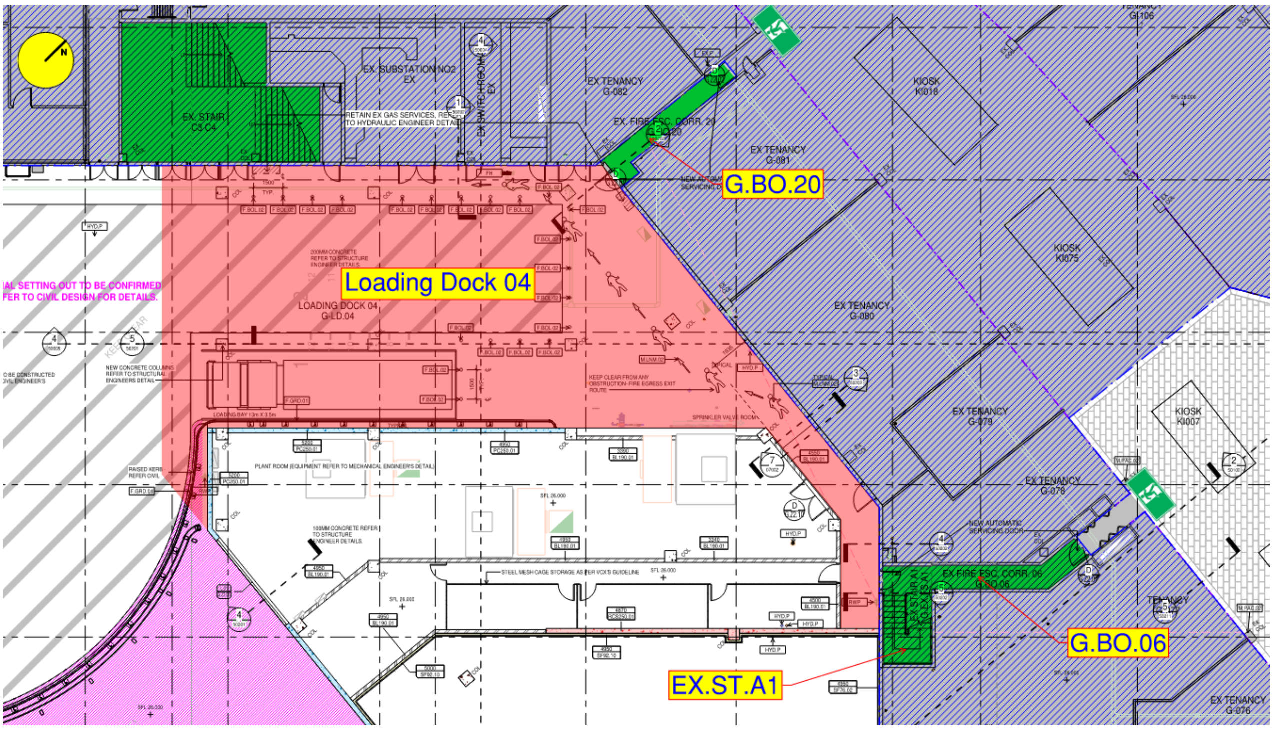

Figure 69: Fire-isolated corridors 06 and 20 that discharge into Loading Dock 04 on Ground Floor

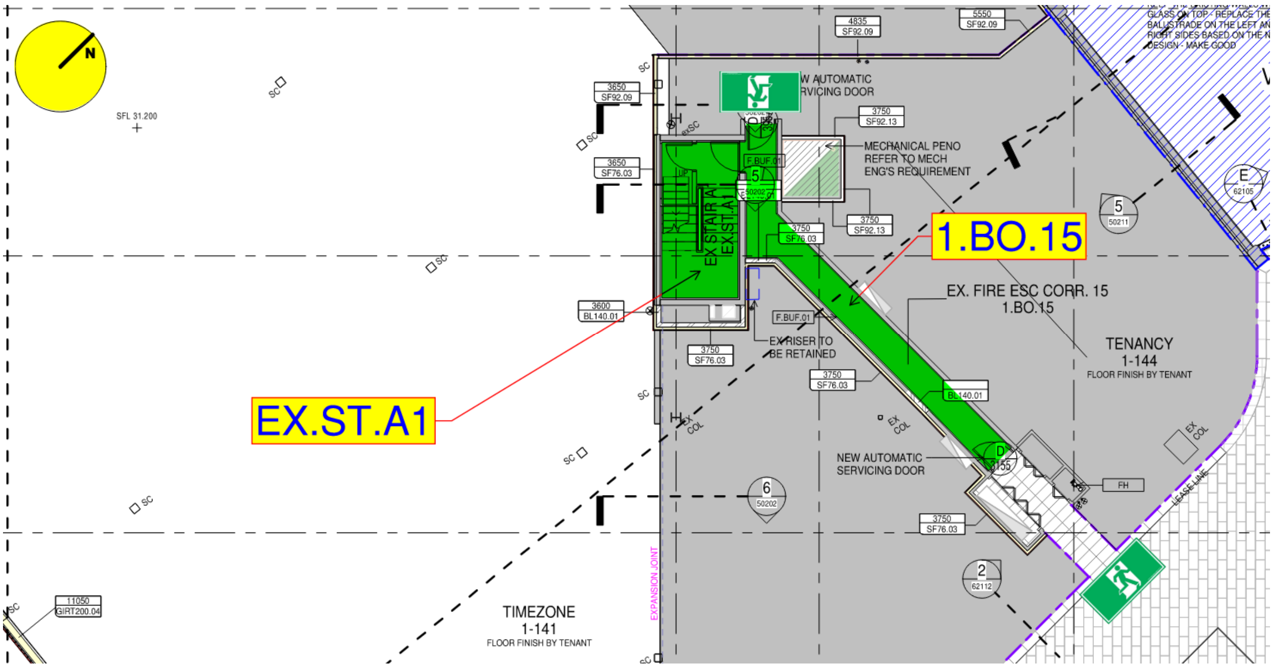

Figure 70: Fire-isolated corridor 15 that discharges into fire-isolated Stair A1 on First Floor

17.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P5 and E2P2.

17.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

17.5 Intent of the BCA

The intent of Performance Requirement D1P5 (formerly DP5) is to provide fire-isolated exits, where necessary, to facilitate safe evacuation of occupants and fire brigade intervention. The Guide to BCA states that fire-isolated exits are used to:

- "*Enable people to evacuate safely past a storey on fire*;
- *"Facilitate fire brigade access to carry out operations such as search and rescue and fire-fighting*;
- *"Minimise the distance people need to travel in a fire affected area before they are able to access a "safe place", such as a fire-isolated stairway*."

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident from above that fire-isolated exits in a building are required to provide occupants with safe means of egress while reducing the time they might have to travel through the fire affected areas, as well as facilitating fire brigade's personnel fast and safe access to these areas.

The Guide to the BCA indicates that the intent of Clause D2D12 (formerly D1.7) is "*to enable occupants to safely enter a fire-isolated exit which discharges to a safe location*". While the BCA allows fire-isolated exits to discharge into semi-enclosed parts of the building provided with adequate openings "*to aid smoke ventilation*", the path of travel from the point of discharge of a fire-isolated exit must be adequately protected from combustion products so occupants may reach a road or open space safely.

17.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design should facilitate safe occupant evacuation and fire brigade intervention even though some fire-isolated exits discharge into areas that do not comply with the BCA DtS provisions.

It is considered that if it can be demonstrated that occupants do not have to evacuate via the fire-escape corridors that discharge into areas that do not comply with the BCA DtS provisions if a fire stars in those areas, and alternative escape paths that would facilitate safe occupant evacuation are available, and fire brigade personnel are provided with alternative access routes, then compliance with Performance Requirements D1P5 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute qualitative deterministic analysis in accordance with the following:

1. Identify where fire-isolated exits discharge into non-compliant locations and assess the configuration of those spaces.

2. Identify fire scenarios that could occur in those spaces, and whether they could compromise safe occupant evacuation from the fire-isolated exits.

3. Identify occupants who have to or may be evacuating via the subject fire-isolated exits.

4. Develop a fire safety strategy that would allow occupants from the rooms that discharge into the subject fire-isolated exits and from other parts of the GSC to evacuate the building safely.

5. Identify alternative access routes for fire brigade intervention and determine whether their intervention is facilitated.

6. If the adopted fire safety strategy provides an adequate warning to occupants that would enable them to evacuate safely and facilitates fire brigade intervention, then compliance with the relevant Performance Requirements of the BCA is achieved.

17.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *Occupants from plant room AP4 on Ground Floor Mezzanine and from Tenancy 1-144 on First Floor shall be provided with timely and adequate warning that conditions in Loading Dock 04 may not be tenable and evacuation via fire-isolated corridors 06 and 15 may not be safe and shall be provided with an alternative escape path.*

2. *Occupants in other parts of the GSC shall be provided with adequate warning that evacuation via fire-isolated corridors 06, 15, 19 and 20 may not be safe and alternative escape routes shall be used.*

3. *Fire brigade shall be provided with alternative access routes to the GSC that do not involve travel via fire-isolated corridors 06, 15, 19 and 20.*

17.8 Fire Scenarios

Tenability in the performance-based fire-escape corridor may be compromised if a fire starts in the areas that are connected to or are adjacent to the corridor; therefore, the following fire scenarios were identified as requiring assessment:

6. Fire scenario 7.1 – fire starts in storage units (adjacent Tenancy G-074)

7. Fire scenario 7.2 – fire starts in the new mechanical plantroom or Loading Dock 04

8. Fire scenario 7.3 – fire starts in Tenancy 1-134 or 1-135

17.9 Assessment

17.9.1 Fire Scenario 7.1 – Fire Starts in Storage Units (adjacent Tenancy G-074)

The storage room has a single doorway on its northern elevation that opens directly into the new Ground Floor Loading Dock 04 (G-LD.04). Smoke detectors—identified by the symbol ‘S’—are installed in front of this doorway as well as in front of each individual storage unit door within the room. This area is designated as Fire Alarm Zone FAZ-03, as highlighted in orange in Figure 71 below.

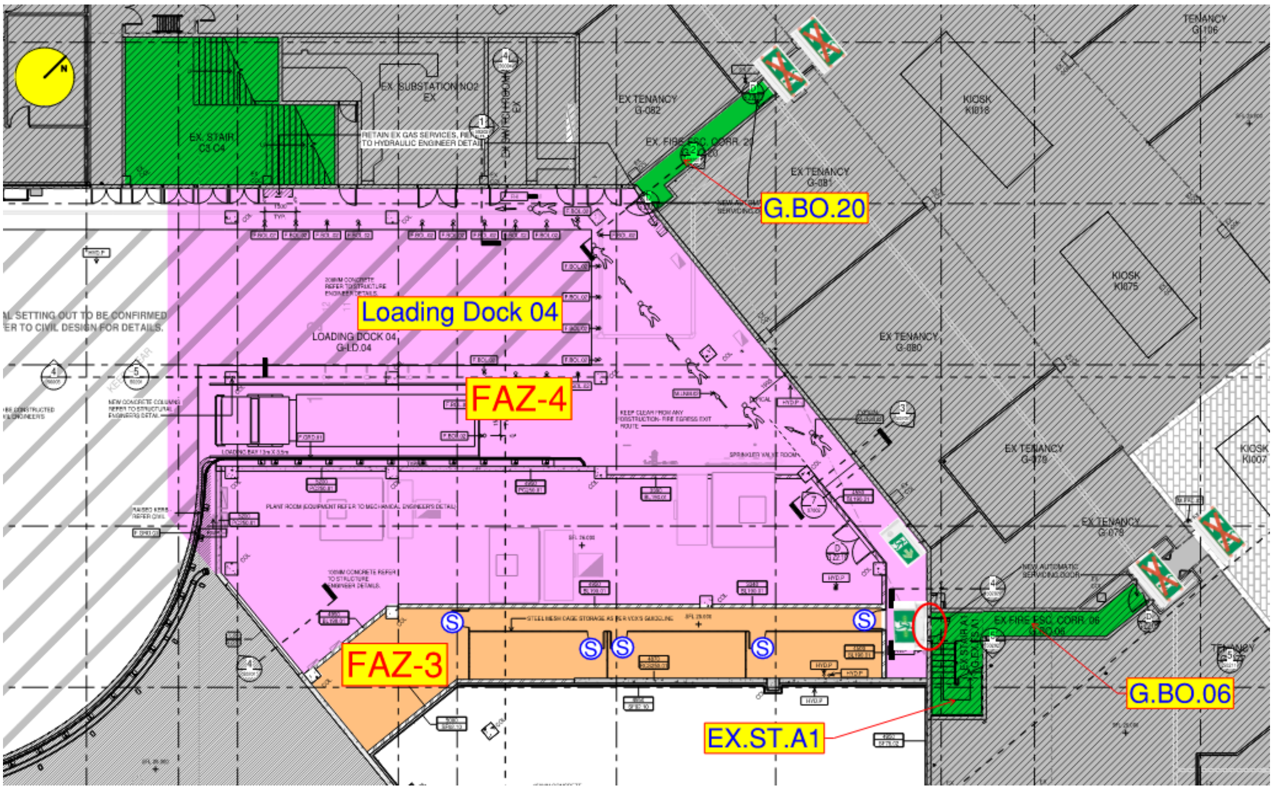

Figure 71: Loading Dock 04 fire alarm zones FAZ-3 and FAZ-4

These smoke detectors are connected to the dynamic RED exit signage located at fire-isolated stairs and corridors G.BO.06, G.BO.20, 1.BO.15, and EX.ST.A1 (refer to Figure 71 and Figure 72). Additionally, these detectors are also linked to dynamic GREEN directional exit signage above the door from Loading Dock 04 to fire-isolated corridor G.BO.06, as well as to the dynamic GREEN exit signage with sounder located along the evacuation path from Plantroom AP.ENT to this same door (refer to Figure 71).

In the event of a fire within FAZ-03, the smoke detectors will activate the dynamic RED signs, displaying a red cross in place of the green running man. This signals that affected egress paths—such as corridor G.BO.06, G.BO.20 and 1.BO.15—are no longer safe, and prevents occupants from the retail mall from entering these corridors.

Simultaneously, the dynamic GREEN exit signage and directional signage with sounder will activate. The audible alert warns occupants in Loading Dock 04, the mechanical room, and the storage units to evacuate. The illuminated green running man symbol indicates that they may safely egress into corridor G.BO.06 to re-enter the retail mall or they can egress via Loading Dock 04 into the open air.

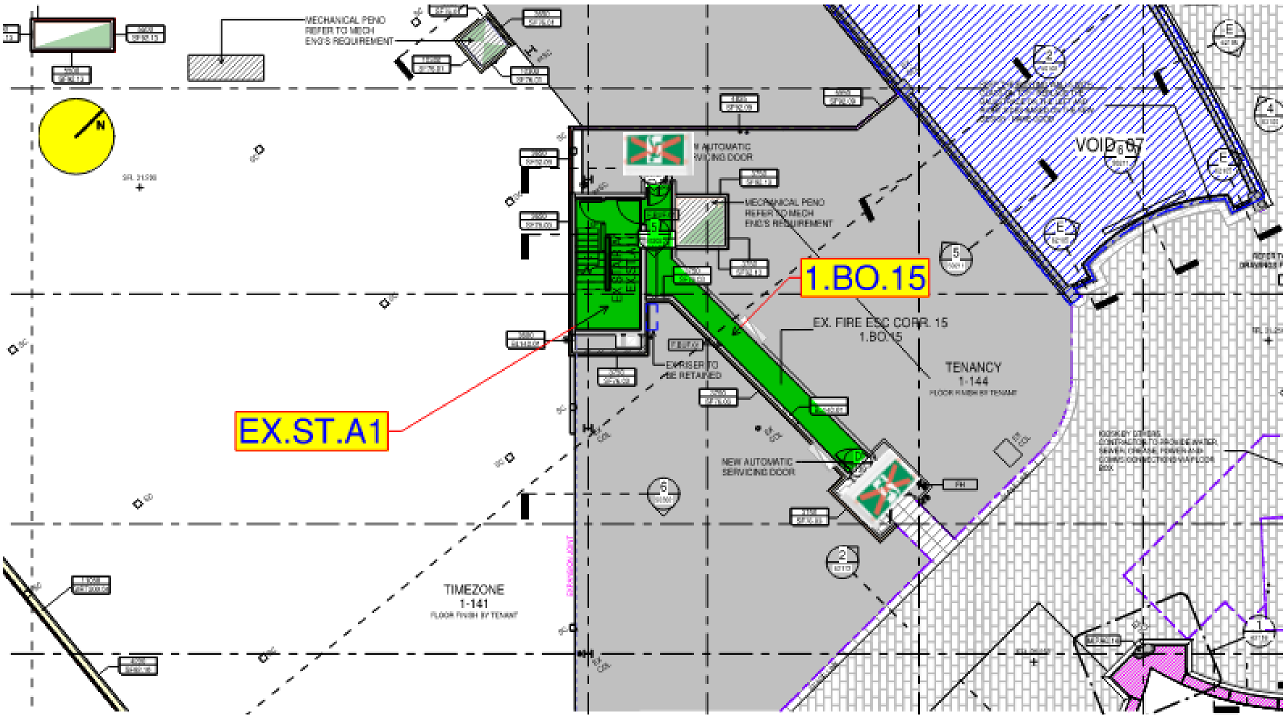

Figure 72: RED dynamic exit signage above corridor 1.BO.15

17.9.2 Fire Scenario 7.2 – Fire Starts in New Mechanical Plantroom

The new mechanical plantroom also has one (1) doorway on its northern elevation that opens directly into the same Loading Dock 04. Existing Tenancy G-080 has two (2) exits: one via the shopfront and one (1) doorway on its southern elevation that also opens directly into Ground Floor Loading Dock 04 (G-LD.04).

Loading Dock 04 is open to the air along its south-western side; however, the size of this opening is less than two-thirds of the dock's total perimeter.

Both the mechanical plantroom and Loading Dock 04 (G-LD.04) are equipped with heat detectors and are designated as Fire Alarm Zone FAZ-04, highlighted in pink. FAZ-04 shares the same egress strategy as FAZ-03, as outlined in Section 17.9.1. These detection systems are connected to the same dynamic RED exit signage located at fire-isolated stairs and corridors G.BO.06, G.BO.20, 1.BO.15, and EX.ST.A1. They are also linked to dynamic GREEN directional exit signage above the door from Loading Dock 04 to fire-isolated corridor G.BO.06, as well as to dynamic GREEN exit signage with a sounder located along the evacuation path from Plantroom AP.ENT to the same door (refer to Figure 71).

In the event of a fire within FAZ-04—either in the mechanical room or within Loading Dock 04—the heat detectors will activate the dynamic exit signage, displaying a red cross in place of the green running man. This indicates that the affected egress paths such as G.BO.06, G.BO.20, 1.BO.15, and EX.ST.A1 are no longer safe and prevents occupants from entering the associated corridors or stairwells.

Simultaneously, the dynamic GREEN exit signage and directional signage with sounder will activate. The audible alert warns occupants in Loading Dock 04, the mechanical room, and the storage units to evacuate. The illuminated green running man symbol indicates that occupants may safely egress either through corridor G.BO.06 to re-enter the retail mall.

Tenancy G-080 is provided with two (2) means of egress. If occupants open the southern exit door and encounter untenable conditions in Loading Dock 04, they may turn back and evacuate via the shopfront or they can re-enter into the retail mall via corridor G.BO.06.

Based on the above discussion, it is considered that the alternative building design with existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) is capable of adequately facilitating occupant evacuation.

17.9.3 Fire Scenario 7.3 – Fire Starts in Tenancy 1-134 or 1-135

Existing tenancies 1-136 and 1-138 have two (2) exits: one via the shopfront, and one (1) doorway on the south-eastern elevation that opens onto the balcony which then leads into the lobby preceding the stairwell.

The existing balcony is open to the air and is expected to have a relatively low fuel load, as it is used as a back-of-house circulation space for Tenancies 1-136 and 1-138.

Tenancies 1-134 and 1-135 are provided with smoke detection and are designated as Fire Alarm Zone FAZ-05 as shown in Figure 73 highlighted in orange. This zone is connected to the dynamic exit signage located at the entrance to the fire-isolated corridor 1.BO.19. In the event of a fire within either tenancies, activation of the smoke detectors will trigger the dynamic RED exit signage, displaying a red cross to prevent occupants from egressing into corridor 1.BO.19.

If smoke from Tenancy 1-134 or 1-135 enters the lobby preceding the stairwell as occupants attempt to evacuate, and the conditions become untenable, occupants may turn back and evacuate via the shopfront.

Occupants from Tenancies 1-136 and 1-138 who are egressing via the balcony into the lobby may also retreat and evacuate through the shopfront if untenable conditions are encountered in the lobby. While smoke may travel from the lobby into the balcony as doors are opened, the south-eastern side of the balcony is open to air, allowing any smoke to dissipate without compromising conditions on the balcony.

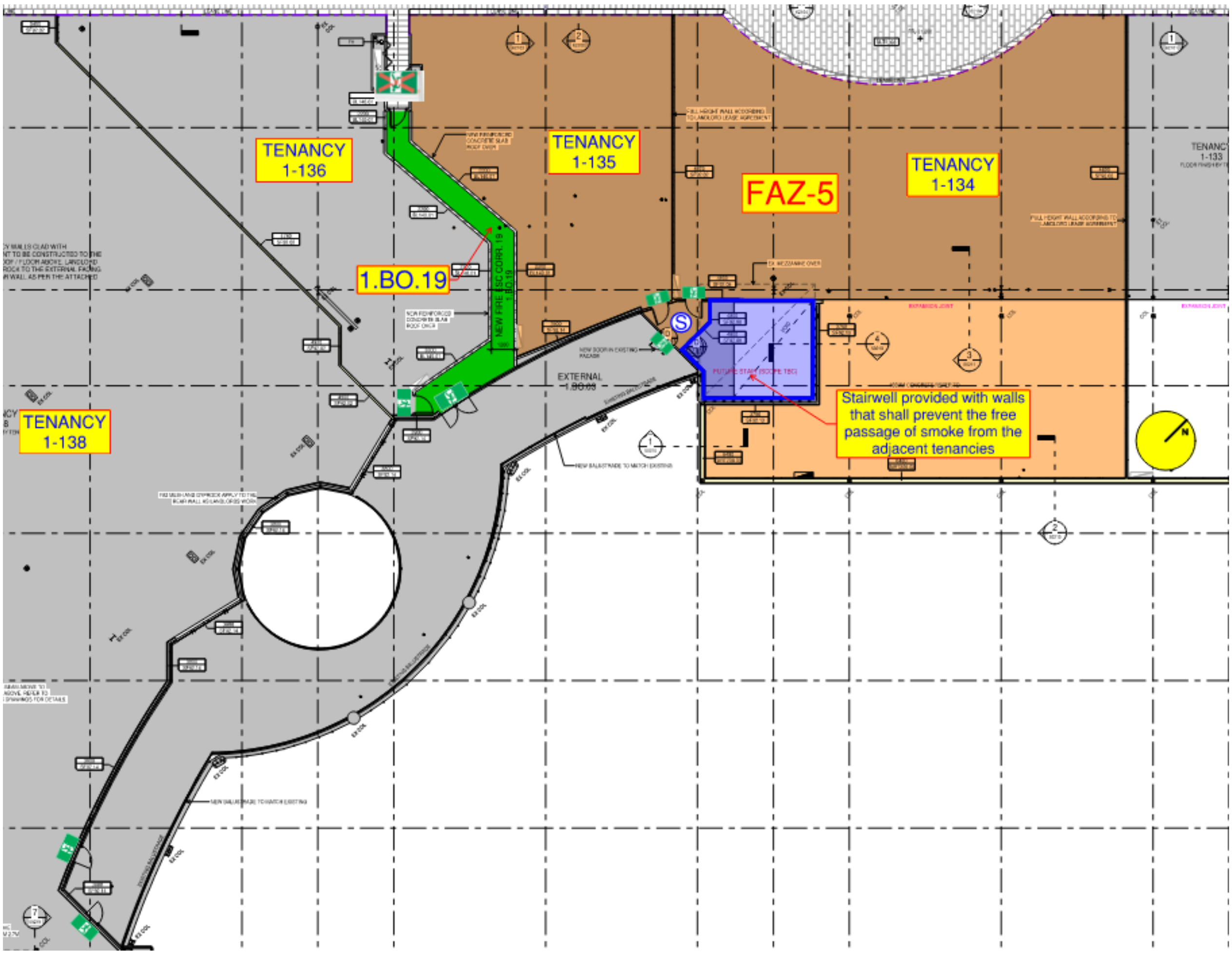

Figure 73: First Floor balcony fire alarm zone FAZ-5

17.10 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements on a comparative basis, as outlined in Section 25.

18. Performance Solution No. 8 – Performance-based Fire Hydrant System

18.1 Relevant BCA DtS Provisions

BCA Clause E1D2(2) states that a fire hydrant system must be installed to AS 2419.1-2021.

Clause 3.5.1(b) of AS 2419.1-2021 states that where external fire hydrants are installed, fire hydrant coverage from an external attack fire hydrant shall be used to achieve coverage to the lowest four storeys included in the calculation of the rise in storeys in compliance with the DtS provisions of the NCC and the storey immediately below these storeys, provided all parts of the building are covered.

Clause 3.5.1(c) of AS 2419.1-2021 states that where all parts of the building are not covered by external hydrants in accordance with (b), internal fire hydrants located in accordance with Clause 3.6.2 shall be installed to provide coverage to those arts of the building not protected by external fire hydrants.

Clause 3.5.3.3(a)(i) of AS 2419.1-2021 states that each external attack fire hydrant shall be located not more than 50 m from a fire brigade pumping appliance located on a hardstand.

Clause 3.5.3.3(a)(ii) of AS 2419.1-2021 states that each external attack fire hydrant shall be located less than 100 m from a fire brigade pumping appliance located on a hardstand when providing fire hydrant protection from— (A) a podium; (B) to a building that is provided with a sprinkler system conforming to AS 2118.1; and (C) to a Class 9c building.

Clause 3.5.3.3(b) of AS 2419.1-2021 states that all parts of a building that are protected by an external attack fire hydrant located in accordance with Item (a)(i) (not more than 50 m from a fire brigade pumping appliance located on a hardstand), shall be not more than 70 m from the external attack fire hydrant.

Clause 3.5.3.3(c) of AS 2419.1-2021 states that all parts of a building that are protected by an external attack fire hydrant located in accordance with Item (a)(ii) (less than 100 m from a fire brigade pumping appliance located on a hardstand), shall be not more than 40 m from the external attack fire hydrant.

Clause 3.6.1(e) of AS 2419.1-2021 states that where internal fire hydrants are installed, all parts of the floor shall not be more than 40 m from an internal fire hydrant installed in accordance with Clause 3.6.2.

Clause 3.6.2(a)(ii) of AS 2419.1-2021 states that where fire-isolated exits are provided, internal fire hydrants shall be located in every required fire-isolated exit, other than where coverage is provided in accordance with Clause 3.5.1, regardless of the number of fire hydrants needed to provide coverage.

Clause 3.6.2(b) of AS 2419.1-2021 states that where required non-fire-isolated exits are provided, internal fire hydrants shall be located not more than 4 m from a required exit, except that internal fire hydrants need not be located adjacent to each required non-fire-isolated exit, provided fire hydrant coverage to all parts of the floor is achieved.

Provisions of AS 2419.1-2021 notwithstanding, DFES requests that performance-based fire hose coverage is measured based on the provisions of AS 2419.1-2005, i.e. each hose length used shall be 30 m, and 10 m hose stream with at least 1 m of hose extended into the last protected room is considered. This requirement is reflected in the DFES Built Environment Branch (BEB) Info Note: "*Variations to AS 2419.1:2021 fire hydrant installations based on the FES Commissioner's Operational Requirements*".

18.2 Performance Solution

Fire hose coverage to the GSC is provided from external and internal attack fire hydrants. External fire hydrants are located outside the footprint of the building and internal fire hydrants are located in the retail malls, the existing open-deck carpark on the north-west side of the centre and in the new Loading Dock 04 (refer to the fire hose coverage diagrams in Appendix D).

Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m, which does not comply with the provisions of Clause 3.5.3.3(b) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m, which does not comply with the provisions of Clause 3.5.3.3(c) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m, which does not comply with the provisions of Clause 3.6.1(e) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Internal fire hydrants are not located in every fire-isolated exit, which does not comply with the provisions of Clause 3.6.2(a)(ii) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Internal fire hydrants installed in retail malls are provided more than 4 m from required exits, which does not comply with the provisions of Clause 3.6.2(b) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

18.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P3.

18.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

18.5 Intent of the BCA

The intent of Performance Requirement E1P3 (formerly EP1.3) is to install a fire hydrant system that is capable of providing "*adequate water, under sufficient pressure and flow, to allow the fire brigade to fight fires*".

The Guide to the BCA highlights that fire hydrant systems "*are intended for use only by a fire brigade*" and stresses that compliance with the DtS provisions of Clause E1D2 (formerly E1.3) is not compulsory if alternative means can be found to satisfy the appropriate authority that Performance Requirement E1P3 is satisfied.

It is reasonable to assume that an extra length of hose from internal and external fire hydrants required to achieve complete fire hose coverage and/or the performance-based locations of fire hydrants may have an adverse impact on fire brigade intervention.

It is therefore necessary to consult with the local fire brigade to determine whether a performance-based fire hydrant system facilitates their intervention. DFES are the main authority in Western Australia that can provide expert advice in regard to fire brigade intervention requirements.

18.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based fire hose coverage with 2 lengths of hose from internal fire hydrants, 3 lengths of hose from external fire hydrants and hydrants installed on the podium, fire hydrants not provided in every fire-isolated exits and internal fire hydrants located more than 4 m from non-fire-isolated exits do not have an adverse impact on DFES intervention.

If DFES confirm that the performance-based aspects of the fire hydrant system facilitate their intervention, then compliance with Performance Requirement E1P3 is achieved.

The methodology adopted for this assessment is an absolute, qualitative deterministic analysis in accordance with the following:

1. Identify configuration of the fire hydrant system and locations of the onsite attack fire hydrants.
2. Assess the performance-based locations of fire hydrants installed more than 4 m from non-fire-isolated exits and the potential impact these locations may have on firefighting operations.
3. Assess the ability of the fire brigade to identify where additional hose may be required to achieve coverage and the impact on fire brigade operations.
4. Review the water supply capacity and the performance of the fire hydrant system to ascertain the required demand is available.
5. Consult with DFES in regard to the proposed fire safety strategy and determine whether their intervention is facilitated.

18.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *External attack fire hydrants at street level shall be located not more than 50 m from a DFES pumping appliance parked on a hardstand.*
2. *External attack fire hydrants located on the podium (the roof of the north-east open-deck carpark) shall be located not more than 100 m from a DFES pumping appliance parked on a hardstand.*

3. *Internal attack fire hydrants shall be located not more than 25 m from exits.*

4. *Where additional internal attack fire hydrants are required in the retail mall, they shall be located not more than 25 m from the hydrants that are located within 25 m from exits.*

5. *Extended fire hose coverage to the building must facilitate DFES intervention, i.e.:*

    c. *All parts of the building shall be not more than 90 m from external attack fire hydrants; and*

    d. *Where parts of the building cannot be reached with hose connected to external attack fire hydrants, these parts shall be not more than 60 m from internal attack fire hydrant installed in the retail malls.*

    e. *The length of fire hose laid inside the building must not exceed 60 m.*

    f. *At least 1 m of hose must extend into the furthermost protected room.*

6. *The flow and pressure at the discharge outlets of the attack fire hydrants shall comply with the requirements of AS 2419.1-2021, i.e. 15 l/sec flow @ 700 kPa pressure without the use of a fire brigade pumping appliance and 30 l/s flow @ 700 kPa pressure when boosted by a fire brigade pumping appliance.*

7. *Signage must be provided to enable DFES identify the areas that require additional length of fire hose to achieve complete coverage.*

18.8 Assessment

Fire hose coverage to the retail mall is achieved by the use of 3 lengths of hose from external attach fire hdyrants, with no more than 60 m of hose laid inside the building and 2 lengths of hose from internal attack fire hdyrants. Fire hose coverage diagrams are provided in Appendix D of this report.

To justify that an extra length of hose facilitates DFES intervention, it is necessary to understand what impact using the extra hose would have on fire brigade's operations.

AS 2419.1-2005 imposes a 60 m limitation on the length of fire hydrant hose coverage from internal and external fire hydrants, respectively. It is considered that these limitations, in part, arise from the following two considerations:

1. The conditions in which fire brigade personnel may have to operate to connect and advance the hose to the fire seat.

2. The time it takes for the firefighters to complete their setup, reach the fire seat, and commence firefighting.

When fire brigade personnel respond to a structural fire, it is understood that in accordance with the Standard Operating Procedures (SOP's), they must be rigged into their Breathing Apparatus (BA) before they approach an area where their safety could be compromised, i.e. a smoke logged environment.

To connect to an internal fire hydrant, firefighters would be expected to be rigged into their BA's (usually the air supply is between 20 minutes and 30 minutes, depending on the wearer's physical condition, exertion rate, stress level, etc.), as conditions inside a building could quickly deteriorate. Firefighters are also required to locate, and advance to, a suitable internal fire hydrant. Hence, firefighters have already depleted part of their air supply before they even commence laying the hose to the fire seat.

Fire brigade's personnel connecting to an external fire hydrant or laying hose from a fire appliance to the building are expected to be operating in a smoke free, or relatively smoke free, environment and seldom would be required to be rigged into their BA before entering the building. An external fire hydrant is considered relatively easy to locate as the conditions outside would generally be tenable. Once they are inside the building, firefighters can proceed to the fire seat without expending their air supply on locating and connecting to the internal fire hydrant. Hence an additional (second) length of hose is allowed by AS 2419.1 for external fire hydrants.

The performance-based design requires 3 lengths of hose to achieve full coverage, however all of these lengths of hose can be set up external to the building. This will allow the fire brigade to set up in relative safety and facilitates their intervention.

If fire fighters are unaware that a third length of hose is required to achieve fire hydrant coverage, they may assume that 2 lengths is sufficient and advance into the building on that basis. Therefore, signage that shall indicate that 3 lengths of hose are required to achieve full coverage shall be provided at the fire hydrant booster assembly and at the FDCIE, which is expected to be the first port of call for the responding crews. This will provide adequate warning of a performance-based fire hydrant system and would allow firefighters to connect the additional length of hose, if required, while they are external to the building.

The performance-based design was discussed with DFES during an FEB meeting on 06 June 2025. DFES confirmed they would generally support a third length of hose from external attack hydrant, internal attack hydrants located not more than 25 m from exits with additional internal attack dyrants located not more than 25 m from the internal hydrants that are located within 25 m from eixts to achieve full fire hose coverage provided adequate signage in accordance with DFES Guideline GL-03 was provided on-site, scaled fire hose coverage diagrams were attached to the FSER and confirmation that the fire hydrant system achieved adequate flow and pressure was provided with the FSER.

Based on the above discussion it is reasonable to conclude that the performance-based hose coverage with the use of 3 lengths of hose from the external and internal attack hydrants and from the DFES pumping appliance facilitate fire brigade intervention because the following conditions are met:

1. External attack fire hydrants at street level is located no more than 50 m from a DFES pumping appliance and located no more than 100 m on the podium.
2. Fire hydrant coverage to the retail mall from external attack hydrants is achieved in accordance with the provisions of AS 2419.1-2005, except an additional length of 30 m of hose is permitted to be used, with that additional length being outside the building and not more than 60 m of hose being inside the building (refer to the scaled fire hose coverage diagrams provided in Appendix D).

3. Fire hydrant coverage to the retail mall from internal attack hdyratns is achieved in accordance with the provisions of AS 2419.1-2021, except additional internal attack fire hydrants shall be located not more than 25 m from the hydrants that are located within 25 m from exits.

4. The pressure and flow at the fire hydrants comply with the requirements of AS 2419.1-2021, i.e. the system is capable of providing 15 l/sec flow @ 700 kPa pressure without the use of a fire brigade pupmping appliance and 30 l/sec flow @ 700 kPa when boosted by a fire brigade pumping appliance.

5. Signage shall be provided at the booster assembly, at the onsite fire hydrants, at the Fire Brigade Panel (FDCIE) and on the fire hydrant system block plans to advise DFES that 3 lengths of hose are required for external hydrants and 2 length of hose are required from internal hydrants. The signage shall be as detailed in item 67 in Section 9.10 of this FSER.

18.9 Conclusion

This assessment demonstrates that the acceptance criteria for the analysis are met. Therefore, the Performance Solution achieves compliance with Performance Requirement E1P3, as outlined in Section 25.

19. Performance Solution No. 9 – Performance-based Attack on Fire by Building Occupants

19.1 Relevant BCA DtS Provisions

BCA Clause E1D3(2)(a) states that a fire hose reel system must be provided to serve the whole building where one or more fire hydrants are installed.

19.2 Performance Solution

Fire hose coverage to the GSC is provided both from internal and external attack fire hydrants; hence fire hose reels are prescribed.

Fire hose reels in the refurbished and extended parts of the GSC (areas highlighted pink and cyan in Figure 74 and Figure 75 below) are not provided and the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, which does not comply with the DtS provisions of Clause E1D3(2)(a).

Figure 74: Areas where fire hose reels are omitted on Ground Floor

19.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P1.

19.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

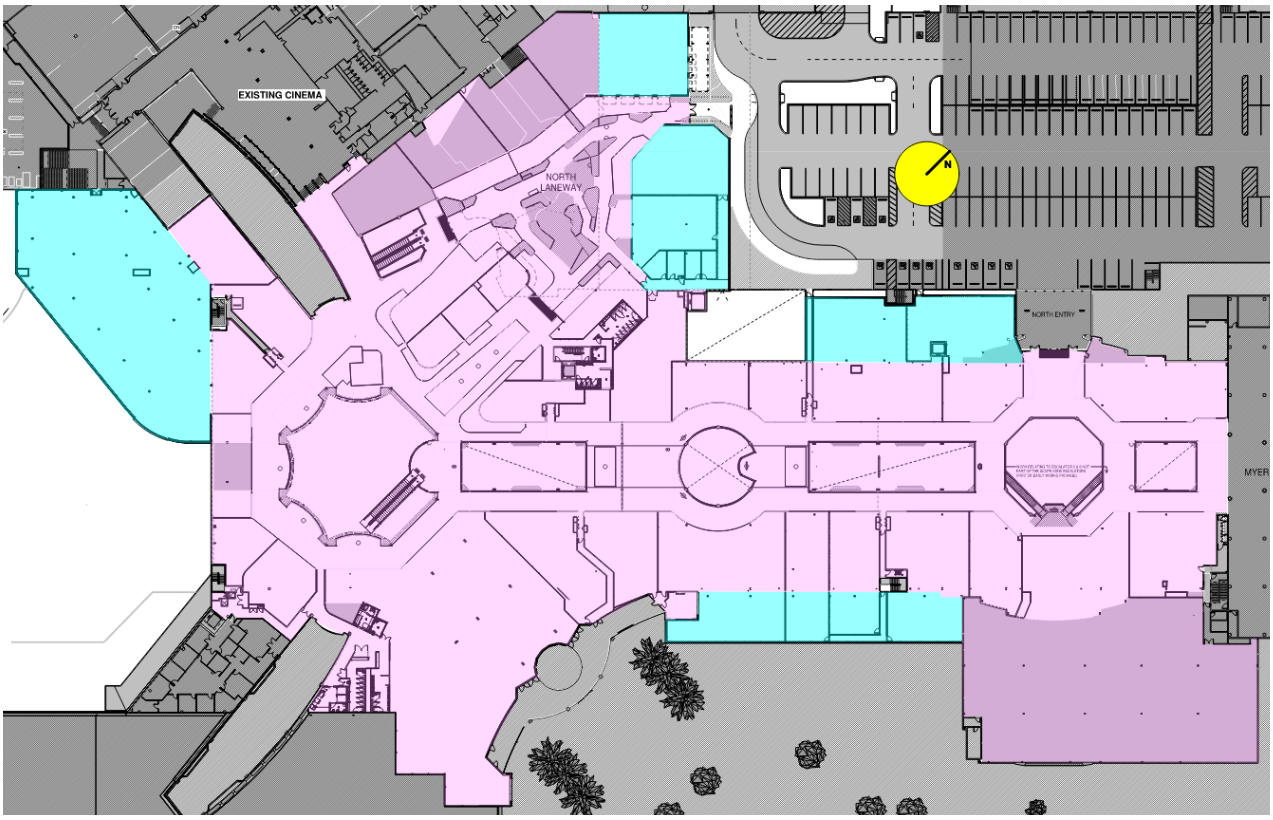

Figure 75: Areas where fire hose reels are omitted on First Floor

19.5 Intent of the BCA

The intent of Performance Requirement E1P1 (formerly EP1.1) is to allow occupants to fight fire in the initial stages of its development, which "*may reduce the hazard, allow more time for evacuation and prevent structural damage*". The Guide to the BCA also indicates that fire hose reels "*must be installed when necessary, and be appropriate to a number of factors, including*:

- *the size of the fire compartment which is a measure of the size of any potential fire;*
- *the function of the building will affect the fire load in the building;*
- *the fire-safety systems which can affect the rate of fire spread (e.g. if a sprinkler system is installed in a building, it should extinguish the fire or reduce its growth rate); and*
- *the fire hazard which means the danger in terms of potential harm and degree of exposure arising from the start and spread of fire, and the smoke and gases generated by a fire*".

The Guide to the BCA stresses that compliance with BCA Clause E1D3 (formerly E1.4) is not compulsory if alternative means can be found to satisfy the appropriate authority that Performance Requirement E1P1 is satisfied.

It is evident that fire hose reels are provided for occupants to commence the initial attack on a fire. The above notwithstanding, the design must adequately address occupant safety. It is therefore reasonable to conclude that if deployment of a fire hose reel could potentially compromise occupant safety, alternative means of initial attack on a fire may be more appropriate.

19.6 Assessment Methodology

The purpose of this assessment is to demonstrate that omission of fire hose reels will not have an adverse impact on the ability of occupants to fight fire in the initial stages of its development.

If it can be demonstrated that provision of portable fire extinguishers in lieu of fire hose reels facilitates the initial occupant attack on a fire, then compliance with Performance Requirement E1P1 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative deterministic analysis in accordance with the following:

1. Develop a fire safety strategy to facilitate occupants' initial attack on a fire and assess the following aspects of the provision of portable fire extinguishers:
    a. Class of fire risk that portable fire extinguishers are suitable for, and the typical fire risks expected to be present in the building, including forklifts.
    b. Usability of portable fire extinguishers with regard to approaching the fire.
    c. The risk of users of portable fire extinguishers impeding their own egress or the egress of others.

19.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Occupants shall be provided with adequate fire safety measures that would facilitate their initial attack on a fire.*

19.8 Assessment

Fire hose reels (FHR) are provided to facilitate occupant attack on a fire in the initial stages of fire development, potentially prior to the commencement of emergency evacuation, but most certainly before it is completed. Fire hose reels are only suitable for Class A fire risks, i.e. ordinary combustibles such as wood, paper, cloth, rubber (small quantities) and plastic. Inside a building, FHR are prescribed to be installed either within 4 m of exits (Clause E1D3(5)(b) of the BCA) or in paths of travel to exits, if system coverage is not achieved from FHR installed adjacent to an exit (Clause E1D3(5)(c) of the BCA).

Most occupants do not know how to operate a FHR, as FHR training is seldom provided, and may not be comfortable in using it. However, if an untrained occupant decides to use a FHR they could be exposed to and could be exposing others to several hazards.

Most people are generally familiar with portable fire extinguishers (PFEs), and many are comfortable with using them. The type of PFE proposed is suitable for Class A (ordinary combustibles), Class B (flammable liquids) and E (energized electrical equipment) fire risks.

Portable fire extinguishers are considered superior to fire hose reels for a number of reasons, including the following:

1. FHRs are only suitable for Class A fire risk and should not be used on energized electrical equipment. A modern building is generally provided with multiple items of electrical equipment and to minimize the risk of electrocution, all power points are generally protected with residual current devices (RCD). However, some electrical equipment may not be adequately protected due to an installation fault, or an RCD may fail to operate properly. Shopping malls may have power points recessed into the floor or be provided with electrical forklifts in the Back of House (BoH) areas and will have forklift charging stations. When a FHR is used, large areas are likely to be wetted and after a few moments water is likely to start pooling on the floor. If water comes into contact with energized electrical equipment that for any reason is not protected, the FHR operator or others risk electrocution.

   AB(E) type portable fire extinguishers do not present a risk of electrocution.

2. Generally, people could overestimate how safe they are when operating a FHR due to the continuous supply of water from the hose. Hence, they may be tempted to continue the attack on a fire even when it is not safe to do so, and they otherwise would have attempted to evacuate the building. This may lead to the occupant being exposed to an increased risk.

   Portable fire extinguishers are provided with a limited quantity of extinguishing medium and people tend to evacuate the area as soon as the extinguisher is depleted, or they realize that their effort is not having an impact on the fire.

3. After being coiled on the drum for a prolonged period of time, when deployed, the rubber hose often does not lay flat on the floor but tends to spiral or undulate and this can increase the difficulties encountered when attempting to use a FHR. Approaching a fire and maneuvering with a FHR is considered potentially difficult as the FHR must be unfurled and potentially dragged around corners or through doors to reach the fire location. The friction may be considerable, and the FHR user may therefore experience difficulties, be forced to concentrate on navigating to the fire and take a relatively long time to approach the fire.

   A portable fire extinguisher is generally easier to lift and maneuver to the fire location.

4. As FHRs are installed adjacent to exits or in paths of travel to exits, when stretched to the area of fire origin, which could be in the middle of the floor, the hose can create a trip hazard in the path of evacuating occupants, including a hazard to the user.

   A portable fire extinguisher presents a much lower trip hazard.

It is considered that PFEs placed in clearly marked and easily accessible locations (adjacent to exits or in paths of travel to exits) will provide occupants who decide to commence an initial attack on a fire with more efficient and safe firefighting measures than a fire hose reel system would.

Based on the above discussion, it is reasonable to conclude that provision of portable fire extinguishers in lieu of fire hose reels facilitates initial occupants' attack on a fire.

19.9 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with Performance Requirement E1P1, as outlined in Section 25.

20. Performance Solution No. 10 – Omission of Sprinklers from Skylights and External Covered Area

20.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17 and Specification 18 as applicable.

Clause S17C2(a) of BCA Specification S17 states that an automatic sprinkler system must comply with AS 2118.1-2017.

Clause 3.1.2 of AS 2118.1-2017 states that for a building to be classified as a sprinkler protected building, the building shall be sprinkler protected throughout, other than where exceptions are permitted in Clause 3.1.3. Clause 3.1.3 does not provide an exemption for omission of sprinklers under skylights.

20.2 Performance Solution

Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy (areas highlighted red in Figure 76 and Figure 77, respectively), which does not comply with the DtS provisions of Clause 3.1.2 of AS 2118.1-2017 and the DtS provisions of Clause S17C2(a) of BCA Specification S17 and Clause E1D4(b).

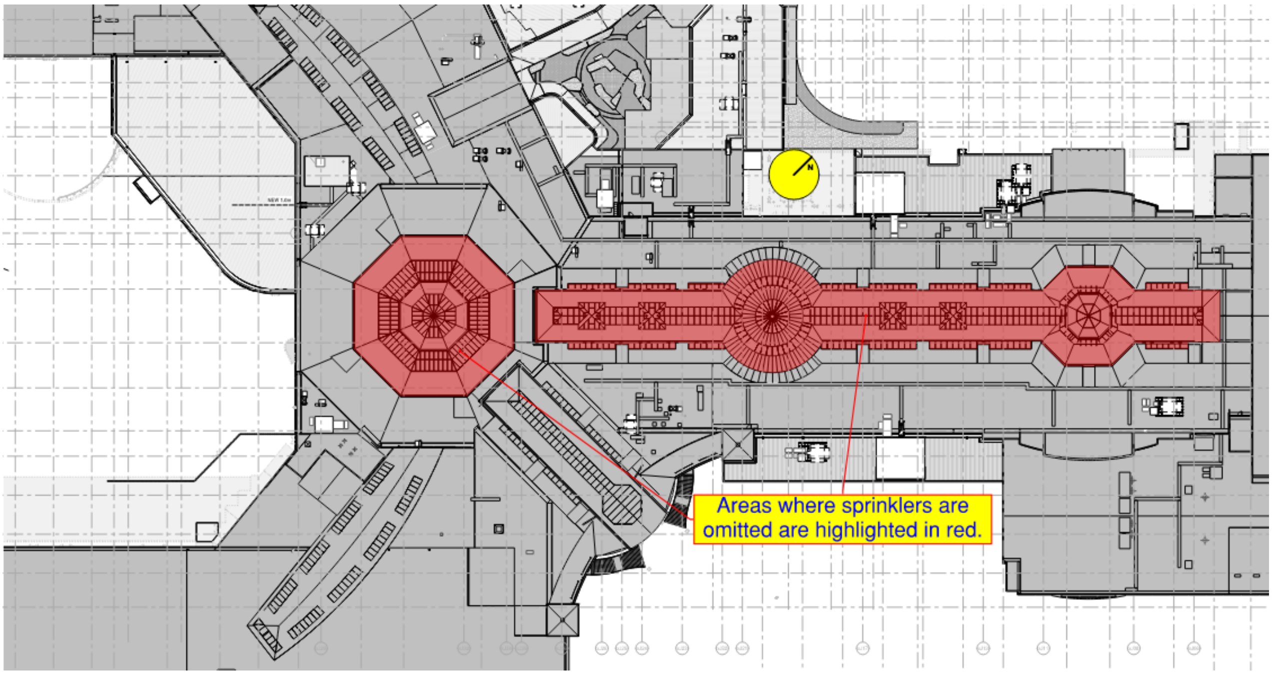

Figure 76: Omission of sprinkler from Plaza and Myer mall skylights

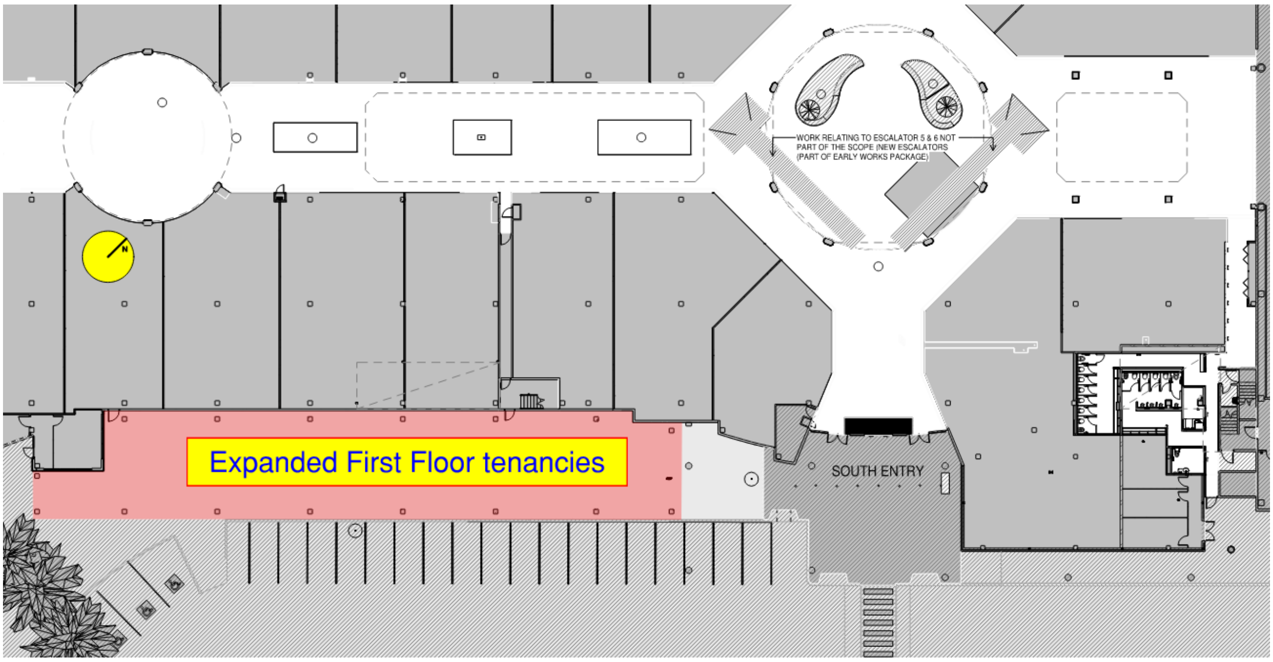

Figure 77: Omission of sprinkler below new extended tenancies on First Floor

20.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as E1P4 and E2P2.

20.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

20.5 Intent of the BCA

The intent of Performance Requirement E1P4 (formerly EP1.4) is "life safety and fire suppression".

Performance Requirement E1P4 uses the term "*to the degree necessary*". The Guide to the BCA states that the use of this term means that the "*BCA recognises that not all buildings need an automatic fire suppression system*".

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that parts of a building that present a very low fire risk or where the height of the roof above the fire seat would result in significant delay in sprinkler activation may not need sprinkler protection to satisfy Performance Requirements E1P4 and E2P2, as long as adequate fire safety measures are provided to warn occupants of a potential fire and facilitate their evacuation; to minimise the risk of fire spread throughout the building; and to facilitate fire brigade intervention.

20.6 Assessment Methodology

The purpose of this assessment is to demonstrate that omission of sprinkler protection from selected areas in an otherwise sprinkler protected building would not result in a fire that could spread uncontrolled through the rest of the building.

If it can be demonstrated that a fire originating in an area that is not provided with sprinkler protection will not spread to adjacent areas and occupant evacuation during a fire that is not sprinkler controlled is facilitated, then compliance with Performance Requirement E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative and quantitative deterministic analysis in accordance with the following:

1. Determine the type of sprinkler system provided in the retail mall and identify areas where sprinkler protection is not provided.

2. Identify worst-case fire scenarios that could occur in the retail mall where sprinkler protection is not provided, i.e. fires involving kiosks or displays, including vehicle displays.

3. Undertake fire and smoke modelling for the worst-case fire scenarios in the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria (refer to Performance Solution No. 5).

4. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters (refer to Performance Solution No. 5).

5. Compare the derived ASET and RSET to determine if the design is acceptable.

6. Identify the expected fire load in the area below the First Floor tenancies expansion along the south-east façade.

7. Determine whether a fire that has a potential to spread to the rest of the building could start in this area.

8. Develop a fire safety strategy that would enhance the fire safety measures in the areas where sprinklers are not provided (if required).

20.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *Where sprinklers are omitted from the retail mall skylights, the ASET calculated for the sensitivity fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

2. *Where sprinklers are omitted from the retail mall skylights, routine conditions for fire fighters must be maintained up until fire brigade apply water to the fire for the design fire scenarios.*

3. *Where sprinklers are omitted from the soffit below the First Floor tenancies extension, the area shall be kept free of combustibles and used as circulation space only.*

20.8 Assessment

The ASET vs. RSET results from Performance Solution 5 (refer to Section 15) indicate that the Available Safe Egress Time (ASET) exceeds the Required Safe Egress Time (RSET) for the sensitivity fire scenarios. This demonstrates that tenable conditions within the retail mall—for both occupant egress and firefighter access—are maintained at 2.1 m above Ground Floor and First Floor levels until fire brigade intervention.

The areas beneath the soffit, located below the First Floor tenancy extensions, are used for circulation purposes. It is not anticipated that any combustible materials will be stored in these areas due to security considerations. As such, the risk of fire ignition in this zone is minimal, given the low or negligible fire load.

20.9 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements on a comparative basis, as outlined in Section 25.

21. Performance Solution No. 11 – Performance-based Fire Sprinkler System in North Laneway

21.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17.

Clause S17C2(a) of BCA Specification 17 states that an automatic fire sprinkler system must comply with AS 2118.1-2017.

Clause 3.1.1.2 of AS 2118.1-2017 states that "*to be classified as a sprinkler-protected building, a building shall be sprinkler-protected throughout, other than where exceptions are permitted in Class 3.1.3 (see Clause 5.6.10)*".

Clause 3.1.3 of AS 2118.1-2017 does not provide cover canopies, which are addressed in Clause 5.6.10.

Clause 5.6.10 of AS 2118.1-2017 states that "*sprinklers shall be installed under all canopies where goods are stored or handled or where the dividing wall between the canopy and the building has an FRL less than --/30/30. Notwithstanding the requirements of Clauses 3.1.1.2 and 3.1.1.3, in the case of canopies of non-combustible construction less than 2.5 m in width over pedestrian walkways, sprinklers may be omitted*".

Clause 5.5.3 of AS 2118.1-2017 in parts states that "*the distance between rows of sprinklers shall comply with the following requirements:*

(a) "Rooms not exceeding 3.7 m in width shall have a minimum of one row of sprinklers along the length of the room.

(b) "Rooms exceeding 3.7 m but not exceeding 7.4 m in width shall have one row of sprinklers at each side along the length of the room.

(c) "In rooms exceeding 7.4 m in width, conventional, spray or ceiling type sprinklers shall be provided centrally positioned under the ceiling to supplement the sidewall sprinklers".

21.2 Performance Solution

The North Laneway, located on the northwest side of Level 1 adjacent to the cinema entrance, forms part of the new Food & Beverage (F&B) precinct. It is situated outside the main shopping mall, with F&B tenancies positioned along both the east and west sides (spaces highlighted purple in Figure 78 below), and a central seating area located between them.

Canopies are provided around the full perimeter of the North Laneway. They protect both external seating areas of the tenancies (areas identified with blue square hatching in Figure 78 below) and parts of the circulation space outside the tenancies' lease areas.

The canopies on the western side of the Laneway (canopies highlighted dark green in Figure 78 below) are protected with conventional sprinklers, and full compliance with the provisions of AS 2118.1 is achieved.

The canopies on the eastern side of the Laneway are up to 9.0 m wide; however, they are protected with a single row of vertical sidewall sprinklers that are installed against the external walls of the adjacent tenancies. Based on the provisions of Clause 5.5.3(a) of AS 2118.1, it is reasonable to conclude that a single row of sprinklers can protect only up to 3.7 m of the canopy when measured from the location of the sprinkler.

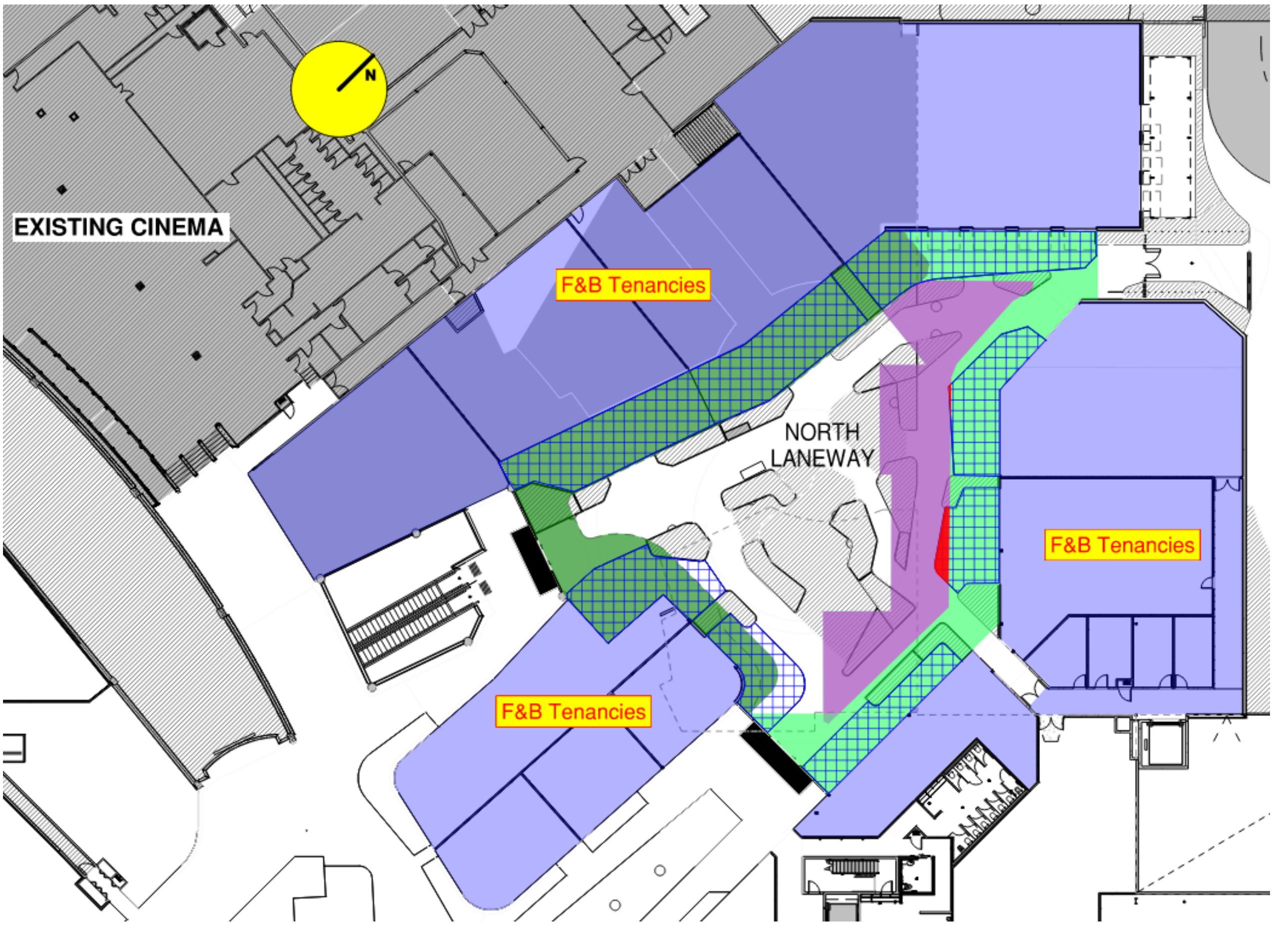

Figure 78: North Laneway layout and extent of sprinkler protection to canopies

Parts of the eastern canopies that are considered to be provided with compliant sprinkler protection in accordance with Clause 5.5.3(a) of AS 2118.1 are highlighted light green in Figure 78 and parts of the canopies that are not protected are highlighted dark pink.

While the 'unprotected' canopies are generally located above circulation space, there are 2 areas where the full extent of the tenancy seating is not protected (areas highlighted red in Figure 78 above). Therefore, the eastern canopies are provided with performance-based sprinkler protection that does not comply in full with the provisions of Clauses 3.1.3, 5.5.3(c) and 5.6.10 of AS 2118.1-2017 and the DtS provisions of BCA Clause E1D4(b) and Clause S17C2(a) of BCA Specification 17.

21.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P4.

21.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

21.5 Intent of the BCA

The intent of Performance Requirement E1P4 (formerly EP1.4) is "*life safety and fire suppression*".

Performance Requirements E1P4 states "*An automatic fire suppression system must be installed to the degree necessary to control the development and spread of fire appropriate to:*

a. the size of the fire compartment; and

b. the function or use of the building; and

c. the fire hazard; and

d. the height of the building."

It is evident that if the risk of a significant fire developing in parts of the building is limited, extending sprinkler protection that complies in full with the provisions of AS 2118.1 to these parts may not be necessary to achieve compliance with Performance Requirement E1P4.

21.6 Assessment Methodology

The purpose of this assessment is to demonstrate that performance-based fire sprinkler protection to parts of the eastern canopies that are located more than 3.7 m from the sprinklers would not result in a fire that could spread uncontrolled through the rest of the building.

If it can be demonstrate that the performance-based fire sprinkler system is adequate for the hazard protected, i.e. sprinklers are capable of providing protection to all parts where fire load is present, then compliance with Performance Requirements E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative, deterministic analysis in accordance with the following:

1. Establish the location where the performance-based sprinkler system is provided.
2. Identify areas under the canopies where fire load is present and where a fire could occur.
3. Assess the performance of vertical sidewall sprinklers and the area that they can protect (based on spray patterns provided in the sprinkler datasheets).
4. Determine whether the performance-based sprinkler system is capable of providing an adequate level of protection to the areas under the eastern canopies.
5. If the performance-based sprinkler system is capable of protecting the hazard concerned, then compliance with Performance Requirement E1P4 is achieved.

21.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *The performance-based sprinkler system under the eastern canopies of the North Laneway shall be capable of controlling a potential fire under the canopy.*

21.8 Assessment

The proposed vertical sidewall sprinklers for the North Laneway eastern canopies are Reliable Model F1 or F1-FR. At a pressure of 207 kPa (30 PSI), these sprinklers can protect an area up to 5.7 m wide.

This extended coverage—from 3.7 m to 5.7 m—ensures that all seating areas, where the primary fire load is located, are fully protected. In the event of a fire within the seating area, the sprinklers will control the fire.

Areas outside the sprinkler coverage (such as walkways and fixed planters beneath the canopy) are considered to have minimal combustible load.

Figure 79 illustrates the new extended sprinkler coverage in light green, with the F&B seating area shown in blue hatching. As shown, the sprinkler coverage extends beyond the F&B seating area into the central walkway and planter boxes.

The extended coverage ensures that all areas containing significant fire load are protected by the sprinkler system, enabling effective fire control in the event of an incident. Given that all hazards of concern are within sprinkler coverage and unprotected areas contain minimal combustible material, the performance-based sprinkler system is considered capable of protecting the hazard concerned. Therefore, the design is assessed to comply with Performance Requirement E1P4.

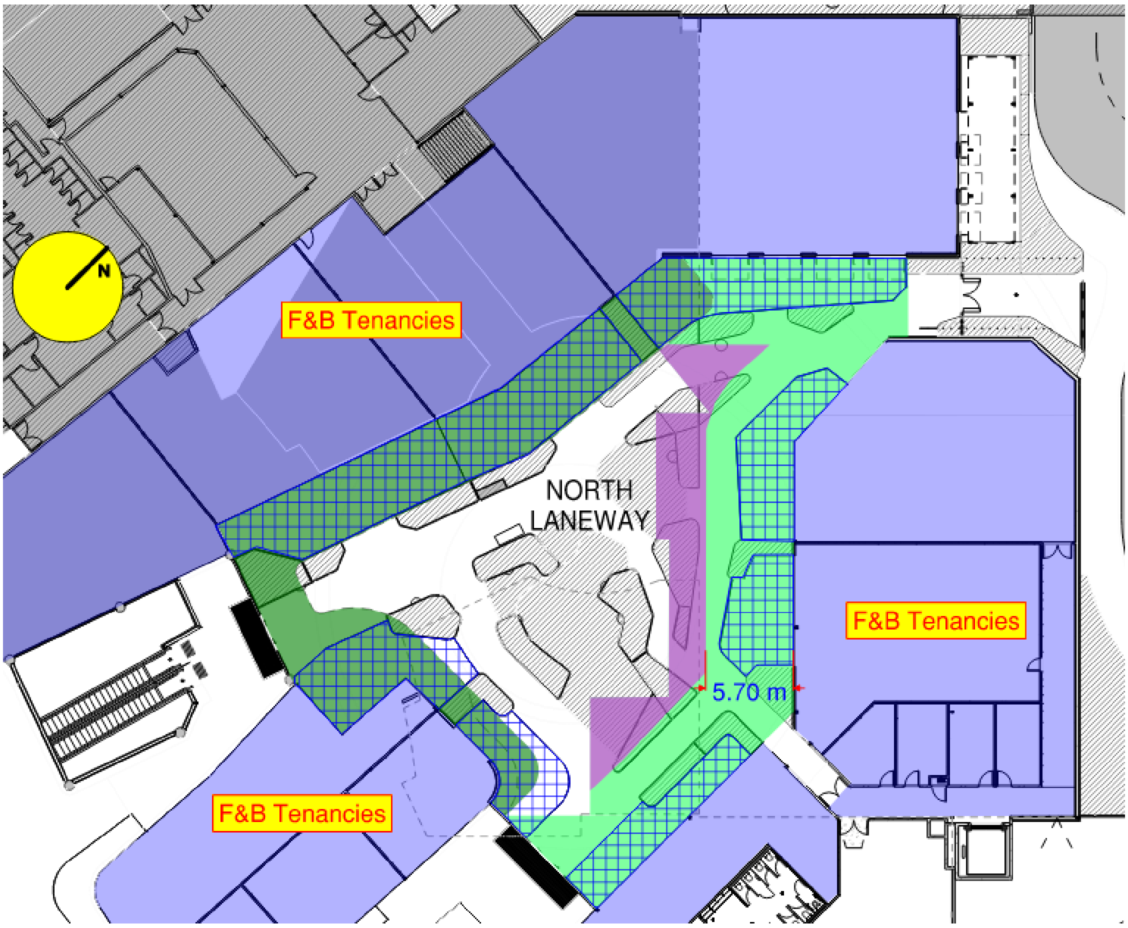

Figure 79: North Laneway layout and extent of sprinkler protection to canopies with extended coverage

21.9 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with Performance Requirement E1P4, as outlined in Section 25.

22. Performance Solution No. 12 – Performance-based Separation between Sprinklered and Non-sprinklered Parts

22.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17 and Specification 18 as applicable.

Clause S17C3(a) of BCA Specification 17 states that where a part of a building is not protected with sprinklers, the sprinklered and non-sprinklered parts must be fire-separated with a wall or floor which must comply with any specific requirements of DtS provisions of the BCA.

BCA Clause C3D9(1)(b) states that if a building has parts of different classifications located alongside one another in the same storey, the parts must be separated in that storey by a fire wall if each building element in that storey does not have the higher FRL prescribed by Specification 5.

Clause S5C22(3)(c)(i) of BCA Specification 5 states that fire walls between the carpark and the rest of the building shall achieve a minimum FRL 60/60/60 from the direction used as a carpark.

Glazed openings in fire walls are not covered by BCA Part C4, and therefore shall be considered a performance-based design. The benchmark FRL for a glazed opening in a fire wall that achieves FRL 60/60/60, considering that glazed openings are non-load-bearing, should be --/60/60.

22.2 Performance Solution

The existing north-west open-deck carpark that is not provided with sprinkler protection abuts parts of the centre that have glazed sections in the bounding walls. These glazed sections are located at the north and north-west entrances to the retail mall and along the façade of the external tenancy adjacent to the north-west entrance to the mall (the glazed sections of the walls are clouded red in Figure 80).

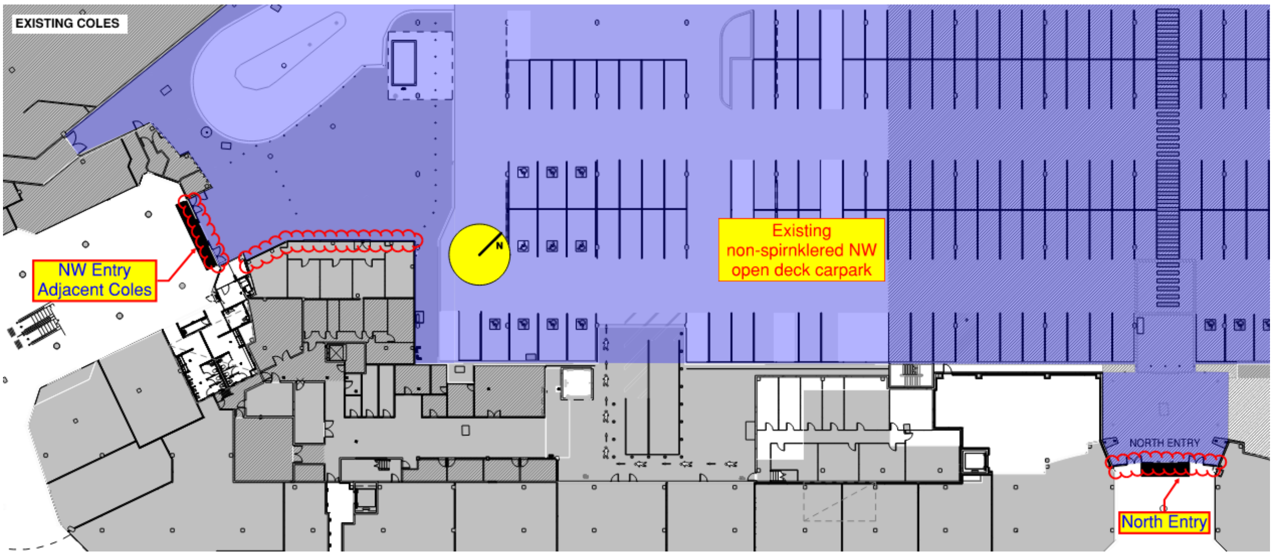

Figure 80: Locations where the walls between the sprinkler protected retail parts of the centre and the open-deck carpark that is not sprinkler protected have glazed sections

The glazed sections of the walls that are exposed to the open-deck carpark that is not sprinkler protected will not be protected and will not achieve FRL --/60/60, which does not comply with the DtS provisions of Clause S17C3(a) of BCA Specification 17 and Clause E1D4(b).\

22.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as C1P2(1)(d) and E1P4.

22.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

22.5 Intent of the BCA

The intent of Performance Requirement C1P2(1)(d) (formerly CP2(a)(iv)) is to minimise the risk of fire spreading through a building that could endanger the occupants and impede the actions of the fire brigade.

The Guide to the BCA states that "*the BCA recognises that different building elements require differing degrees of protection to avoid the spread of fire*". The Guide also highlights that compliance with the DtS provisions in regards to fire separation "*is not compulsory if alternative means can be found to satisfy the appropriate authority that the Performance Requirements will be achieved*". This provision is intended "*to allow the appropriate authority to determine the degree of compliance necessary in each particular case after considering each building scenario*".

The intent of Performance Requirement E1P4 is "*life safety and fire suppression*".

Performance Requirement E1P4 uses the term "*to the degree necessary*". The Guide to the BCA states that the use of this term means that the "*BCA recognises that not all buildings need an automatic fire suppression system*".

It is evident that if adequate separation is not provided between parts of the building that are not protected with sprinklers and the sprinkler-protected parts, a fire in the non-sprinklered part may overwhelm the sprinkler system in the protected part, which may lead to fire spread through the building.

22.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based separation between sprinklered and non-sprinklered parts would not increase the risk of fire spread through the building.

If it can be demonstrated that a fire starting in the non-sprinklered part of the building will not spread to the sprinklered part via the unprotected glazed openings, then compliance with Performance Requirements C1P2(1)(d) and E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify the type of construction between sprinklered and non-sprinklered parts.

2. Establish fire scenarios in the non-sprinklered open-deck carpark that may have the worst impact on the glazed openings.

3. Identify the location of fire in each fire scenario relative to the exposed openings.

4. Determine the configuration of the radiant heat sources that may radiate heat toward the glazed openings.

5. Identify target points at the glazed openings that are likely to be exposed to the highest radiant heat flux during a fire in the open-deck carpark.

6. Calculate the radiant heat flux at the target points using module Radiation from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013].

22.7 Acceptance Criteria

There is a lot of information about critical heat fluxes for different combustible materials, i.e. heat fluxes at which combustible materials are expected to ignite under piloted and non-piloted conditions.

The Australian Building Codes Board suggests the following heat flux intensity that can cause piloted and non-piloted ignition of timber and curtain materials [ABCB, 2020a]:

Material	Piloted Ignition	Non-piloted Ignition
Timber	20 kW/m²	35 kW/m²
Curtain material	10 kW/m²	20 kW/m²

Table 47: Heat flux required to cause piloted and non-piloted ignition of some materials

The above values form part of the BCA Verification Method C1V1 [ABCB, 2022a]. In accordance with C1V1 a wall located 3 m of the side or rear boundary of an allotment needs to withstand a radiant heat flux of 20 kW/m². BCA Clause C4D3(2)(a) states that only those openings that are less than 3 m from the fire-source feature shall be protected. It is therefore reasonable to conclude that an opening located 3 m from the side or rear boundary of the allotment and exposed to a radiant heat flux of 20 kW/m² without protection achieves compliance with the BCA Performance Requirements.

AS 1530.4-2014 “Methods for fire tests on building materials, components and structures; Part 4: Fire-resistance tests for elements of construction” [SA, 2014] suggests different values for critical radiant heat flux (refer to Table 48 below).

TABLE A3

TYPICAL RADIANT HEAT INTENSITIES FOR VARIOUS PHENOMENA

Phenomena	kW/m²
Maximum for indefinite exposure for humans	
Pain after 10 s to 20 s	4
Pain after 3 s	10
Piloted ignition of cotton fabric after a long time	13
Piloted ignition of timber after a long time	13
Non-piloted ignition of cotton fabric after a long time	25
Non-piloted ignition of timber after a long time	25
Non-piloted ignition of gabardine fabric after a long time	27
Non-piloted ignition of black drill fabric after a long time	38
Non-piloted ignition of cotton fabric after 5 s	42
Non-piloted ignition of timber in 20 s	45
Non-piloted ignition of timber in 10 s	55

Table 48: Typical radiant heat intensities for various phenomena, as per AS 1530.4-2014

The values provided by the BCA are more conservative than those provided by the Australian Standard. Still it is evident that radiant heat from a fire should not cause non-piloted ignition if the heat flux does not exceed 20 kW/m², or piloted ignition if the heat flux is 10 kW/m² or less.

Before a fire can spread from one area to the other, the exposed combustible materials must be heated to a temperature at which piloted or non-piloted ignition can occur. Piloted ignition occurs when a combustible material is directly exposed to a pilot flame generally in the presence of a heat source. Considering that all glazed openings have doors in them, it is conservatively assumed that during a worst-case fire scenario piloted ignition of lightweight furnishings adjacent to these doors may occur.

Therefore, the acceptance criterion for this assessment is:

1. *Radiant heat flux at the closest edge of the exposed glazed openings must not exceed the critical limit for piloted ignition of light-weight furnishings, i.e. 10 kW/m².*
2. *Radiant heat flux at the closest edge of the exposed light-weight walls must not exceed the critical limit for piloted ignition of light-weight furnishings, i.e. 20 kW/m².*

22.8 Radiant Heat Flux Assessment Input Parameters

22.8.1 Fire Scenario Selection

An essential aspect of a fire safety engineering assessment is the identification of appropriate fire scenarios.

The most likely and highest risk fire scenario for the north-west entrance adjacent to Coles involves a fire occurring in a vehicle parked in the Click and Collect drive-through area. In this scenario, the vehicle is positioned closest to the glazed entry. This scenario is illustrated in Figure 81 below and is identified as Fire Scenario 1 (FS-01). As shown in Figure 81, the vehicle is located approximately 12 m from the glazed entry. Such fire could also adversely impact the shopfront glazing of the adjacent tenancy, which is approximately 13.6 m from the vehicle.

Another potential scenario that could affect the shopfront glazing is a fire occurring in a vehicle parked in the driveway of the open-deck carpark. This scenario is illustrated in Figure 81 below and is identified as Fire Scenario 2 (FS-02). As shown in Figure 81, the vehicle is located approximately 7.6 m from the glazed entry.

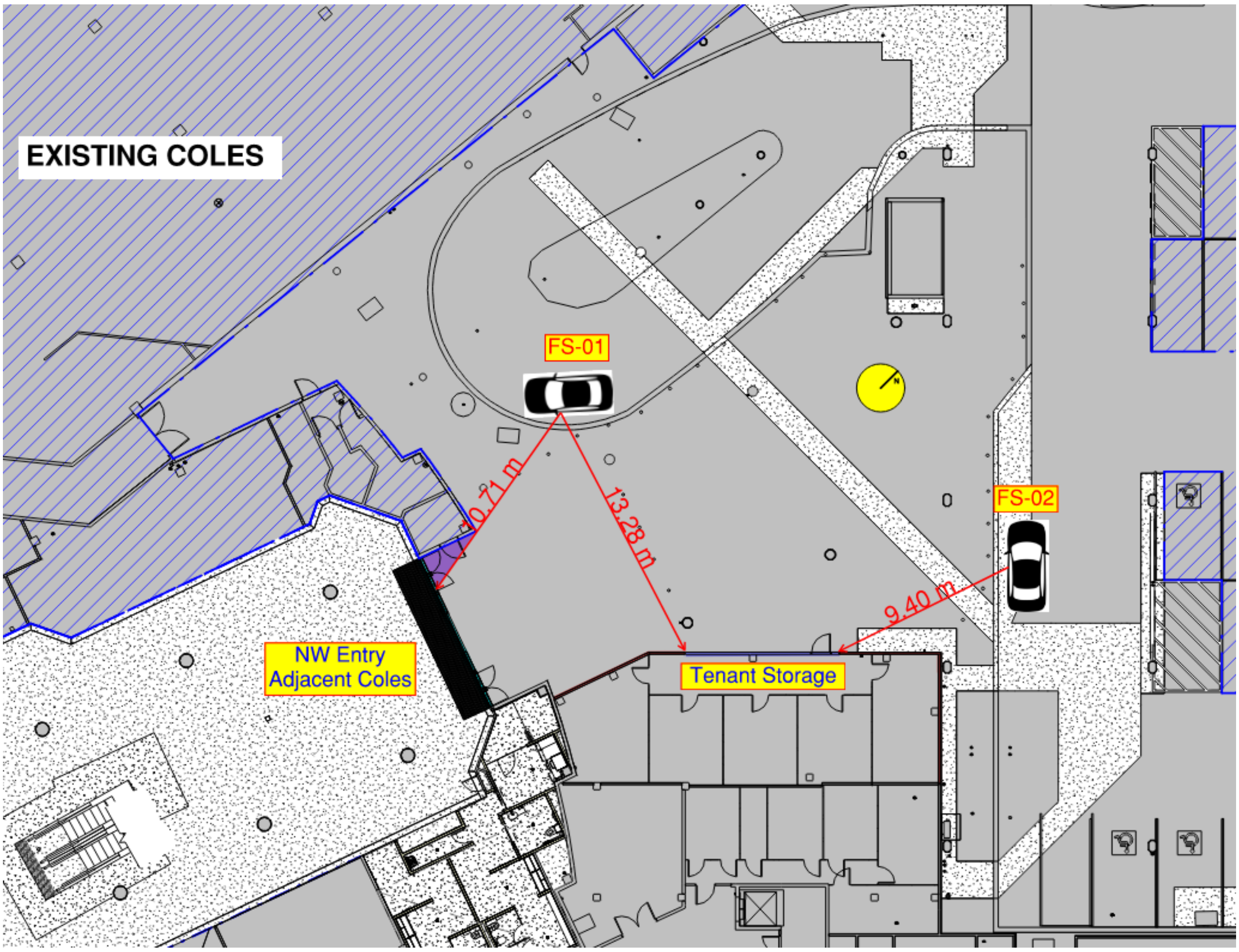

Figure 81: Fire scenarios for the north-west entrance adjacent Coles to the adjacent tenancy

The most likely and highest risk fire scenario for the north entrance involves a fire occurring in a vehicle parked in the bay closest to the north entrance. This scenario is shown in Figure 82 and is identified as Fire Scenario 3 (FS-03).

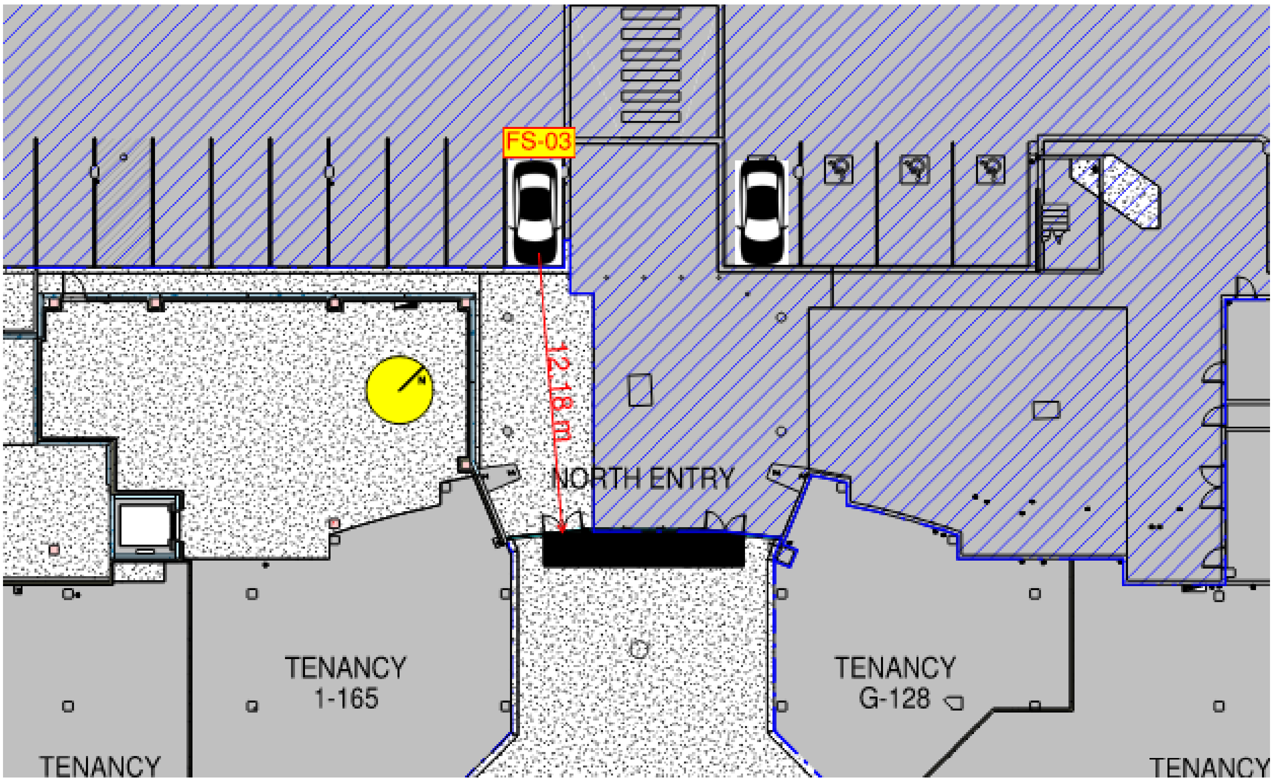

Figure 82: Fire scenario for the north entrance

22.9 Assessment

Radiant heat flux at a target point is determined by the distance from the radiant heat source(s) and the size, temperature and orientation of the radiant heat source(s). A radiant heat source is usually assumed as a flat grey-body surface with emissivity of 1.

FS-01 and FS-03 is expected to be accessed by vehicles from general public. The largest vehicle in a retail mall carpark from general public is expected to be a people mover/van. According to whichcar.com.au, the five most common people mover/van in Australia and their dimensions (based on specifications provided on www.carsales.com.au) are listed in Table 49 below.

Make	Type	Series	Badge	Model	Length, mm	Width, mm	Height, mm
Hyundai	People Mover	Staria	(No Badge)	2021	5,253	1,997	1,990
LDV	Bus	Deliver	(No Badge)	2024	5,940	2,062	2,525
Toyota	Commuter	Hiace	Commuter	2021	5,915	1,950	2,280
Mercedes-Benz	Bus	VS30	415 Transfer	2024	5,932	2,020	2,578
Renault	Bus	X62	(No Badge)	2017	6,198	2,070	2,475

Table 49: Models and dimensions of the most popular family cars

The leading area of fire origin in cars is the engine area, running gear or wheel area. These areas of origin account for 66% of all fire starts [Ahrens, 2020]. Analysis of photographs of real fires involving family cars suggest that the most significant flame front occurs when fire originates in the motor compartment and then spreads into the passenger compartment (refer to Figure 83).

Figure 83: SUV fire

The analysis of the above photograph also suggests that a fire involving the engine compartment creates 2 distinct flame fronts: the engine compartment flame front and the passenger compartment flame front. The engine compartment flame front is divided into front and side sources, while the passenger compartment flame front is divided into side and rear sources. Larger vehicles are expected to generate greater radiant heat levels. As shown in Table 49, the longest and widest vehicle is the Renault X62, measuring 6,198 mm in length and 2,070 mm in width. The tallest vehicle is the Mercedes-Benz, with a height of 2,578 mm. For a conservative assessment, the tallest and longest dimensions have been adopted. An approximate representation of the side radiant heat source based on these dimensions is illustrated in Figure 84.

Figure 84: Side radiant heat sources of a people mover/van

Fire Scenario FS-02 differs from FS-01 and FS-03 in that the northwest (NW) covered carpark is accessed by a Heavy Rigid Vehicle (HRV) to reach Loading Dock 05. Figure 63 below illustrates the swept path of the HRV accessing Loading Dock 05. In the figure, the HRV is highlighted in cyan, the tenant storage areas are shown in pink, and the swept path is indicated by green and red lines. As shown in Figure 63, the swept path pass is in close proximity to the tenant storage areas.

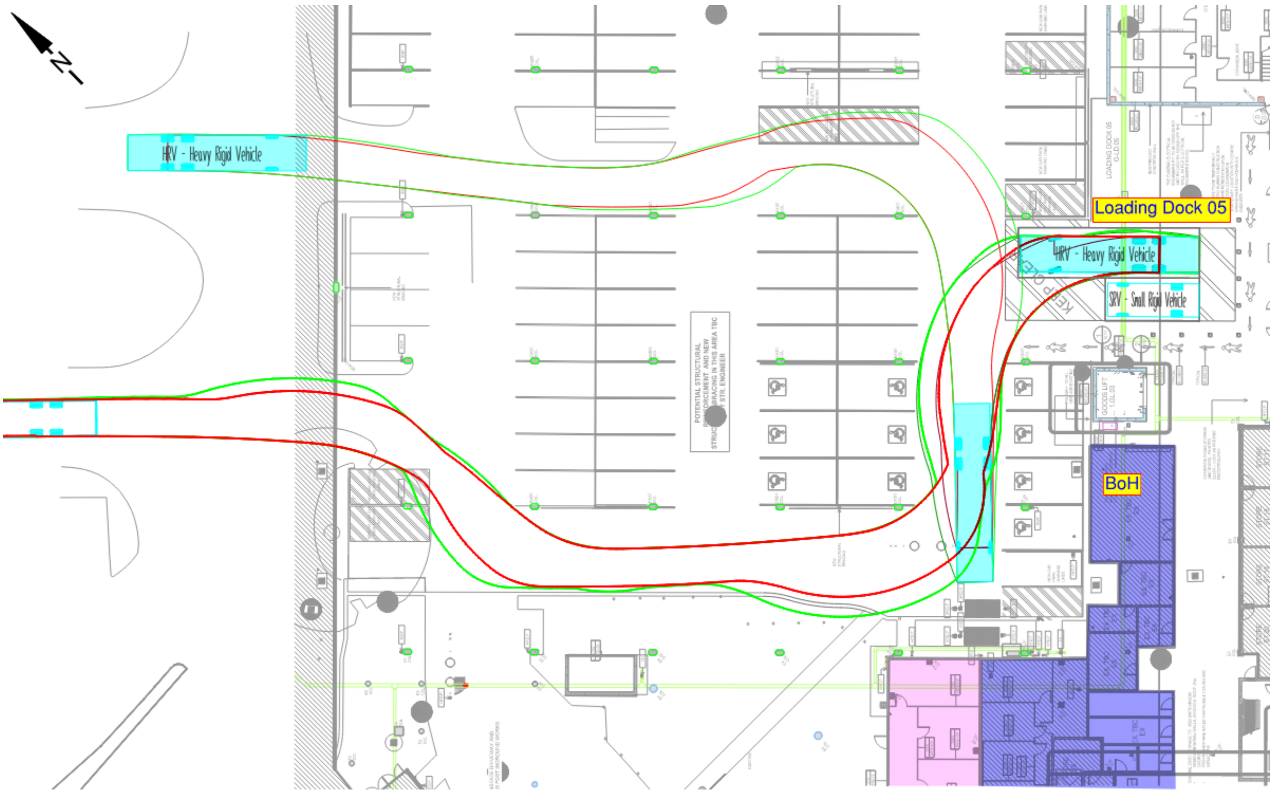

Figure 85: Swept Path for HRV accessing Loading Dock 05.

Vicinity Centres has confirmed that the largest Heavy Rigid Vehicle (HRV) expected to access Loading Dock 05 is approximately 12.5 m long, 2.5 m wide, and 4.3 m high. As the proportion of the cab to the truck body may vary between manufacturers, this assessment adopts a representative model based on a leading brand. According to aussietruckloans.com.au, Isuzu has been the leading truck brand in Australia for over 30 years. Therefore, for the purpose of this assessment, an approximate representation of the side profile of a radiant heat source from an Isuzu HRV—based on the above dimensions—is illustrated in Figure 86 below.

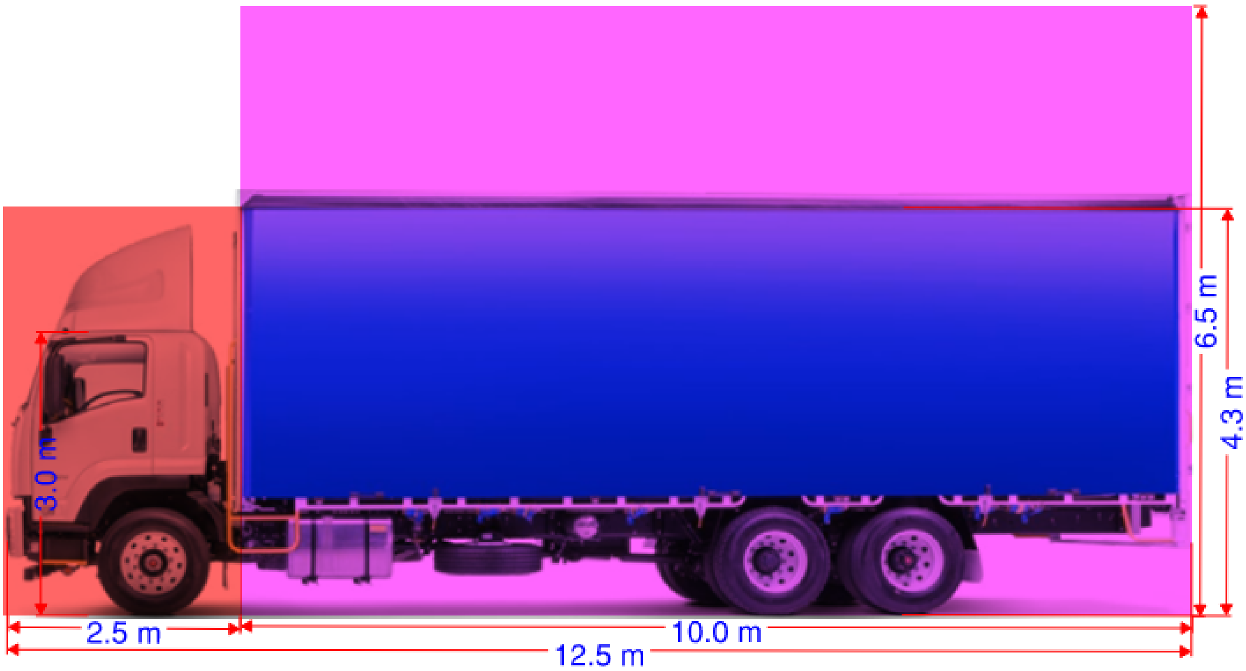

Figure 86: Side radiant heat sources of a HRV truck

It is assumed for the purpose of this assessment that all radiant heat sources have a temperature of 830°C [DFES, 2021c]. While DFES recommends a flame temperature of 680°C for fires that are open to external atmosphere, there will be some radiative heat feedback involved from the hot smoke layer under the carpark soffit; therefore the next highest temperature was used. It would be overly conservative to use a temperature of 1,038°C that is recommended for shops, storage or factory use building, as flame in an open deck carpark would partially intermittent and would not create a solid front over the whole surface of the radiant heat source.

22.9.1 Radiant Heat Flux from Motor Vehicle FS-01 to NW Entry

Assuming that the people mover/van is parked at collect and click, the target point at the NW entry is expected to be exposed to the radiant heat sources described in Table 50 and Table 51.

Source	Width of source, m	Height of source, m	Source size, m	RL of centre of source	Source temp.
Side – engine compartment (S1)	1.07	2.58	1.07 x 2.58	1.29 m	830°C
Side – passenger compartment (S2)	5.13	2.55	5.13 x 2.55	2.54 m	830°C

Table 50: Size and temperature of the radiant heat flux sources – vehicle fire exposure

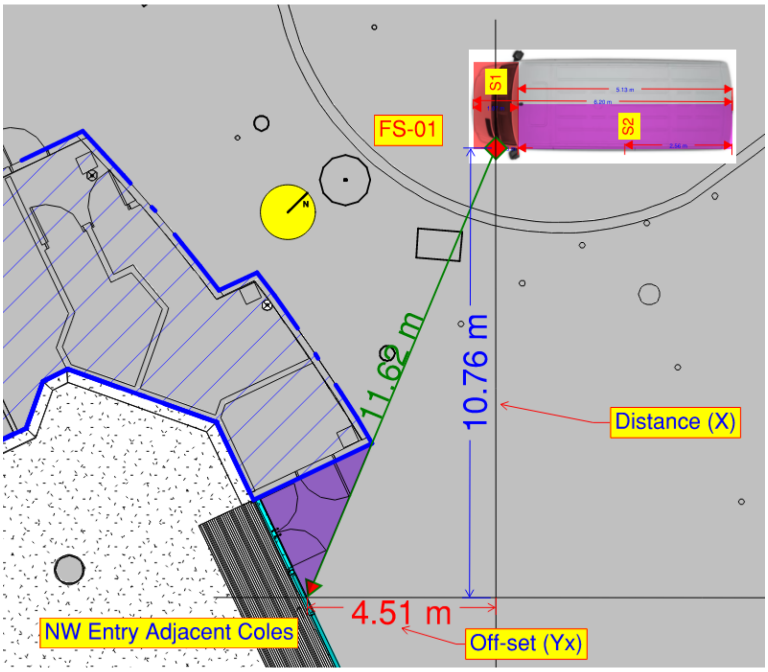

Figure 87: Radiant heat source S1 for the vehicle fire exposure FS-01

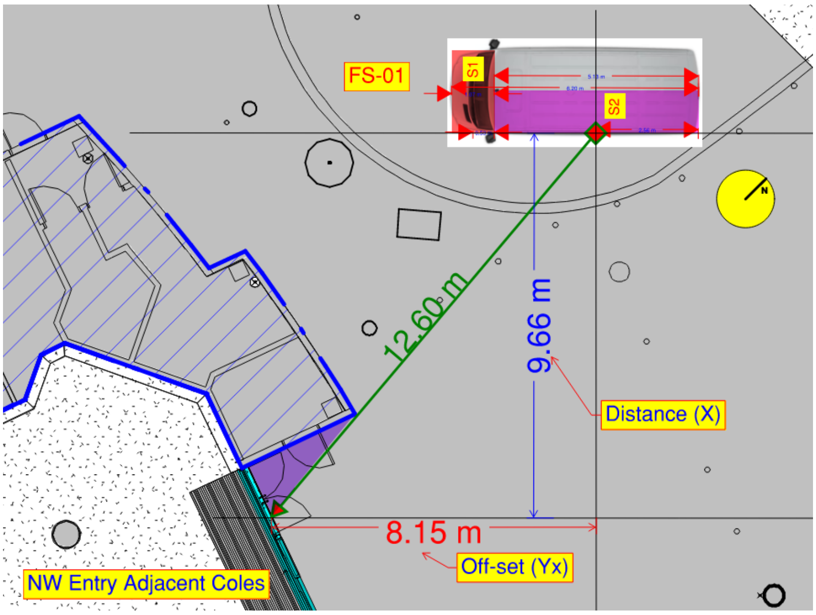

Figure 88: Radiant heat source S2 for the vehicle fire exposure FS-01

Source	Distance (X)	Off-set (Yx)	Elevation (Zx)*
Side – engine compartment (S1)	10.76 m	4.51 m	0.00 m
Side – passenger compartment (S2)	9.66 m	8.15 m	-1.25 m

Table 51: Location of the centre of the radiant heat flux sources versus the target point – vehicle fire exposure to NW entry

Radiant heat flux calculations for each radiant heat source were carried out using module Radiation from FireWind 3.6. The results are provided in Section 39.1 of Appendix M and are summarised in Table 52.

Source	Maximum combined radiant heat flux at the target point	Acceptance criterion: less than 10 kW/m²
Side – engine compartment (S1)	2.144	Yes
Side – passenger compartment (S2)		

Table 52: Radiant heat flux at the target point – vehicle fire exposure to NW entry

It is evident from Table 52 that the maximum radiant heat flux at the target point that is exposed to a vehicle fire should not exceed 2.144 kW/m².

22.9.2 Radiant Heat Flux from Motor Vehicle FS-01 to Tenant Storage

Assuming that the people mover/van is parked at collect and click, the target point at the tenant storage entry is expected to be exposed to the radiant heat sources described in Table 53 and Table 54.

Source	Width of source, m	Height of source, m	Source size, m	RL of centre of source	Source temp.
Side – engine compartment (S1)	1.07	2.58	1.07 x 2.58	1.29 m	830°C
Side – passenger compartment (S2)	5.13	2.55	5.13 x 2.55	2.54 m	830°C

Table 53: Size and temperature of the radiant heat flux sources – vehicle fire exposure to tenant storage

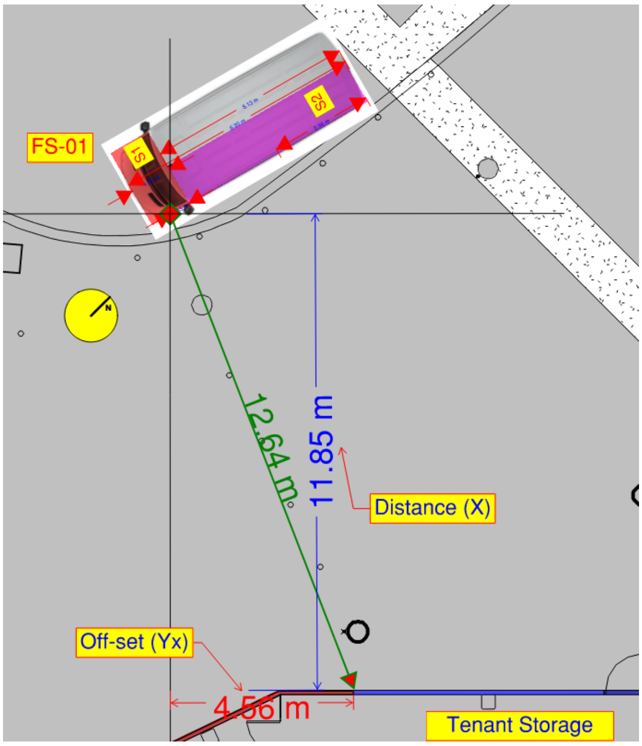

Figure 89: Radiant heat source S1 for the vehicle fire exposure FS-01 to tenant storage

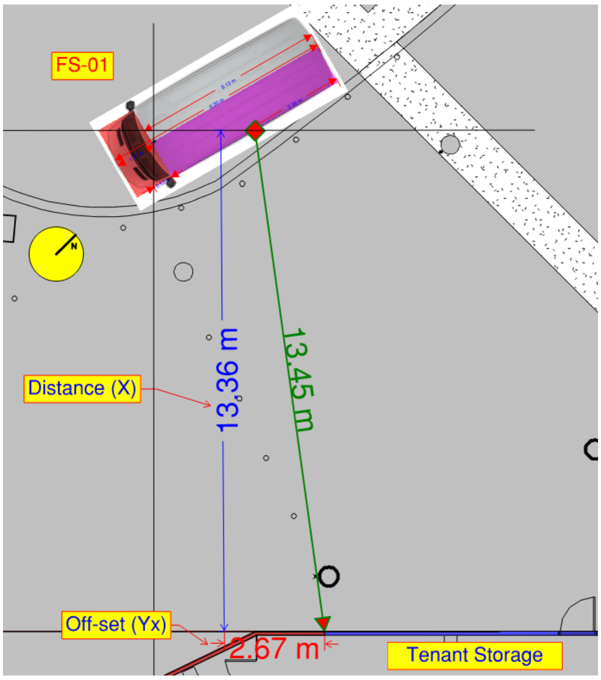

Figure 90: Radiant heat source S2 for the vehicle fire exposure FS-01 to tenant storage

Source	Distance (X)	Off-set (Yx)	Elevation (Zx)*
Side – engine compartment (S1)	11.85 m	4.56 m	0.00 m
Side – passenger compartment (S2)	13.36 m	2.67 m	-1.25 m

Table 54: Location of the centre of the radiant heat flux sources versus the target point – vehicle fire exposure

Radiant heat flux calculations for each radiant heat source were carried out using module Radiation from FireWind 3.6. The results are provided in Section 39.2 of Appendix M and are summarised in Table 55.

Source	Maximum radiant heat flux at the target	Maximum combined radiant heat flux at the target point	Acceptance criterion: less than 10 kW/m²
Side – engine compartment (S1)	0.424 kW/m²	2.202	**Yes**
Side – passenger compartment (S2)	1.778 kW/m²		

Table 55: Radiant heat flux at the target point – vehicle fire exposure

It is evident from Table 55 that the maximum radiant heat flux at the target point that is exposed to a vehicle fire should not exceed 2.202 kW/m².

22.9.3 Radiant Heat Flux from Motor Vehicle FS-02 to Tenant Storage

Assuming the Heavy Rigid Vehicle (HRV) catches fire while driving past the tenant storage—which is considered the worst-case scenario—the target point at the tenant storage is expected to be exposed to the radiant heat levels described in Table 56 and Table 57.

Source	Width of source, m	Height of source, m	Source size, m	RL of centre of source	Source temp.
Side – engine compartment (S1)	2.50	4.30	2.50 x 4.30	2.16 m	830°C
Side – truck compartment (S2)	8.00*	6.45	8.00 x 6.45	4.30 m	830°C

Table 56: Size and temperature of the radiant heat flux sources – vehicle fire exposure

Note *: Due to the length of the HRV, portions of the vehicle are obstructed by the north-east elevation, thereby reducing the effective size of the radiant heat source. This is illustrated in the Figure 91 and Figure 92 below, with the obstructed area highlighted in purple.

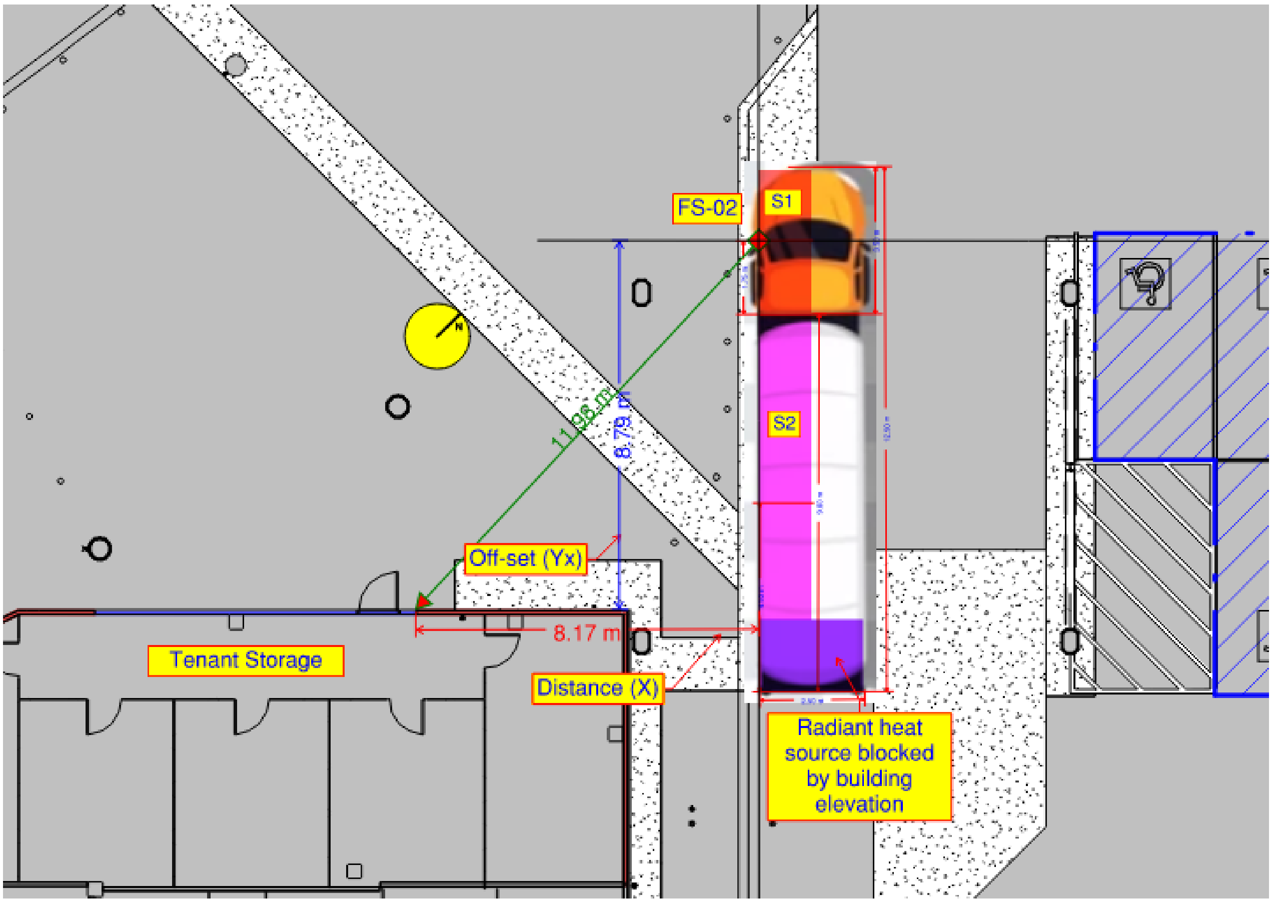

Figure 91: Radiant heat source S1 for the vehicle fire exposure FS-02

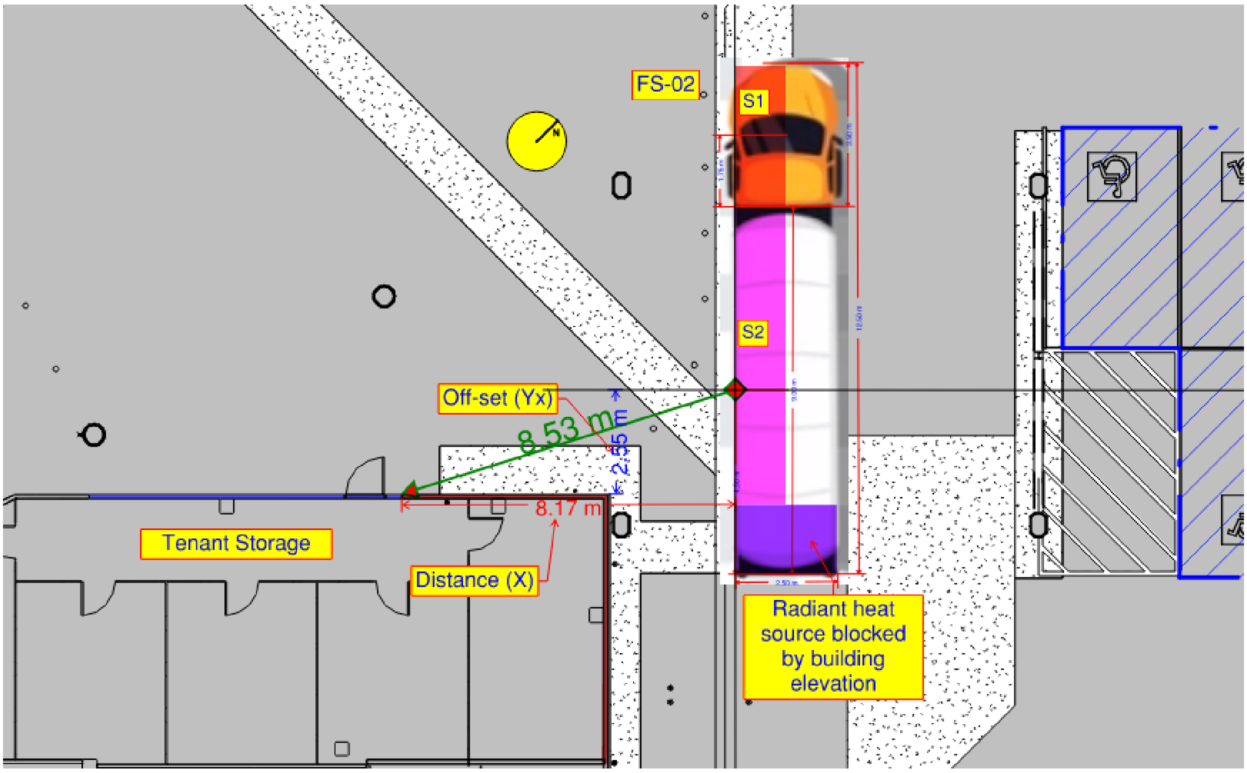

Figure 92: Radiant heat source S2 for the vehicle fire exposure FS-02

Source	Distance (X)	Off-set (Yx)	Elevation (Zx)*
Side – engine compartment (S1)	8.17 m	9.23 m	0.00 m
Side – truck compartment (S2)	8.17 m	3.03 m	-2.14 m

Table 57: Location of the centre of the radiant heat flux sources versus the target point – vehicle fire exposure

Radiant heat flux calculations for each radiant heat source were carried out using module Radiation from FireWind 3.6. The results are provided in Section 39.3 of Appendix M and are summarised in Table 58.

Source	Maximum combined radiant heat flux at the target point	Acceptance criterion: less than 20 kW/m²
Side – engine compartment (S1)	14.64	Yes
Side – truck compartment (S2)		

Table 58: Radiant heat flux at the target point – vehicle fire exposure

It is evident from Table 58 that the maximum radiant heat flux at the target point that is exposed to a vehicle fire should not exceed 14.64 kW/m².

22.9.4 Radiant Heat Flux from Motor Vehicle FS-03 to North Entry

The worst case scenario with the largest radiant surface is when the people mover/van reverse parked into the disable car bay, the target point at the north entry is expected to be exposed to the radiant heat sources described in Table 59 and Table 60.

Source	Width of source, m	Height of source, m	Source size, m	RL of centre of source	Source temp.
Rear (S3)	2.07	3.81	2.07 x 3.81	0.00 m	830°C

Table 59: Size and temperature of the radiant heat flux sources – vehicle fire exposure to the north entry

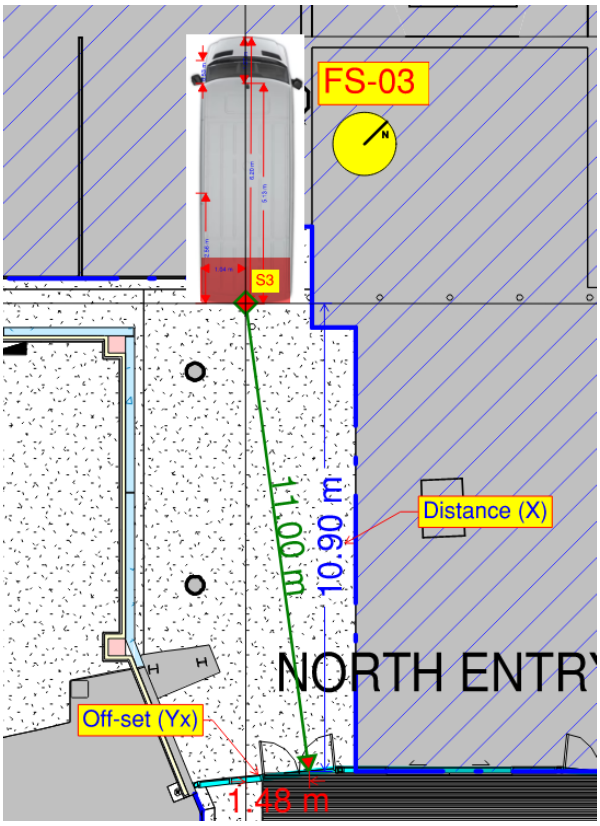

Figure 93: Radiant heat sources for the vehicle fire exposure FS-03

Source	Distance (X)	Off-set (Yx)	Elevation (Zx)*
Rear (S3)	10.90 m	1.48 m	0.00 m

Table 60: Location of the centre of the radiant heat flux sources versus the target point – vehicle fire exposure

Radiant heat flux calculations for each radiant heat source were carried out using module Radiation from FireWind 3.6. The results are provided in Section 39.4 of Appendix M and are summarised in Table 61.

Source	Maximum radiant heat flux at the target	Acceptance criterion: less than 10 kW/m²
Front (S3)	1.683 kW/m²	Yes

Table 61: Radiant heat flux at the target point – vehicle fire exposure to North Entry

It is evident from Table 61 that the maximum radiant heat flux at the target point that is exposed to a vehicle fire should not exceed 1.683 kW/m².

22.9.5 Summary

The combined radiant heat flux at the northwest (NW) entrance from the FS-01 vehicle fire is expected to be no more than 2.144 kW/m², and no more than 2.202 kW/m² at the tenant storage. From the FS-02 vehicle fire, the combined radiant heat flux at the tenant storage is expected to be no more than 14.64 kW/m², and from FS-03, no more than 1.683 kW/m² at the north entrance. These results satisfy the nominated acceptance criteria. It is therefore reasonable to conclude that the radiant heat emitted from vehicle fires is not sufficient to ignite lightweight furnishings within the GSC.

22.10 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with Performance Requirement C1P2(1)(d) and E1P4, as outlined in Section 25.

23. Performance Solution No. 13 – Performance-based Increased Air Velocity through Make-up Air Openings

23.1 Relevant BCA DtS Provisions

BCA Clause E2D15(2)(a) states that *"where the floor area of a Class 6 part of a fire compartment … is more than 2,000 m², the fire compartment, including the enclosed common walkway or mall, must be provided with— an automatic smoke exhaust system complying with Specification 21"*.

Clause S21C6(2) of BCA Specification 21 states *"the velocity of make-up air through doorways must not exceed 2.5 m/s"*.

23.2 Performance Solution

Make-up air is provided for the smoke exhaust systems in the Timezone and JB Hi-Fi tenancies from the retail mall via the shopfronts. The smoke exhaust rates in both tenancies and the make-up air provisions during trading hours are BCA DtS compliant for both tenancies.

After-hours however the net free open area of the openings does not allow to achieve make-up air velocity of less than 2.5 m/s and is increased up to 3.5 m/s, which does not comply with the DtS provisions of Clause S21C6(2) of BCA Specification 21 and Clause E2D15(2)(a).

23.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E2P2.

23.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(d), i.e. "*comparison with the Deemed-to-Satisfy Provisions*".

23.5 Intent of the BCA

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

The intent of Clause S21C6 of Specification 21 (formerly Clause 6 of Specification E2.2b) is *"to provide air to replace that being exhausted by the smoke exhaust system"*.

The Guide to the BCA states that the intent of Clause S21C6(2) (formerly Clause 6(b) of Specification E2.2b) is to ensure that make-up air introduced below the smoke layer is at relatively low velocities, to minimise any disturbance to the smoke layer. The Guide further clarifies that *"make-up air introduced at higher velocities may cause:*

- *"smoke to be drawn down from the hot layer, called the "venturi effect", leading to a loss of visibility in the space below; and*
- *"difficulties for people attempting to exit against the in-rush of air through doorways"*.

It is evident that the intent of the BCA is to ensure that the make-up air velocity is low enough to prevent significant disturbance to the smoke layer that could compromise safe occupant evacuation.

23.6 Assessment Methodology

The purpose of this assessment is to demonstrate that after-hours the increased make-up air velocity through the Timezone and JB Hi-Fi shopfront openings does not have an adverse impact on safe occupant evacuation and fire brigade intervention.

The level of fire safety inherent in a BCA DtS compliant design represents an acceptable community standard for new building works in Australia.

It is considered that if it can be demonstrated that the increased make-up air velocity through the roller-shutters does not disturb the smoke layer to a degree that is greater to that afforded by a BCA DtS compliant design, compliance with Performance Requirement E2P2 is achieved on a comparative basis.

The methodology adopted for the assessment is a quantitative comparative analysis in accordance with the following:

1. Determine the after-hours make-up air velocity through the Timezone and JB Hi-Fi shopfront openings and identify BCA DtS compliant air velocity.
2. Create a model that is reflective of the Timezone and JB Hi-Fi tenancies.
3. Carry out Computational Fire Dynamics (CFD) modelling using computer program FDS-6 [McGrattan, 2023] and determine what impact increased air velocities have on the fire plume and on the tenability conditions in the performance-based design and the BCA DtS compliant desing.
4. Determine whether increased make-up air velocity through the shopfront openings in the performance-based desig has an adverse impact on tenability conditions when compared to the BCA DtS compliant design.

23.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *The increased after-hours make-up air velocity through the Timezone and JB Hi-Fi shopfront openings must not adversely affect tenability conditions inside the tenancies when compared to a BCA DtS compliant design.*

23.8 Assessment

The risk of make-up air entering Timezone and JB Hi-Fi at an elevated velocity was assessed by modelling a fire located inside the tenancy approximately 2 m from the roller-shutter directly in the path of make-up air. During this scenario, air entrainment into the fire plume may be increased, which in turn may increase smoke production and generally create turbulence around the fire seat.

The CFD modelling carried out for this scenario demonstrated that make-up air coming from the retail mall is unlikely to disturb the fire plume and the smoke layer in the Timezone or JB Hi-Fi to a degree that is much different to what would happen in a BCA DtS compliant design where the make-air flow through the perforated section of the shopfront roller-shutter does not exceed 2.5 m/s.

The only difference between the performance-based and BCA DtS compliant designs is the air velocity through the perforated section of the shopfront roller-shutter. In the performance-based design the air velocity is 3.5 m/s, while in the BCA DtS compliant design this velocity is 2.5 m/s, i.e. DtS compliant).

The following screenshots (refer to Figure 94 to Figure 97) illustrate a velocity slice file through the centre of the fire seat and the shopfront roller-shutter. The image on the left is the performance-based design with air velocity through the roller-shutter of 3.5 m/se and the image on the right is the BCA DtS complaint design with air velocity through the roller-shutter of 2.5 m/s.

The black contour illustrates air velocity of 2.2 m/s (air velocity between the roller-shutter and the fire seat did not exceed 2.3m/s; hence the slice file was taken at 2.2 m/s).

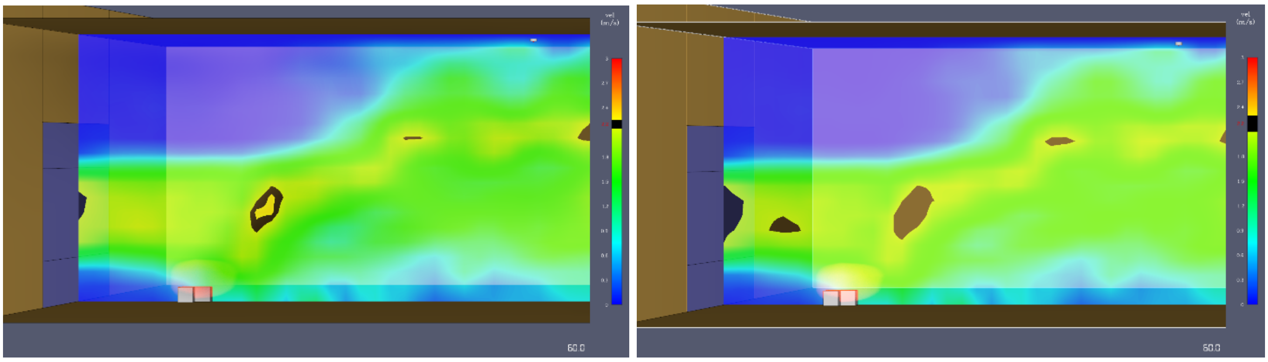

Figure 94: Velocity at 60 seconds after the fire starts

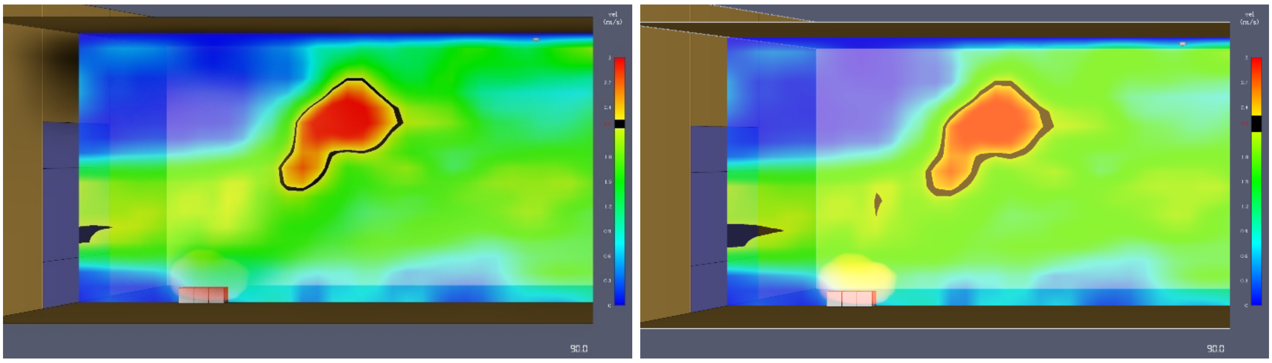

Figure 95: Velocity at 90 seconds after the fire starts

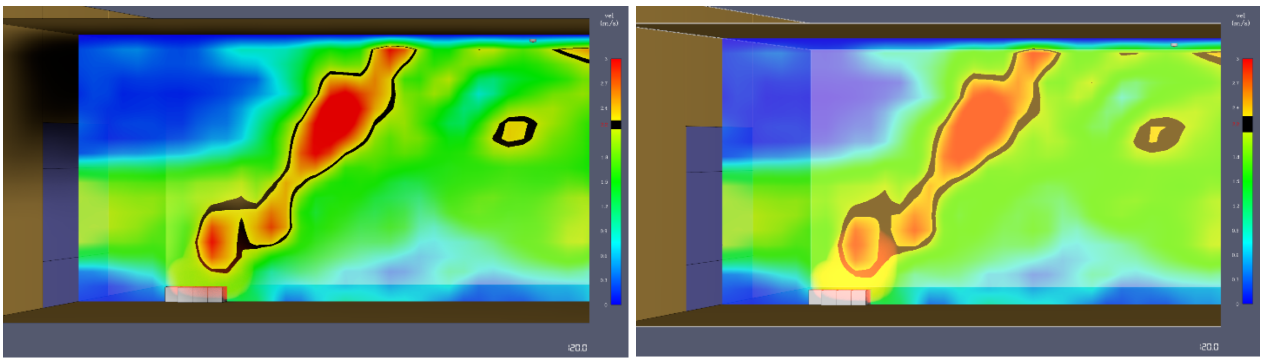

Figure 96: Velocity at 120 seconds after the fire starts

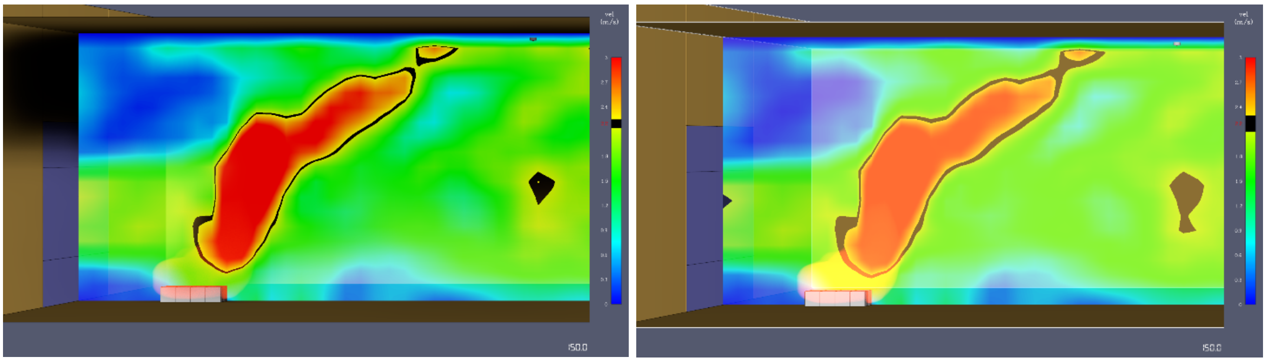

Figure 97: Velocity at 150 seconds after the fire starts

In both designs smoke detectors activated at 36.3 seconds after the fire started; therefore, the first time step was taken as 60 seconds. After that the dynamics of air velocity were assessed every 30 seconds up until 150 seconds, which is considered sufficient to establish a trend.

It is evident that make-up air coming through the roller-shutter at an elevated speed creates a deflection in the fire plume; however, the difference in deflection between the air velocity of 3.5 m/s and 2.5 m/s is niglegible.

It is therefore reasonable to conclude that the increased air velocity in the performance-based design should not have an adverse impact on tenable conditions inside the store.

A screenshot of air velocity through the store at 1.5 m above finished floor (refer to Figure 98 below) indicates that the make-up air velocity coming through the perforated section of the roller-shutter generally does not exceed 2.0 m/s between the shopfront and the fire seat, and the air velocity at this height throughout the tenancy is generally less than 1.0 m/s, which is within the BCA DtS compliant range.

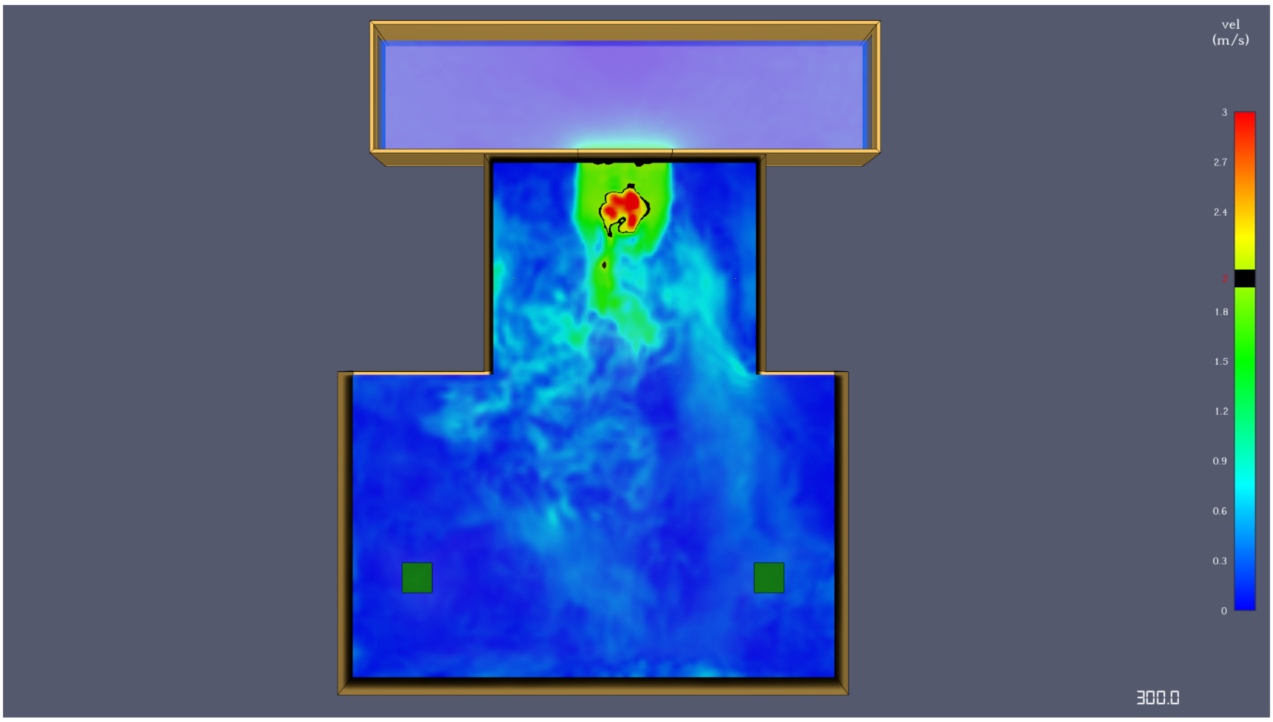

Figure 98: Air velocity through the shopfront at 300 seconds after the fire starts – horizontal slice file

It is therefore reasonable to conclude that the increased make-up air velocity through the Timezone and JB Hi-Fi shopfront roller-shutters after-hours should not disturb the smoke layer inside the tenancies and should not adversely affect tenability conditions inside the tenancies when compared to a BCA DtS compliant design, which satisfies the nominated acceptance criterion.

23.9 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements on a comparative basis, as outlined in Section 25.

24. Performance Solution No. 14 – Performance-based Increased Noise Levels of Existing Smoke Exhaust Fans

24.1 Relevant BCA DtS Provisions

Clause E2D15(2)(a) states that a building "*containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit*" in a fire compartment with a floor area greater than 2,000 m² must be provided with "*an automatic smoke exhaust system complying with Specification 21*".

The BCA DtS provisions do not directly reference AS 1668.1-2015 for automatic smoke exhaust system compliance, except for power supply wiring to exhaust fans (Clause S21C7(7) of BCA Specification 21).

The above notwithstanding, compliance with the provisions of AS 1668.1 is considered a good industry good; hence any deviations from the provisions of AS 1668.1 should be addressed as a performance-based design.

Clause 4.6 of AS 1668.1-2015 states that the noise level in occupied spaces during operation of the smoke control systems shall not exceed 65 dB. Where the internal occupied ambient noise exceeds 60 dB, the smoke control system shall not exceed 5 dB above the internal occupied ambient noise levels, to a maximum level of 80 dB.

24.2 Performance Solution

The existing smoke exhaust fans (SEFs) located in the Myer retail mall and Plaza generate noise levels that exceed 80 dB (up to 90 dB) measured at First Floor, which does not comply with the provisions of Clause 4.6 of AS 1668.1-2015. The SEFs are retained, and the impact of the increased noise levels is assessed in this Performance Solution.

24.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E2P2.

24.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*".

24.5 Intent of the BCA

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient "*time to evacuate before the onset of untenable conditions*". The Guide to the BCA identifies the untenable conditions as: "*dangerous temperatures, low visibility and dangerous levels of toxicity*".

It is evident that for a successful completion of an emergency evacuation a building must be provided with a smoke hazard management system that facilitates timely response from occupants.

A smoke exhaust system that generates increased noise levels may interfere with occupants' ability to hear the fire alarm and therefore may result in a delayed response to an emergency.

24.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the increased noise levels emitted by the existing SEFs will not delay occupant evacuation.

If Myer retail mall and Plaza are provided with fire safety measures (EWIS and visual alarm devices) that would prompt occupants to commence evacuation even if the noise levels generated by the existing SEFs exceed 80 dB, then compliance with Performance Requirement E2P2 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute qualitative deterministic analysis in accordance with the following:

1. Determine the noise levels emitted by the existing SEFs in the Myer retail mall and Plaza smoke zones.
2. Identify the characteristics of the occupant warning system provided in the Myer retail mall and Plaza smoke zones and determine whether the emergency warning messages can be heard when SEFs are operating.
3. If the noise levels could compromise interpretation of the warning messages, develop an enhanced occupant warning strategy that would prompt occupants to commence evacuation when the SEFs are operating.

24.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *The increased noise levels emitted by the existing SEFs must not adversely affect the ability of occupants to interpret audible and visual warnings in the fire-affected area as a cue to commence evacuation.*

24.8 Assessment

Noise levels were measured on the first floor within the Myer retail mall and plaza while the smoke exhaust fans were operating directly above the measurement point. Accordingly, it is expected that noise levels will decrease as occupants move away from the operating fans.

The smoke exhaust fans are separated into smoke zones within the Myer retail mall and plaza. Each fan will only activate when a smoke detector within the corresponding zone detects a fire. Fans in other zones will remain inactive until a fire is detected in those zones. However, activation of any smoke exhaust fan will initiate a full building evacuation. This ensures that occupants in unaffected areas of the mall will still hear the evacuation warning and evacuate accordingly.

Occupants located directly beneath an operating smoke exhaust fan producing noise levels exceeding 80 dB may not initially hear the evacuation warning. However, they are likely to become aware of the loud fan operation and may also observe visual cues—such as other occupants evacuating. These environmental cues serve as prompts to assess their surroundings. Once they move beyond the immediate smoke zone, the evacuation warning is expected to become audible.

Additionally, activation of the smoke exhaust system is typically accompanied by visible or olfactory cues—such as the presence of smoke—which further alert occupants to the emergency.

During an evacuation, retail and security staff are expected to assist patrons by providing verbal instructions and using clear body language to guide them to safety. In situations where occupants do not respond to noise, smoke, or visual cues, staff will actively intervene to assist with evacuation.

Occupants directly beneath the operating smoke exhaust fans may experience a slight delay in evacuation due to the time required to understand the situation. However, this delay is accounted for in the ASET vs. RSET analysis presented in Performance Solution 5 (Section 15), which includes a 120-second pre-movement time to reflect the time occupants may take to recognise the situation and initiate evacuation.

It is therefore considered that the increased noise levels emitted by the existing smoke exhaust fans (SEFs) will not adversely impact occupants' ability to interpret audible and visual warnings as cues to initiate evacuation within the fire-affected area.

24.9 Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements on a comparative basis, as outlined in Section 25.

25. Compliance with Performance Requirements of the BCA

The fire safety strategy detailed in Section 9 achieves compliance with the relevant Performance Requirements of the BCA as documented in the following sections.

25.1 Performance Requirement C1P1

The following Performance Solution has been assessed against Performance Requirement C1P1:

1. Performance Solution No. 1 – Performance-based FRL of loadbearing structure.

The table below outlines how the performance-based design achieves compliance with Performance Requirement C1P1.

Performance Requirement C1P1		
A building must have elements which will, to the degree necessary, maintain structural stability during a fire appropriate to—		
(a)	The function or use of the building	The building is a Class 6 retail building. The performance-based design is considered to be appropriate to the function and use of the building.
(b)	The fire load	The potential fire load is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered to be appropriate to the fire load.
(c)	The potential fire intensity	The potential fire intensity is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered appropriate to the potential fire intensity.
(d)	The fire hazard	The potential fire hazard is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered appropriate to the fire hazard.
(e)	The number of storeys in the building	The building has a rise in storeys of 3. The performance-based design is considered appropriate to the number of storeys in the building.
(f)	Its proximity to other property	The building is not exposed to a fire-source feature. The performance-based design is considered appropriate to the proximity to other properties.

Performance Requirement C1P1		
(g)	Any active fire safety systems installed in the building	The retail mall is provided with an automatic sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017. The specialty shops, mini-major (not provided with automatic smoke exhaust), enclosed BoH areas and loading docks within the scope of this project shall be provided with a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018. The retail mall within the scope of this project shall be provided with Emergency Warning and Intercommunication System (EWIS) in accordance with Clause E4D9(d) and AS 1670.4-2018. The retail mall is provided with automatic smoke exhaust. The performance-based design is considered appropriate to the active fire safety systems installed in the building.
(h)	The size of any fire compartment	The retail mall is designed as a single fire compartment with a total floor area of approximately 73,500 m². The performance-based design is considered appropriate to the size of fire compartment.
(i)	Fire brigade intervention	Fire brigade intervention was considered in the FSER using qualitative deterministic analysis and was demonstrated to be facilitated. The performance-based design is considered appropriate to fire brigade intervention.
(j)	Other elements they support	The performance-based loadbearing steel columns and walls support the first floor above. The performance-based design is considered appropriate to elements the load-bearing structure supports.
(k)	The evacuation time	The evacuation time was not quantified, but it was considered in the analysis qualitatively. The performance-based design is considered appropriate to the evacuation time.

Table 62: Compliance with Performance Requirement C1P1

25.2 Performance Requirement C1P2(1)(a), C1P2(1)(c), C1P2(1)(d)

The following Performance Solution has been assessed against Performance Requirement C1P2(1)(a), C1P2(1)(c) and C1P2(1)(d):

1. Performance Solution No. 1 – Performance-based FRL of loadbearing structure

The following Performance Solution has been assessed against Performance Requirement C1P2(1)(d):

2. Performance Solution No. 2 – Non-fire-rated plant rooms and cabling to AHUs

The table below outlines how the performance-based design achieves compliance with Performance Requirement C1P2(1)(a), C1P2(1)(c), and C1P2(1)(d).

Performance Requirement C1P2(1)(a), C1P2(1)(c), C1P2(1)(d)		
(1)	A building must have elements which will, to the degree necessary, avoid the spread of fire—	
(a)	to exits; and	
(c)	between buildings; and	
(d)	in a building	
(2)	Avoidance of the spread of fire referred to in (1) must be appropriate to—	
(a)	The function or use of the building	The building is a Class 6 retail building. The performance-based design is considered to be appropriate to the function and use of the building.
(b)	The fire load	The potential fire load is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered to be appropriate to the fire load.
(c)	The potential fire intensity	The potential fire intensity is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered appropriate to the potential fire intensity.
(d)	The fire hazard	The potential fire hazard is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered appropriate to the fire hazard.
(e)	The number of storeys in the building	The building has a rise in storeys of 3. The performance-based design is considered appropriate to the number of storeys in the building.
(f)	Its proximity to other property	The building is not exposed to a fire-source feature. The performance-based design is considered appropriate to the proximity to other properties.

Performance Requirement C1P2(1)(a), C1P2(1)(c), C1P2(1)(d)		
(g)	Any active fire safety systems installed in the building	The retail mall is provided with an automatic sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017. The specialty shops, mini-major (not provided with automatic smoke exhaust), enclosed BoH areas and loading docks within the scope of this project shall be provided with a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018. The retail mall within the scope of this project shall be provided with Emergency Warning and Intercommunication System (EWIS) in accordance with Clause E4D9(d) and AS 1670.4-2018. The retail mall is provided with automatic smoke exhaust. The performance-based design is considered appropriate to the active fire safety systems installed in the building.
(h)	The size of any fire compartment	The retail mall is designed as a single fire compartment with a total floor area of approximately 73,500 m². The performance-based design is considered appropriate to the size of fire compartment.
(i)	Fire brigade intervention	Fire brigade intervention was considered in the FSER using qualitative deterministic analysis and was demonstrated to be facilitated. The performance-based design is considered appropriate to fire brigade intervention.
(j)	Other elements they support	The performance-based loadbearing steel columns and walls support the first floor above. The performance-based design is considered appropriate to elements the load-bearing structure supports.
(k)	The evacuation time	The evacuation time was not quantified, but it was considered in the analysis qualitatively. The performance-based design is considered appropriate to the evacuation time.

Table 63: Compliance with Performance Requirement C1P2(1)(a), C1P2(1)(c) and C1P2(1)(d)

25.3 Performance Requirement D1P4

The following Performance Solution has been assessed against Performance Requirement D1P4:

1. Performance Solution No. 3 – Performance-based non-fire-isolated exits
2. Performance Solution No. 4 – Extended travel distances from areas not provided with automatic smoke exhaust
3. Performance Solution No. 5 – Performance-based egress and smoke hazard management provisions in the retail malls

The table below outlines how the performance-based building design achieves compliance with Performance Requirement D1P4.

Performance Requirement D1P4		
Exits must be provided from a building to allow occupants to evacuate safely, with their number, location and dimensions being appropriate to—		
(a)	The travel distance	Travel distances have been considered in Performance Solutions No. 3, No. 4 and No. 5 and the impact of extended travel distances was assessed using quantitative and qualitative comparative analysis. It has been demonstrated that all occupants should be able to evacuate out of GSC safely. The performance-based design is considered appropriate to the travel distances.
(b)	The number, mobility and other characteristics of the occupants	The number, mobility, and other characteristics of the occupants have been considered in the analysis. The performance-based design is considered appropriate to the number, mobility, and other characteristics of the occupants.
(c)	The function or use of the building	The building is a Class 6 retail shopping centre. The performance-based design is considered appropriate to the function and use of the building.
(d)	The height of the building	The building has an effective height of 10 m. The performance-based design is considered appropriate to the height of the building.
(e)	Whether the exit is from above or below the ground level	The building has exits from above ground level only. The configuration and location of the exits has been considered in the analysis.

Table 64: Compliance with Performance Requirement D1P4

25.4 Performance Requirement D1P5

The following Performance Solution has been assessed against Performance Requirement D1P5:

1. Performance Solution No. 6 – Performance-based access to fire-isolated corridor 03
2. Performance Solution No. 7 – Performance-based discharge from fire-Isolated exits

The table below outlines how the performance-based design achieves compliance with Performance Requirement D1P5.

Performance Requirement D1P5		
To protect evacuating occupants from a fire in the building exits must be fire-isolated, to the degree necessary, appropriate to—		
(a)	The number of storeys connected by the exits	The maximum number of storeys connected by fire-isolated Stair 1 is 3. The performance-based design is considered appropriate to the number of storeys connected by the exits.
(b)	The fire safety system installed in the building	The retail mall is provided with an automatic sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017. The specialty shops, mini-major (not provided with automatic smoke exhaust), enclosed BoH areas and loading docks within the scope of this project shall be provided with a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018. The retail mall within the scope of this project shall be provided with Emergency Warning and Intercommunication System (EWIS) in accordance with Clause E4D9(d) and AS 1670.4-2018. The retail mall is provided with automatic smoke exhaust. The performance-based design is considered appropriate to the active fire safety systems installed in the building.
(c)	The function or use of the building	The building is a Class 6 retail building. The performance-based design is considered to be appropriate to the function and use of the building.
(d)	The number of storeys passed through by the exits	The maximum number of storeys passed through by the existing fire-isolated star is 3. The performance-based design is considered appropriate to the number of storeys passed by the exits.
(e)	Fire brigade intervention	Fire brigade intervention has been considered using qualitative deterministic analysis and has been demonstrated to be facilitated. The performance-based design is considered appropriate to the fire brigade intervention.

Table 65: Compliance with Performance Requirement D1P5

25.5 Performance Requirement E1P1

The following Performance Solution has been assessed against Performance Requirement E1P1:

1. Performance Solution No. 9 – Performance-based attack on fire by building occupants.

The table below outlines how the performance-based building design achieves compliance with Performance Requirement E1P1.

Performance Requirement E1P1		
A fire hose reel system must be installed to the degree necessary to allow occupants to safely undertake initial attack on a fire appropriate to—		
(a)	The size of the fire compartment	The retail mall is designed as a single fire compartment with a total floor area of approximately 73,500 m². The performance-based design is considered appropriate to the size of fire compartment.
(b)	The function or use of the building	The building is a Class 6 retail building. The performance-based design is considered to be appropriate to the function and use of the building.
(c)	Any other fire safety systems installed in the building	The retail mall is provided with an automatic sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017. The specialty shops, mini-major (not provided with automatic smoke exhaust), enclosed BoH areas and loading docks within the scope of this project shall be provided with a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018. The retail mall within the scope of this project shall be provided with Emergency Warning and Intercommunication System (EWIS) in accordance with Clause E4D9(d) and AS 1670.4-2018. The retail mall is provided with automatic smoke exhaust. The performance-based design is considered appropriate to the active fire safety systems installed in the building.
(d)	The fire hazard	The potential fire hazard is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered appropriate to the fire hazard.

Table 66: Compliance with Performance Requirement E1P1

25.6 Performance Requirement E1P3

The following Performance Solution has been assessed against Performance Requirement E1P3:

4. Performance Solution No. 8 – Performance-based fire hydrant system

The table below outlines how the performance-based design achieves compliance with Performance Requirement E1P3.

Performance Requirement E1P3		
A fire hydrant system must be provided to the degree necessary to facilitate the needs of the fire brigade appropriate to—		
(a)	Fire-fighting operations	The extended fire hose coverage was considered in the assessments. Fire hose coverage from external and internal hydrants with an additional length of hose is considered to facilitate the needs of the fire brigade and is appropriate to fire-fighting operations.
(b)	The floor area of the building	The building is a 3-storey shopping centre with a total floor area of 73,500 m². Fire hose coverage from external and internal hydrants with an additional length of hose is considered appropriate to the floor area of the building.
(c)	The fire hazard	The potential fire hazard is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered appropriate to the fire hazard.

Table 67: Compliance with Performance Requirement E1P3

25.7 Performance Requirement E1P4

The following Performance Solution has been assessed against Performance Requirement E1P4:

1. Performance Solution No. 10 – Omission of sprinklers from skylights and external covered area.
2. Performance So0lution No. 11 – Performance-based separation between sprinklered and non-sprinklered parts

The table below outlines how the performance-based design achieves compliance with Performance Requirement E1P4.

Performance Requirement E1P4		
An automatic fire suppression system must be installed to the degree necessary to control the development and spread of fire appropriate to —		
(a)	The size of the fire compartment	The retail mall is designed as a single fire compartment with a total floor area of approximately 73,500 m². The performance-based design is considered appropriate to the size of fire compartment.
(b)	The function or use of the building	The building is a Class 6 retail building. The performance-based design is considered to be appropriate to the function and use of the building.
(c)	The fire hazard	The potential fire hazard is consistent with a Class 6 retail building and was considered in the analysis. The performance-based design is considered appropriate to the fire hazard.
(d)	The height of the building	The building has an effective height of 10 m. The performance-based design is considered appropriate to the height of the building.

Table 68: Compliance with Performance Requirement E1P4

25.8 Performance Requirement E2P2

The following Performance Solution has been assessed against Performance Requirement E2P2:

1. Performance Solution No. 2 – Non-fire-rated plant rooms and cabling to AHUs
2. Performance Solution No. 3 – Performance-based non-fire-isolated exits
3. Performance Solution No. 4 – Extended travel distances from areas not provided with automatic smoke exhaust
4. Performance Solution No. 5 – Performance-based egress and smoke hazard management provisions in the retail malls
5. Performance Solution No. 6 – Performance-based access to fire-isolated corridor 03
6. Performance Solution No. 7 – Discharge from fire-isolated exits
7. Performance Solution No. 12 – Performance-based increased air velocity through make-up air openings
8. Performance Solution No. 13 – Performance-based increased noise levels of existing smoke exhaust fans

The table below outlines how the performance-based design achieves compliance with Performance Requirement E2P2.

<table>
<tr><th colspan="3">Performance Requirement E2P2</th></tr>
<tr><td>(1)</td><td colspan="2">In the event of a fire in the building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building so that—</td></tr>
<tr><td>(a)</td><td>The temperature will not endanger human life</td><td rowspan="3">The assessment provided in this FSER considers the impact of combustion products on occupants and thereby generally considers the temperature, visibility, and toxicity of the smoke. The analysis demonstrates that the performance-based design facilitates safe occupant evacuation on equivalence principals (quantitative and qualitative comparative assessment of extended travel distances from areas not provided with smoke exhaust and absolute quantitative deterministic assessment of extended travel distances from areas with performance-based smoke exhaust system).

Therefore, the temperature and toxicity are not expected to endanger human life and the level of visibility is expected to enable the evacuation routes to be determined.</td></tr>
<tr><td>(b)</td><td>The level of visibility will enable the evacuation route to be determined</td></tr>
<tr><td>(c)</td><td>The level of toxicity will not endanger human life</td></tr>
<tr><td>(2)</td><td colspan="2">The period of time occupants take to evacuate referred to in (1) must be appropriate to—</td></tr>
<tr><td>(a)</td><td>The number, mobility and other characteristics of the occupants</td><td>The number, mobility, and other characteristics of the occupants have been considered in the analysis.

The period of time occupants take to evacuate referred to in item (1) above is appropriate to the number, mobility and other characteristics of the occupants.</td></tr>
</table>

Performance Requirement E2P2		
(b)	The function or use of the building	The building is a Class 6 shopping centre. The period of time occupants take to evacuate referred to in item (1) above is appropriate to the function and use of the building.
(c)	The travel distance and other characteristics of the building	Travel distances have been considered in Performance Solutions No. 4 and No. 5 and the impact of extended travel distances was assessed using either absolute quantitative deterministic or quantitative and qualitative comparative analysis. It has been demonstrated that all occupants should be able to evacuate from the GSC safely. The period of time occupants takes to evacuate referred to in item (1) above is appropriate to the travel distance and other characteristics of the building.
(d)	The fire load	The potential fire load is consistent with a Class 6 retail shopping centre and has been considered in the analysis. The period of time occupants takes to evacuate referred to in item (1) above is appropriate to the fire load.
(e)	The potential fire intensity	The potential fire intensity is consistent with a Class 6 retail shopping centre and has been considered in the analysis. The period of time occupants takes to evacuate referred to in item (1) above is appropriate to the potential fire intensity.
(f)	The fire hazard	The potential fire hazard is consistent with a Class 6 retail shopping centre and has been considered in the analysis. The period of time occupants takes to evacuate referred to in item (1) above is appropriate to the potential fire hazard.
(g)	Any active fire safety systems installed in the building	The retail mall is provided with an automatic sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017. The specialty shops, mini-major (not provided with automatic smoke exhaust), enclosed BoH areas and loading docks within the scope of this project shall be provided with a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018. The retail mall within the scope of this project shall be provided with Emergency Warning and Intercommunication System (EWIS) in accordance with Clause E4D9(d) and AS 1670.4-2018. The retail mall is provided with automatic smoke exhaust. The period of time occupants take to evacuate referred to in item (1) above is appropriate to the active fire safety systems installed in the building.
(h)	Fire brigade intervention	Fire brigade intervention was considered in the FSER using qualitative deterministic analysis and was demonstrated to be facilitated. The period of time occupants take to evacuate referred to in item (1) above is appropriate to fire brigade intervention.

Table 69: Compliance with Performance Requirement E2P2

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- MBIE, 2020: "*C/VM2 – Verification Method: Framework for Fire Safety Design – For New Zealand Building Code Clauses C1-C6 Protection from Fire, Amendment 6*", Ministry of Business, Innovation and Employment, Wellington 6140, New Zealand – p. 30, Table 2.2.
- NFSN/NFCC, 2017: "*Efficiency and Effectiveness of Sprinkler Systems in the United Kingdom: an Analysis from Fire Service Data*", National Fire Sprinkler Network and National Fire Chiefs Council, UK.
- Richardson, J., 1983: "*An assessment of the performance of automatic sprinkler systems*", Fire Technology, 19 – pp. 275-279.
- Rohr, K.D., 2003: "*U.S. experience with sprinklers*", Quincy, MA; National Fire Protection Association, Fire Analysis and Research Division, USA – Table 12, p. 46.
- Thomas, P.H., 1981: "*Testing products and materials for their contribution to flashover in rooms*", F. and Matls., Volume 5, Issue 3, pp. 103-111.

27. Appendix A – Assumptions and Limitations

The following assumptions and limitations apply to this report:

a) The assessment provided in this report is limited to the analysis of fire safety; specifically, the ability of the performance-based building design to satisfy the BCA Performance Requirements in respect to fire safety arising out of accidental fires and arson attacks of opportunity (i.e., arson attacks that use ignition sources readily available in the building, and do not involve use of accelerants and/or tampering with the installed fire safety measures). The assessment only takes into consideration fires originating from a single source, with fuel load and distribution compatible with the use of the area under consideration. Acts of premeditated arson (i.e., introduction of accelerants; fuel loads that are not typical for the area under consideration; tampering with fire safety measures), terrorism or any other fires initiated due to malicious acts of one or more individuals are specifically excluded from the scope of the assessment.

b) The assessment specifically excludes assessment of all other types of emergency situations and assumes that suitable measures will be set in place to handle those types of emergencies. The building surveyor and/or permit authority must ensure that they are satisfied that the performance-based building design has adequate provisions for life safety in emergency situations other than those originating from accidental fires or arson attacks of opportunity.

c) The report specifically excludes assessment of property damage / loss of business continuity as a result of a fire; or insurer requirements; or environmental protection requirements, unless specifically stated otherwise in this report. The assessment is based on the objectives of the BCA as outlined in Section 2.1.

d) The Performance Solution(s) is(are) developed to demonstrate compliance with the BCA Performance Requirements and may not provide the level of property protection inherent in a BCA DtS compliant design.

e) The BCA Performance Requirements identified in this report may have parts which are not entirely fire safety related and which are not specifically covered by this fire safety engineering assessment. Such aspects include but are not limited to general occupational health and safety matters (i.e., safety during day-to-day operations, or during emergencies other than emergencies arising from accidental fires), and access and amenity. The building surveyor and/or permit authority or other specialist parties shall be responsible for assessing and certifying the ability of the design to satisfy those portions of the BCA Performance Requirements that are not fire safety related and for ensuring that the design provides adequate safety for day-to-day operation and/or emergencies other than those arising from accidental fires.

f) This report relies on third parties for the identification of non-compliances with the BCA DtS provisions. BCA Consultants take no responsibility for the accuracy of the information provided by third parties.

g) This report may in parts rely on input from stakeholders to develop an appropriate fire engineering brief (FEB) criteria and assessment parameters. Fire scenarios, identified during the FEB process as being worst credible fire scenarios, are considered representative of such scenarios. This report does not assess system performance and the ability of the design to meet the BCA Performance Requirements for fire scenarios that are more severe or hazardous than the fire scenarios identified as requiring assessment. Fire engineering methodologies and acceptance criteria identified during the FEB process as being appropriate for this project are considered appropriate for justifying compliance with the BCA Performance Requirements. Acceptance of this report by the stakeholders is considered to be acceptance that the report satisfies the requirements set out in the FEB.

h) The FSER may use in parts comparative assessment to determine compliance with the BCA Performance Requirements and relies on the BCA DtS provisions to achieve an adequate level of fire safety.

i) This fire safety engineering assessment aims to provide appropriate supporting evidence demonstrating that the Performance Solutions are capable of satisfying the nominated BCA Performance Requirements in respect to fire safety. This report may in parts rely on:

1. The accuracy of conclusions and opinions drawn in past research when assessing the level of performance achieved by the performance-based design.

2. The opinions of the fire engineers and other stakeholders working on the project in respect to the intent of the BCA Performance Requirements (i.e., the BCA DtS provisions require the fire safety design to facilitate the safe evacuation of the occupants; however, no fire safety design can guarantee occupants will be safe in the event of a fire). This report has been produced on the basis that new fire safety designs need to provide suitable measures that can be shown (using appropriate supporting evidence) to either facilitate the safe evacuation of the occupants in the event of identified reasonable worst credible fire scenarios; or provide at least equivalent fire safety performance to a design complying with the BCA DtS provisions).

3. Opinions of other professionals as part of the FEB process (i.e., in confirming acceptance of nominated reasonable worst credible fire scenarios and appropriate assessment methodologies, tenability criteria and acceptance criteria, etc.).

4. Opinion of the building surveyor and/or permit issuing authority in respect of the suitability of the selected base case BCA DtS compliant designs used for comparative assessments.

5. Modelling tools developed by other organisations as a means of assessing performance.

6. Minimum BCA DtS provisions for achieving an acceptable level of fire safety and compliance with the BCA Performance Requirements.

j) This FEB has been produced and issued by BCA Consultants and any intellectual property contained within this report is to remain the property of BCA Consultants and must not be distributed to parties except for those directly involved in the project to which this report relates without written approval of BCA Consultants.

28. Appendix B – DFES FEB Meeting Minutes

The following is a copy of the minutes for the FEB Meeting with DFES on 22 April 2025 prepared by BCA Consultants (WA) Pty Ltd.

The document is included in its entirety and the original page numbering is maintained.

Minutes of FEB Meeting No.1

CLIENT/DEPARTMENT: Multiplex
PROJECT/SUBJECT: Galleria Schopping Centre
PURPOSE: FEB meeting
DATE: 22/04/2025 **STARTED:** 9.00am **FINISHED:** 10.00am
LOCATION: DFES Built Environment Branch (Teams Meeting)
OUR REFERENCE: 20240380-E0302-Mn-0001
PRESENT:

Name	Company/Position	Contact	Initials
Brendan O'Regan	DFES – Fire Engineer	Brendan.O'Regan@dfes.wa.gov.au	BO'R
Alexis Wake	DFES – Building Fire Safety Officer	Alexis.Wake@dfes.wa.gov.au	AW
Kylie Judd	Multiplex – Project Manager	Kylie.Judd@multiplex.global	KJ
Vincent Chi	Buchan – Architect	Vincent.Chi@buchan.au	VC
Nick Rae	Buchan – Architect	Nick.Rae@buchan.au	NR
Nikola Stojanovic	Build Plus Group – Project manager client	nik.stojanovic@buildplusgroup.com	NS
Mark Viska	BCA – Building Surveyor	mviska@bcagroup.com.au	MV
Chris Meisinger	BCA – Fire Engineer	cmeisinger@bcagroup.com.au	CM
Alex Alexandrovski	BCA – Fire Safety Engineer	aalexandrovski@bcagroup.com.au	AA
Amy Chao	BCA – Fire Safety Engineer	achao@bcagroup.com.au	AC

APOLOGIES:

Name	Company/Position	Contact	Initials
No apologies			

OBJECTIVE:
Present the fire safety strategy for the project to DFES and agree on the methodology to document the proposed Performance Solutions.

Item	Topic	Who	Due Date
Note:	*We believe the following record to be an accurate summary of decisions and related discussions. We will appreciate notification of exceptions to this record within three (3) business days of its receipt. Failing such notification, we will consider this a statement of fact in which you concur.*	BO'R, AW, KJ, VC, NS, NR, MV, CM, AC, AA	30.04.2025
1.	**Acceptance of previous minutes: No Previous Minutes**		
2.	**General**		
2.1.	AA started the meeting by introducing the project.		
2.2.	The previous design was completed by Arup; BCA Consultants has now taken over.		
2.3.	The scope of works has slightly changed from the previous design by Arup. The work is now limited to the central part of the mall, with a new Timezone tenancy and minor extensions to JD Sports and the tenancies along the southeast side adjacent to Rebel Sport.		

Item	Topic	Who	Due Date
2.4.	The two circular stairs (previously part of the food court) located on the south side are to be removed, and the food court will be converted into a JB Hi-Fi store.		
2.5.	Myer is fire-separated from the rest of the mall by fire-rated sliding doors that close upon fire alarm activation.		
3.	**Perf. Sol. 1 – Reduction in structural fire rating**		
3.1.	MV explained that, generally, all areas with three storeys—including Myer and the plant rooms—are fire separated from the rest of the centre. Hence, the shopping mall is classified as Type B Construction, which requires a 180-minute fire rating.		
3.2.	AA followed by explaining that the proposed Performance Solution is to reduce the fire rating requirement from nomial 180 minutes to 120 minutes.		
3.3.	The proposed approach is to carry out a burnout calculation using the Eurocode, Law and CIB W14 formulae.		
3.4.	As the building is sprinkler-protected, the assessment will concentrate on a redundancy scenario assuming sprinkler failure.		
3.5.	A 75% glass breakage will be used for the sprinkler failure scenario.		
3.6.	BO'R commented that DFES recommend a 50% glass breakage.		
3.7.	AA noted DFES's comments and will look into it.		
3.8.	BO'R asked about the slab.		
3.9.	AA responded that it is a reinforced concrete slab, which would inherently provide a fire rating. However, this will need to be confirmed with the structural engineer for the exact rating provided.		
3.10.	BO'R acknowledged the comments.		
4.	**Perf. Sol. 2 – Extended travel distances in areas without smoke exhaust**		
4.1.	Extended travel distances to a single exit or a point of choice are capped at 30 metres.		
4.2.	A proposed quantitative comparative assessment will be carried out, comparing the Deemed-to-Satisfy (DtS) sprinkler detection time to the performance-based smoke detection time, i.e. a comparison of DtS RSET time versus performance-based RSET.		
4.3.	BO'R had no objections.		
5.	**Perf. Sol. 3 – Extended travel distances in areas with smoke exhaust**		
5.1.	Extended travel distances between alternative exits and to the nearest of the alternative exits were discussed.		
5.2.	The proposed solution is to maintain tenable conditions in the retail malls for the duration of occupant evacuation.		
5.3.	The existing smoke exhaust system has multiple exhaust points. The size of the system will be determined through CFD modelling.		
5.4.	There are no smoke baffles in the retail mall, so the smoke reservoir length will exceed 60 metres.		

Item	Topic	Who	Due Date
5.5.	BO'R noted that DFES provided response to ARUP report and advised that incorporating original DFES comments into the current report would resolve most of DFES concerns.		
5.6.	DFES also commented that they disagree with the medium fire size proposed by ARUP.		
5.7.	AA responded that fast fire growth scenarios will be used as the base case, along with the failure of the largest smoke exhaust fan as a redundancy fire scenario.		
5.8.	BO'R had no objection.		
5.9.	AA continued that the Rebel Sport and Timezone tenancies will have smoke exhaust systems that are Deemed-to-Satisfy (DtS) compliant.		
5.10.	For the JB Hi-Fi tenancy, smoke exhaust provision will depend on the selling floor area.		
5.11.	If the area is less than 1,000 m², smoke exhaust will be omitted; otherwise, it will be provided.		
5.12.	BO'R had no objection to the proposed smoke exhaust approach.		
5.13.	BO'R asked about occupant egress from tenancies with an alternative exit leading directly to the outside.		
5.14.	ARUP proposed that all occupants from such tenancies will use the external exit and not re-enter the mall. DFES disagrees with this approach.		
5.15.	DFES believes that if the mall is the main entrance, occupants are likely to re-enter the mall.		
5.16.	AA explained that BCA Consultants propose a 50/50 occupant split in such tenancies if the main entrance is connected to the mall.		
5.17.	This approach is based on Project 6, and evacuation will be modelled using Pathfinder.		
5.18.	BO'R had no objection.		
5.19.	AA added that the two curved stairs are being removed. A new internal stair will be provided to replace the curved stairs.		
5.20.	Smoke detection will be installed in the tenancies adjacent to the balcony.		
5.21.	BO'R asked whether the new internal stair will be fire-isolated.		
5.22.	AA responded that the stair will be smoke-separated only, as it connects just two levels.		
6.	**Perf. Sol. 4 –Fire isolated corridors discharge into covered areas**		
6.1.	The discharge of fire-isolated corridors into covered areas or fenced loading dock was discussed.		
6.2.	Potential solutions are still being considered. Dynamic signage may be provided if the escape path could be compromised.		
6.3.	BO'R asked, in scenarios where occupants egress into a fenced off loading dock, whether the exit gates in the fence can be located closer to the exit doors to avoid the need to traverse the loading dock to reach open space.		

Item	Topic	Who	Due Date
6.4.	AA will look into this.		
6.5.	BO’R also inquired about egress widths.		
6.6.	AA confirmed that all egress routes will be modelled, and any minor shortfalls in width (if present) will be identified and addressed in the Fire Safety Engineering Report (FSER).		
6.7.	BO’R agreed and noted that DFES will review the FSER to understand the egress discharge provisions, with particular attention to the availability of alternative exits.		
7.	**Perf. Sol. 5 – Class 6 exits discharge into non-compliant areas**		
7.1.	Discharge into a roofed car park, which is a separate building but connected to the retail mall, was discussed.		
7.2.	Once occupants leave the retail building, they are considered to be in a place of relative safety.		
7.3.	BO’R had no objections.		
8.	**Perf. Sol. 6 – Fire hose coverage**		
8.1.	The proposed approach is to provide two lengths of hose for internal hydrants within the mall (i.e. hydrants spaced 25-30 metres apart within the mall). However, 2 lengths of hose used to reach into deeper tenancies.		
8.2.	BO’R asked whether the hydrants are existing.		
8.3.	AA responded that some hydrants may be changed or replaced and confirmed this will be looked into.		
8.4.	BO’R noted that DFES prefers hydrants to be spaced at 24 metres apart but will accept 25–30 metres in areas where a 24-metre spacing is not achievable due to layout constraints. However, DFES prefers internal hydrants within large tenancies if adequate coverage cannot be achieved from two directions (i.e. from the retail mall and from outside).		
9.	**Perf. Sol. 7 – Extinguishers in lieu of Fire Hose Reels**		
9.1.	Fire extinguishers are proposed in lieu of fire hose reels throughout the mall, except in the car park and major tenancies.		
9.2.	BO’R had no objection to the proposal.		
10.	**Perf. Sol. 8 – Omission of sprinklers from particular parts**		
10.1.	AA explained that sprinklers are proposed to be omitted from the north laneway canopy.		
10.2.	VC added that the canopy is constructed of lightweight steel with a solid polycarbonate roof.		
10.3.	BO’R noted that if the canopy is non-combustible and fuel loads are managed, the omission may be acceptable.		
10.4.	AA clarified that polycarbonate is combustible and has a low melting temperature.		
10.5.	BO’R responded that if it can be justified that fire spread is not a concern—due to surrounding sprinkler protection, absence of nearby fire sources, and appropriate design—then the omission may be acceptable.		

Item	Topic	Who	Due Date
10.6.	AA acknowledged this.		
10.7.	AA continued that the roofs of the atrium and of the Meyer Mall are not sprinkler-protected and that the proposed assessment will consider any potential fuel load below these roofs.		
10.8.	BO'R asked whether a larger fire size will be considered in the CFD modelling.		
10.9.	AA confirmed that this is the intention.		
10.10.	AA further noted that the southeast extension of the first-floor tenancy has created a 'covered walkway' on the ground floor below. Sprinklers are proposed to be omitted from this area.		
10.11.	Management will be asked to ensure no fire load is present in this walkway. If that cannot be assured, sprinklers will be installed.		
10.12.	The walls are not fire-rated but are made of concrete slabs and walls.		
10.13.	BO'R had no objection, on the understanding that it is essentially a 'covered walkway' with no fire load present.		
11.	**Perf. Sol. 9 – Omission of fire-resistant cabling to the AHUs**		
11.1.	AA explained that in a worst-case scenario, four AHUs (air handling units) will be lost, but there will still be enough AHUs to support the operation of the smoke exhaust system.		
11.2.	BO'R asked whether a reduced AHU scenario, such as after-hours operation, will be considered.		
11.3.	AA will check the operations after-hours. The original design, as understood, is that all doors will open on fire alarm at all times.		
11.4.	BO'R asked whether security will be in place if all doors are open during nighttime.		
11.5.	AA responded that, to our understanding, security will be in place during such occasions.		
12.	**Perf. Sol. 10 – Existing smoke exhaust fans produce noise levels exceed maximum prescribed**		
12.1.	Noise levels produced by the existing smoke exhaust fans will be assessed to determine whether they interfere with alarm signals.		
12.2.	BO'R suggested the use of visual alarms.		
12.3.	AA responded that visual alarms will be considered if noise levels could interfere with the alarms.		
12.4.	DFES had no further comments regarding the proposed performance solution.		
13.	**EWIS system**		
13.1.	BO'R asked whether the EWIS (Emergency Warning and Intercommunication System) covers the entire shopping centre.		
13.2.	BO'R explained that the DFES records indicate that the existing parts of the mall do not have EWIS coverage. This may fall outside the current scope.		

Item	Topic	Who	Due Date
13.3.	KJ responded that she will resolve this with the client and confirm the coverage as part of the FEB submission.	KJ	30.04.2025

Next Meeting: N/A **Location:**

Chair: Alex Alexandrovski **Title:** Senior Fire Engineer

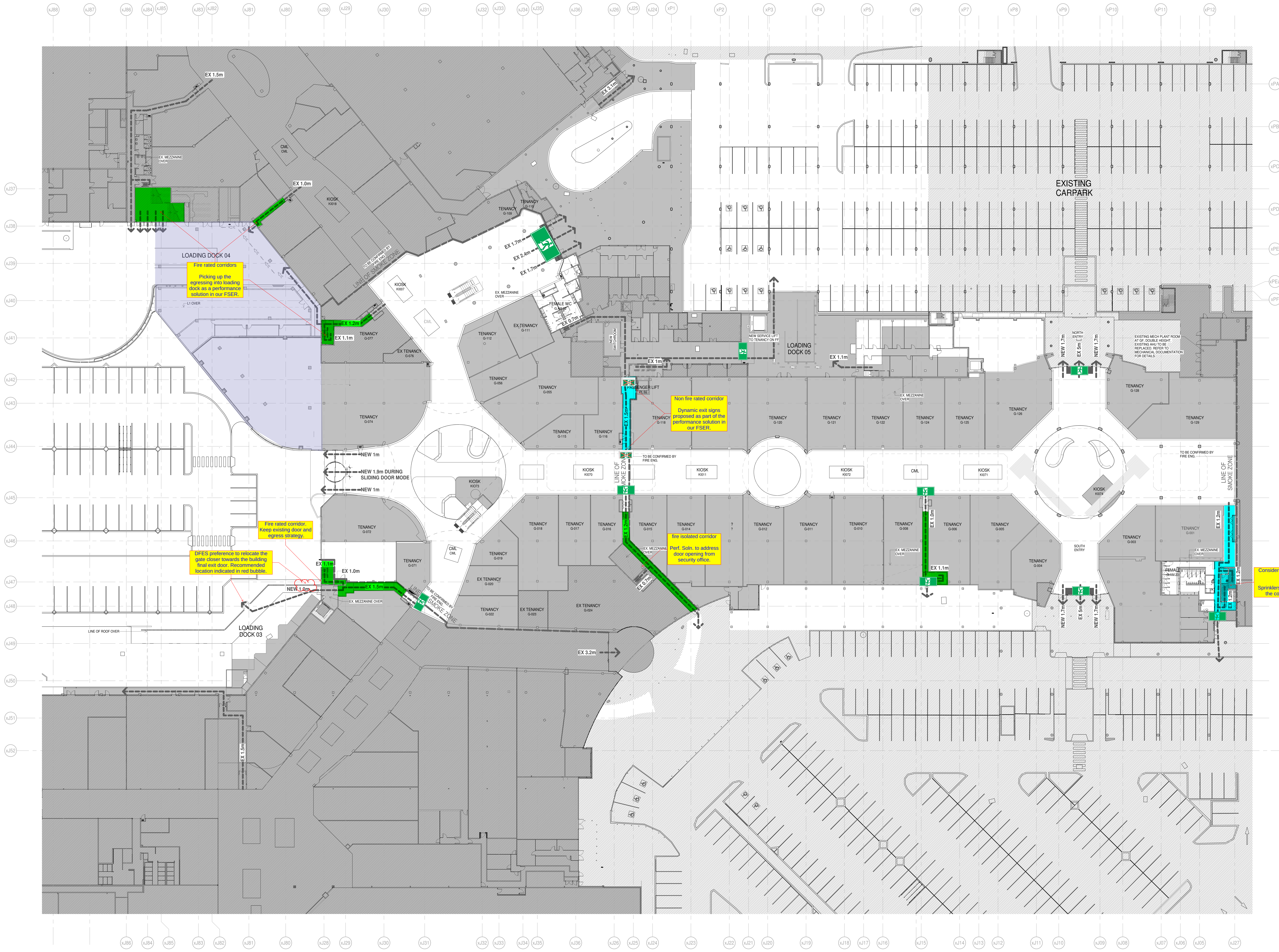
PREPARED BY: Amy Chao

DISTRIBUTION: All present

29. Appendix C – Fire Rated Corridors

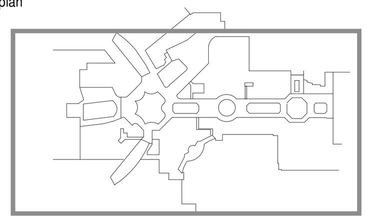
The following is a copy of the markup within the area of scope that identified the fire rated corridors.

The document is included in its entirety and the original page numbering is maintained.



Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC

Keyplan



File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION
- ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

BCA Legend

- Fire rated corridor
- Non fire rated corridor

Rev. A 06.05.2025

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status: TENDER
Date Plotted: 17/04/2025 5:50:40 PM
Scale: As indicated @A0
0 2.5 5 10 15 20M

Drawing Title
GROUND FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

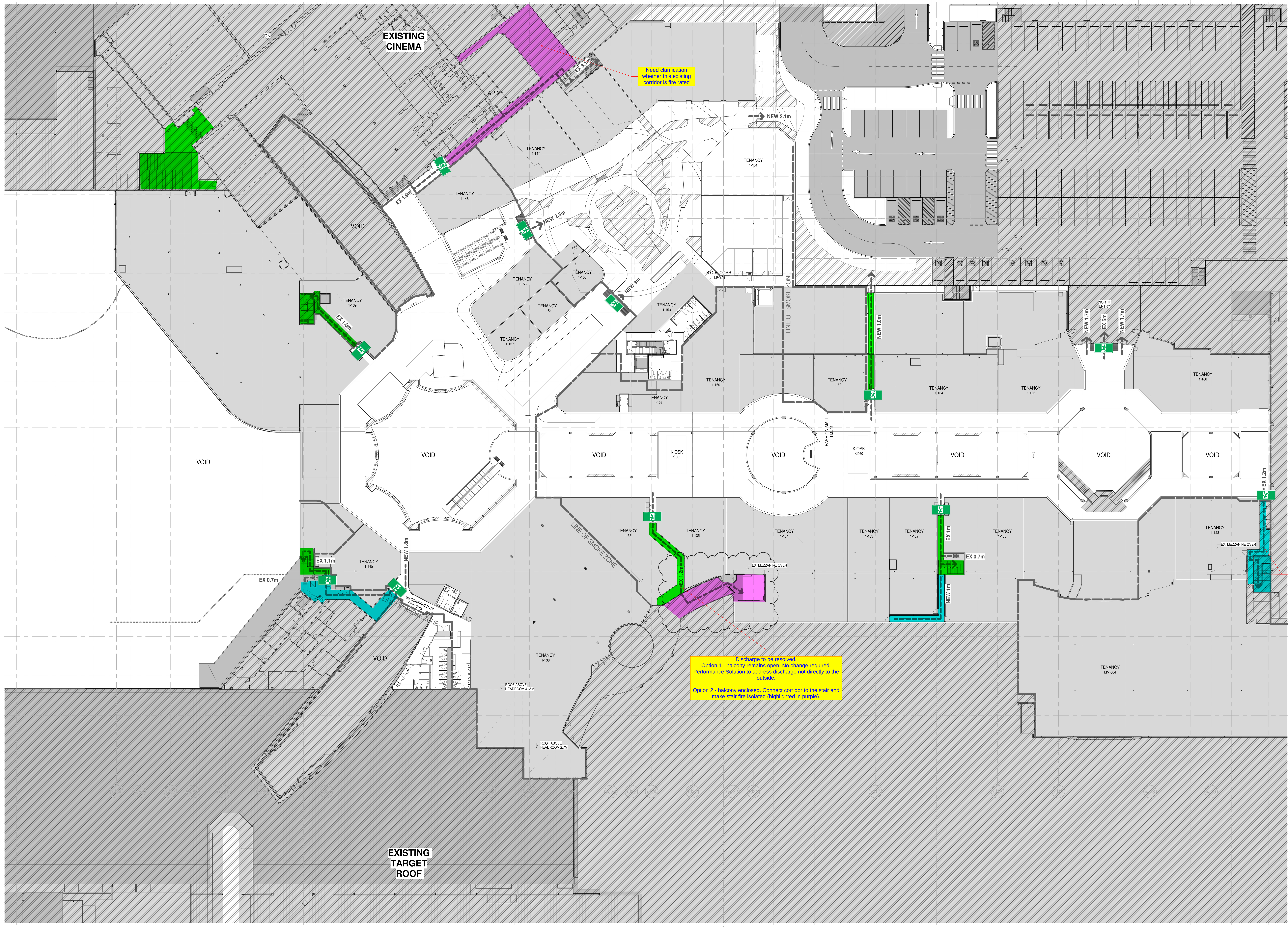
Drawing Number: GAL-BUC-AR-04-0L-0-18001
Revision: B

BUCHAN

Perth Studio
+ 61 8 9211 9898 / **buchan.au**

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION

Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC



Keyplan

File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION
- ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

BCA Legend

- Fire rated corridor
- Non fire rated corridor

Rev. A 06.05.2025

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status: TENDER
Date Plotted: 17/04/2025 5:50:09 PM
Scale: As indicated @A0
0 2.5 5 10 15 20M

Drawing Title
FIRST FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number: GAL-BUC-AR-04-1L-0-18003
Revision: B

BUCHAN

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ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION

30. Appendix D – Fire Hydrant Coverage Plans

The following is a copy of the "Fire Hydrant Coverage" plans for the GSC within the area of scope prepared by Firesafe Group Pty Ltd.

The document is included in its entirety and the original page numbering is maintained.

GENERAL NOTE:

- HYDRANT COVERAGE IS BASED ON 3 x 30M HOSE LENGTHS (30M EXTERNAL + 60M INTERNAL) AS PER FIRE ENGINEERING BRIEF
- HYDRANT COVERAGE IS BASED ON 2 x 30M HOSE LENGTHS FOR INTERNAL HYDRANTS AS PER FIRE ENGINEERING BRIEF

NOTE:

1. EXISTING SINGLE STAIR FIRE HYDRANT TO BE REPLACED WITH A NEW DUAL HEAD FIRE HYDRANT.
2. EXISTING FIRE HYDRANT TO BE RELOCATED OUTSIDE OF L1 BUILDING ENVELOPE TO BE CLASSIFIED AS AN EXTERNAL FIRE HYDRANT.
3. EXISTING FIRE HYDRANT SHOWN IS CLASSIFIED AS AN INTERNAL FIRE HYDRANT DUE TO LOADING DOCK CANOPY/COVER ABOVE.

FURTHER NOTES:

1. ORIGINAL DESIGN TO AS2419.1 – 2005. MODIFICATIONS TO THE EXISTING HYDRANT SYSTEM TO COMPLY WITH PARTS OF AS2419.1-2021 AS PER THE FIRE ENGINEERING BRIEF
2. FIRE HYDRANT HOSE COVERAGE ACHIEVED USING 3 X LENGTHS OF HOSE FROM EXTERNAL ATTACK HYDRANTS, HOWEVER THE LENGTH OF HOSE LAID INSIDE THE BUILDING SHALL NOT EXCEED 60M AS PER THE FIRE ENGINEERING BRIEF.
3. AT LEAST 1M OF HOSE SHALL EXTEND INTO THE FURTHERMOST PROTECTED ROOM AS PER THE FIRE ENGINEERING BRIEF
4. EXTERNAL PIPEWORK EXPOSED TO WEATHER WILL BE OF MILD STEEL, MEDIUM GRADE, AND PAINTED FOR CORROSION PROTECTION.
5. SIGNAGE MUST BE PROVIDED TO INFORM DFES THAT ADDITIONAL HOSE LENGTHS ARE REQUIRED
6. THE FLOW AND PRESSURE OF DISCHARGE AT THE REQUIREMENTS OF AS2419-2021 (5 L/SEC EACH @ 700KPA)
7. EXTINGUISHERS SHALL BE PROVIDED IN LIEU OF FIRE HOSE REELS AS PER THE FIRE ENGINEERING BRIEF.
8. EXISTING FIRE HOSE REELS IN THE SCOPE OF WORKS AREA TO BE DEMOLISHED
9. EACH SPECIALTY TENANCY SHALL BE PROVIDED WITH AT LEAST ONE FIRE EXTINGUISHER AS PER THE FIRE ENGINEERING BRIEF.
10. REFER TO FW-40-XL-X-400 SERIES OF DRAWINGS FOR FIRE HYDRANT COVERAGE LAYOUTS
11. REFER TO FW-46-XL-X-200 SERIES DRAWINGS FOR FIRE PIPEWORK LAYOUTS
13. REFER TO FD-45-XL-X-200 SERIES DRAWINGS FOR DRY FIRE LAYOUTS

TOLERANCE: DIMENSIONS NOTED AND ANY SETOUTS ARE CORRECT TO WITHIN +/- 50MM

REFERENCE DRAWINGS

DRAWING TITLE	DRAWING NUMBER	REV	DATE
ARCHITECTURE	GAL-AR-BUC-MOD-BUILD	V10	05.05.2025
STRUCTURE	GAL-HRA-ST-MOD-BUILD	V5	06.06.2025
MECHANICAL	GME-LNK-ME-MOD-BUILD	V7	09.06.2025
ELECTRICAL	GAL-STN-EL-MOD-BUILD	V8	02.06.2025
HYDRAULICS	GAL-STN-EL-MOD-BUILD	V7	09.06.2025
INTERIORS			

APPLICABLE STANDARDS

☐	AS2118.1 - 2017	AUTOMATIC FIRE SPRINKLER SYSTEMS
☐	AS2118.6 - 2012	COMBINED SPRINKLER & HYDRANT SYSTEMS
☐	AS2419.1 - 2005	FIRE HYDRANT SYSTEMS
X	AS2419.1 - 2021	FIRE HYDRANT SYSTEMS
☐	AS 2441 - 2005	FIRE HOSE REEL SYSTEMS
☐	AS2419 - 2013	FIRE PUMP SETS
☐	AS2304 - 2019	WATER STORAGE TANKS FOR FIRE PROTECTION SYSTEMS
☐	AS2444.1 - 2001	PORTABLE FIRE EXTINGUISHERS & FIRE BLANKETS
☐	AS1670.1 - 2018	FIRE DETECTION, WARNING CONTROL & INTERCOM SYSTEMS
☐	AS1670.4 - 2018	EMERGENCY WARNING & INTERCOM SYSTEMS
☐	AS1668.1 - 2015	FIRE & SMOKE CONTROL IN MULTI-COMPARTMENT BUILDINGS

PROJECT SPECIFIC DOCUMENTATION:

X	FEB / FER	GAL-BCA-FE-RPT-0002 [D]
X	SPECIFICATION	GAL-FCS-FS-SPC-001 [B]

DESIGN CRITERIA SUMMARY

LEGEND OF SYMBOLS

eDFH	EXISTING DUAL HEAD FIRE HYDRANT
FH	NEW FIRE HYDRANT
DFH	NEW DUAL HEAD FIRE HYDRANT
red line	FIRE HOSE EXTERNAL LENGTH (MAX 30 METRES)
green line	FIRE HOSE INTERNAL LENGTH (MAX 60 METRES)
blue line	FIRE HOSE SPRAY (MAX 10M)
magenta line	INTERNAL HYDRANT TO HYDRANT DISTANCE

FOR INTERNAL INFORMATION

WCG		WCD	
WMG		WMD	
WCS	25009	WCH	
WMS		WMH	

KEY / SITE PLAN

REVISIONS

REV	BY	DESCRIPTION	DATE
A	DM	PRELIMINARY ISSUE	06/05/25
B	DM	BUILDING LICENCE	14/05/25
C	DM	BUILDING LICENCE	09/06/25
D	DM	BUILDING LICENCE	13/06/25

BUILDING LICENCE

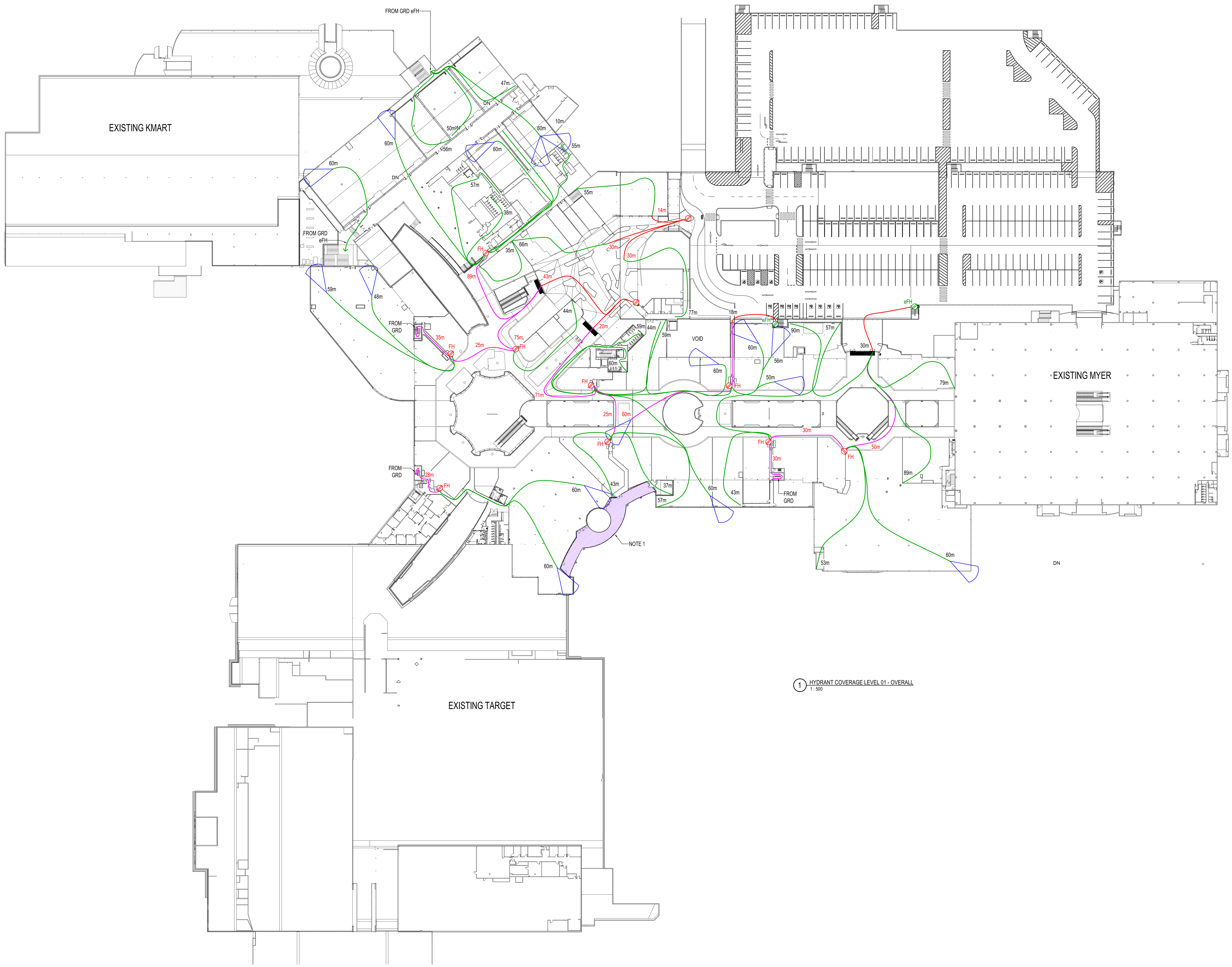
CLIENT: VICINITY CENTRES; PERRON GROUP

CONTRACTOR: Firesafe GROUP PTY LTD
U2/16 ASPIRATION CCT BIBRA LAKE WA 6163
PH (08) 9437 7777 FAX (08) 9418 6355

PROJECT:
GALLERIA
COLLIER RD & WALTER RD W,
MORLEY, WESTERN AUSTRALIA

DESCRIPTION:
FIRE WET - MAIN WORKS
FIRE HYDRANT COVERAGE LAYOUT - LEVEL 00

DRAWN:	SCALE:	SHT SIZE:
DM	1 : 500	A0
CHECKED: RB	DATE: 29.04.2025	
PROJECT NO: WCS25009	DRAWING NO: GAL-FCS-FW-05-0L-0-401	REV: D



1 HYDRANT COVERAGE LEVEL 01 - OVERALL
1 : 500

GENERAL NOTE:

- HYDRANT COVERAGE IS BASED ON 3 x 30M HOSE LENGTHS (30M EXTERNAL + 60M INTERNAL) AS PER FIRE ENGINEERING BRIEF
- HYDRANT COVERAGE IS BASED ON 2 x 30M HOSE LENGTHS FOR INTERNAL HYDRANTS AS PER FIRE ENGINEERING BRIEF

NOTE:

1. POTENTIAL HYDRANT COVERAGE SHORTFALL IF FACADE LINE IS EXTENDED TO FRONT OF EXISTING BALCONY

FURTHER NOTES:

1. ORIGINAL DESIGN TO AS2419.1 – 2005. MODIFICATIONS TO THE EXISTING HYDRANT SYSTEM TO COMPLY WITH PARTS OF AS2419.1-2021 AS PER THE FIRE ENGINEERING BRIEF
2. FIRE HYDRANT HOSE COVERAGE ACHIEVED USING 3 X LENGTHS OF HOSE FROM EXTERNAL ATTACK HYDRANTS, HOWEVER THE LENGTH OF HOSE LAID INSIDE THE BUILDING SHALL NOT EXCEED 60M AS PER THE FIRE ENGINEERING BRIEF.
3. AT LEAST 1M OF HOSE SHALL EXTEND INTO THE FURTHERMOST PROTECTED ROOM AS PER THE FIRE ENGINEERING BRIEF
4. EXTERNAL PIPEWORK EXPOSED TO WEATHER WILL BE OF MILD STEEL, MEDIUM GRADE, AND PAINTED FOR CORROSION PROTECTION.
5. SIGNAGE MUST BE PROVIDED TO INFORM DFES THAT ADDITIONAL HOSE LENGTHS ARE REQUIRED
6. THE FLOW AND PRESSURE OF DISCHARGE AT THE REQUIREMENTS OF AS2419-2021 (5 L/SEC EACH @ 700KPA)
7. EXTINGUISHERS SHALL BE PROVIDED IN LIEU OF FIRE HOSE REELS AS PER THE FIRE ENGINEERING BRIEF.
8. EXISTING FIRE HOSE REELS IN THE SCOPE OF WORKS AREA TO BE DEMOLISHED
9. EACH SPECIALTY TENANCY SHALL BE PROVIDED WITH AT LEAST ONE FIRE EXTINGUISHER AS PER THE FIRE ENGINEERING BRIEF.
10. REFER TO FW-40-XL-X-400 SERIES OF DRAWINGS FOR FIRE HYDRANT COVERAGE LAYOUTS
11. REFER TO FW-46-XL-X-200 SERIES DRAWINGS FOR FIRE PIPEWORK LAYOUTS
13. REFER TO FD-45-XL-X-200 SERIES DRAWINGS FOR DRY FIRE LAYOUTS

TOLERANCE: DIMENSIONS NOTED AND ANY SETOUTS ARE CORRECT TO WITHIN +/- 50MM

REFERENCE DRAWINGS

DRAWING TITLE	DRAWING NUMBER	REV	DATE
ARCHITECTURE	GAL-AR-BUC-MOD-BUILD	V10	09.06.2025
STRUCTURE	GAL-HRA-ST-MOD-BUILD	V5	06.06.2025
MECHANICAL	GME-LNK-R24-ME-BUILD	V7	09.06.2025
ELECTRICAL	GAL-STN-EL-MOD-BUILD	V8	02.06.2025
HYDRAULICS	GAL-STN-HY-MOD-BUILD	V7	09.06.2025
INTERIORS			

APPLICABLE STANDARDS

[ ]	AS2118.1 - 2017	AUTOMATIC FIRE SPRINKLER SYSTEMS
[ ]	AS2118.6 - 2012	COMBINED SPRINKLER & HYDRANT SYSTEMS
[ ]	AS2419.1 - 2005	FIRE HYDRANT SYSTEMS
X	AS2419.1 - 2021	FIRE HYDRANT SYSTEMS
[ ]	AS 2441 - 2005	FIRE HOSE REEL SYSTEMS
[ ]	AS2419 - 2013	FIRE PUMP SETS
[ ]	AS2304 - 2019	WATER STORAGE TANKS FOR FIRE PROTECTION SYSTEMS
[ ]	AS2444.1 - 2001	PORTABLE FIRE EXTINGUISHERS & FIRE BLANKETS
[ ]	AS1670.1 - 2018	FIRE DETECTION, WARNING CONTROL & INTERCOM SYSTEMS
[ ]	AS1670.4 - 2018	EMERGENCY WARNING & INTERCOM SYSTEMS
[ ]	AS1668.1 - 2015	FIRE & SMOKE CONTROL IN MULTI-COMPARTMENT BUILDINGS

PROJECT SPECIFIC DOCUMENTATION:

X	FEB / FER	FEB GAL-BCA-FE-RPT-0002 [D]
X	SPECIFICATION	GAL-FCS-FS-SPC-001 [B]

DESIGN CRITERIA SUMMARY

LEGEND OF SYMBOLS

eDFH	EXISTING DUAL HEAD FIRE HYDRANT
FH	NEW FIRE HYDRANT
DFH	NEW DUAL HEAD FIRE HYDRANT
(red line)	FIRE HOSE EXTERNAL LENGTH (MAX 30 METRES)
(green line)	FIRE HOSE INTERNAL LENGTH (MAX 60 METRES)
(blue line)	FIRE HOSE SPRAY (MAX 10M)
(magenta line)	INTERNAL HYDRANT TO HYDRANT DISTANCE

FOR INTERNAL INFORMATION

WCG		WCD	
WMG		WMD	
WCS	25009	WCH	
WMS		WMH	

KEY / SITE PLAN

REVISIONS

REV	BY	DESCRIPTION	DATE
A	DM	PRELIMINARY ISSUE	06/05/25
B	DM	BUILDING LICENCE	14/05/25
C	DM	BUILDING LICENCE	20/05/25
D	DM	BUILDING LICENCE	09/06/25
E	DM	BUILDING LICENCE	13/06/25

BUILDING LICENCE

CLIENT:
VICINITY CENTRES
PERRON GROUP

CONTRACTOR:

Firesafe GROUP PTY LTD
U2/16 ASPIRATION CCT BIBRA LAKE WA 6163
PH (08) 9437 7777 FAX (08) 9418 6355

PROJECT:
GALLERIA
COLLIER RD & WALTER RD W, MORLEY, WESTERN AUSTRALIA

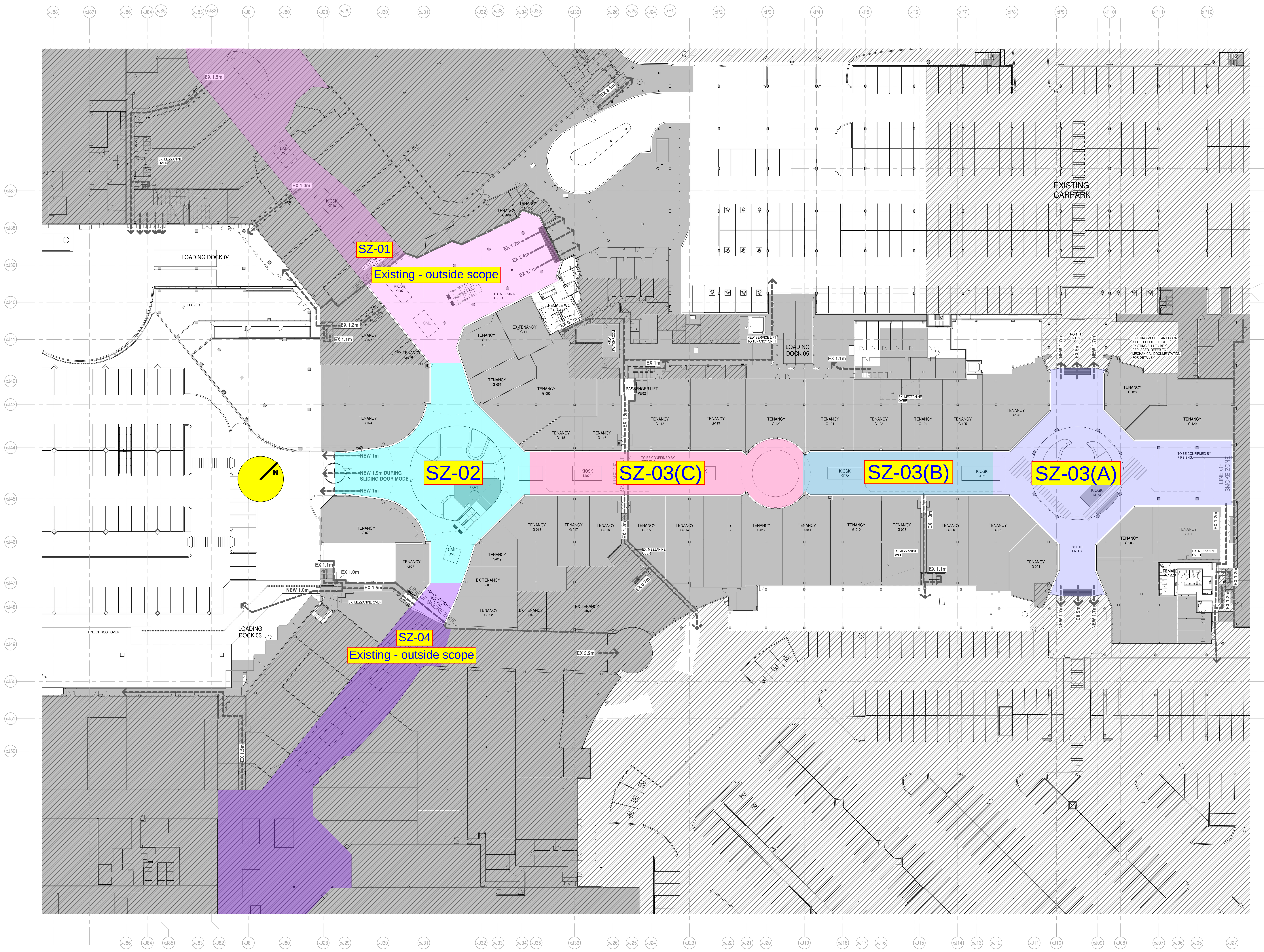
DESCRIPTION:
FIRE WET - MAIN WORKS FIRE HYDRANT COVERAGE LAYOUT - LEVEL 01

DRAWN:	SCALE:	SHT SIZE:
DM	1 : 500	A0
CHECKED: RB	DATE: 29.04.2025	
PROJECT NO: WCS25009	DRAWING NO: GAL-FCS-FW-05-1L-0-401	REV: E

31. Appendix E – Smoke Zones

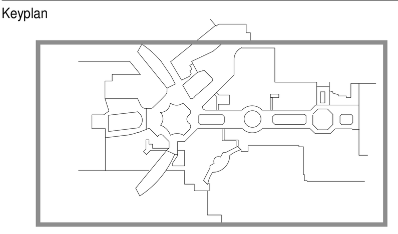
The following is a copy of the markup within the area of scope, identifying the designated smoke zones.

The document is included in its entirety and the original page numbering is maintained.



Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC

Keyplan



File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION
- ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status: TENDER
Date Plotted: 17/04/2025 5:50:40 PM
Scale: As indicated @A0
0 2.5 5 10 15 20M

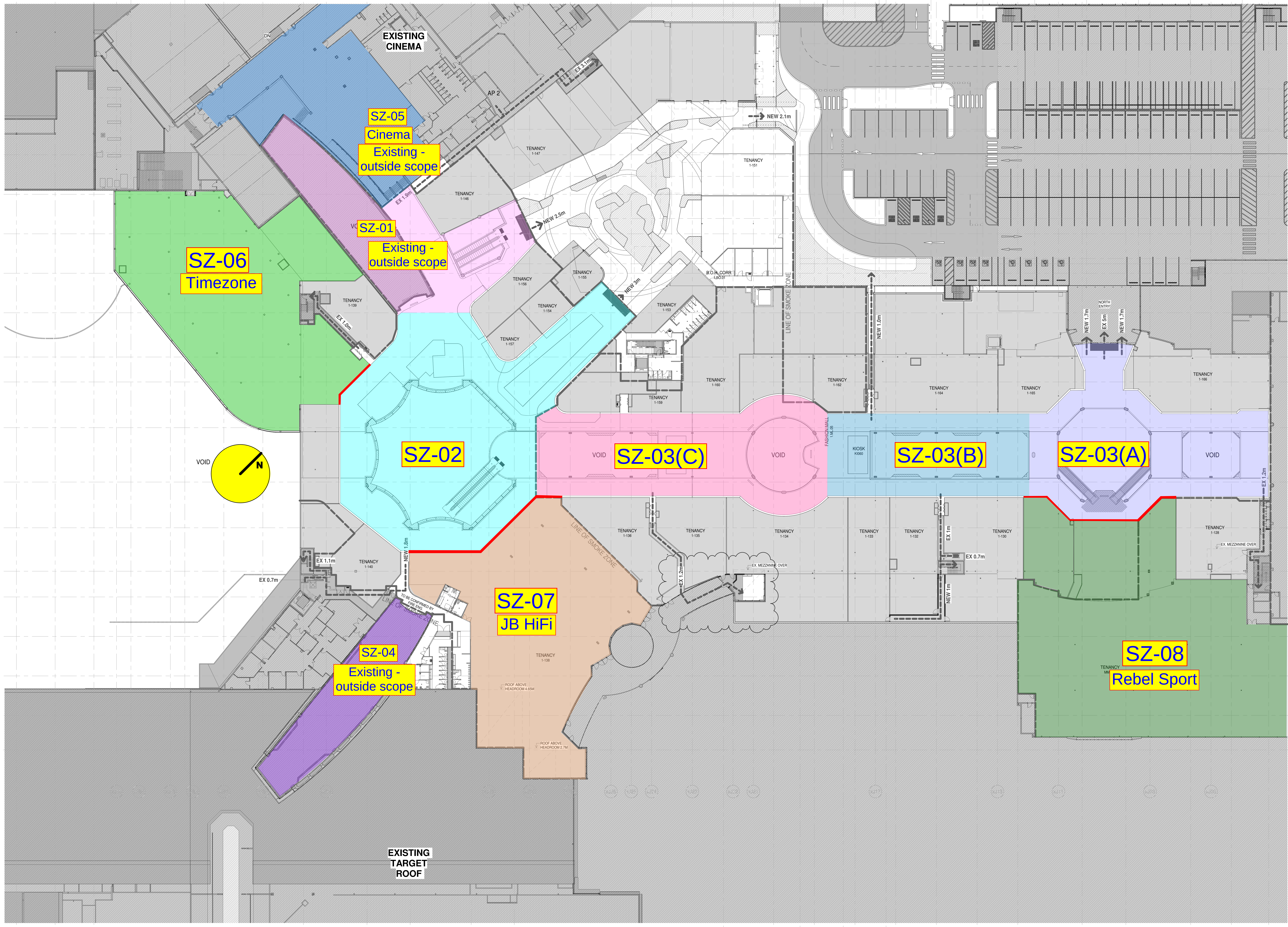
Drawing Title
GROUND FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number: GAL-BUC-AR-04-0L-0-18001
Revision: B

BUCHAN

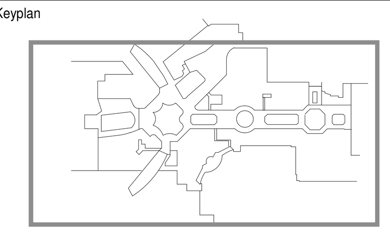
Perth Studio
+ 61 8 9211 9898 / buchan.au

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION



Rev.	Date	Description	Iss.	Appr.
A	13.03.25	ISSUED FOR TENDER	BUC	VC
B	17.04.25	ISSUED FOR TENDER	BUC	VC

Keyplan



File
Autodesk Docs://19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

LEGEND

- BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY
- SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT
- NEW FLOOR
- EXISTING FLOORS/WALLS
- D EXISTING DRAIN PITS LOCATION
- S EXISTING SERVICES PITS LOCATION
- ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120/-/- REFER TO STRUCTURAL ENG. DOCUMENTATION

VICINITY CENTRES

PERRON GROUP

GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number
19049A

Status: TENDER

Date Plotted: 17/04/2025 5:50:09 PM

Scale: As indicated @A0

Drawing Title
FIRST FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number: GAL-BUC-AR-04-1L-0-18003

Revision: B

BUCHAN

Perth Studio
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ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION

32. Appendix F – DFES FEB Meeting No. 2 Minutes

The following is a copy of the minutes for the second FEB Meeting with DFES on 3 June 2025 prepared by BCA Consultants (WA) Pty Ltd.

The document is included in its entirety and the original page numbering is maintained.

CLIENT/DEPARTMENT:	Multiplex
PROJECT/SUBJECT:	Galleria Schopping Centre
PURPOSE:	FEB meeting
DATE:	3/06/2025 **STARTED:** 10.00am **FINISHED:** 10.30am
LOCATION:	DFES Built Environment Branch (Teams Meeting)
OUR REFERENCE:	20240380-E0302-Mn-0002

PRESENT:

Name	Company/Position	Contact	Initials
Brendan O'Regan	DFES – Fire Engineer	Brendan.O'Regan@dfes.wa.gov.au	BO'R
Shane Gobbee	DFES – Building Fire Safety Officer	Shane.Gobbee@dfes.wa.gov.au	SG
Alex Alexandrovski	BCA – Fire Safety Engineer	aalexandrovski@bcagroup.com.au	AA
Amy Chao	BCA – Fire Safety Engineer	achao@bcagroup.com.au	AC

APOLOGIES:

Name	Company/Position	Contact	Initials
No apologies			

OBJECTIVE:
Present the fire safety strategy for the project to DFES and agree on the methodology to document the proposed Performance Solutions.

Item	Topic	Who	Due Date
Note:	*We believe the following record to be an accurate summary of decisions and related discussions. We will appreciate notification of exceptions to this record within three (3) business days of its receipt. Failing such notification, we will consider this a statement of fact in which you concur.*	BO'R, SB, AA, AC	06.06.2025
1.	**Acceptance of previous minutes: Minutes of FEB Meeting No. 1**		
2.	**General**		
2.1.	AA began by describing changes to the fire safety strategy since the original scheme was presented to DFES on 22 April 2025.		
2.2.	Revision B of the FEB (Fire Engineering Brief) has already been submitted to DFES for review; however, as the project progressed, additional deviations have been identified that will be addressed in the revised FEB.		
3.	**Separation between sprinklers and non-sprinklered area.**		
3.1.	Two areas (NW entry and North entry) are currently only separated by glazing between sprinklered and non-sprinklered zones.		
3.2.	No current works are being undertaken in these areas.		
3.3.	Future works may involve modifications to the Coles Click and Collect drive-thru (NW entry), but no works are proposed at the North entry.		
3.4.	The proposed solution is carry out radiant heat flux assessment from the nearest vehicles.		
3.5.	Both entries are protected by bollards, preventing vehicle intrusion.		

Item	Topic	Who	Due Date
3.6.	BO'R inquired whether the tenancy adjacent to the NW entry is sprinklered.		
3.7.	AA confirmed that the tenancy is sprinklered, but the glazed shopfront does not achieve the prescribed level of fire separation.		
3.8.	AA added that drencher systems are difficult to install due to limitations in the existing water supply.		
3.9.	BO'R asked for the source temperature used in the radiant heat flux assessment.		
3.10.	AA responded: 830°C.		
3.11.	BO'R expressed no objection to the proposed method but recommended considering fire involving the largest vehicle that may be present in the area, such as a delivery truck.		
3.12.	AA clarified that the loading area is not adjacent to NW or North entries, but a people mover may be parked there. Thus, the assessment will consider this type of vehicle.		
3.13.	BO'R had no further comments.		
4.	**JB-HiFi and Timezone – After-Hours Make-Up Air**		
4.1.	AA noted that Timezone and JB Hi-Fi after-hours are provided with make-up air to their smoke exhaust systems through the roller shutters. The make-up air velocity is increased up to 3.5 m/s, which exceeds the BCA DtS compliant 2.5 m/s.		
4.2.	Proposed Solution: Use CFD modelling to demonstrate that this increased airflow will not pose a hazard.		
4.3.	BO'R asked if these tenancies are equipped with smoke exhaust systems.		
4.4.	AA responded: • Timezone: Complies with Deemed-to-Satisfy (DtS) smoke exhaust provisions. • JB Hi-Fi: Design still in development. If the selling floor area > 1,000 m², a DtS smoke exhaust system will be provided.		
4.5.	AA added that CFD modelling for similar projects showed that air velocity 0.5 m from the roller shutter drops to around 2 m/s.		
4.6.	BO'R had no objections to the proposed solution.		
5.	**Plant Rooms – MSSB and Air Handling Units**		
5.1.	AA explained that air handling units (AHUs) located in the plant rooms are used to supply air to the smoke exhaust system and cannot be fire-stopped.		
5.2.	Proposed Solution: Use CFD modelling to demonstrate that the loss of two plant rooms is still within acceptable limits.		
5.3.	BO'R had no objections.		
6.	**Fire Hose Coverage**		
6.1.	AA continued that fire hose coverage for the Myer Mall and Plaza is provided via three lengths of hose from external hydrants that are located 50 m from the building with some hydrants located up to 100 m from the building and 2 lengths of hose from internal hydrants.		

Item	Topic	Who	Due Date
6.2.	Some of the external hydrants are located under the covered area in the open deck carpark		
6.3.	GF is provided with 1 internal hydrant. 1F is provided with approximately 8 internal hydrants.		
6.4.	The latest standard requires internal hydrants to be within 4 m of non-fire-isolated exits. This project does not comply with that requirement. Instead, hydrants are positioned to ensure adequate coverage, with typical spacing around 25 m.		
6.5.	BO'R commented that DFES prefers hydrants on both sides of retail malls and recommends using 2 hose lengths only for deeper tenancies.		
6.6.	BO'R suggested adding 1–2 additional internal hydrants on the first floor.		
6.7.	AA acknowledged the feedback and will consult with Fire Safety about potentially adding another hydrant to the first-floor corridor.		
7.	**Submission Process**		
7.1.	AA asked how to proceed with the submission of the revised FEB.		
7.2.	BO'R advised to submit the revised FEB via email, with a note stating that DFES has not yet provided comments on the original FEB.		

Next Meeting: N/A **Location:**

Chair: Alex Alexandrovski **Title:** Senior Fire Engineer

PREPARED BY: Amy Chao

DISTRIBUTION: All present

33. Appendix G – Performance Solution No. 1 - Equivalent Fire Severity Calculations

The following is a sample of equivalent fire severity calculations for the GSC carried out using the Eurocode formula. The calculations were performed using Microsoft Excel spreadsheet.

Parameters highlighted orange are outside the validated range of the Eurocode formulae and indicate that the fire affected room maybe under-ventilated. If the size of the opening is increased, the equivalent fire severity reduces. The size of the ventilation opening was not increased, and a more severe equivalent fire severity was used.

Loading Dock 04	fuel load	e	1,200.00	MJ/m²
	conversion factor	k_b	0.065	min*m$^{2.3}$/MJ

Location	Area, A_f	Height, H_r	Vertical openings				Roof opening		Net free open area	
			ID	Width	Height	Area, A_v	%	Area, A_h	100%	
Loading Dock 04	351.40	4.80				64.32	0%	0.00	100%	64.32
			Opening	13.40	4.80	64.32				

α_v	$0.025 \leq \alpha_v \leq 0.25$	0.183
α_h	$\alpha_h \leq 0.20$	0.00
b_v		34.96
w_f	> 0.5	0.88
t_e	equivalent fire severity	68

Figure 99: Equivalent fire severity for the Loading Dock 04

Mech plant room	fuel load	e	400.00	MJ/m²
	conversion factor	k_b	0.065	min*m$^{2.3}$/MJ

Location	Area, A_f	Height, H_r	Vertical openings				Roof opening		Net free open area	
			ID	Width	Height	Area, A_v	%	Area, A_h	25%	
Mech plant room	202.20	4.80				17.92	0%	0.00	25%	4.48
			Opening	5.60	3.20	17.92				

α_v	$0.025 \leq \alpha_v \leq 0.25$	0.022
α_h	$\alpha_h \leq 0.20$	0.00
b_v		15.26
w_f	> 0.5	2.62
t_e	equivalent fire severity	68

Figure 100: Equivalent fire severity for the Mechanical plantroom adjacent Loading Dock 04

Mecca G-074	fuel load	e	1,300.00	MJ/m²
	conversion factor	k_b	0.09	min*m$^{2.3}$/MJ

Location	Area, A_f	Height, H_r	Vertical openings				Roof opening		Net free open area	
			ID	Width	Height	Area, A_v	%	Area, A_h	75%	
Mecca G-074	800.00	3.65				127.07	0%	0.00	75%	95.30
			shopfront	23.70	3.65	86.51				
			glazing	6.40	3.10	19.84				
			glazing	7.40	2.80	20.72				

α_v	$0.025 \leq \alpha_v \leq 0.25$	0.471
α_h	$\alpha_h \leq 0.20$	0.00
b_v		68.64
w_f	> 0.5	0.72
t_e	equivalent fire severity	85

Figure 101: Equivalent fire severity for the Ground Floor tenancy G-074 Mecca

JD Sports GF-1.165	fuel load	e	1,300.00	MJ/m²
	conversion factor	k_b	0.09	min*m$^{2.3}$/MJ

Location	Area, A_f	Height, H_r	Vertical openings				Roof opening		Net free open area	
			ID	Width	Height	Area, A_v	%	Area, A_h	75%	
JD Sports GF	371.10	3.65				91.62	0%	0.00	75%	68.71
			shopfront	25.10	3.65	91.62				

α_v	$0.025 \le \alpha_v \le 0.25$	0.185
α_h	$\alpha_h \le 0.20$	0.00
b_v		35.22
w_f	> 0.5	0.94
t_e	equivalent fire severity	110

Figure 102: Equivalent fire severity for the Ground Floor tenancy 1.165 JD Sports

JD Sports 1F-1.165	fuel load	e	1,300.00	MJ/m²
	conversion factor	k_b	0.09	min*m$^{2.3}$/MJ

Location	Area, A_f	Height, H_r	Vertical openings				Roof opening		Net free open area	
			ID	Width	Height	Area, A_v	%	Area, A_h	75%	
JD Sports 1F	391.00	3.70				91.87	0%	0.00	75%	68.90
			shopfront	24.83	3.70	91.87				

α_v	$0.025 \le \alpha_v \le 0.25$	0.176
α_h	$\alpha_h \le 0.20$	0.00
b_v		34.14
w_f	> 0.5	0.98
t_e	equivalent fire severity	114

Figure 103: Equivalent fire severity for the First Floor tenancy 1.165 JD Sports

JD Sports GF+ 1F	fuel load	e	1,300.00	MJ/m²
	conversion factor	k_b	0.09	min*m$^{2.3}$/MJ

Location	Area, A_f	Height, H_r	Vertical openings				Roof opening		Net free open area	
			ID	Width	Height	Area, A_v	%	Area, A_h	75%	
JD Sports GF+ 1F	762.10	7.35				183.49	0%	0.00	75%	137.61
			GF Shopfront	25.10	3.65	91.62				
			1F shopfront	24.83	3.70	91.87				

α_v	$0.025 \le \alpha_v \le 0.25$	0.181
α_h	$\alpha_h \le 0.20$	0.00
b_v		34.66
w_f	> 0.5	0.96
t_e	equivalent fire severity	113

Figure 104: Equivalent fire severity for the Ground Floor and First Floor tenancy 1.165 JD Sports

Skechers G-125	fuel load	e	1,300.00	MJ/m²
	conversion factor	k_b	0.09	min*m$^{2.3}$/MJ

Location	Area, A_f	Height, H_r	Vertical openings				Roof opening		Net free open area	
			ID	Width	Height	Area, A_v	%	Area, A_h	75%	
Skechers	129.00	3.65				30.30	0%	0.00	75%	22.72
			D.4/02	8.30	3.65	30.30				

α_v	$0.025 \le \alpha_v \le 0.25$	0.176
α_h	$\alpha_h \le 0.20$	0.00
b_v		34.13
w_f	> 0.5	0.98
t_e	equivalent fire severity	115

Figure 105: Equivalent fire severity for the Ground Floor tenancy G-125 Sketchers

34. Appendix H – Performance Solution No. 4 – Sprinkler and Smoke Detector Modelling

The following are the output results from sprinkler activation time modelling carried out using module '*Sprinkler*' from the FireWind 3.6 suite of fire safety engineering software and smoke detector activation time modelling carried out using computer program CFAST 7.6.0.

For all fire scenarios the fire seat was assumed to be located 0.0 m above the floor level and the ambient temperature to be 23°C.

34.1 Sprinkler Activation Times – BCA DtS Compliant Design

The maximum horizontal radial distance from a sprinkler to the axis of the fire is 2.5 m (based on a 3.0 m x 4.0 m nominal sprinkler grid).

The sprinkler heads are "standard response" with the Response Time Index (RTI) of 135 $ms^{-1/2}$ and the conduction factor (C-factor) of 0.85 $m/s^{-1/2}$. The activation temperature of the sprinklers is 68°C. In some areas sprinklers may have a higher activation temperature; however, a higher temperature will yield a longer RSET; hence it will not be assessed.

The input parameters used in calculations are summarised below:

Item	Parameter
Height of the ceiling above fuel	2.8 m and 6.0 m
Distance of detector from axis of fire	2.5 m (based on a 3.0 m x 4.0 m nominal sprinkler grid to AS 2118.1)
Ambient temperature	23°C
Detector activation temperature	68°C
RTI for heat detector	135 $ms^{-1/2}$
C-factor for heat detector	0.85 $m/s^{-1/2}$
Fire growth rate	Medium and Ultra-fast [refer to Table 20 in Section 10.5.2]

Table 70: Input parameters for sprinkler activation time modelling – BCA DtS compliant design

Calculations of sprinkler activation times for different fire scenarios are repetitive in nature, therefore the output data for each calculation was not provided. Only one sample calculation for fire scenario BCD-11 is included in this assessment (refer to Figure 106 below) and all other calculated times are summarised in Table 71 below.

Fire scenario	Fire type	Ceiling height	Radial distance to sprinkler	Ambient temp.	Sprinkler temp. rating	RTI	C-factor	Detection time (sec)
BCD-11	k-300	2.8 m	2.5 m	23°C	68°C	135 $ms^{-1/2}$	0.85 $m/s^{-1/2}$	297
BCD-12	k-75	2.8 m	2.5 m	23°C	68°C	135 $ms^{-1/2}$	0.85 $m/s^{-1/2}$	103
BCD-21	k-300	6.0 m	2.5 m	23°C	68°C	135 $ms^{-1/2}$	0.85 $m/s^{-1/2}$	430
BCD-22	k-75	6.0 m	2.5 m	23°C	68°C	135 $ms^{-1/2}$	0.85 $m/s^{-1/2}$	138

Table 71: Summary of sprinkler activation times – BCA DtS compliant design

Program Sprinkler

```
Height of ceiling above fuel 2.8 m
Distance of detector from axis of fire 2.5 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 135 (m.s)
Conduction factor C 0.85 (m/s)
```

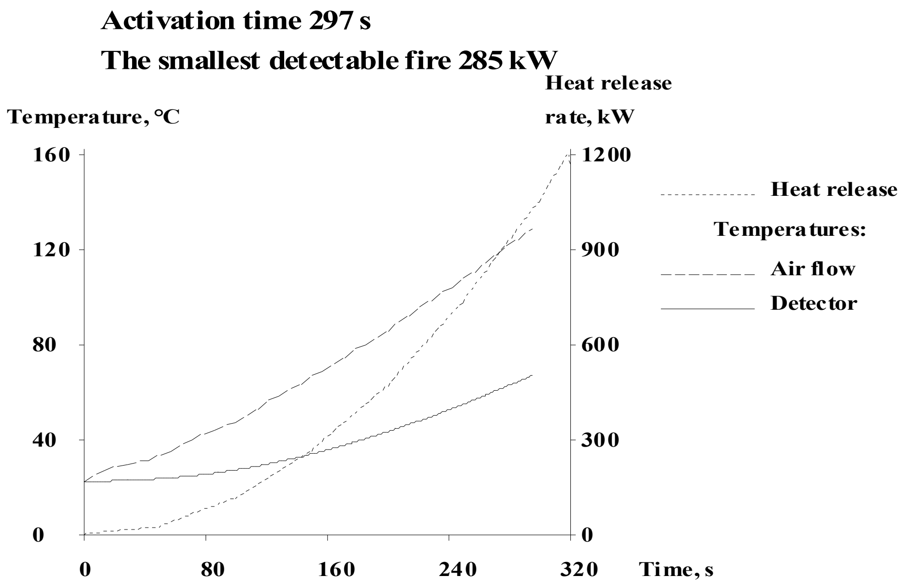


Figure 106: Sprinkler activation time for fire scenario BCD-11

From Figure 106 it is evident that the first sprinkler in fire scenario BCD-11 is expected to activate at 431 seconds after the fire starts.

34.2 Sprinkler Activation Times – Performance-based Design

The maximum horizontal radial distance from a sprinkler to the axis of the fire is 2.5 m (based on a 3.0 m x 4.0 m nominal sprinkler grid).

The sprinkler heads are “fast response” with the Response Time Index (RTI) of 50 ms$^{-1/2}$ and the conduction factor (C-factor) of 0.65 m/s$^{-1/2}$. The activation temperature of the sprinklers is 68°C. In some areas sprinklers may have a higher activation temperature; however, a higher temperature will yield a longer RSET; hence it will not be assessed.

The input parameters used in calculations are summarised below:

Item	Parameter
Height of the ceiling above fuel	2.8 m and 6.0 m
Distance of detector from axis of fire	2.5 m (based on a 3.0 m x 4.0 m nominal sprinkler grid to AS 2118.1)
Ambient temperature	23°C
Detector activation temperature	68°C

RTI for heat detector	50 $ms^{-1/2}$
C-factor for heat detector	0.65 $m/s^{-1/2}$
Fire growth rate	Medium and ultra-fast [refer to Table 20 in Section 10.5.2]

Table 72: Input parameters for sprinkler activation time modelling – Performance-based design

Calculations of sprinkler activation times for different fire scenarios are repetitive in nature, therefore the output data for each calculation was not provided. Only one sample calculation for fire scenario PBD-11-Spkl is included in this assessment (refer to Figure 107 below) and all other calculated times are summarised in Table 73 below.

Fire scenario	Fire type	Ceiling height	Radial distance to sprinkler	Ambient temp.	Sprinkler temp. rating	RTI	C-factor	Detection time (sec)
PBD-11-Spkl	k-300	2.8 m	2.5 m	23°C	68°C	50 $ms^{-1/2}$	0.65 $m/s^{-1/2}$	246
PBD-12-Spkl	k-75	2.8 m	2.5 m	23°C	68°C	50 $ms^{-1/2}$	0.65 $m/s^{-1/2}$	78
PBD-21-Spkl	k-300	6.0 m	2.5 m	23°C	68°C	50 $ms^{-1/2}$	0.65 $m/s^{-1/2}$	378
PBD-22-Spkl	k-75	6.0 m	2.5 m	23°C	68°C	50 $ms^{-1/2}$	0.65 $m/s^{-1/2}$	109

Table 73: Summary of sprinkler activation times – Performance-based design

Program Sprinkler

```
Height of ceiling above fuel 2.8 m
Distance of detector from axis of fire 2.5 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 50 (m.s)½
Conduction factor C 0.65 (m/s)½
```

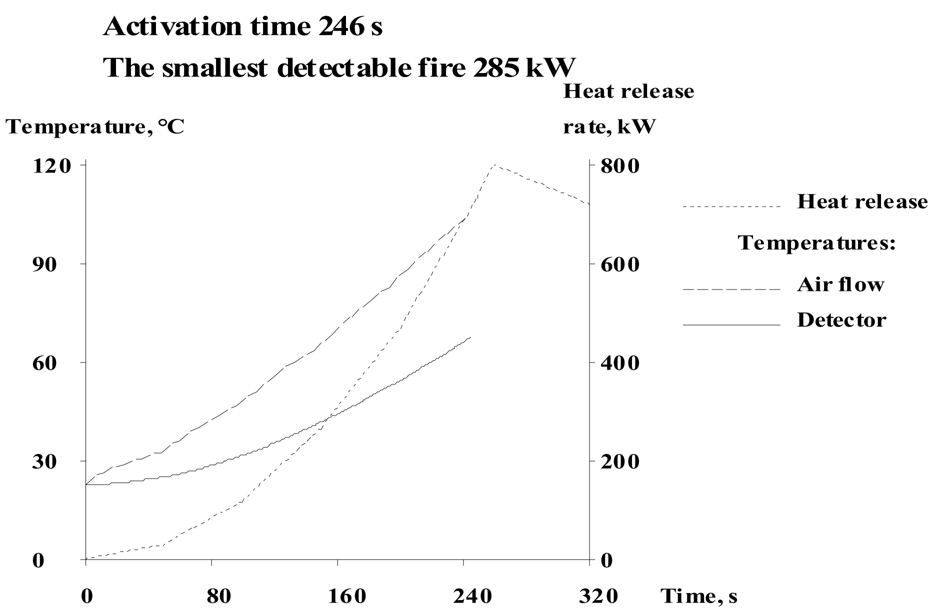


Figure 107: Sprinkler activation time for fire scenario PBD-11-Spkl

From Figure 107 it is evident that the first sprinkler in fire scenario PBD-11-Spkl is expected to activate at 246 seconds after the fire starts.

34.3 Smoke Detector Activation Time – Performance-based Design

The maximum horizontal radial distance from a smoke detector to the axis of the fire plume is 7.1 m (based on a 10.0 m x 10.0 m nominal smoke detector spacing – refer to Figure 42 in Section 10.2.1).

To determine smoke detector activation time a zone model consisting of a single 20 m x 20 m compartment was created. A 2.0 m wide by 2.4 m high opening was provided between the compartment of fire origin and the outside. The axonometric view of the model environment is provided in Figure 108.

The floor-to-ceiling heights modelled were 2.8 m and 6.0 m and the fire was located in the middle of the compartment in the centre of a 10.0 m x 10.0 m smoke detector grid.

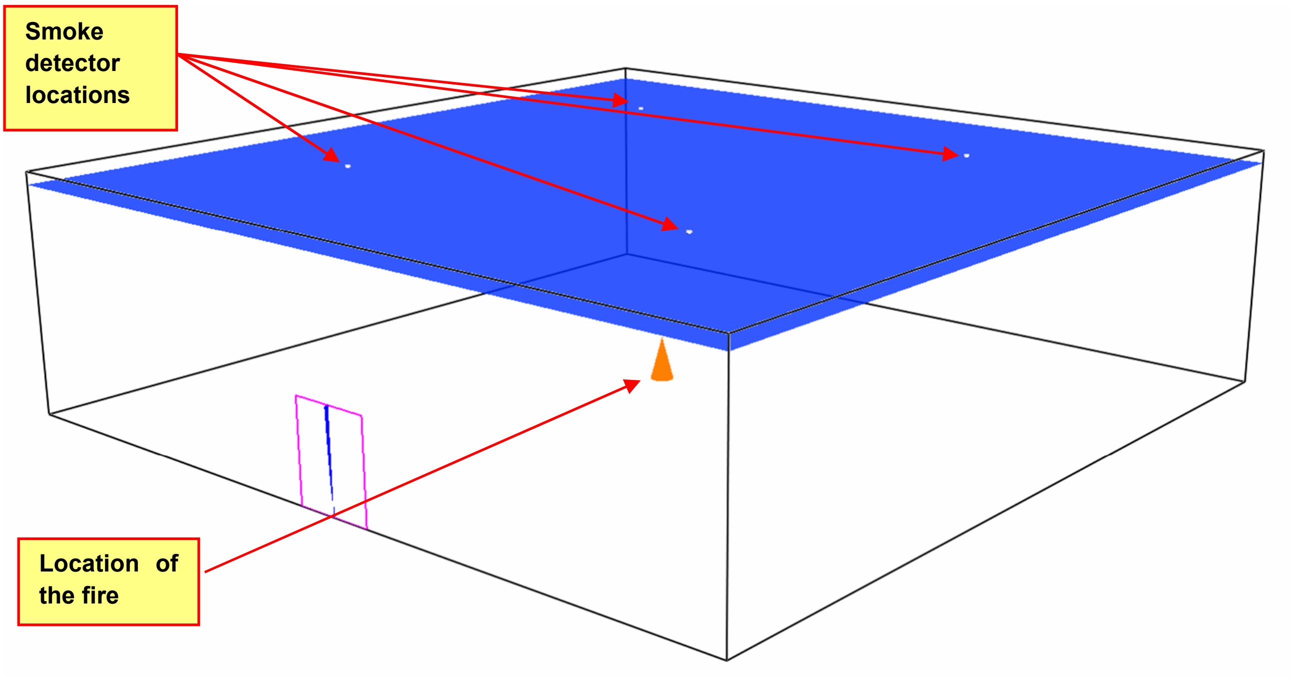


Figure 108: Axonometric view of the smoke detector activation model environment

The ambient temperature was taken as 23°C and smoke detector activation temperature was taken as 28°C (refer to Section 10.2.1).

Medium and ultra-fast [refer to Table 20 in Section 10.5.1] t-squared growth rate fires were modelled.

Electronic format input parameters and the output data for the different fire scenarios are provided with this report to DFES. An electronic copy of this data is available to all relevant stakeholders upon request.

Modelling of smoke detector activation times for different fire scenarios are repetitive in nature, therefore the output data is provided only for fire scenario PBD-11-SD, as produced by CFAST (refer to Figure 109 below).

The calculated times of smoke detector activation are summarised in Table 74 below.

Fire scenario	Fire type	Ceiling height	Radial distance to detector	Ambient temperature	Detector temperature rating	Detection time (sec)
PBD-11-SD	k-300	2.8 m	7.1 m	23°C	28°C	42
PBD-12-SD	k-75	2.8 m	7.1 m	23°C	28°C	16
PBD-21-SD	k-300	6.0 m	7.1 m	23°C	28°C	53
PBD-22-SD	k-75	6.0 m	7.1 m	23°C	28°C	17

Table 74: Summary of smoke detector activation times – performance-based design

```
CFAST

Release Version  : CFAST 7.6.0
Revision         : CFAST7.6.0-2-g3fb0ef4d
Revision Date    : Wed Feb 3 11:21:54 2021 -0500
Compilation Date : Wed 02/03/2021  12:59 PM

Heat Alarm (Sensor 1) has activated at 42 s in compartment 1
Heat Alarm (Sensor 2) has activated at 42 s in compartment 1
Heat Alarm (Sensor 3) has activated at 42 s in compartment 1
Heat Alarm (Sensor 4) has activated at 42 s in compartment 1
Total execution time =  0.188     seconds
Total time steps =        569
Normal exit from CFAST
```

Figure 109: Summary of smoke detector activation times for fire scenario PBD-11-SD.

35. Appendix I – Performance Solution No. 5 – Output Results from Sprinkler Activation Time Modelling

Sprinkler activation time modelling was carried out using module Sprinkler from the FireWind 3.6 suite of fire safety engineering software.

For sprinklers installed on a nominal 3 m x 4 m grid the maximum horizontal radial distance from a sprinkler to the axis of a fire plume is 2.5 m, with the maximum distance to the second row of sprinklers being 4.92 m.

For all fire scenarios the fire seat was assumed to be located 0.3 m above the floor level.

The activation temperature of a sprinklers was taken as 68°C. The building is provided with fast response sprinklers; therefore, the sprinkler Response Time Index (RTI) was taken as 50 $ms^{-1/2}$. The conduction factor (C-factor) was taken as 0.65 $m/s^{-1/2}$.

Item	Parameter
Height of the ceiling above fuel	8.8 m, 20.6 m and 25.5 m
Distance of detector from axis of fire	2.5 m (based on a 3.0 m x 4.0 m nominal sprinkler grid to AS 2118.1)
Ambient temperature	23°C
Detector activation temperature	68°C
RTI for heat detector	50 $ms^{-1/2}$
C-factor for heat detector	0.65 $m/s^{-1/2}$
Fire growth rate	Fast to medium and ultra-fast to fast [refer to Section 10.5.2]

Table 75: Input parameters for sprinkler activation time modelling

The sprinkler activation times were calculated using module Sprinkler from the FireWind 3.6 suite of fire safety engineering software. Table 76 summarises the results of sprinkler activation time modelling. Screenshots of the calculations are provided in Sections 35.1 to 35.4.

Fire Scenario	Roof height (m)	First sprinkler activation time (sec)	Fifth sprinkler activation time (sec)	HRR (MW)
PL-DF-01	20.6	501	593	12.95
PL-RF-01				
PL-SF-01		257	304	13.63
MM-DF-02	8.8	242	346	3.46
MM-RF-02				
MM-SF-02		129	182	3.89
MM-DF-03	25.5	645	682	20.09
MM-RF-03				
MM-SF-03		330	348	21.00

Table 76: Summary of sprinkler activation times

35.1 Screenshots – Plaza Atrium, 20.6 m high roof, fast t^2 to medium t^2 fire

Height of roof above fuel: 20.6 m – 0.3 m = 20.3 m

Program Sprinkler

Height of ceiling above fuel 20.3 m

Distance of detector from axis of fire 2.5 m

Ambient temperature 23 oC

Detector Actuation Temperature 68 oC

Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$

Conduction factor C 0.65 $(m/s)^{1/2}$

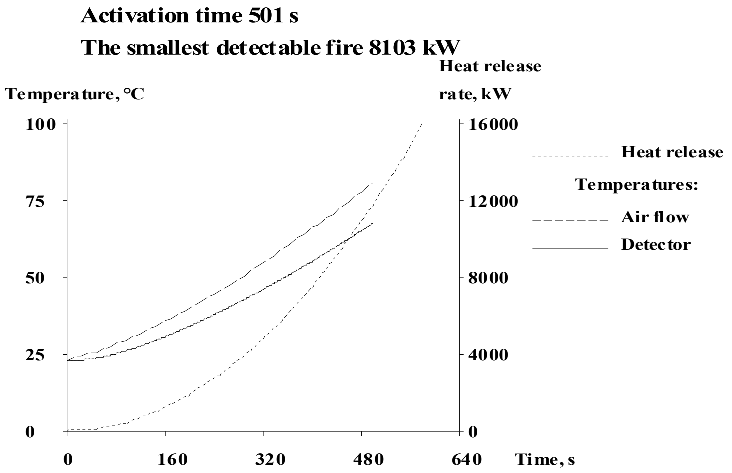


Figure 110: PL-DF-01 / PL-RF-01 – first row sprinkler activation times

Program Sprinkler

Height of ceiling above fuel 20.3 m

Distance of detector from axis of fire 4.92 m

Ambient temperature 23 oC

Detector Actuation Temperature 68 oC

Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$

Conduction factor C 0.65 $(m/s)^{1/2}$

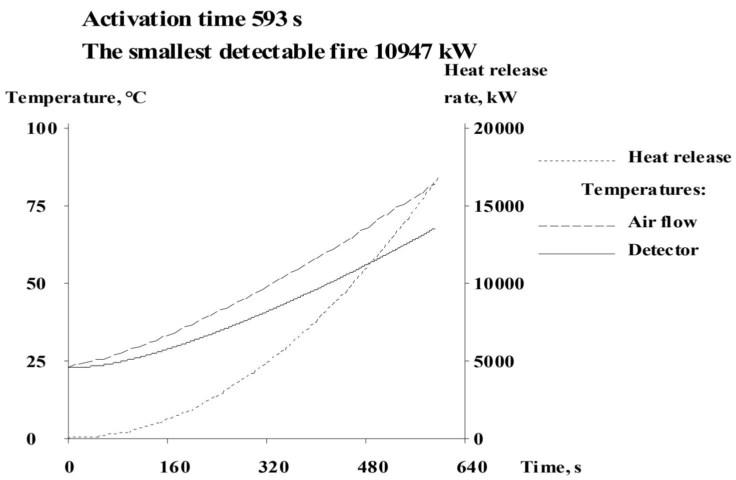


Figure 111: PL-DF-01 / PL-RF-01 – second row sprinkler activation times

35.2 Screenshots – Plaza Atrium, 20.6 m high roof, ultra-fast t² to fast t² fire

Height of roof above fuel: 20.6 m – 0.3 m = 20.3 m

Program Sprinkler

Height of ceiling above fuel 20.3 m
Distance of detector from axis of fire 2.5 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$
Conduction factor C 0.65 $(m/s)^{1/2}$

Activation time 257 s
The smallest detectable fire 8103 kW

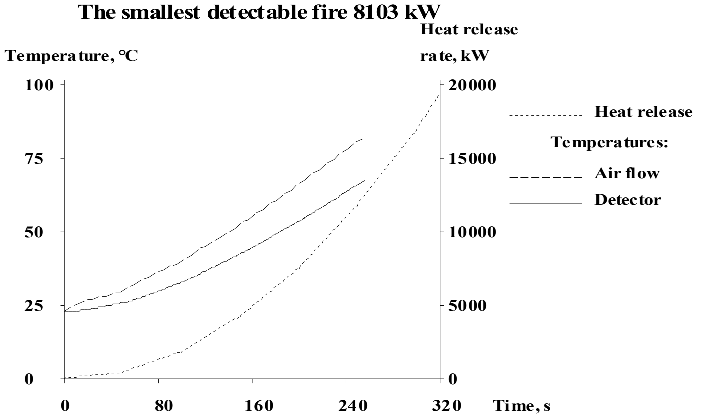


Figure 112: PL-SF-01 – first row sprinkler activation times

Program Sprinkler

Height of ceiling above fuel 20.3 m
Distance of detector from axis of fire 4.92 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$
Conduction factor C 0.65 $(m/s)^{1/2}$

Activation time 304 s
The smallest detectable fire 10947 kW

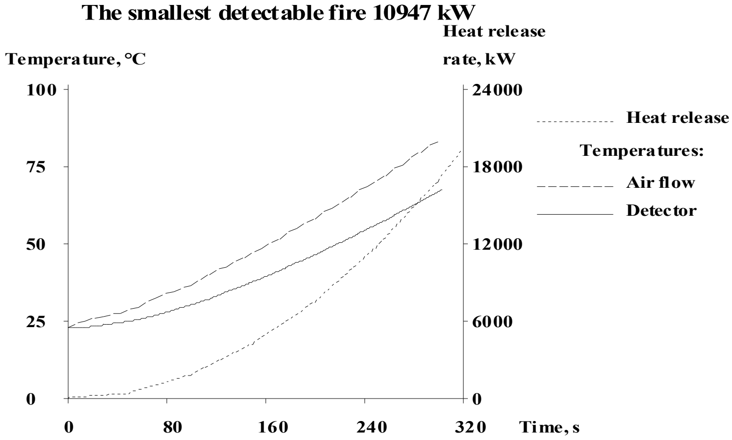


Figure 113: PL-SF-01 – second row sprinkler activation times

35.3 Screenshots – Myer Mall GF, 8.8 m high roof, fast t² to medium t² fire

Height of roof above fuel: 8.8 m – 0.3 m = 8.5 m

Program Sprinkler

Height of ceiling above fuel 8.5 m

Distance of detector from axis of fire 2.5 m

Ambient temperature 23 oC

Detector Actuation Temperature 68 oC

Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$

Conduction factor C 0.65 $(m/s)^{1/2}$

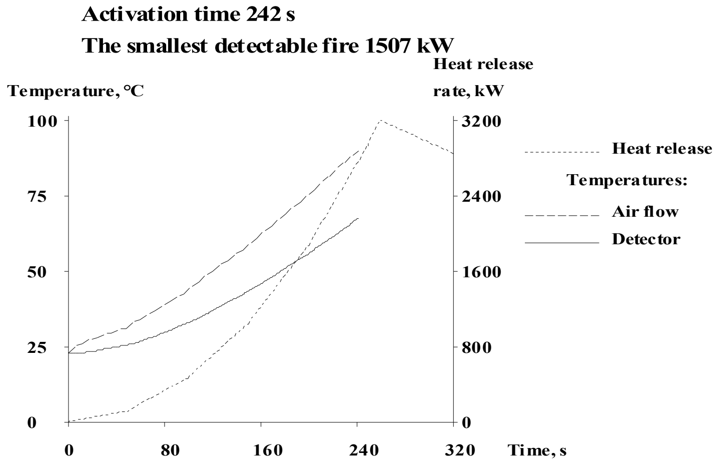


Figure 114: MM-DF-02 / MM-RF-02 – first row sprinkler activation times

Program Sprinkler

Height of ceiling above fuel 8.5 m

Distance of detector from axis of fire 4.92 m

Ambient temperature 23 oC

Detector Actuation Temperature 68 oC

Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$

Conduction factor C 0.65 $(m/s)^{1/2}$

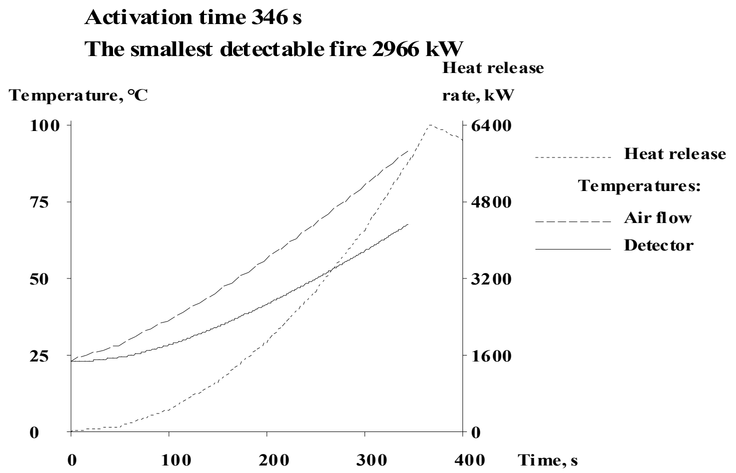


Figure 115: MM-DF-02 / MM-RF-02 – second row sprinkler activation times

35.4 Screenshots – Myer Mall GF, 8.8 m high ceiling, ultra-fast t² to fast t² fire

Height of roof above fuel: 8.8 m – 0.3 m =8.5 m

Program Sprinkler

Height of ceiling above fuel 8.5 m

Distance of detector from axis of fire 2.5 m

Ambient temperature 23 oC

Detector Actuation Temperature 68 oC

Detector Response Time Index (RTI) 50 (m.s)$^{1/2}$

Conduction factor C 0.65 (m/s)$^{-1/2}$

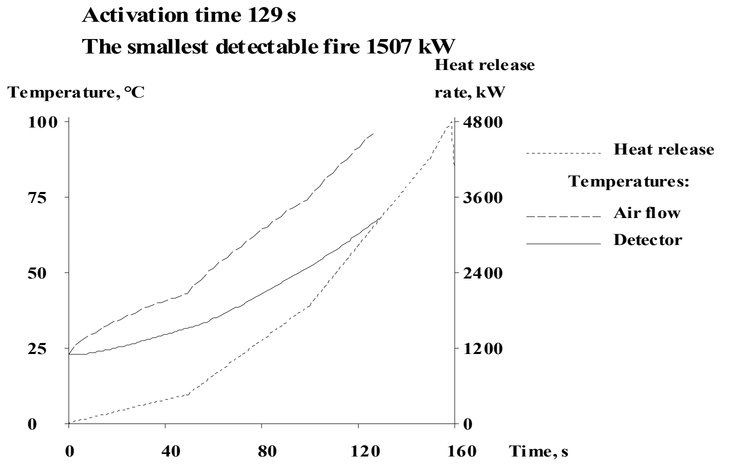


Figure 116: MM-SF-02 – first row sprinkler activation times

Program Sprinkler

Height of ceiling above fuel 8.5 m

Distance of detector from axis of fire 4.92 m

Ambient temperature 23 oC

Detector Actuation Temperature 68 oC

Detector Response Time Index (RTI) 50 (m.s)$^{1/2}$

Conduction factor C 0.65 (m/s)$^{-1/2}$

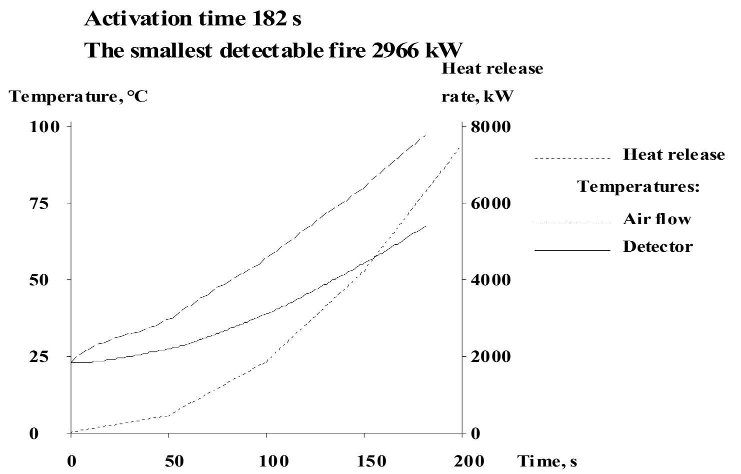


Figure 117: MM-SF-02 – second row sprinkler activation times

35.5 Screenshots – Myer Mall Atrium, 25.5 m high roof, fast t² to medium t² fire

Height of roof above fuel: 25.5 m – 0.3 m = 25.2 m

Program Sprinkler

Height of ceiling above fuel 25.2 m
Distance of detector from axis of fire 2.5 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$
Conduction factor C 0.65 $(m/s)^{1/2}$

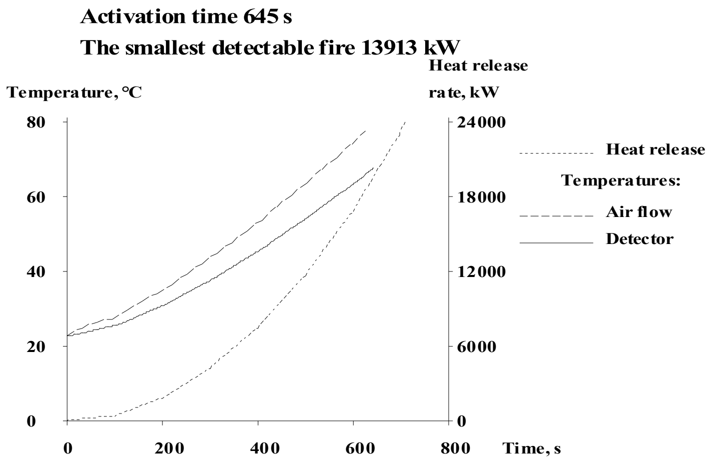


Figure 118: MM-DF-03 / MM-RF-03 – first row sprinkler activation times

Program Sprinkler

Height of ceiling above fuel 25.2 m
Distance of detector from axis of fire 4.92 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 50 $(m.s)^{1/2}$
Conduction factor C 0.65 $(m/s)^{1/2}$

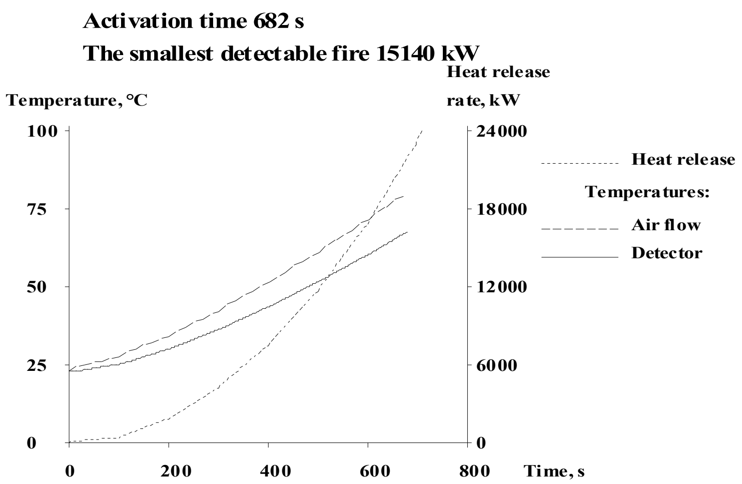


Figure 119: MM-DF-03 / MM-RF-03 – second row sprinkler activation times

35.6 Screenshots – Myer Mall Atrium, 25.5 m high ceiling, ultra-fast t^2 to fast t^2 fire

Height of roof above fuel: 25.5 m – 0.3 m =25.2 m

Program Sprinkler

Height of ceiling above fuel 25.2 m
Distance of detector from axis of fire 2.5 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 50 $(m.s)^{½}$
Conduction factor C 0.65 $(m/s)^{½}$

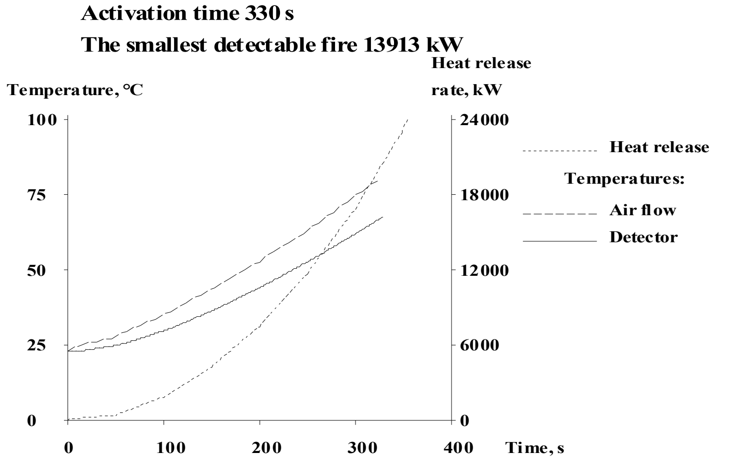


Figure 120: MM-SF-03 – first row sprinkler activation times

Program Sprinkler

Height of ceiling above fuel 25.2 m
Distance of detector from axis of fire 4.92 m
Ambient temperature 23 oC
Detector Actuation Temperature 68 oC
Detector Response Time Index (RTI) 50 $(m.s)^{½}$
Conduction factor C 0.65 $(m/s)^{½}$

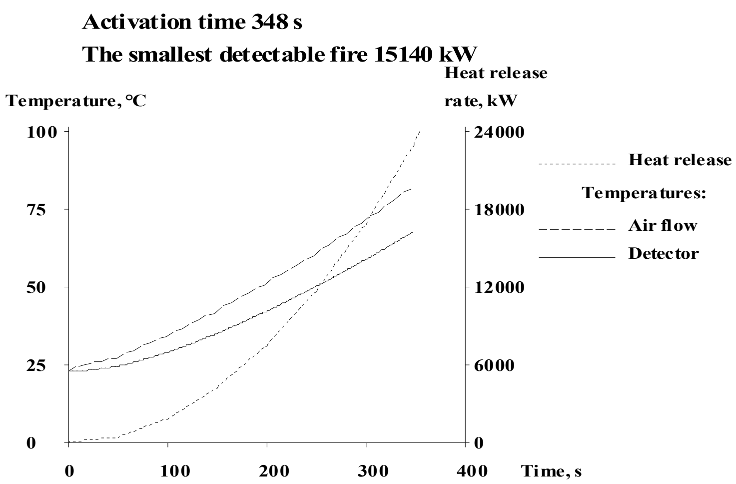


Figure 121: MM-SF-03 – second row sprinkler activation times

36. Appendix J – Performance Solution No. 5 – Output Results from CFD Modelling

36.1 General

The fire and smoke movement modelling was carried out using the computer model Fire Dynamics Simulator 6.7.5 (FDS). The model consists of 5 meshes and cover the GSC.

The adopted grid size was 0.3 m x 0.3 m x 0.3 m, which is equivalent to a D^*/δ_x value of between 6.82 and 11.87 for the fire sizes with HRR ranging between 1.57 MW and 3.17 MW (refer to Section 10.3.1 and Table 77 below).

Fire scenario	HRR	D*	Grid size	D^*/δ_x
PL-DF-01 / PL-RF-01	12.95 MW	2.661	0.3 x 0.3 x 0.3	8.87
PL-SF-01	13.63 MW	1.570	0.3 x 0.3 x 0.3	5.23
MM-DF-02 / MM-RF-02	3.46 MW	3.171	0.3 x 0.3 x 0.3	10.57
MM-SF-02	3.89 MW	2.715	0.3 x 0.3 x 0.3	9.05
MM-DF-03 / MM-RF-03	20.09 MW	1.645	0.3 x 0.3 x 0.3	5.48
MM-SF-03	21.00 MW	3.228	0.3 x 0.3 x 0.3	10.76

Table 77: D^*/δ_x values

The slice files were taken for occupant tenability at 2.1 m AFFL and for fire brigade tenability at 1.5 m AFFL.

The design fire height, based on the 0.3 m x 0.3 m x 0.3 m mesh grids is 0.3 m, as the base of the fire is located 1 grid cell above the floor level. It is believed that this is a conservative assumption, as most fires will have an ignition source that is not located at the floor level.

The input parameters for the FDS models are summarised in Table 78 below.

Parameter	Description
Number of meshes	7 total 4 for the WWS and 3 for the retail mall
Type of mesh	Cartesian
Mesh size	0.3 x 0.3 x 0.3
Material properties	Material properties ignored
Boundary conditions	Inert (default)
Major geometrical or other simplifications or assumptions	All roller-shutters in the WWS shopfront descend to 2.4 m upon fire alarm activation.
Steady-state or transient?	Steady state
Simulation time	1,500 seconds for design and 600 seconds for redundancy and sensitivity fire scenarios
Radiative fraction	35% (default)

Parameter	Description
Reaction/combustion properties (material, heat of combustion)	Fuel chemical composition – $CH_{1.565}O_{0.2585}N_{0.0148}$. Fuel by-products: CO – 0.04 g/g Heat of combustion – 20 MJ/kg
Soot yield (value and means of including in model)	7.0%
Visibility factor (or parameters used to obtain visibility output)	Visibility factor C = 3 (default for reflective exit signs) Visibility slice files based on 10 m visibility and taken at 2.1 m above the floor level
Heat release rate per unit area (HRRPUA)	600 kW/m²
Means of achieving fire growth rate (ramp, multiple fire objects)	A steady state single fire with a t-squared ramp up

Table 78: CFD Input Parameters

36.2 PL-DF-01a / PL-DF-01b

Fire scenario	RSET (sec)	Safety Factor	RSET x Safety Factor (sec)	ASET			Acceptance criteria met?
				Due to Visibility (sec)	Due to Temp. (sec)	DFES (sec)	
PL-DF-01a		1.5		1,320	> 1,500	> 1,500	Yes
PL-DF-01b		1.0		1,320	> 1,500	> 1,500	Yes

Table 79: PL-DF-01a / PL-SF-01b – ASET/RSET summary

36.2.1 Heat Release Rate

Figure 122: Modelled Heat Release Rate

36.2.2 PL-DF-01a / PL-DF-01b – Smoke Detector Activation Times

Figure 123: Sprinkler activation times (screenshot from the output file)

36.2.3 PL-DF-01a / PL-DF-01b – Visibility Screenshot

Figure 124: Visibility screenshot at time of RSET (design egress scenario) = 297 seconds

Figure 125: Visibility screenshot at time of RSET (sensitivity egress scenario) = 345 seconds

Figure 126: Visibility screenshot at time of RSET x 1.5 = 446 seconds

Figure 127: Visibility screenshot at time of ASET = 1,320 seconds

36.2.4 PL-DF-01a / PL-DF-01b – Temperature Screenshot

Figure 128: Temperature screenshot at time of RSET x 1.5 = 446 seconds

Figure 129: Temperature screenshot at time = 1,500 seconds (ASET has not been reached)

36.2.5 PL-DF-01a / PL-DF-01b – DFES Tenability Screenshot

Figure 130: Temperature screenshot at time = 1,500 seconds

36.3 PL-RF-01

Fire scenario	RSET (sec)	Safety Factor	RSET x Safety Factor (sec)	ASET			Acceptance criteria met?
				Due to Visibility (sec)	Due to Temp. (sec)	DFES (sec)	
PL-RF-01	299	1.0	299	570	> 600	N/A	Yes

Table 80: PL-RF-01– ASET/RSET summary

36.3.1 Heat Release Rate

Figure 131: Modelled Heat Release Rate

36.3.2 PL-RF-01 – Smoke Detector Activation Times

Figure 132: Smoke detectors activation times (screenshot from the output file)

36.3.3 PL-RF-01 – Visibility Screenshot

Figure 133: Visibility screenshot at time of RSET = 299 seconds

Figure 134: Visibility screenshot at time of ASET = 570 seconds

36.3.4 PL-RF-01 – Temperature Screenshot

Figure 135: Temperature screenshot at time of RSET = 299 seconds

Figure 136: Temperature screenshot at time = 600 seconds (ASET has not been reached)

36.4 PL-SF-01

Fire scenario	RSET (sec)	Safety Factor	RSET x Safety Factor (sec)	ASET			Acceptance criteria met?
				Due to Visibility (sec)	Due to Temperature (sec)	DFES (sec)	
PL-SF-01	293	1.0	293	400	> 600	N/A	Yes

Table 81: PL-SF-01– ASET/RSET summary

36.4.1 Heat Release Rate

Figure 137: Modelled Heat Release Rate

36.4.2 PL-SF-01 – Smoke Detector Activation Times

Figure 138: Sprinkler activation times (screenshot from the output file)

36.4.3 PL-SF-01 – Visibility Screenshot

Figure 139: Visibility screenshot at time of RSET = 293 seconds

Figure 140: Visibility screenshot at time of ASET = 400 seconds

36.4.4 PL-SF-01 – Temperature Screenshot

Figure 141: Temperature screenshot at time of RSET = 293 seconds

Figure 142: Temperature screenshot at time = 600 seconds (ASET has not been reached)

36.5 MM-DF-02a / MM-DF-02b

Fire scenario	RSET (sec)	Safety Factor	RSET x Safety Factor (sec)	ASET			Acceptance criteria met?
				Due to Visibility (sec)	Due to Temperature (sec)	DFES (sec)	
MM-DF-02a	286	1.5	429	1,040	> 1,500	> 1,500	Yes
MM-DF-02b	334	1.0	334	1,040	> 1,500	> 1,500	Yes

Table 82: MM-DF-02a / MM-DF-02b – ASET/RSET summary

36.5.1 Heat Release Rate

Figure 143: Modelled Heat Release Rate

36.5.2 MM-DF-02a / MM-DF-02b– Smoke Detection Activation Times

Figure 144: Smoke detectors activation times (screenshot from the output file)

36.5.3 WW-DF-02a / WW-DF-02b – Visibility Screenshot

Figure 145: Visibility screenshot at time of RSET (design egress scenario) = 286 seconds

Figure 146: Visibility screenshot at time of RSET (sensitivity egress scenario) = 334 seconds

Figure 147: Visibility screenshot at time of RSET x 1.5 = 429 seconds

Figure 148: Visibility screenshot at time of ASET = 1,040 seconds

36.5.4 MM-DF-02a / MM-DF-02b – Temperature Screenshot

Figure 149: Temperature screenshot at time of RSET = 429 seconds

Figure 150: Temperature screenshot at time = 1,500 seconds (ASET has not been reached)

36.5.5 MM-DF-02a / MM-DF-02b – DFES Tenability Screenshot

Figure 151: Temperature screenshot at time = 1,500 seconds

36.6 MM-RF-02

Fire scenario	RSET (sec)	Safety Factor	RSET x Safety Factor (sec)	ASET			Acceptance criteria met?
				Due to Visibility (sec)	Due to Temp. (sec)	DFES (sec)	
MM-RF-02	299	1.0	299	> 600	> 600	N/A	Yes

Table 83: MM-RF-02– ASET/RSET summary

36.6.1 Heat Release Rate

Figure 152: Modelled Heat Release Rate

36.6.2 MM-RF-02 – Smoke Detector Activation Times

Figure 153: Smoke detectors activation times (screenshot from the output file)

36.6.3 MM-RF-02 – Visibility Screenshot

Figure 154: Visibility screenshot at time of RSET = 286 seconds

Figure 155: Visibility screenshot at time = 600 seconds (ASET has not been reached)

36.6.4 MM-RF-02 – Temperature Screenshot

Figure 156: Temperature screenshot at time of RSET = 286 seconds

Figure 157: Temperature screenshot at time = 600 seconds (ASET has not been reached)

36.7 MM-SF-02

Fire scenario	RSET (sec)	Safety Factor	RSET x Safety Factor (sec)	ASET			Acceptance criteria met?
				Due to Visibility (sec)	Due to Temperature (sec)	DFES (sec)	
MM-SF-02	282	1.0	282	470	> 600	N/A	Yes

Table 84: MM-SF-02 – ASET/RSET summary

36.7.1 Heat Release Rate

Figure 158: Modelled Heat Release Rate

36.7.2 MM-SF-02 – Smoke Detector Activation Times

Figure 159: Smoke detectors activation times (screenshot from the output file)

36.7.3 MM-SF-02 – Visibility Screenshot

Figure 160: Visibility screenshot at time of RSET = 282 seconds

Figure 161: Visibility screenshot at time of ASET = 470 seconds

36.7.4 MM-SF-02 – Temperature Screenshot

Figure 162: Temperature screenshot at time of RSET = 282 seconds

Figure 163: Temperature screenshot at time = 600 seconds (ASET has not been reached)

37. Appendix K – Performance Solution No. 5 – Egress Modelling Screenshots

The following is the output data from egress modelling carried out using computer model Pathfinder. The evacuation parameters are provided in Section 10.2.3.

The electronic version of the screenshots provided in this section was submitted to DFES and is available upon request.

37.1 Design egress scenario – GSC-ES-01

A summary of the model setup is provided below:

- Total population 3,707
    - The retail mall GF – 247 occupants: 10 m²/person
    - The retail mall 1F – 313 occupants: 10 m²/person
    - The GF tenancies – 1,150 occupants: 6 m²/person
    - The GF BoH/stores – 40 occupants: 30 m²/person
    - The 1F tenancies – 1,681 occupants: 6 m²/person
    - The 1F BoH/stores – 2 occupants: 30 m²/person
- Occupant speed:
    - 55% of occupants travelling at 0.93 m/s
    - 45% of occupants travelling at 0.80 m/s
- Store rooms, etc., generally not populated

Results:

- All occupants leave First Floor: 224 seconds
- All occupants leave Ground Floor: 232 seconds
- Total egress time: 232 seconds

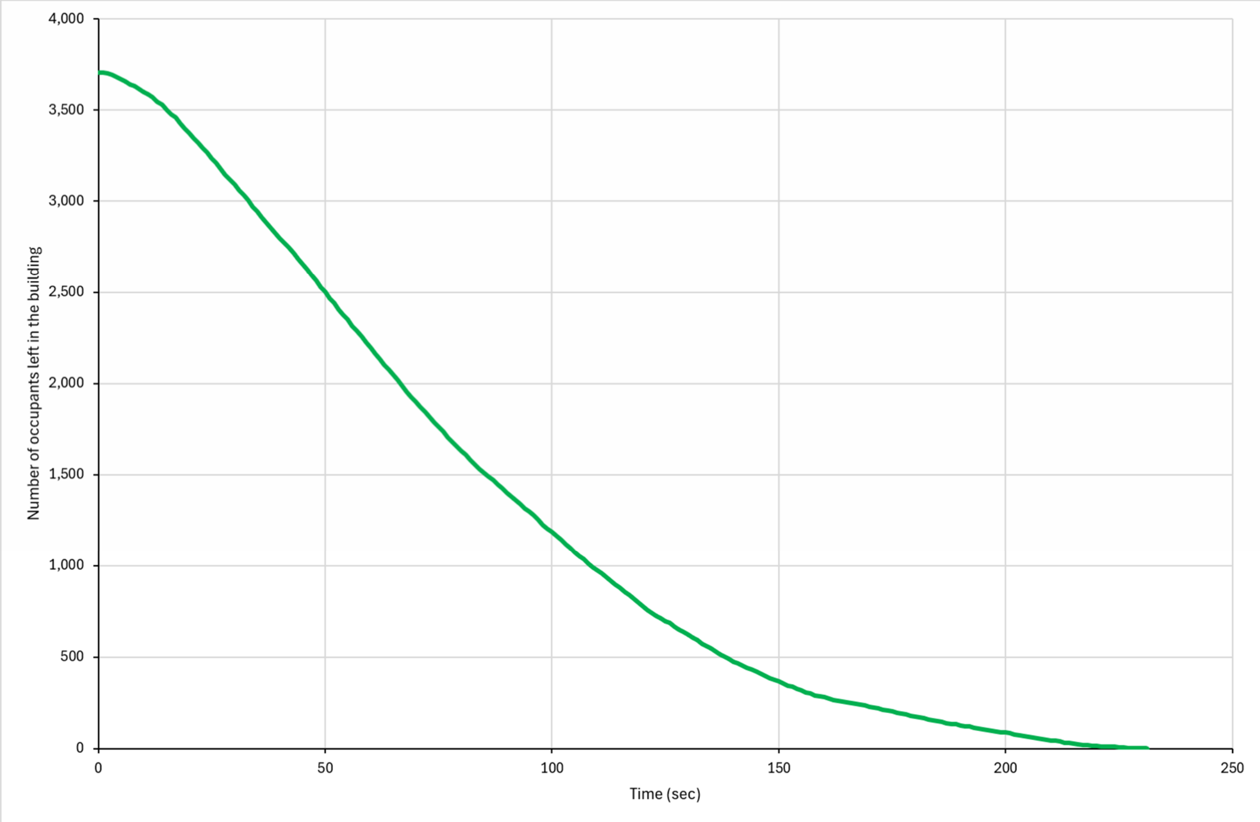


Figure 164: Number of occupants versus the evacuation time – design egress scenario

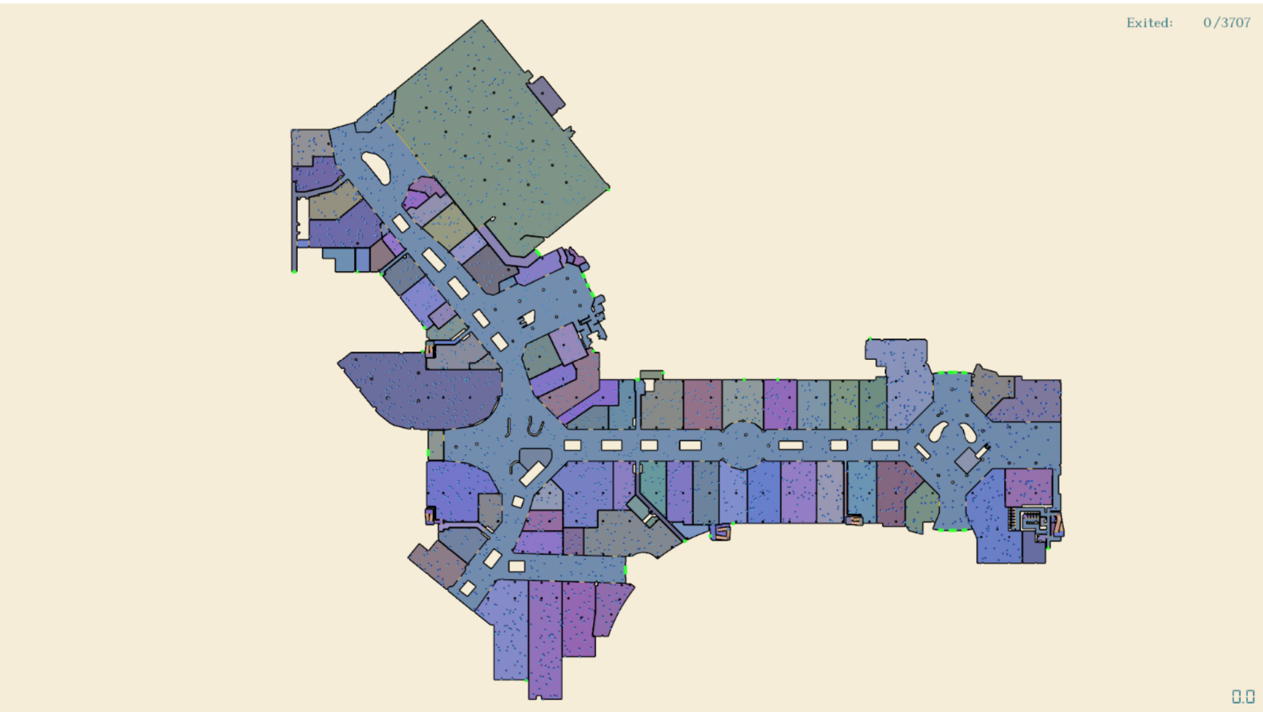


Figure 165: GSC-ES-01 – GF – 0 seconds into the evacuation

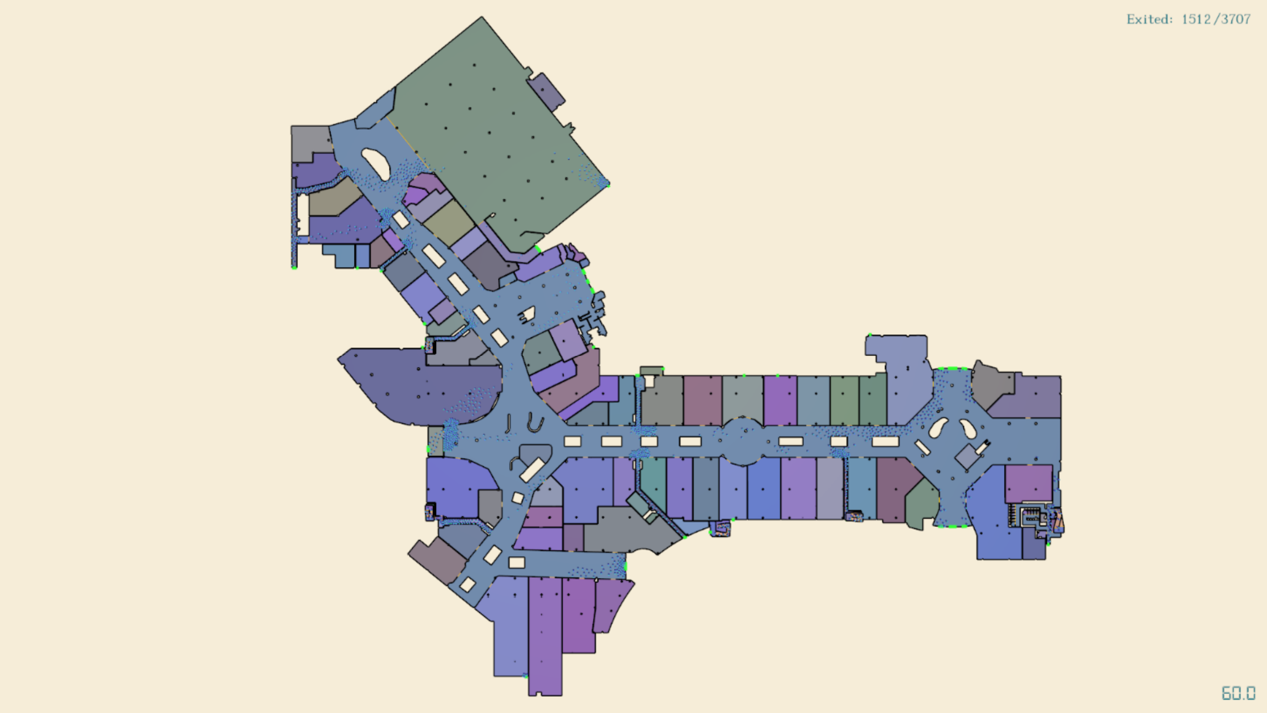


Figure 166: GSC-ES-01 – GF – 60 seconds into the evacuation

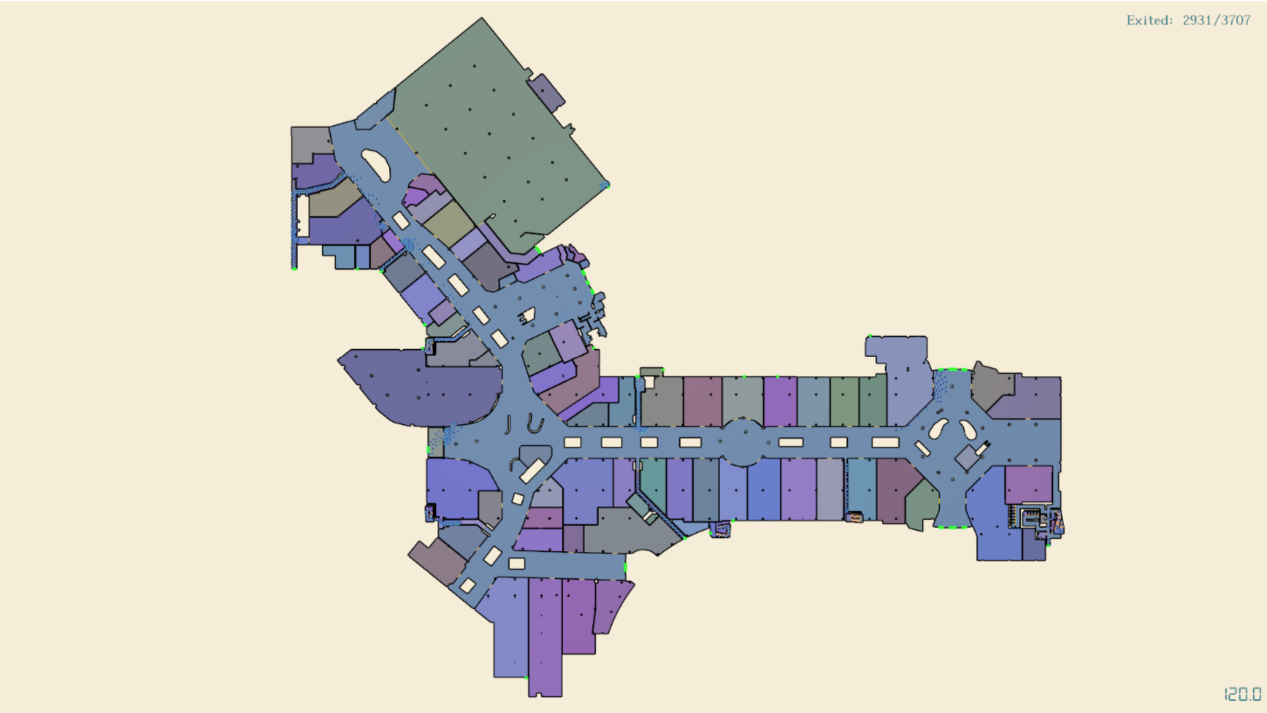


Figure 167: GSC-ES-01 – GF – 120 seconds into the evacuation

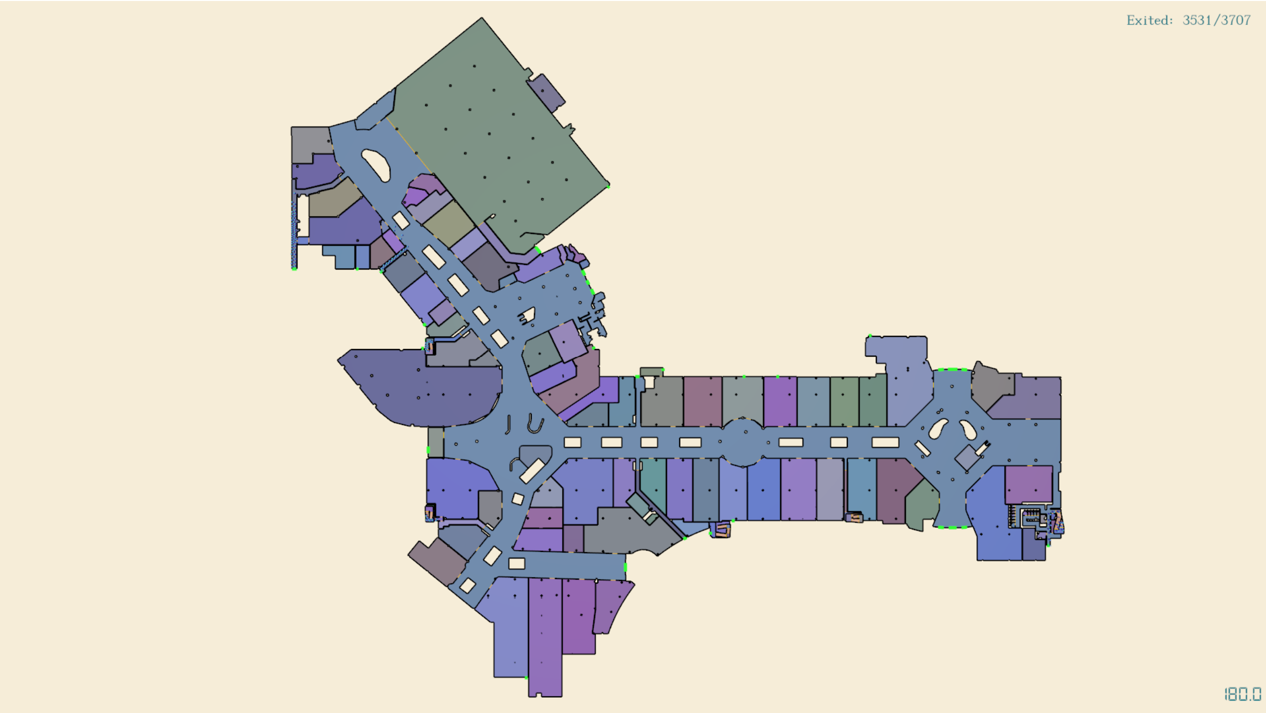


Figure 168: GSC-ES-01 – GF – 180 seconds into the evacuation

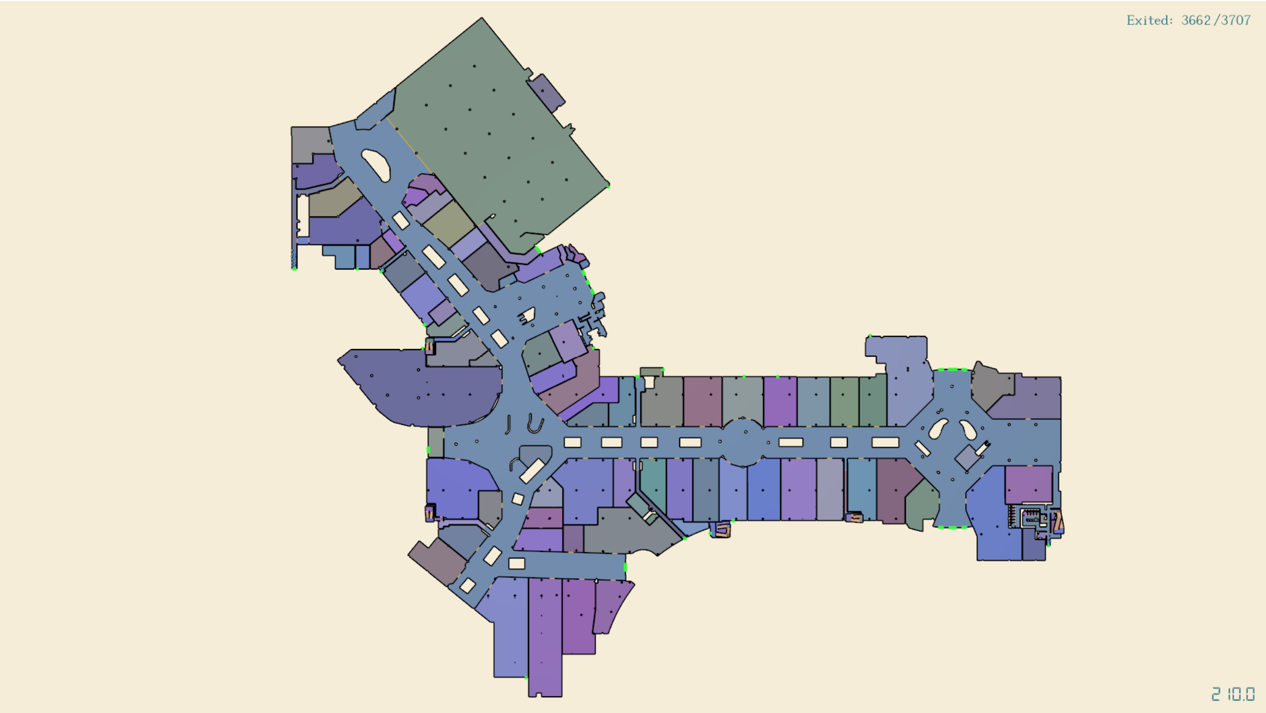


Figure 169: GSC-ES-01 – GF – 210 seconds into the evacuation

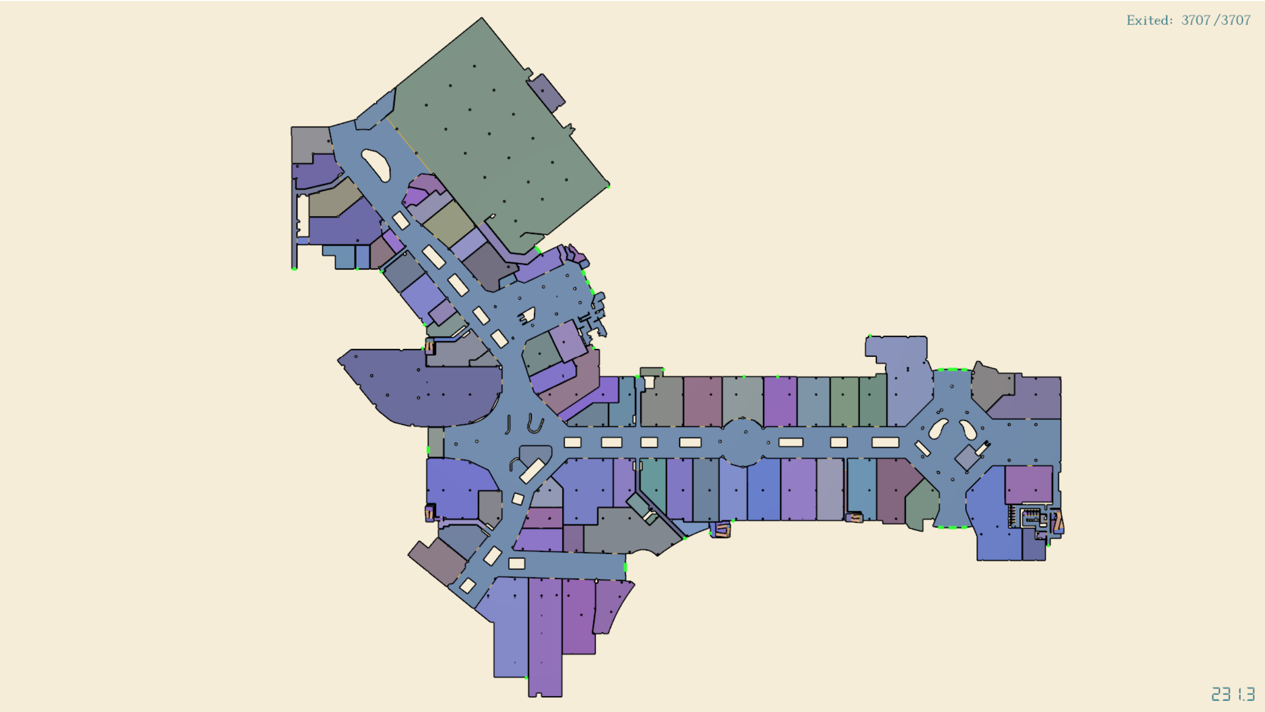


Figure 170: GSC-ES-01 – GF – 232 seconds – all occupants have evacuated the building

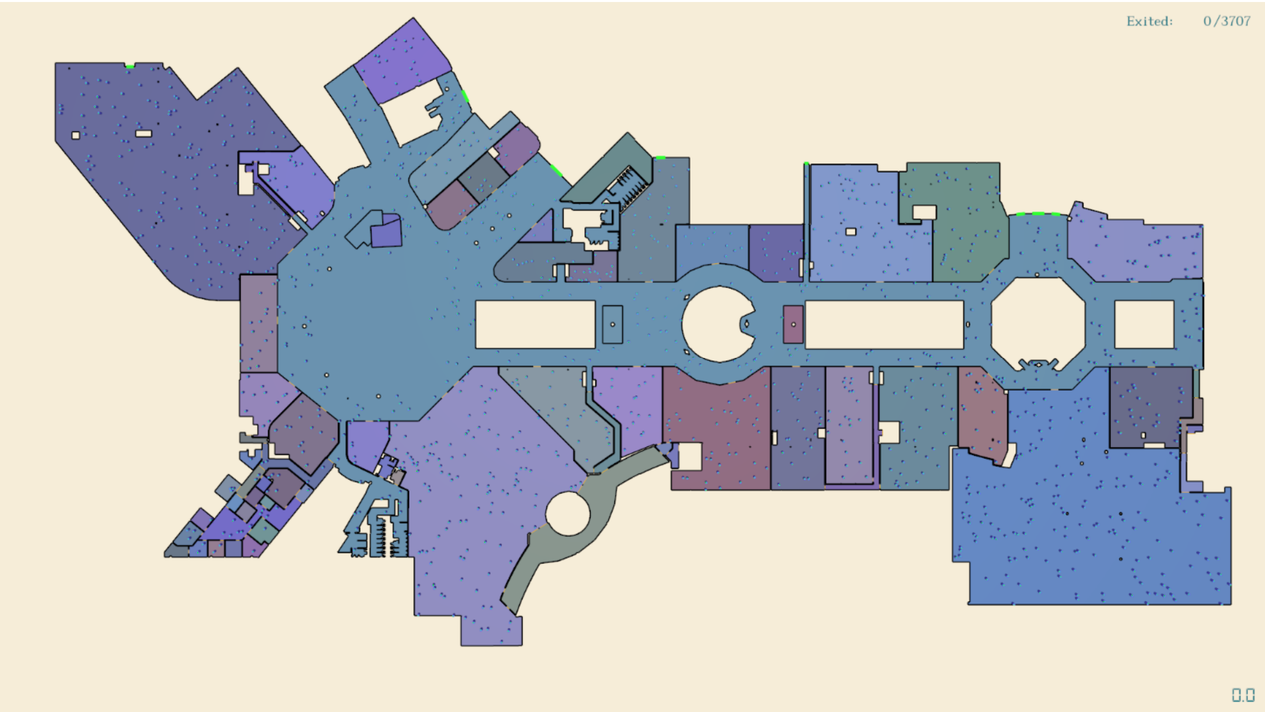


Figure 171: GSC-ES-01 – 1F – 0 seconds into the evacuation

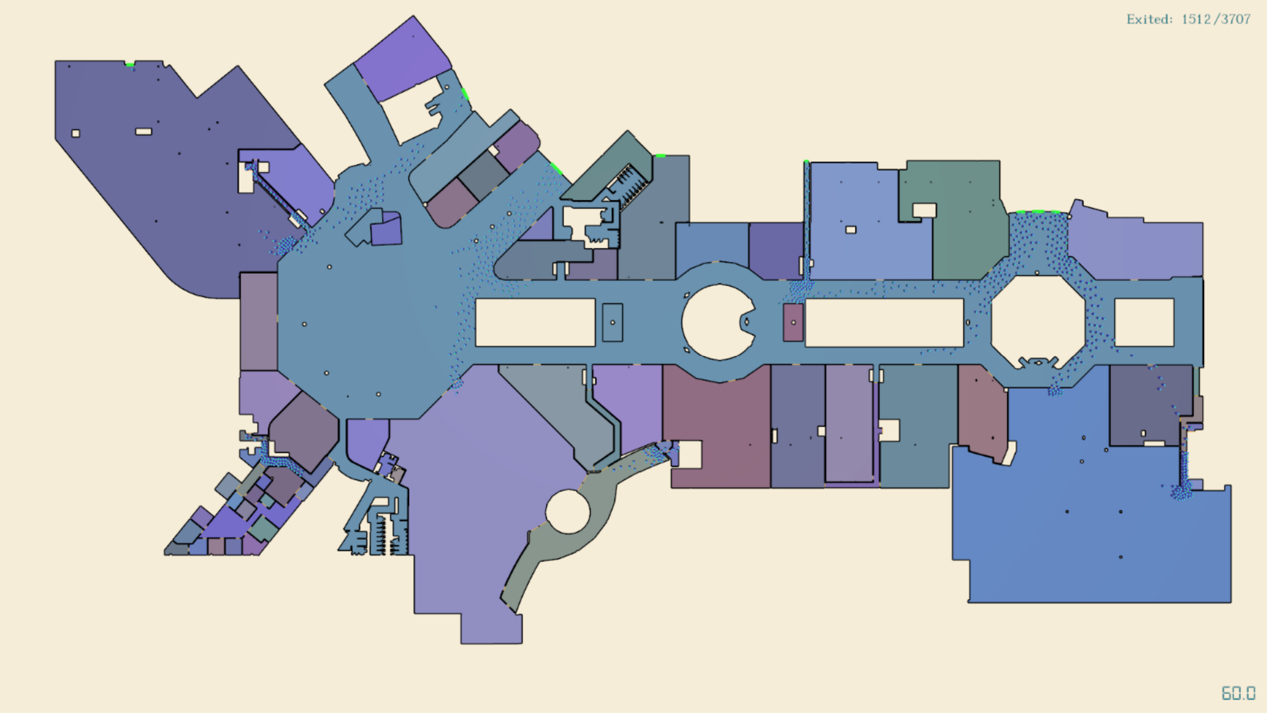


Figure 172: GSC-ES-01 – 1F – 60 seconds into the evacuation

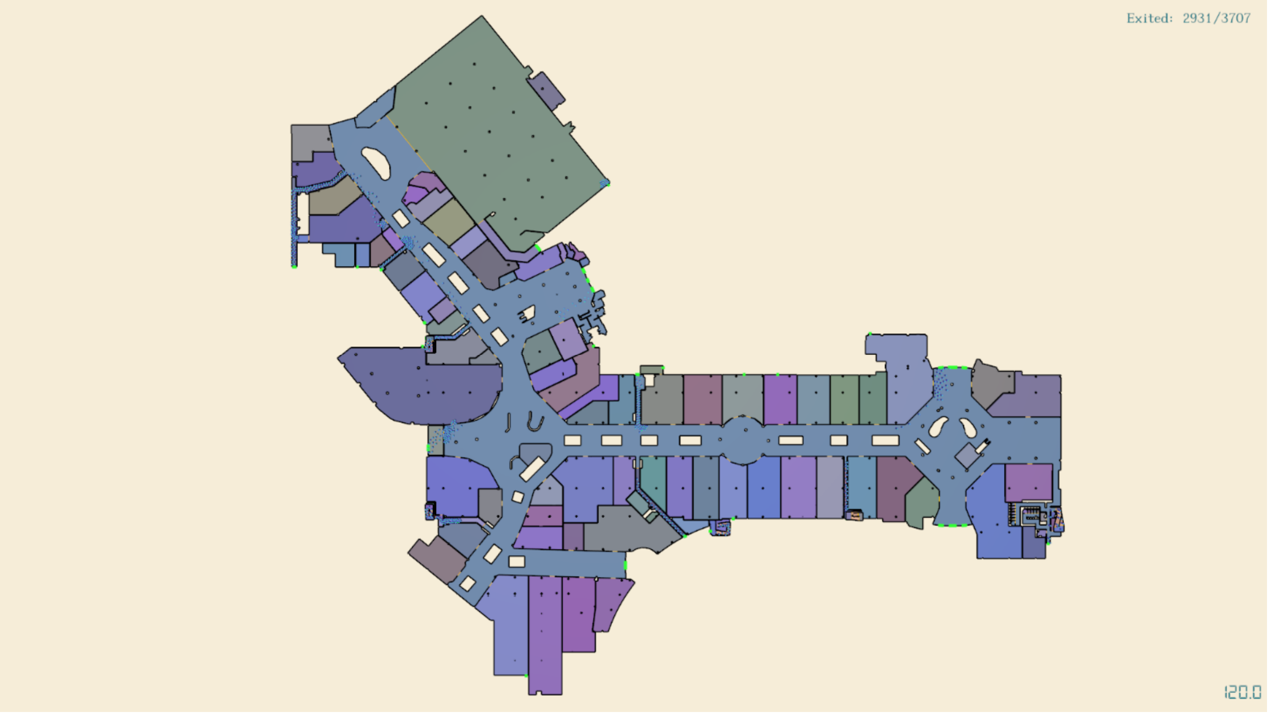


Figure 173: GSC-ES-01 – 1F – 120 seconds into the evacuation

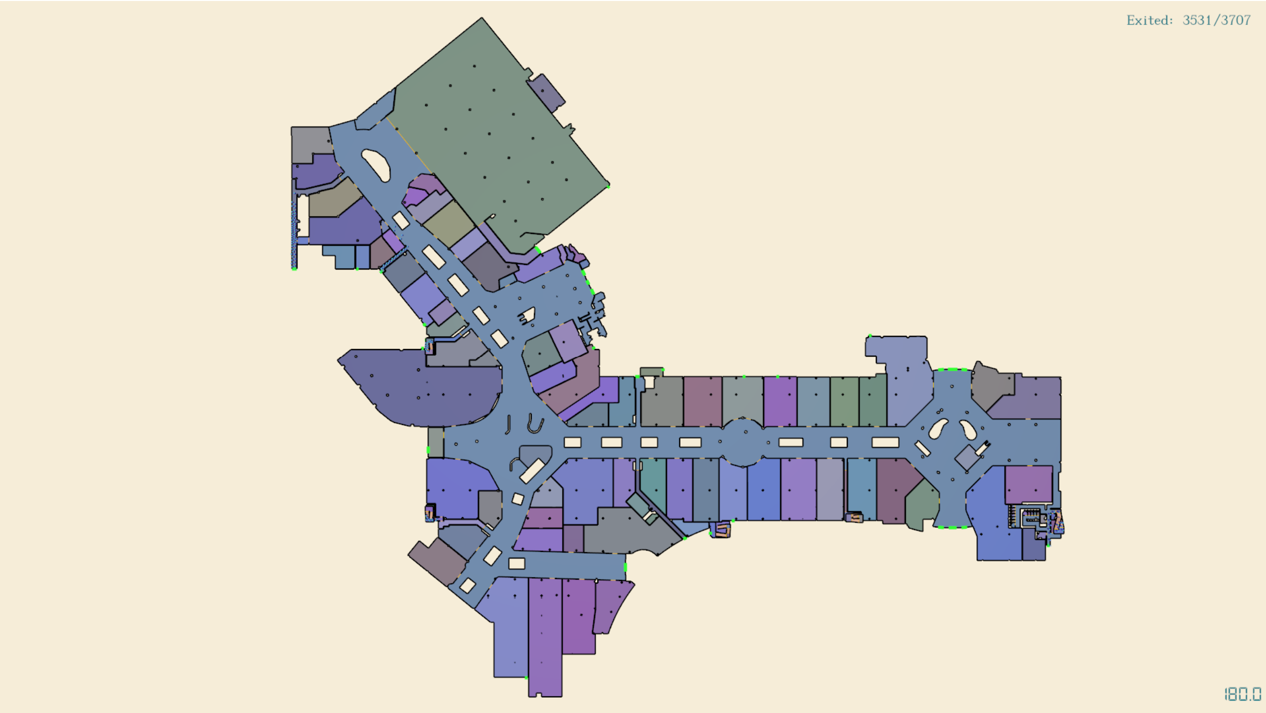


Figure 174: GSC-ES-01 – 1F – 180 seconds into the evacuation

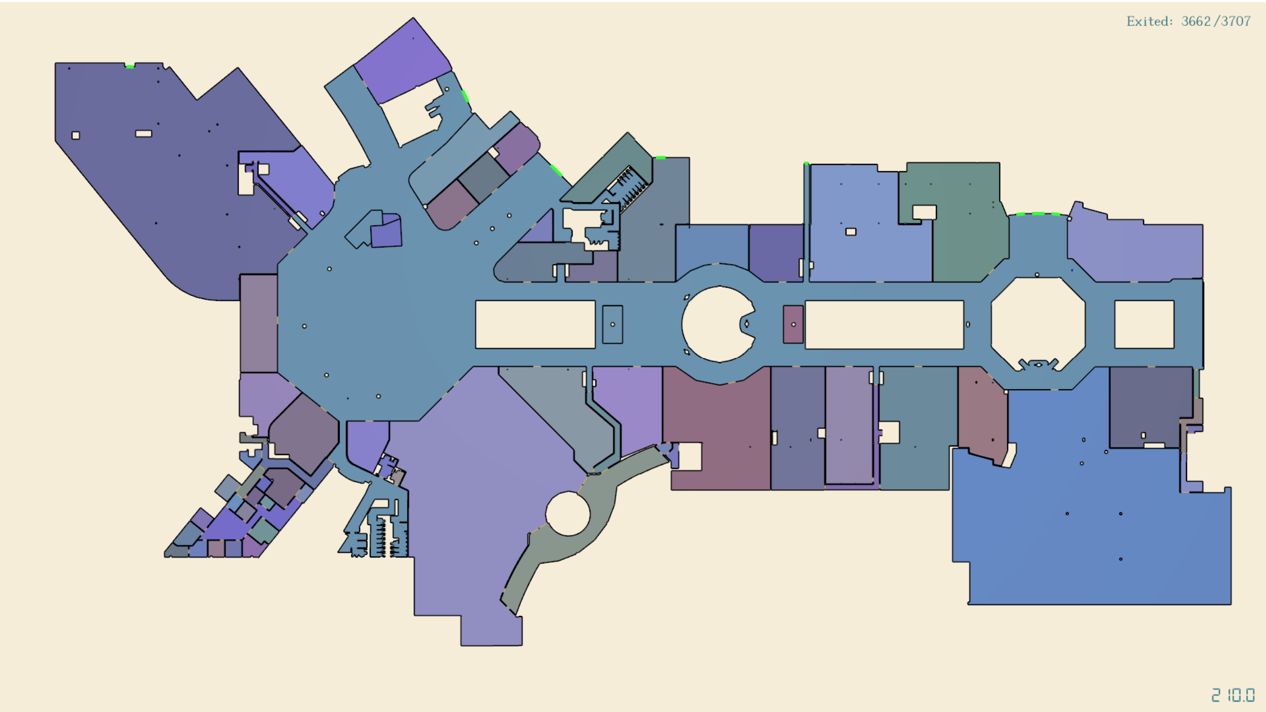


Figure 175: GSC-ES-01 – 1F – 210 seconds into the evacuation

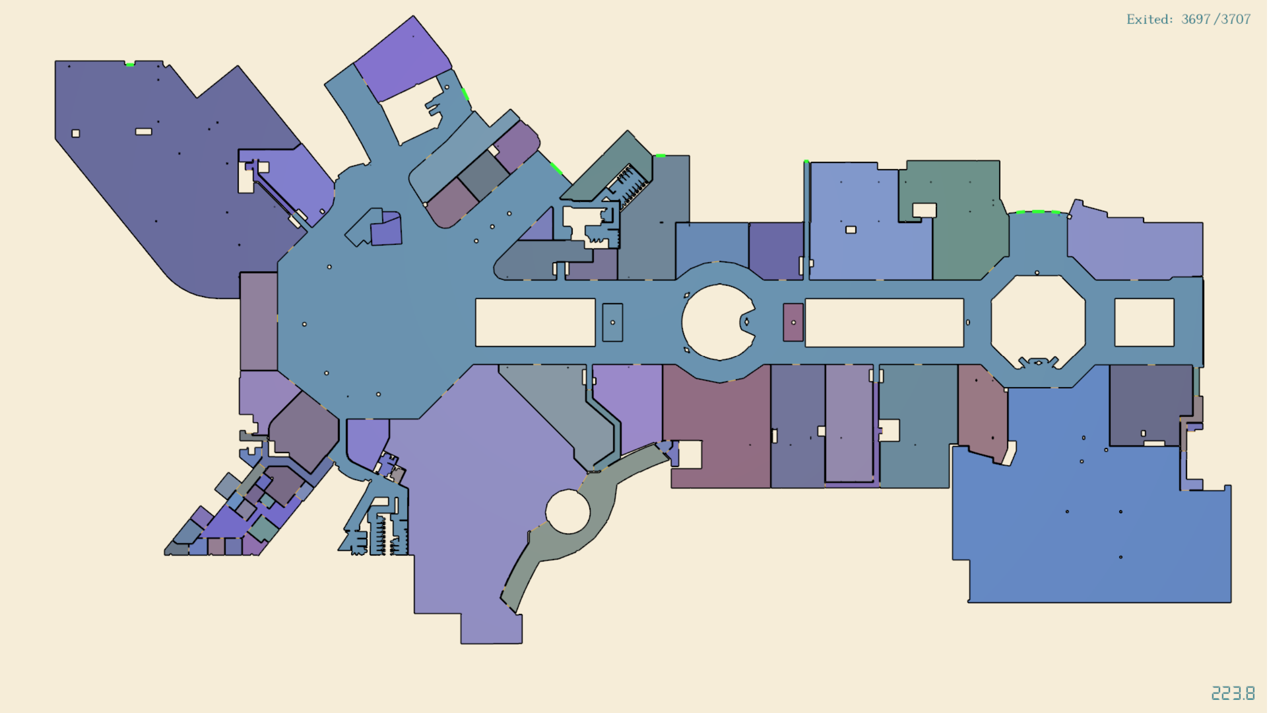


Figure 176: GSC-ES-01 – 1F – 224 seconds – all occupants left First Floor

37.2 Sensitivity egress scenario – GSC-ES-02

A summary of the model setup is provided below:

- Total population 7,352
  - The retail mall GF – 247 occupants: 10 m²/person
  - The retail mall 1F – 313 occupants: 10 m²/person
  - The GF tenancies – 2,304 occupants: 6 m²/person
  - The GF BoH/stores – 40 occupants: 30 m²/person
  - The 1F tenancies – 3,365 occupants: 6 m²/person
  - The 1F BoH/stores – 2 occupants: 30 m²/person
- Occupant speed:
  - 55% of occupants travelling at 0.93 m/s
  - 45% of occupants travelling at 0.80 m/s
- Store rooms, etc., generally not populated

Results:

- All occupants leave First Floor: 308 seconds
- All occupants leave Ground Floor: 420 seconds
- Total egress time: 420 seconds

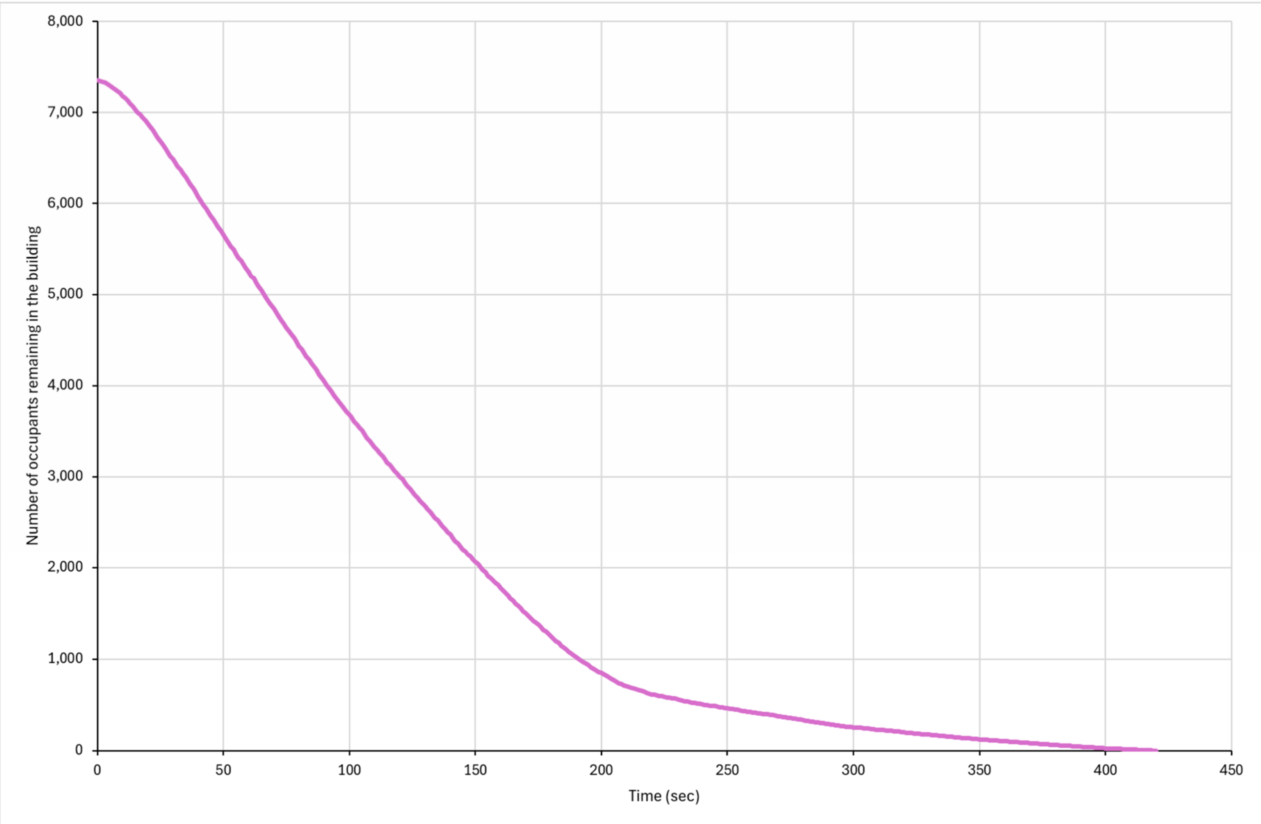


Figure 177: Number of occupants versus the evacuation time – sensitivity egress scenario

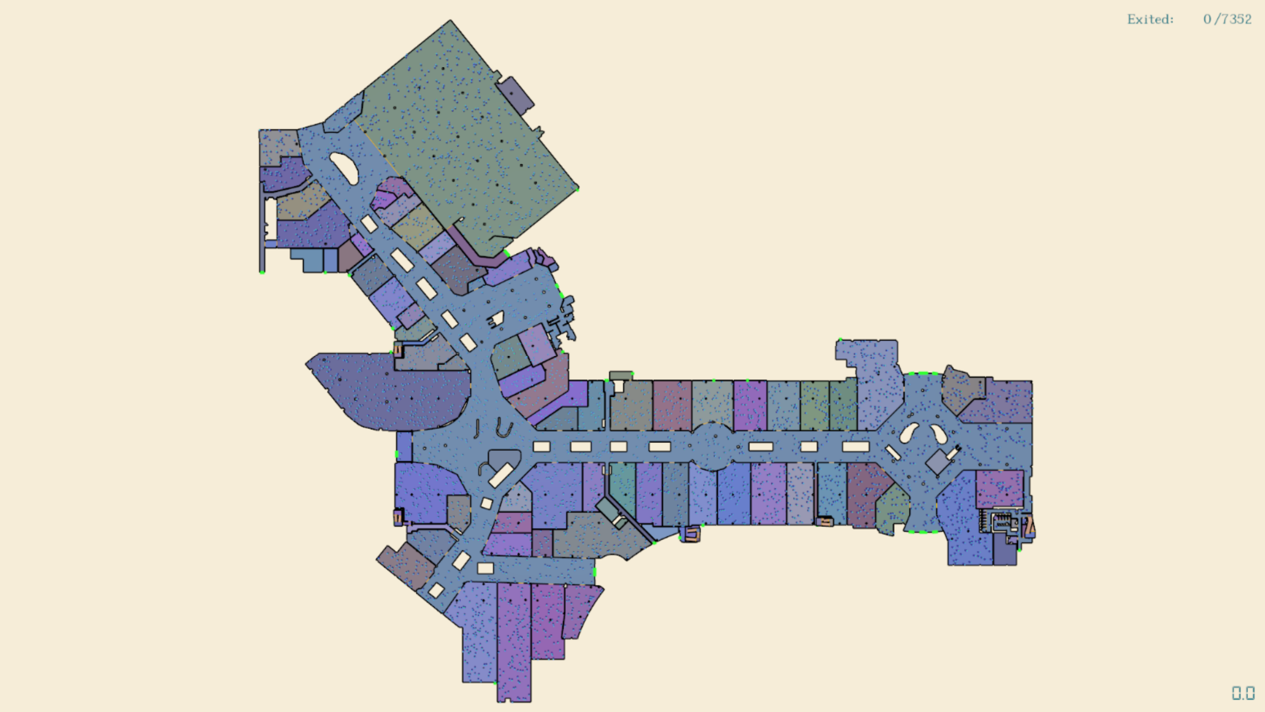


Figure 178: GSC-ES-02 – GF – 0 seconds into the evacuation

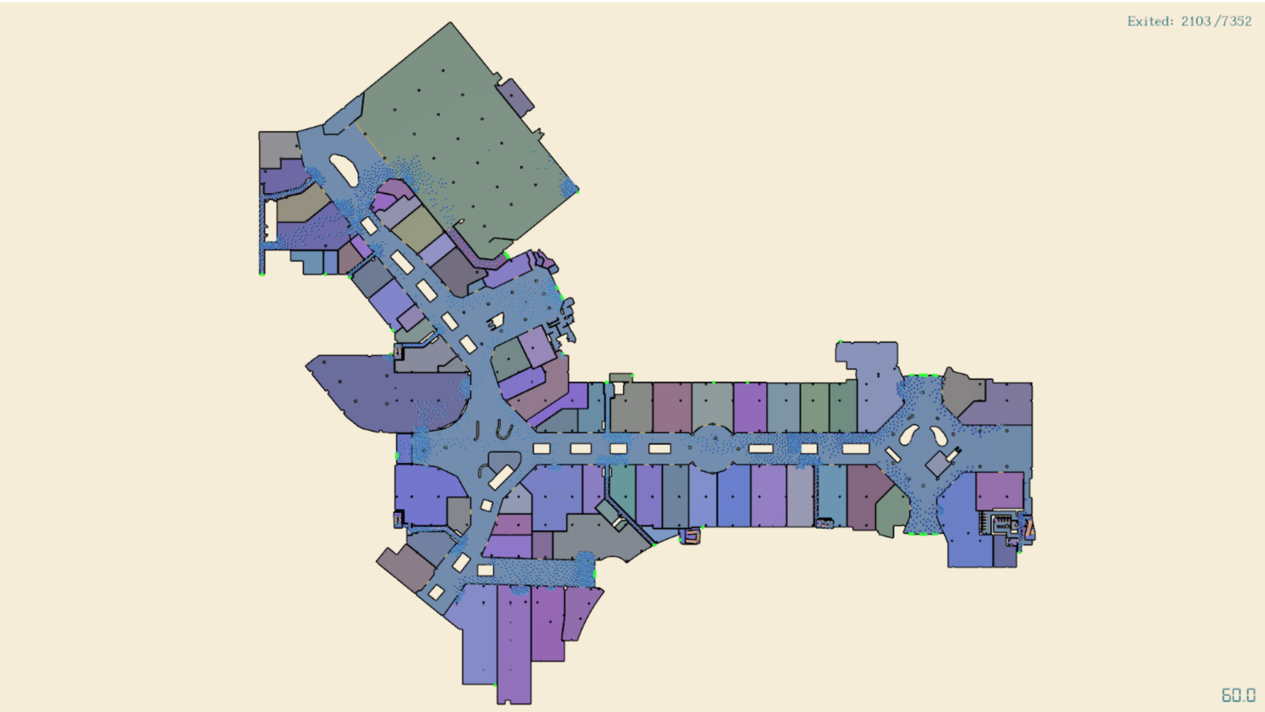


Figure 179: GSC-ES-02 – GF – 60 seconds into the evacuation

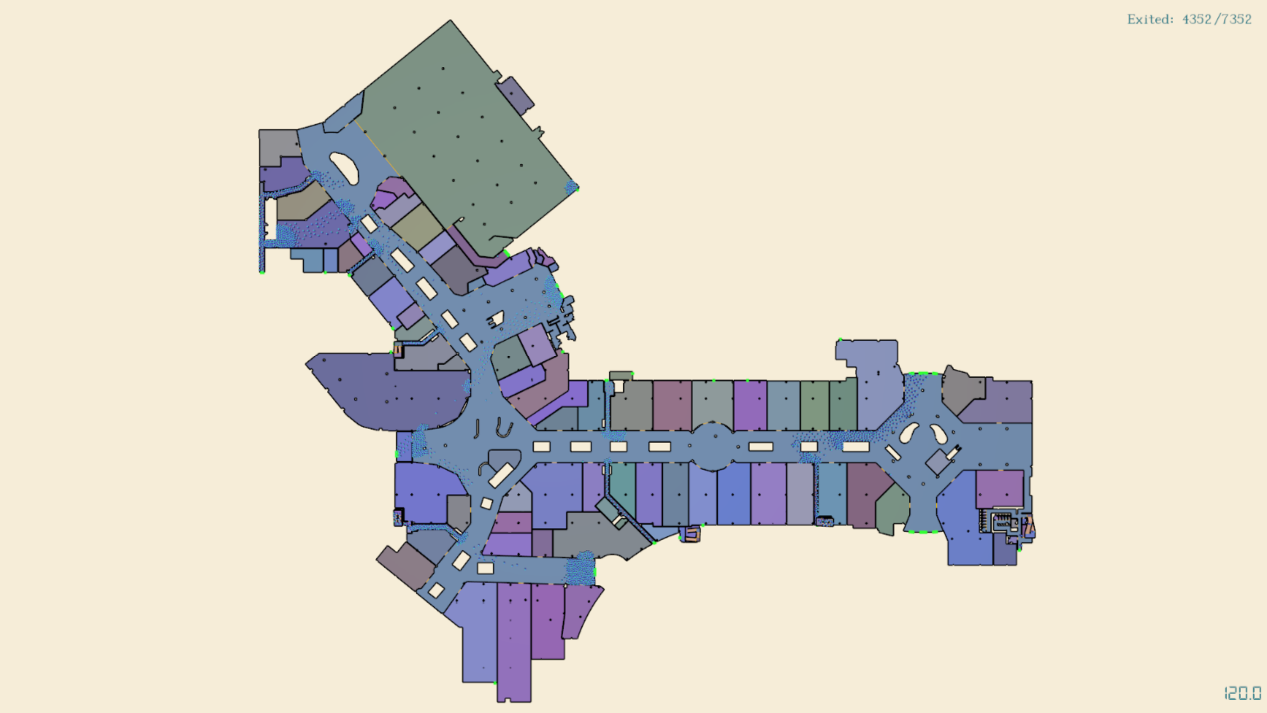


Figure 180: GSC-ES-02 – GF – 120 seconds into the evacuation

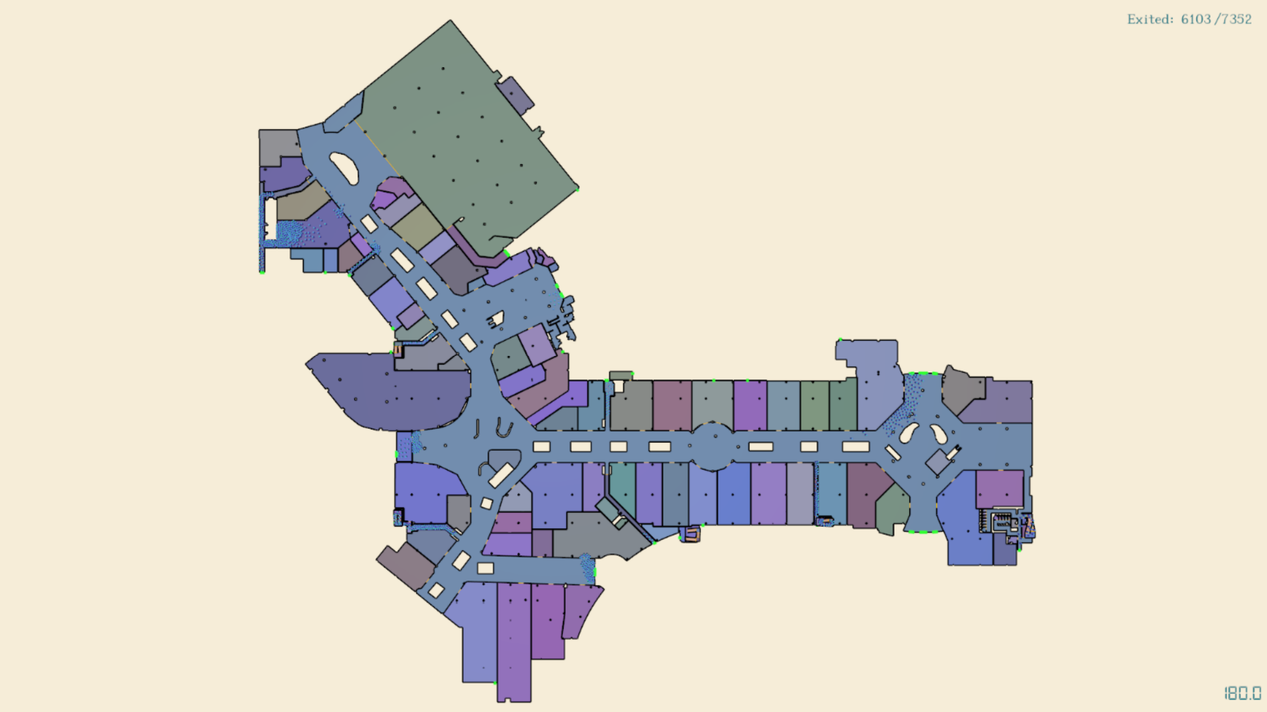


Figure 181: GSC-ES-02 – GF – 180 seconds into the evacuation

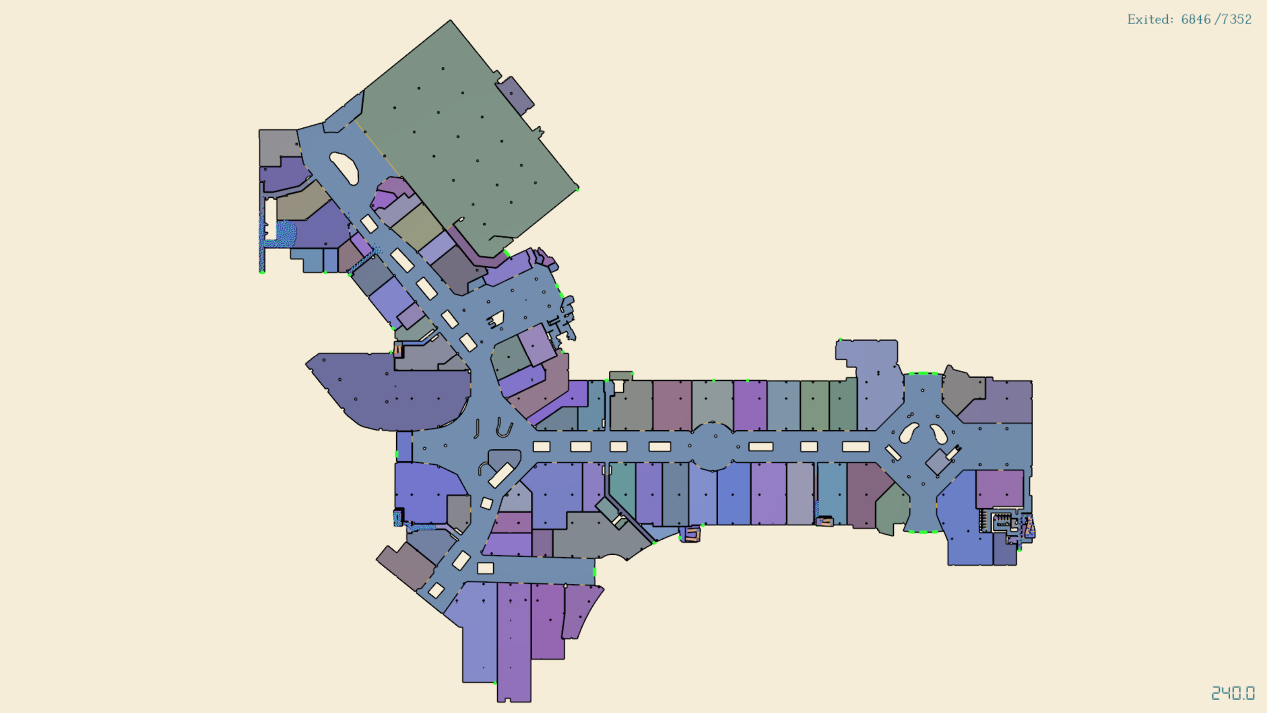


Figure 182: GSC-ES-02 – GF – 240 seconds into the evacuation

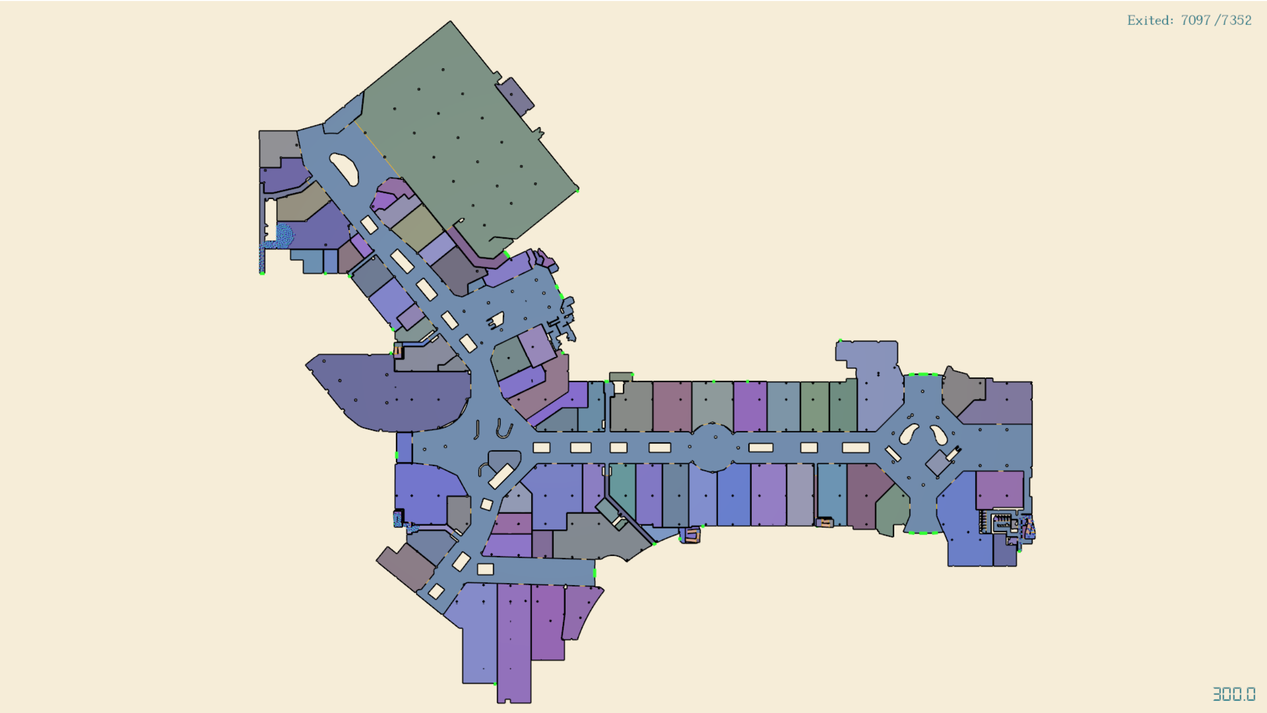


Figure 183: GSC-ES-02 – GF – 300 seconds into the evacuation

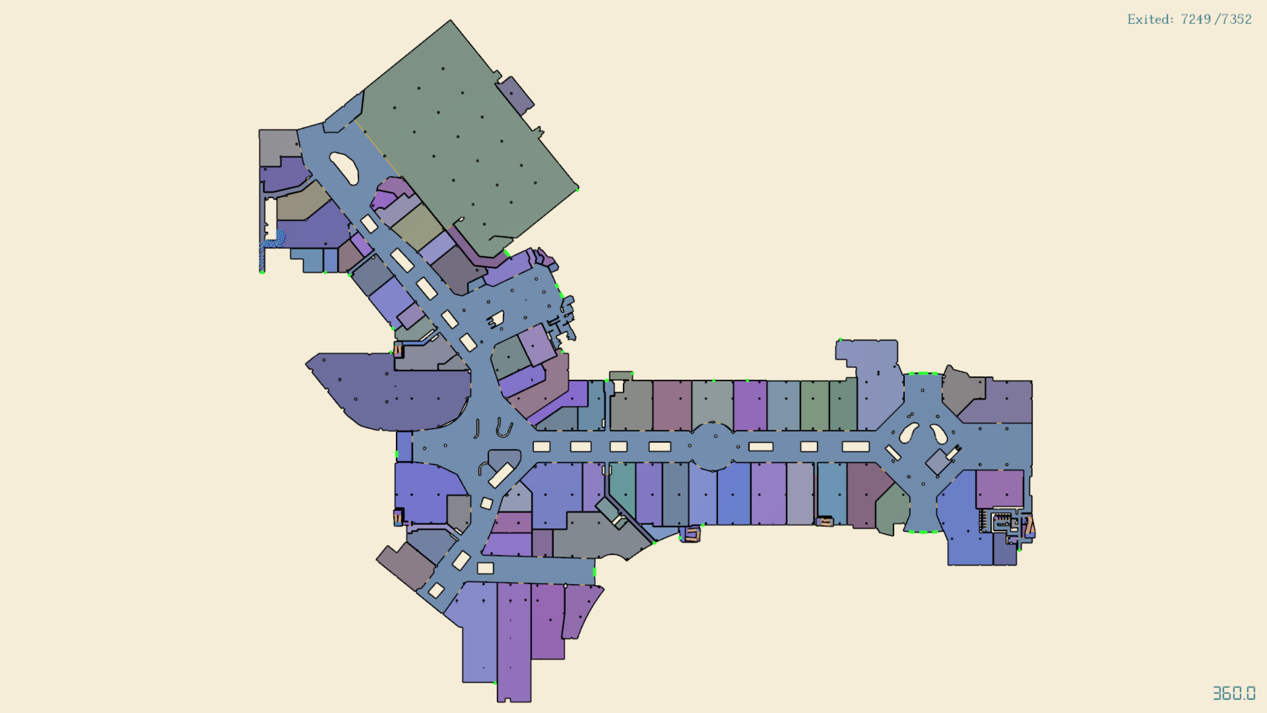


Figure 184: GSC-ES-02 – GF – 360 seconds into the evacuation

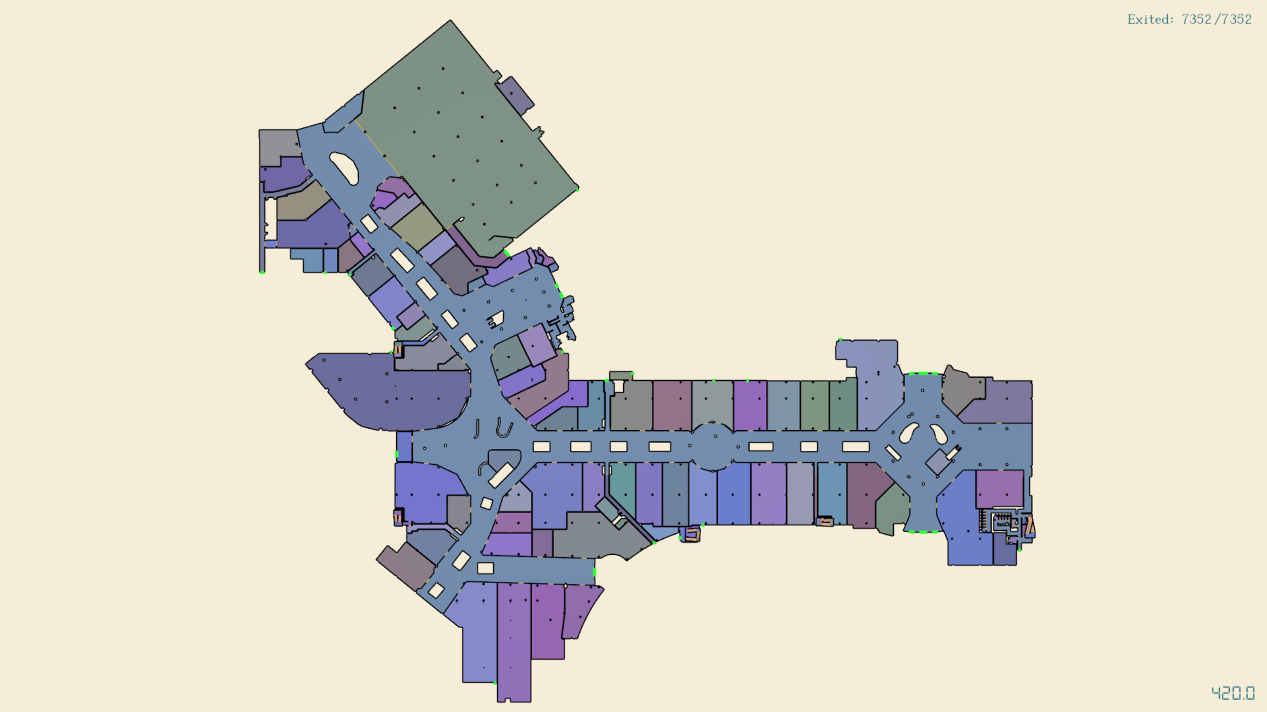


Figure 185: GSC-ES-02 – GF – 420 seconds – all occupants have evacuated the building

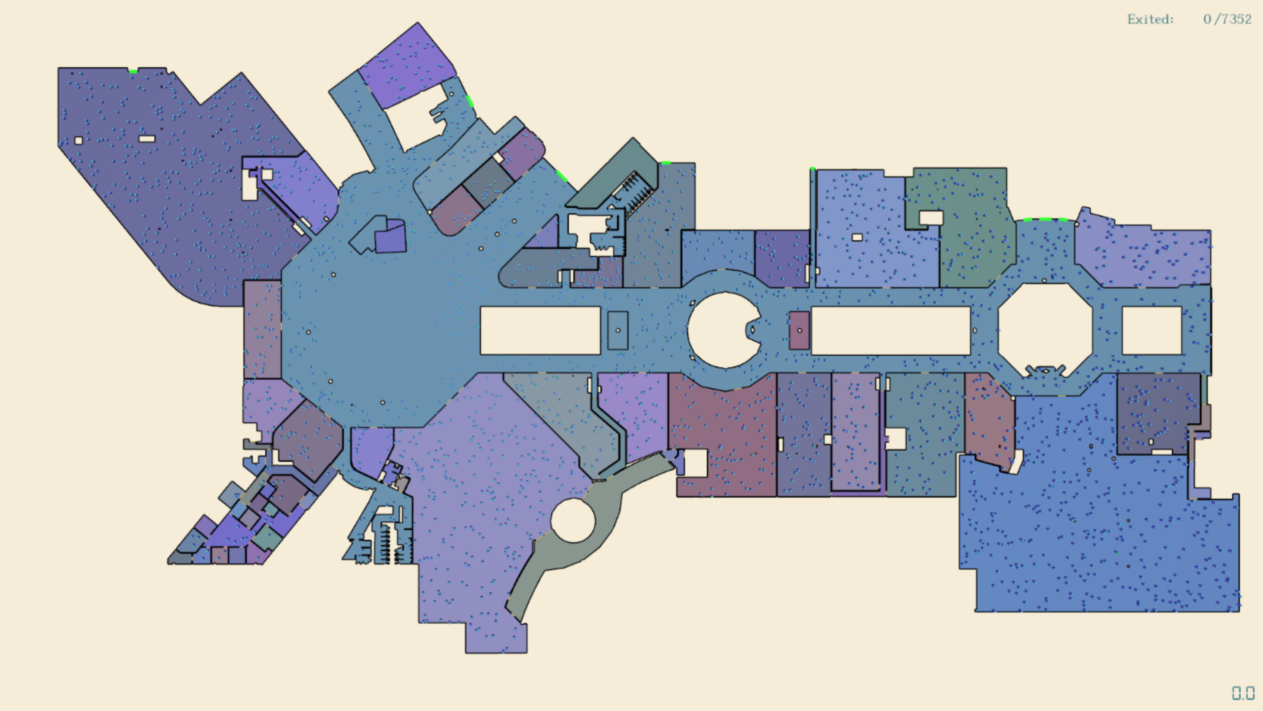


Figure 186: GSC-ES-02 – 1F – 0 seconds into the evacuation

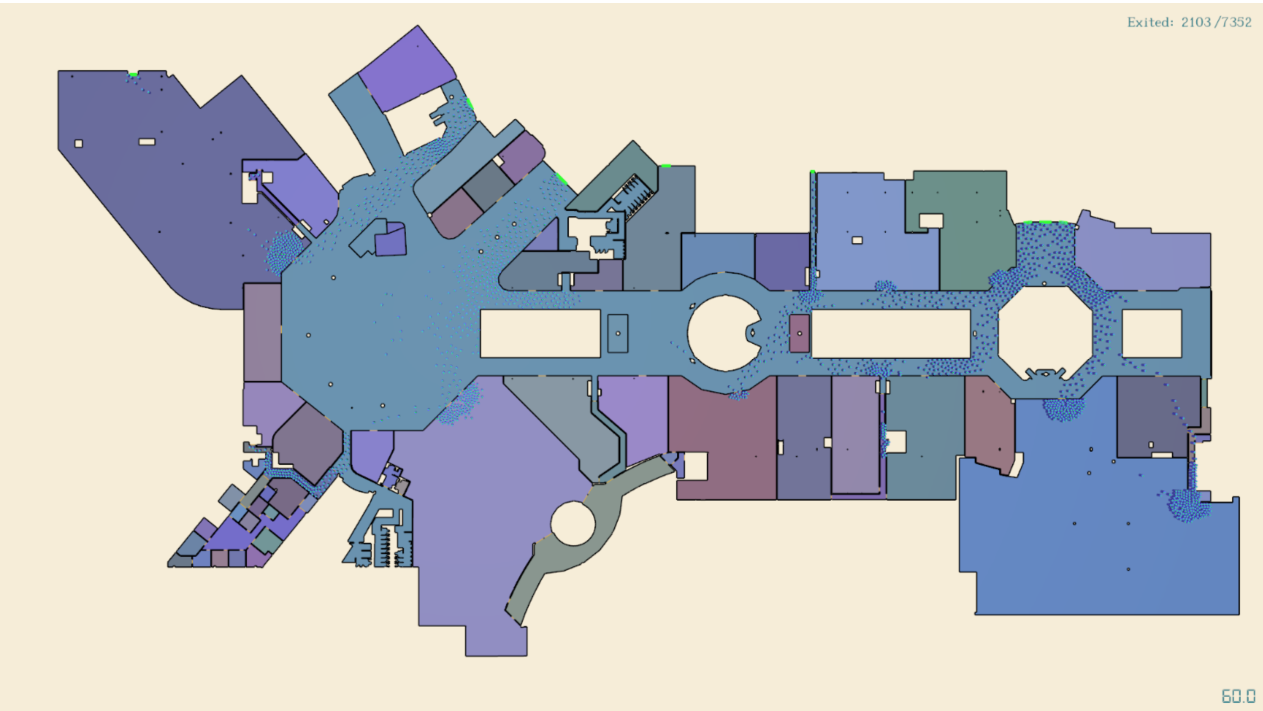


Figure 187: GSC-ES-02 – 1F – 60 seconds into the evacuation

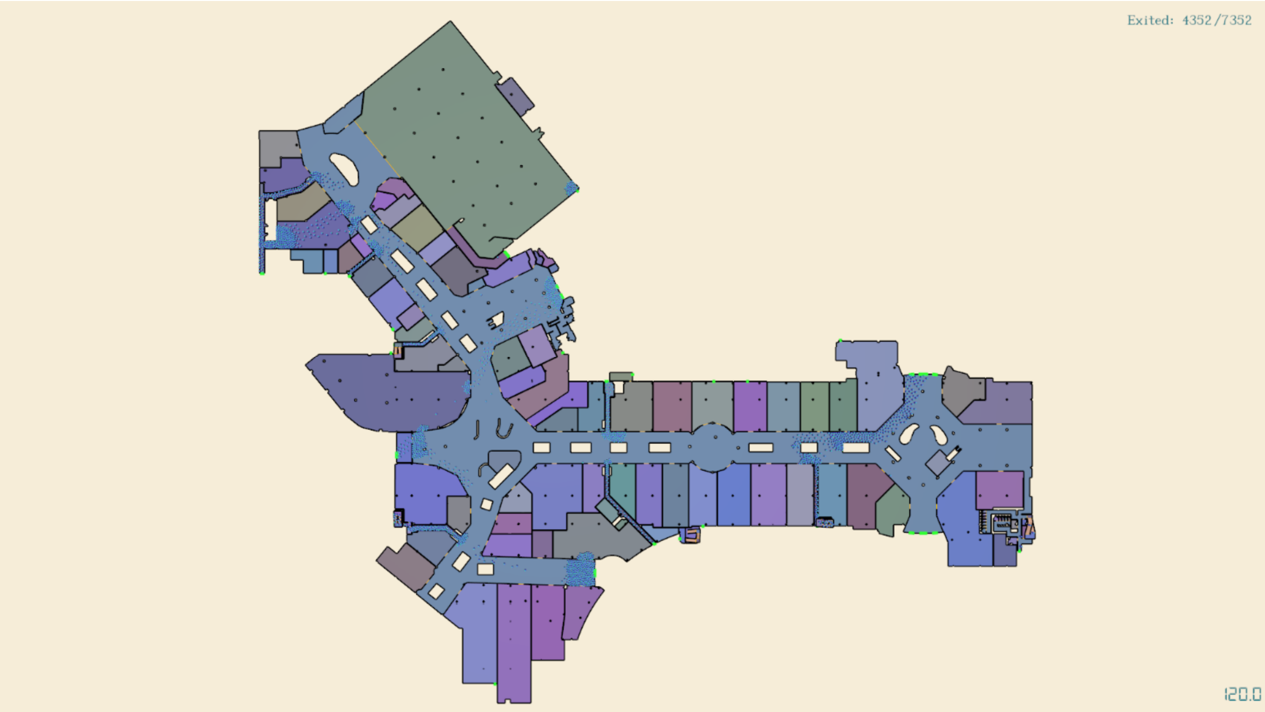


Figure 188: GSC-ES-02 – 1F – 120 seconds into the evacuation

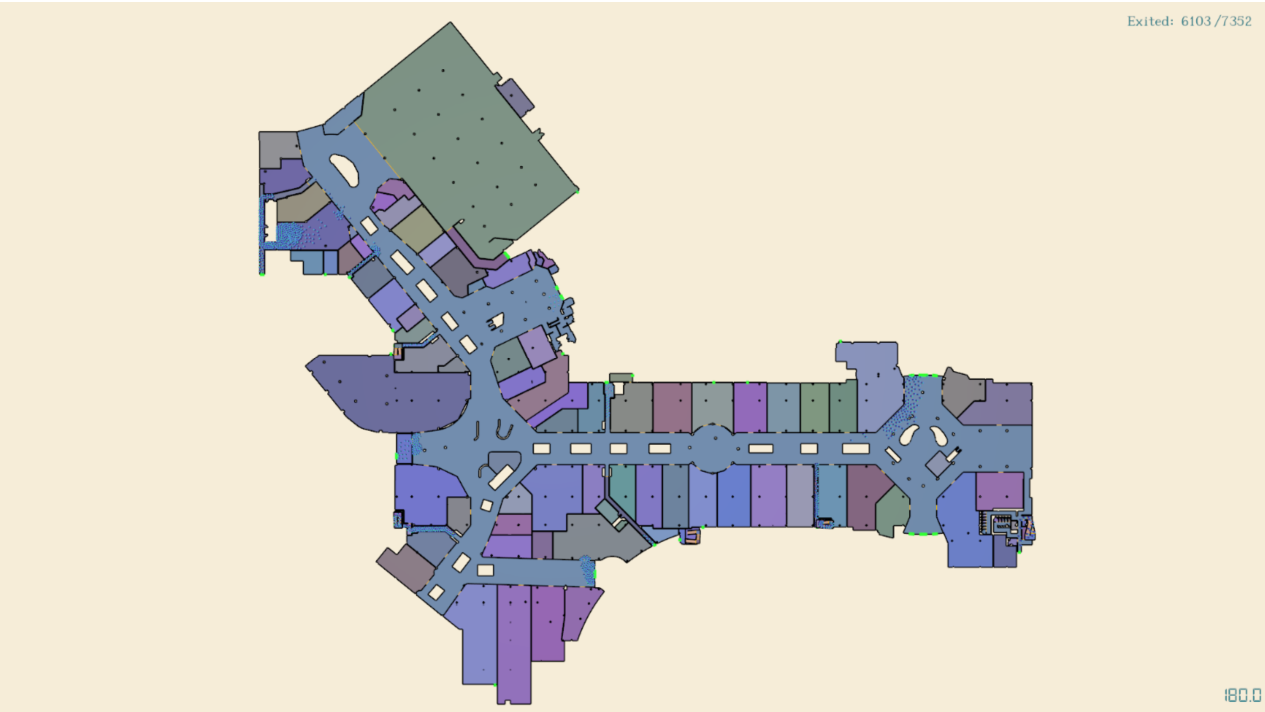


Figure 189: GSC-ES-02 – 1F – 180 seconds into the evacuation

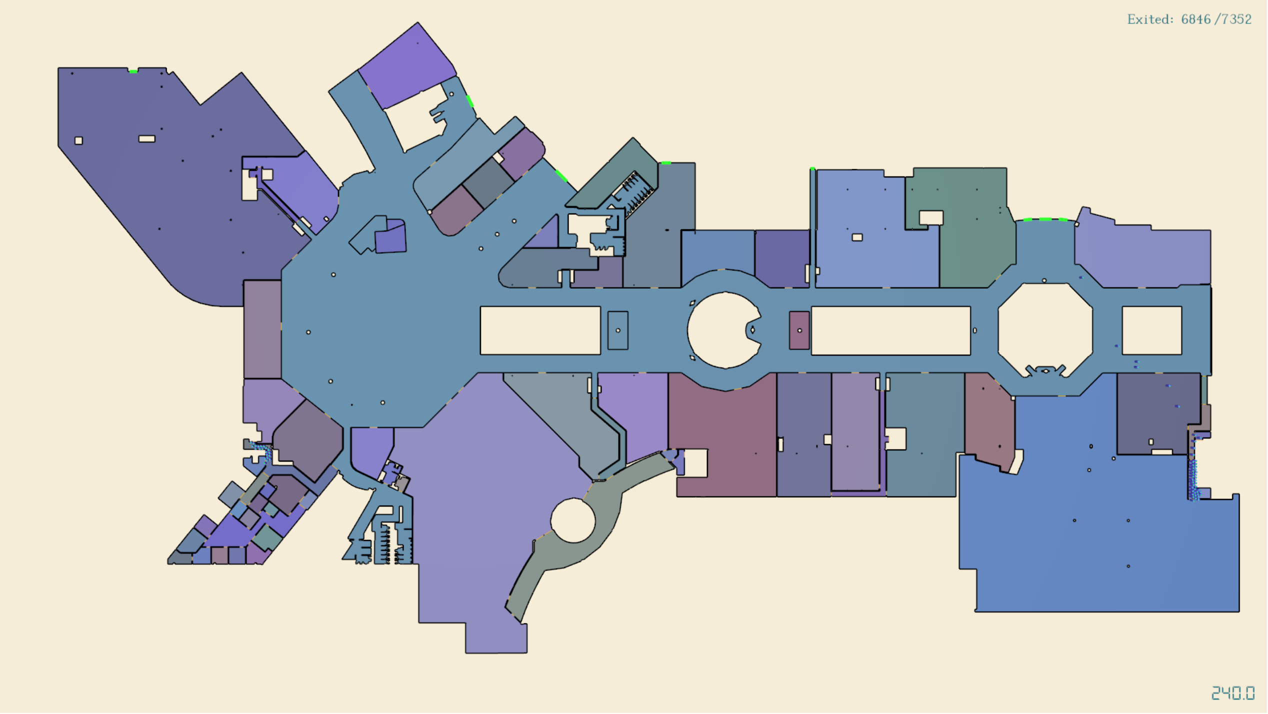


Figure 190: GSC-ES-02 – 1F – 240 seconds into the evacuation

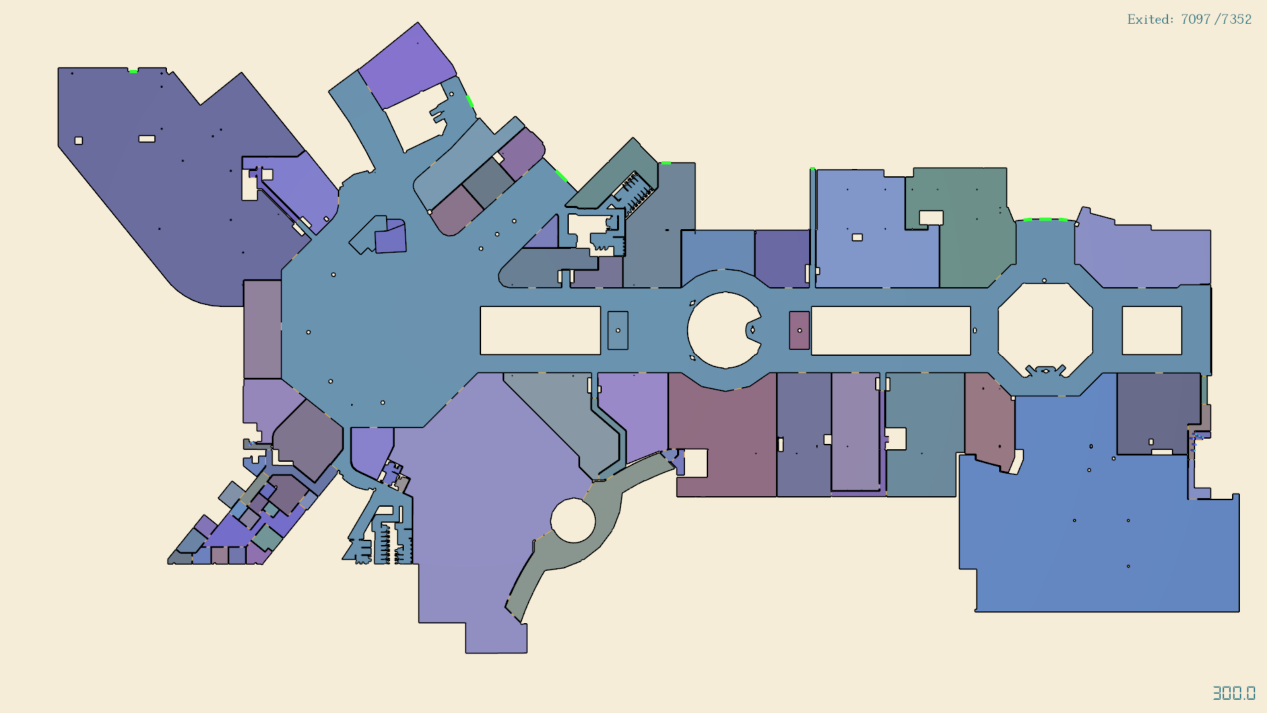


Figure 191: GSC-ES-02 – 1F – 300 seconds into the evacuation

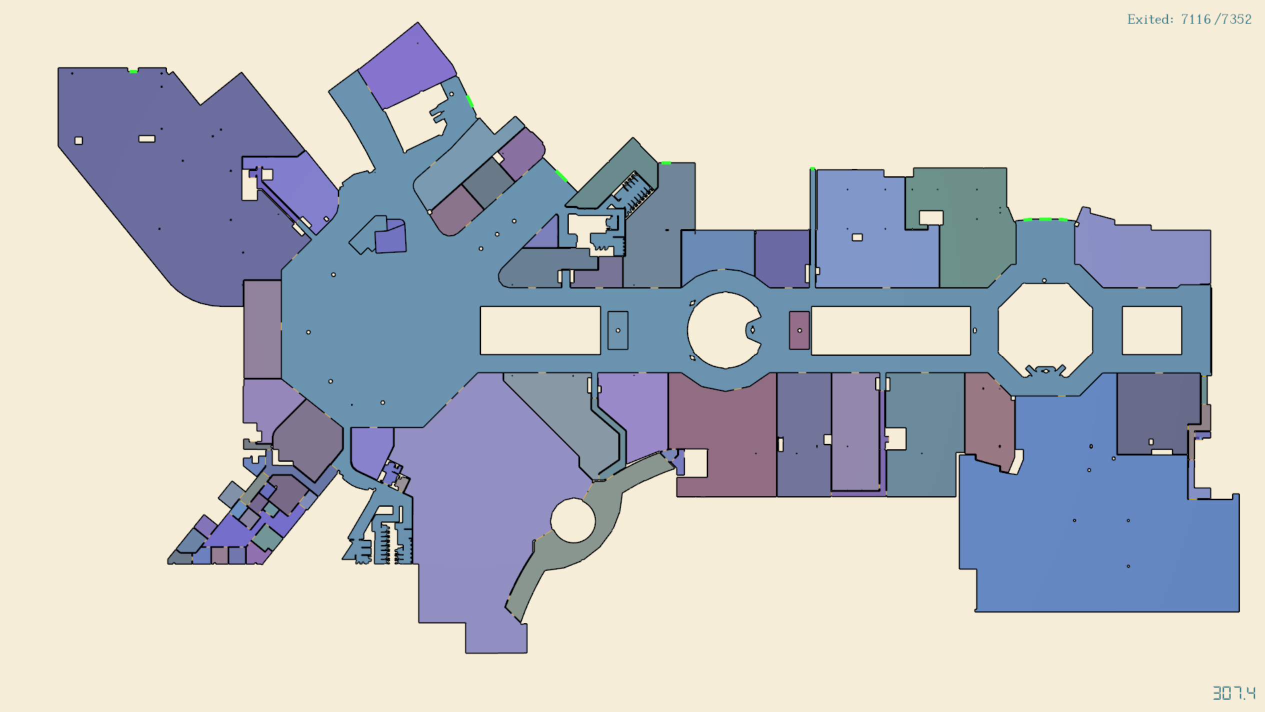


Figure 192: GSC-ES-02 – 1F – 308 seconds – all occupants left First Floor

38. Appendix L – Performance Solution No. 5 – Fire Brigade Intervention Modelling

The following are the results of the Department of Fire and Emergency Services intervention timeline analysis during a potential fire, calculated using the methodology detailed in the "Fire Brigade Intervention Model" [AFAC, 2004].

38.1.1 Purpose of FBIM Assessment

The purpose of this FBIM assessment is to estimate the time laps between the moment when the fire starts and the time of initial attack on the fire begins.

38.1.2 Worst Case Scenario for FBIM Assessment

The development is protected with a fire detection and alarm system and a sprinkler system that are linked to DFES via Direct Brigade Alarm (DBA), which in the event of a fire is expected to raise the alarm and provide timely call out of DFES.

For the purpose of this assessment, it is assumed that a fire starts in specialty shop G-011 on the southern side of Ground Floor retail mall. This location is considered the worst for DFES intervention, as tenability conditions during a Ground Floor fire are expected to be the worst, and G-011 does not have direct egress to outside and is almost equidistant from the nearest exits.

38.1.3 Empirical Calculations of Fire Brigade Intervention

The development is located in an outer suburb of the metropolitan area in Western Australia. The table below identifies the closest DFES fire station and the resources assigned to these stations.

Station	Resources	Distances to the Development	Status
Kiara	Pumper 1 – 1 officer + 3 fire fighters	5.0 km	On call – not available to respond
Malaga	Pumper 2 – 1 officer + 3 fire fighters	5.9 km	Located at the station
Vincent	Pumper 3 – 1 officer + 3 fire fighters	6.9 km	Located at the station

Table 85: DFES fire station closest to the development

Based on the above availability of DFES resources a fire brigade intervention timeline has been developed for the development.

For the purpose of this assessment, the fire brigade intervention timeline starts at the moment of the fire start and develops as follows:

1. A fire originates in specialty shop G-011 on Ground Floor. The smoke detector is estimated to activate after 47 seconds (worst-case scenario) and the alarm is relayed to DFES via the Direct Brigade Alarm (DBA) after 67 seconds (including 20 second verification time).

2. Alarm is relayed from the DFES Communications centre to Malaga and Vincent fire stations.

3. Fire fighters dress, assimilate information and leave the station.

4. The first fire appliance arrives on site. Firefighters dismount, don BA, collect equipment and proceeds to the fire control centre to determine the location of the fire (50 m). Once location of the fire is determined, firefighters 2 and 3 proceed to the external fire hydrant nearest to the fire-affected tenancy (70 m). They flush the fire hydrant, connect 2 lengths of hose, advance to a point of entry into fire-isolated corridor from Ground Floor retail mall between specialty shops G-006 and G-008 (40) and await arrival of the second crew.

5. The second fire appliance arrives on site and parks adjacent to the first pumping appliance.

6. Fire fighters dismount, don BA, collect equipment and under the protection of the first crew travel to the location of the fire hydrant nearest to G-011 (60 m), connect 2 lengths of hose to the hydrant, and then together with the first crew advance to a position where they can fight the fire (10 m).

The timeline of DFES intervention for the development is summarised in Table 86 below.

From Table 86 it is evident that the time laps between the moment the fire starts, and the first hose line goes into operation is approximately 19 minutes (1,127 seconds).

All data for the calculation of different activities was taken from the FBIM Manual [AFAC, 2004].

ID	Activities	Personnel	Work rate	Units	Time required for each task	Cumulative timeline until task completed for Pumper 1	Cumulative timeline until task completed for Pumper 2
1	Fire starts in specialty shop G-011 on Ground Floor				**0 sec**	**0 sec**	**0 sec**
2	**Detection time**				**67 sec**	**67 sec**	**67 sec**
2.1	Smoke detector activates		47 sec	1	47 sec		
2.2	Alarm verification time at the Fire Brigade Panel		20 sec	1	20 sec		
3	**Notify Fire Brigade and dispatch resources**				**105 sec**	**172 sec**	**172 sec**
3.1	Time to relay dispatch information by part manual CAD system		15 sec	1	15 sec		
3.2	Fire fighters dress, assimilate information and leave stations		90 sec	1	90 sec		
4	**Travel to Alarm Address**					**671 sec**	**755 sec**
4.1	Major city outer suburb* (Malaga – Pumper 1)	FF 1-4	42.6 km/h	5.9 km	499 sec		
4.2	Major city outer suburb* (Vincent – Pumper 2)	FF 5-8	42.6 km/h	6.9 km	583 sec		

ID	Activities	Personnel	Work rate	Units	Time required for each task	Cumulative timeline until task completed for Pumper 1	Cumulative timeline until task completed for Pumper 2
5	**Determine fire location (Pumper 1)**				**224 sec**	**895 sec**	
5.1	Dismount appliance and don BA	FF 1, 2, 3	88.1 sec	1	88 sec		
5.2	Travel to location of the FIP	FF 1, 2, 3	1.4 m/s	50 m	36 sec		
5.3	Time to open side hung door with keys	FF 1, 2, 3	10 sec	1	10 sec		
5.4	Interrogate FIP and identify fire location	FF 1, 2, 3	90 sec	1	90 sec		
5.5	Transmit information (*concurrent with item 5.3*)	*FF 1*	*10 sec*	*1*	*10 sec*		
6	**Secure water supply (Pumper 1)**				**222 sec**	**1,077 sec**	
6.1	Travel to the location of external attack fire hydrant	FF 2, 3	1.4 m/s	70 m	50 sec		
6.2	Flush hydrant	FF 2, 3	32.8 sec	1	33 sec		
6.3	Connect hose to hydrant and charge	FF 2, 3	59.6 sec	2	119 sec		
6.4	Await for the second crew to complete their setup	FF 2, 3	20 sec	1	20 sec		
7	**Secure water supply (Pumper 2)**				**322 sec**		**1,077 sec**
7.1	Dismount appliance and don BA	FF 5-7	88.1 sec	1	88 sec		
7.2	Travel to location of external attack hydrant to south-west of southern entrance	FF 5-7	1.4 m/s	30 m	22 sec		
7.3	Flush hydrant	FF 5-7	32.8 sec	1	33 sec		
7.4	Connect hose to hydrant and charge (3 lengths)	FF 5-7	59.6 sec	3	179 sec		

ID	Activities	Personnel	Work rate	Units	Time required for each task	Cumulative timeline until task completed for Pumper 1	Cumulative timeline until task completed for Pumper 2
8	**Get into position to attack fire (Pumpers 1 & 2)**				**50 sec**	**1,127 sec**	**1,127 sec**
8.1	Travel to the main entrance to specialty shop G-011	FF 2, 3, 5-7	1.4 m/s	70 m	50 sec		
Total intervention time before the first line goes into operation						**1,127 sec**	**1,127 sec**

Table 86: Timeline analysis of DFES intervention

Note 1: There is no information in FBIM for travel speeds in Western Australia; therefore, the most conservative travel speed for the “Major City outer suburb” was used, i.e. 42.6 km/h for South Australia (ACT & NSW were excluded because those times include fire fighter response times).

39. Appendix M – Performance Solution No. 12 – Radiant Heat Flux Assessment

All calculations were carried out with the use of module Radiation from the FireWind 3.6 suite of fire safety engineering software.

39.1 Motor Vehicle FS-01 to NW Entry

The input data for FS-01 assessment is provided in Table 50 and Table 51 in Section 22.9.1. The output data from radiant heat flux assessment at source S1 and S2 for FS-01 is provided in Figure 193 below.

A summary of the radiant heat fluxes from the radiant heat sources and the maximum combined radiant heat flux is summarised in Table 87 below. It is evident that the NW Entry should not be exposed to a radiant heat flux that exceeds 2.144 kW/m².

Source	Maximum radiant heat flux at the target
Side – engine compartment (S1)	**2.144 kW/m²**
Side – passenger compartment (S2)	

Table 87: Radiant heat flux at the NW Entry

Program Radiation

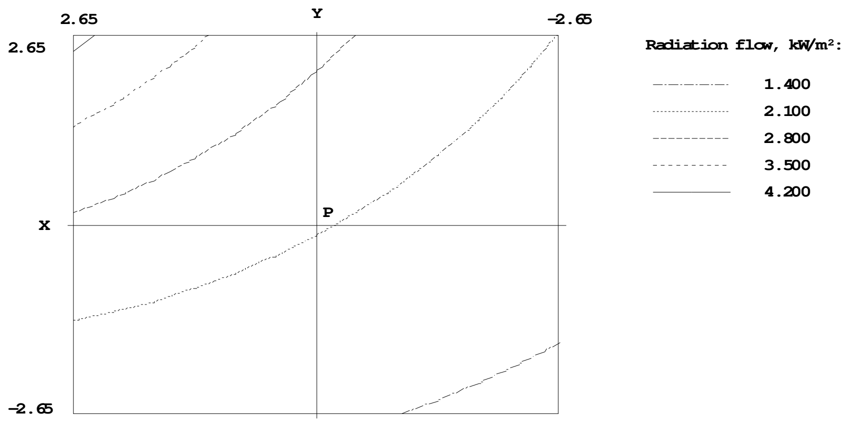
(All dimensions are in meters)

X-sources:

Radiation temperature 830°°

Distance	Offset		Size of source		Opening
X	Yx	Zx	Y	Z	%
10.76	4.51	0.00	1.07	2.58	100
9.66	8.15	-1.25	5.13	2.55	100

RADIATION MAP XY



Nodal radiation data, kW/m² :

Y \ X	2.65	1.32	0.00	-1.32	-2.65
2.65	4.352	3.577	2.963	2.478	2.092
1.32	3.468	2.974	2.544	2.181	1.879
0.00	2.713	2.425	2.144	1.887	1.660
-1.32	2.106	1.956	1.785	1.612	1.449
-2.65	1.635	1.571	1.476	1.366	1.253

Orientation of maximum radiation flow

at point P(0,0,0): $\theta = 94.4°, \ \varphi = 35.0°$

Figure 193: FS-01 – radiant heat flux from Source 1 (S1) ans Source 2 (S2) to NW entry

39.2 Motor Vehicle FS-01 to Tenant Storage

The input data for FS-01 assessment is provided in Table 50 and Table 51 in Section 22.9.1. The output data from radiant heat flux assessment at source S1 and S2 for FS-01 is provided in Figure 194 and Figure 195 below respectively.

A summary of the radiant heat fluxes from the radiant heat sources and the maximum combined radiant heat flux is summarised in Table 88 below. It is evident that the tenant storage should not be exposed to a radiant heat flux that exceeds 2.202 kW/m².

Source	Maximum radiant heat flux at the target	Total radiant heat flux at the target
Side – engine compartment (S1)	0.424 kW/m²	**2.202 kW/m²**
Side – passenger compartment (S2)	1.778 kW/m²	

Table 88: Radiant heat flux at the tenant storage

Program Radiation

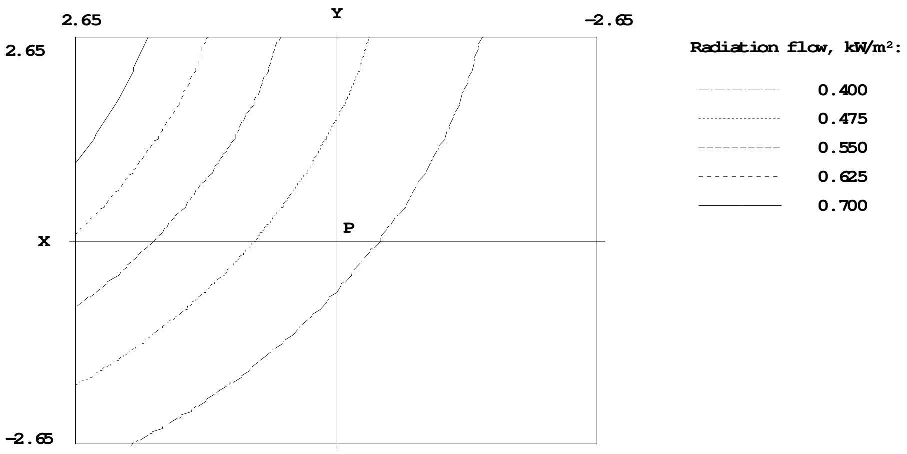
(All dimensions are in meters)

X-sources:

Radiation temperature 830°°

Distance	Offset		Size of source		Opening
X	Yx	Zx	Y	Z	%
11.85	4.56	0.00	1.07	2.58	100

RADIATION MAP XY



Nodal radiation data, kW/m²:

Y \ X	2.65	1.32	0.00	-1.32	-2.65
2.65	0.807	0.627	0.501	0.409	0.340
1.32	0.723	0.576	0.468	0.387	0.324
0.00	0.620	0.510	0.424	0.356	0.303
-1.32	0.516	0.439	0.375	0.322	0.278
-2.65	0.422	0.372	0.326	0.285	0.251

Orientation of maximum radiation flow

at point P(0,0,0): $\theta = 90.0°$, $\varphi = 21.0°$

Figure 194: FS-01 – radiant heat flux from Source 1 (S1) to tenant storage

Program Radiation

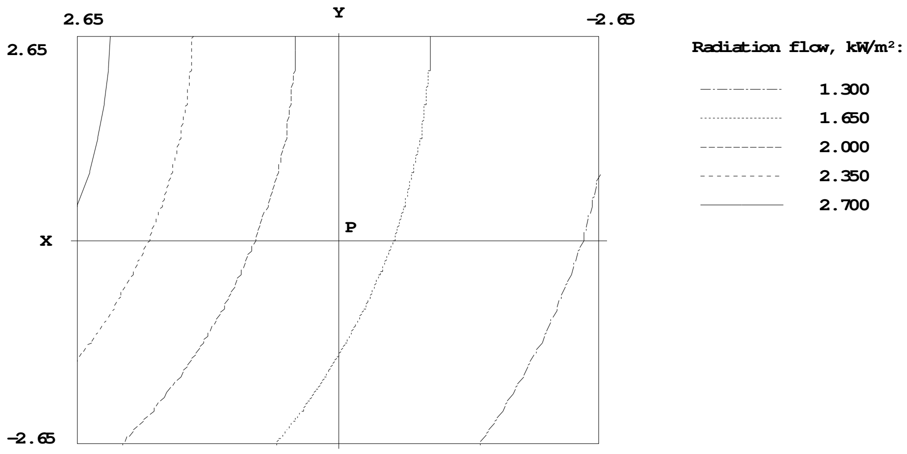
(All dimensions are in meters)

X-sources:

Radiation temperature 830°°

Distance	Offset		Size of source		Opening
X	Yx	Zx	Y	Z	%
13.36	2.67	-1.25	5.13	2.55	100

RADIATION MAP XY



Nodal radiation data, kW/m²:

Y \ X	2.65	1.32	0.00	-1.32	-2.65
2.65	2.854	2.291	1.877	1.565	1.324
1.32	2.797	2.253	1.851	1.546	1.311
0.00	2.637	2.147	1.778	1.495	1.273
-1.32	2.401	1.988	1.668	1.416	1.215
-2.65	2.123	1.795	1.530	1.316	1.141

Orientation of maximum radiation flow

at point P(0,0,0): $\theta = 95.2°,\ \varphi = 10.8°$

Figure 195: FS-01 – radiant heat flux from Source 2 (S2) to tenant storage

39.3 Motor Vehicle FS-02 to Tenant Storage

The input data for FS-02 assessment is provided in Table 56 and Table 57 in Section 29. The output data from radiant heat flux assessment at source S1 and S2 for FS-02 is provided in Figure 196 below.

A summary of the radiant heat fluxes from the radiant heat sources and the maximum combined radiant heat flux is summarised in Table 89 below. It is evident that the tenancy shopfront should not be exposed to a radiant heat flux that exceeds 14.64 kW/m².

Source	Total radiant heat flux at the target
Side – engine compartment (S1)	14.64
Side – truck compartment (S2)	

Table 89: Radiant heat flux at the tenant storage

Program Radiation

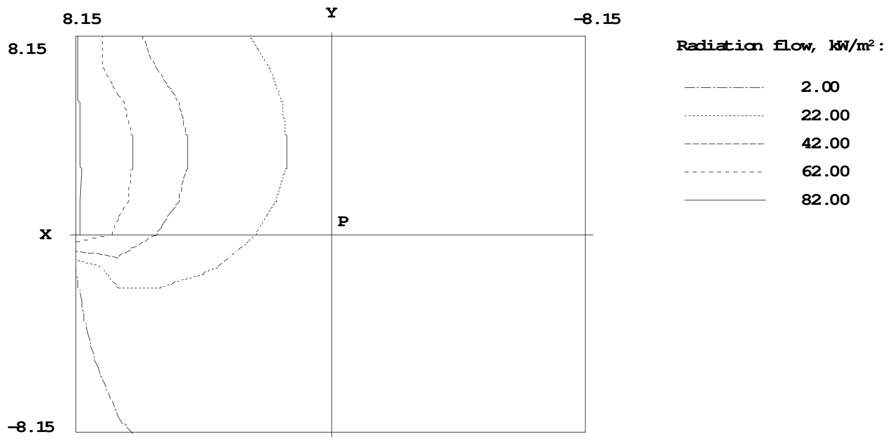
(All dimensions are in meters)

X-sources:

Radiation temperature 830°°

Distance	Offset		Size of source		Opening
X	Yx	Zx	Y	Z	%
8.17	9.23	0	2.5	4.3	100
8.17	3.03	-2.14	8	6.45	100

RADIATION MAP XY



Nodal radiation data, kW/m²:

Y \ X	8.15	4.08	0.00	-4.08	-8.15
8.15	83.78	28.68	14.39	8.234	5.200
4.08	83.95	37.27	17.12	9.188	5.589
0.00	83.94	30.17	14.64	8.280	5.210
-4.08	0.112	11.38	8.914	6.115	4.256
-8.15	0.024	3.833	4.607	3.980	3.161

Orientation of maximum radiation flow

at point P (0,0,0): $\theta = 101.2°$, $\varphi = 18.8°$

Figure 196: FS-02 – radiant heat flux from Soure S1 and S2 to tenant storage

39.4 Motor Vehicle FS-03 to North Entry

The input data for FS-03 assessment is provided in Table 60 and Table 61 in Section 22.9.4. The output data from radiant heat flux assessment at source S3 for FS-03 is provided in Figure 197 below.

A summary of the radiant heat fluxes from the radiant heat sources and the radiant heat flux is summarised in Table 90. It is evident that the North Entry should not be exposed to a radiant heat flux that exceeds 1.683 kW/m².

Source	Maximum radiant heat flux at the target
Rear (S3)	1.683 kW/m²

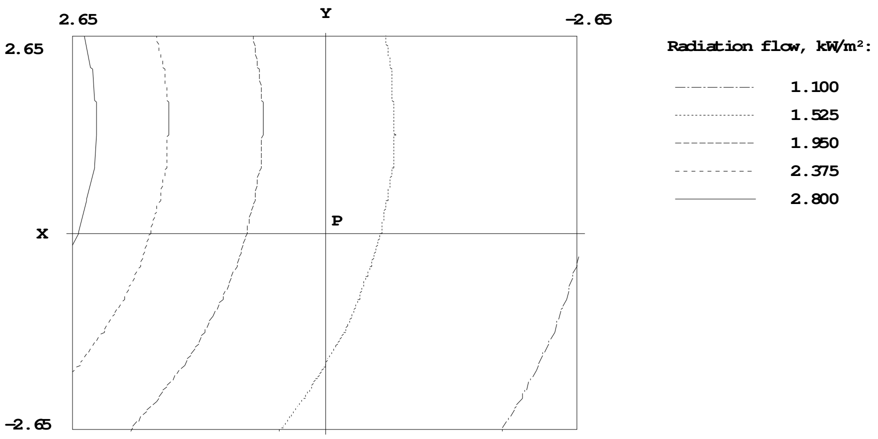
Table 90: Radiant heat flux at the North Entry

Program Radiation

(All dimensions are in meters)
X-sources:
Radiation temperature 830°°

Distance	Offset		Size of source		Opening
X	Yx	Zx	Y	Z	%
10.9	1.48	0	2.07	3.81	100

RADIATION MAP XY



Nodal radiation data, kW/m² :

Y \ X	2.65	1.32	0.00	-1.32	-2.65
2.65	2.879	2.176	1.700	1.363	1.116
1.32	2.960	2.222	1.728	1.381	1.128
0.00	2.831	2.149	1.683	1.352	1.109
-1.32	2.534	1.974	1.575	1.281	1.061
-2.65	2.150	1.737	1.422	1.179	0.990

Orientation of maximum radiation flow
at point P(0,0,0): $\theta = 90.0°$, $\varphi = 7.6°$

Figure 197: FS-03 – radiant heat flux from Source 3 (S3)

40. Appendix N – Peer Review Report for Revision C of FEB

The following is a copy of the peer review report prepared by Fire Engineering Professionals Pty Ltd (ref. no.: 2025 / 2019PBDB-R1.0, dated 2 July 2025) for Revision C of the FEB report that was issued to the design team on 27 May 2025.

The document is included in its entirety and the original page numbering is maintained.

PEER REVIEW REPORT

FOR

PERFORMANCE BASED DESIGN BRIEF (FEB)
GALLERIA SHOPPING CENTRE REDEVELOPMENT

Report 2025 / 2109PBDB – R1.0
02 July 2025

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Vicinity Centres – Building Owner and Client

BCA Consultants – Fire Engineers

REPORT HISTORY

Version	Status	Date	Purpose
Revision 0.0	Preliminary	02/07/2025	For internal review
Revision 1.0	Draft	02/07/2025	For stakeholder review

REPORT AUTHORISATION FOR CURRENT REVISION

Report by:	Reviewed by:	Authorised by:
Atul Bhargava Fire Safety Engineer	Daniel Burgess Director	Atul Bhargava Director
		
Date: 02/07/2025	Date: 02/07/2025	Date: 02/07/2025

1. SUMMARY OF FINDINGS

This report documents the findings of a third-party peer review undertaken of the Performance Based Design Brief (PBDB) prepared for the proposed redevelopment of Galleria Shopping Centre. Fire Engineering Professionals Pty Ltd (FEP) have undertaken this review at the request of Vicinity Centres.

The PBDB for the proposed works has been issued to FEP is identified below:

- Fire Engineering Brief – Galleria Shopping Centre Redevelopment – Document No. 240380_FEB, Revision C dated 28 May 2025.

The Galleria Shopping Centre is an existing two-level shopping centre located within the Morley suburb of Perth, Western Australia. The building has been the subject of a number of developments and refurbishments over the years. The proposed works, which form the subject of this peer review, incorporate central and northern parts of the building on Ground Floor and First Floor. This portion of the building is also called as Myer Mall.

The PBDB (FEB) document prepared by BCA Consultants (WA) Pty Ltd dated 28 May 2025 identifies design objectives, the building characteristics and a list of non-compliances, which have been identified by BCA Consultants (WA) Pty Ltd.

A peer review has been undertaken to comment on the adequacy of the trial concept design associated with the proposed performance solution; the method of analysis and the acceptance criteria documented in the aforementioned report and to identify any gaps or opportunities.

The outcome of the peer review conducted is presented in **Table 1-1** below.

Table 1-1: Peer Review Comments

Item No.	Report Reference	FEP Comments
1.	Page 14 – Table of building characteristics	The building has been identified to contain a rise in storey of 3. However, the building currently contains a Class 9b cinema tenancy and is proposed to contain additional entertainment (Class 9b) tenancies. Therefore, the building is considered to require Type A construction. This needs to be clarified by the Project Certifier and assessed accordingly. Where existing building areas do not comply with these requirements, an upgrade may be required unless addressed by way of a Performance Solution.
2.	Page 16 – Section 4.3	The report identifies that the existing Myer tenancy is fire separated from the main centre by way of fire walls and sliding fire doors. It is recommended that, where this fire separation is relied upon by the proposed works, the fire separation, including protection of all penetrations, be confirmed. It is also noted that Kmart, Coles, Woolworths, Target and the Cinemas are smoke separated from other building portions. It should be clarified whether these tenancies form a separate smoke compartment (by way of smoke proof walls; smoke separated at the shopfront and services protected with smoke dampers etc) or a separate smoke zone (high level smoke separation including a smoke baffle at the shopfront). If a smoke separation is required then special provisions for make-up air (for the operation of smoke control systems) will be required for these tenancies.
3.	*Page 18 – Section 4.4*	Make up air has been identified as being provided by way of the operation of mall AHUs. It is recommended that the AHUs serving the fire affected zones shall shut down upon smoke detector activation.
4.	*Page 21 – Sub-system D*	The proposed omission of fire hose reels is not considered to facilitate first attack on fire by building occupants which may include trained wardens and Security personnel. See Item 9 for further details.
5.	*Page 22 – Section 4.8*	The fuel sources identified in the PBDB only include retail goods for sale. No consideration has been given to brand spaces or EV/Santa displays in the malls. These fuel sources should be considered in the analysis.
6.	*Page 23 – Section 4.9.1 – Item 1 for population identification*	Project 6 populations have been nominated for the performance based assessment. The identified population density does not take into consideration any F&B or entertainment (Class 9b) tenancies where the population should be determined on the basis of Table D2D18. This should be the case for all existing areas which will form part of the emergency egress modelling. Vicinity Centres to identify all F&B and entertainment tenancies (existing and proposed) to the Fire Engineers.
7.	*Page 23 – Section 4.9.1 – Item 6 for population identification*	Research in occupant evacuation in shopping centre indicates that occupants normally evacuate the building (or part) the way they came. Therefore, a 70% occupant discharge into the mall is considered appropriate. Where a reduced discharge from tenancies into the malls is proposed, it should be supported by verified research.

Item No.	Report Reference	FEP Comments
8.	*Page 31 – Table 12 – Item 5 and 6*	Based on the non-compliance identified, it is expected that the travel distances (to an exit and between alternative exits) from all tenancies and BOH areas (including plant areas) via the BOH egress corridors (which are not smoke exhausted) shall comply with BCA DTS provisions. Consideration should also be given to the future tenant's fitout particularly with respect to travel distance to a POC or single exit in locations where a rear exit is not readily available as travel distance to a POC or single exit greater than 30m may not be able to be supported by fire engineers.
9.	*Page 33 – Table 12 – Item 9*	This non-compliance and associated performance solution should be re-considered. Fire hose reels provide an unlimited means of occupant first attack on fire where fire extinguishers provide a highly limited means of firefighting. Shopping centre occupants include centre management staff and security personnel who are likely to be some of the first responders to a fire initiation and are generally trained in the use of hose reels and will benefit from the use of hose reels (to attack a fire) than an extinguisher.
10.	*Page 34 – Item 7*	It is assumed that the existing structure in the areas not highlighted in Figure 10 will meet the FRL required for Type A construction (unless Type B requirement confirmed by the Certifier). It must be noted that all structural elements, where proposed with reduced FRL, must be independent of the existing structure as BCA does not permit a higher FRL structural element to rely on support from a lower FRL element e.g. a 3 hour floor slab must not rely on support from a 2 hour structural column. Vicinity Centres to note that the reduction in FRL for specific element will introduce an inconsistency between the structural elements located alongside each other.
11.	*Page 36 – Item 10*	A standard of performance should be specified for these walls such as Specification 11 of the BCA. It is difficult for the builder and the building manager to interpret what is the construction of a wall which prevents free passage of smoke i.e. is timber or glass (windows - openable or not) acceptable as construction of these walls?
12.	*Page 36 – Item 11*	Whilst the smoke proof bounding construction is shown in Figure 11, JB Hi Fi is missing from the text in Item 11.
13.	*Page 36 – Item 12*	A standard of performance should be specified for the corridor walls such as Specification 11 of the BCA. Notwithstanding, it is recommended that the construction of the corridor should be built to comply as a fire isolated exit. Any non-compliances with this fire isolated corridor should then be addressed as a performance solution.

Item No.	Report Reference	FEP Comments
14.	*Page 36 – Item 13*	A standard of performance should be specified for the corridor walls such as Specification 11 of the BCA. Notwithstanding, it is recommended that the construction of the corridor should be built to comply as a fire isolated exit. Any non-compliances with this fire isolated corridor should then be addressed as a performance solution.
15.	*Page 36 – Item 14*	Is there any internally lit signage proposed as part of the base building development works? These signs may contain combustible materials and may not comply with these requirements unless assessed as attachments under an additional performance solution.
16.	*Page 39 – Item 15*	We understand that there are no combustible roof elements on this project.
17.	*Page 39 – Item 19*	Owing to the unreliability of smoke detectors, it is recommended that a doorway which allows secure entry but with a compliant hardware (single level downward action) in the direction of exit should be provided to the doorway.
18.	*Page 40 – Item 25*	Suitable protected path with appropriate weather resistant line markings is recommended where the discharge of fire isolated exits leads occupants via a non-compliant covered area such as a loading dock or a carpark.
19.	*Page 41 – Item 27*	See comments in Item 9 above.
20.	*Page 42 – Item 28a*	Consideration should be given to sprinkler protection below the skylights if fire load (tenancies, kiosks or brand spaces/displays) are to be located below the skylights. An uncontrolled fire scenario is expected to threaten the non-fire rated columns supporting the roof as well as result in fire spread and untenable conditions. Sprinkler installation is recommended to permit flexibility in the use of floor space below the skylights.
21.	*Page 42 – Item 28b*	Confirmation is required whether the non-sprinkler protected undercroft area highlighted in Figure 19 is to be fire separated from the sprinkler protected carpark by a construction achieving an FRL of 120/120/120 required by BCA DTS provisions with the exception of glazed sections as identified.
22.	*Page 43 – Item 29*	It is assumed that the travel distances via the non-fire isolated stairway (Stair M6) are compliant with BCA DTS provisions i.e. do not exceed 80m.
23.	*Page 45 – Item 30*	Smoke modelling must incorporate sprinkler controlled fire scenarios which incorporate an activation temperature of 93°C. Additionally, the RTI to be utilised for the modelling must be commensurate with the RTI of 93°C sprinkler heads located below the roof.

Item No.	Report Reference	FEP Comments
24.	*Page 45 – Item 30*	Fire engineer to advise Vicinity Centres whether semi-recessed, fully recessed or flush mounted concealed sprinkler heads are permitted throughout the development areas. Consideration shall be given to Clause 10.4.1 of AS2118.1-2017 which does not permit the installation of sprinklers with different response characteristics (response type and RTI) within the same compartment.
25.	*Page 49 – Item 44*	This item appears to be a statement rather than a requirement. Where operation of multiple smoke zones is envisaged, the assessment will ensure adequate make-up air is available for the operation of multiple zones.
26.	*Page 50 – Item 48*	The smoke modelling is proposed to rely on the doorways automatically opening of the exit doors. Recent testing has shown that a number of doors within the building do not appear to have the ability to open automatically in a fire situation.
27.	*Page 50 – Item 49*	The operation of AHUs in the fire affected smoke zone is likely to have a significant adverse impact on the smoke layer and therefore the AHUs serving the fire affected zones must be programmed to shut down.
28.	*Page 59 – Smoke detector activation*	The increase in temperature of 13°C should be utilised for smoke detector activation for conservatism.
29.	*Page 76 – non rated plant rooms and cabling*	Consideration must be given to any plant rooms which house multiple AHUs and MSSBs which, in the event of a fire spread may render multiple AHUs inoperable as means of make up air supply.
30.	*Page 83 – Extended distance to POC*	The extended distance to a point of choice has been identified as relevant for some specialty shops in the development areas. Can these tenancies be identified in the PBDB and PSR?
31.	*Page 92 – Fire scenario selection*	The worst credible scenarios are considered to be those which result in largest plume entrainment. These are likely to be located in the specialty shops with the greatest depth. A minimum of two (2) fire scenarios, located within the specialty shops, are recommended to assess the robustness of the smoke management design. Uncontrolled fire scenarios must also be modelled in the malls (directly below the skylight and below the voids) for an assessment of tenability in the main egress paths along the malls unless kiosks are to be provided with sprinklered canopy or a restriction on the kiosk size is identified in the PBDB and PSR. Where a restriction on kiosk size is identified, an uncontrolled fire size (750kW/m^2 as identified in the PBDB) may be used to calculate the maximum fire size for modelling.

Item No.	Report Reference	FEP Comments
32.	*Page 98 – Discharge of fire isolated corridor on external balcony*	The PBDB notes that there will be a FUTURE non-fire isolated stairway to serve the balcony. The stairway needs to form part of the current development otherwise there appears to be no egress out of the balcony. The assessment should also assess the impact of any unprotected glazing which may be located within 6m of the discharge point of the fire isolated exit.
33.	*Page 106 – Omission of fire hose reels*	Refer to comments in Item 9 above. Consideration may be given to the use of 50m extended length hose reels to provide coverage and use of extinguishers for minor shortfalls.
34.	*Page 109 – Omission of sprinkler protection below skylights*	Refer to Item 31 of this Table. Since a fire separation cannot be provided between sprinkler protected mall and tenancy areas and non-sprinkler protected areas below the skylight, consideration should be given to the potential overwhelming of the sprinkler system once the uncontrolled large fire reaches and activates sprinklers in the areas which are provided with sprinkler protection. This could result in the failure of sprinkler system in controlling the fire which could then spread throughout the building.

2. CONCLUSION

FEP have conducted a review of the Performance Based Design Brief (PBDB) for the proposed Galleria Shopping Centre redevelopment as documented in the following report:

- Fire Engineering Brief – Galleria Shopping Centre Redevelopment – Document No. 240380_FEB, Revision C dated 28 May 2025.

The PBDB report documents a recommended strategy to address the identified non-compliance with the BCA DTS provisions throughout the development areas. The peer review showed that the proposed strategy is deemed acceptable subject to consideration and addressing of comments provided in **Table 1-1** above.

41. Appendix O – BCA Consultants Response to Peer Review Report

The following is a copy of the response to the peer review report prepared by Fire Engineering Professionals Pty Ltd (ref. no.: 2025 / 2019PBDB-R1.0, dated 2 July 2025) issued by BCA Consultants on 9 July 2025 (ref.: 20240380-E0201-L-0001).

The document is included in its entirety and the original page numbering is maintained.

Our Ref: 20240380-E0201-L-0001
Enquiries to: achao@bcagroup.com.au

9/07/2025

Vicinity Centres

Attention: Andre Jones

Dear Andre

**Re: Galleria – Myer Mall & ELP & Coles Expansion Projects
Response to "Peer Review Report for FEB – Galleria Shopping Centre Redevelopment"**

This letter is in response to the "Peer Review Report for Performance Based Design Brief (FEB) – Galleria Shopping Centre Redevelopment" by FEP (ref.: Report 2025 / 2109PBDB – R1.0, dated 02 July 2025) regarding Revision C of the Fire Engineering Brief (FEB) prepared by BCA Consultants (WA) Pty Ltd (ref.: 240380_FEB, Revision C, dated 28 May 2025).

Our response to FEP comments regarding the FEB Revision C is provided below.

No	BCA Report Reference	FEP Comments	BCA Consultant response
1	Page 14 – Table of building characteristics	The building has been identified to contain a rise in storey of 3. However, the building currently contains a Class 9b cinema tenancy and is proposed to contain additional entertainment (Class 9b) tenancies. Therefore, the building is considered to require Type A construction. This needs to be clarified by the Project Certifier and assessed accordingly. Where existing building areas do not comply with these requirements, an upgrade may be required unless addressed by way of a Performance Solution.	The FEB assessment is based on the NCC BCA Compliance Review Report prepared by the building surveyor from the BCA Consultant (Ref.: NCC BCA REVIEW_160015 Galleria Shopping Centre_DD review April 2025_v0), which identifies the building as Type B construction (existing condition). Prior to finalising the FEB, we discussed this classification with the building surveyor and received confirmation to proceed with the design on the basis of Type B construction. The building surveyor has confirmed that the rise in storeys of 3 only occurs within the footprint of the Class 6 shopping centre. Type B construction would apply.
2	Page 16 – Section 4.3	The report identifies that the existing Myer tenancy is fire separated from the main centre by way of fire walls and sliding fire doors. It is recommended that, where this fire separation is relied upon by the proposed works, the fire separation, including protection of all penetrations, be confirmed. It is also noted that Kmart, Coles, Woolworths, Target and the Cinemas are smoke separated from other building portions. It should be clarified whether these tenancies form a separate smoke compartment (by way of smoke proof walls; smoke separated at the shopfront and services protected with smoke dampers etc) or a separate smoke zone (high level smoke separation including a smoke baffle at the shopfront). If a smoke separation is required then special provisions for make-up air (for the operation of smoke control systems) will be required for these tenancies.	The existing fire walls and sliding fire doors separating the Myer tenancy from the main centre will remain unaltered and are not impacted by this development. We agree with the peer reviewer that the fire separation must be maintained, and if any unprotected penetrations are identified during the life of the building, they shall be fire-stopped accordingly. The smoke separation is an existing condition. Based on the existing fire engineering report prepared by ARUP (Ref.: GSC-ARP-FI-RPT-001, Rev. Issue 2, dated 26 July 2023), it is understood that the smoke separation is intended to define separate smoke zones (e.g. high-level smoke separation and smoke baffles at the shopfront), rather than separate smoke compartments. This assumption is supported by the smoke exhaust strategy, which relies on make-up air flow to and from major tenancies via the shopfront.

No	BCA Report Reference	FEP Comments	BCA Consultant response
			A clarification will be added to the FSER accordingly.
3	Page 18 – Section 4.4	Make up air has been identified as being provided by way of the operation of mall AHUs. It is recommended that the AHUs serving the fire affected zones shall shut down upon smoke detector activation.	It is expected that the make-up air entering from the ground floor (i.e. low level) will not adversely impact the operation of the smoke exhaust system in areas not in the fire affected zone. This will be assessed through FDS modelling, which will analyse smoke movement and the performance of the smoke exhaust system to confirm there is no negative impact. The results of the modelling will be presented in the FSER. If the modelling shows significant adverse impact on the smoke layer, then the AHUs serving the fire affected zones will be programmed to shut down.
4	Page 21 – Sub-system D	The proposed omission of fire hose reels is not considered to facilitate first attack on fire by building occupants which may include trained wardens and Security personnel. See Item 9 for further details.	Refer to Item 9 below.
5	Page 22 – Section 4.8	The fuel sources identified in the PBDB only include retail goods for sale. No consideration has been given to brand spaces or EV/Santa displays in the malls. These fuel sources should be considered in the analysis.	Peer reviewer comments are noted. A clarification note will be added to Section 4.8 of the FSER to specify that the potential fuel sources include brand activation spaces, EV displays, and Santa installations. It is worth noting that the fire growth rates proposed for the FDS modelling within the GSC range from medium t-squared to ultra-fast t-squared fires, which are intended to account for these potential fuel sources.
6	Page 23 – Section 4.9.1 – Item 1 for population identification	Project 6 populations have been nominated for the performance based assessment. The identified population density does not take into consideration any F&B or entertainment (Class 9b) tenancies where the population should be determined on the basis of Table D2D18. This should be the case for all existing areas which will form part of the emergency egress modelling.	For the Pathfinder modelling, a sensitivity egress scenario will be presented where occupant numbers in F&B or entertainment tenancy areas accessible to be based on the BCA DtS compliant occupant density of 1 m^2/person with other retail areas accessible to customers based on Project 6 occupant density of 6 m^2/person.

No	BCA Report Reference	FEP Comments	BCA Consultant response
		Vicinity Centres to identify all F&B and entertainment tenancies (existing and proposed) to the Fire Engineers.	
7	Page 23 – Section 4.9.1 – Item 6 for population identification	Research in occupant evacuation in shopping centre indicates that occupants normally evacuate the building (or part) the way they came. Therefore, a 70% occupant discharge into the mall is considered appropriate. Where a reduced discharge from tenancies into the malls is proposed, it should be supported by verified research.	Verified research and supporting documentation will be provided in the FSER to support the proposed distribution of 50% discharge into the mall.
8	Page 31 – Table 12 – Item 5 and 6	Based on the non-compliance identified, it is expected that the travel distances (to an exit and between alternative exits) from all tenancies and BOH areas (including plant areas) via the BOH egress corridors (which are not smoke exhausted) shall comply with BCA DTS provisions. Consideration should also be given to the future tenant's fitout particularly with respect to travel distance to a POC or single exit in locations where a rear exit is not readily available as travel distance to a POC or single exit greater than 30m may not be able to be supported by fire engineers.	The fire safety strategy allows for extended travel distances to a point of choice (POC) or single exit up to 30 metres. Where specialty tenancies have travel distances exceeding 30 metres to a POC or single exit, they must be provided with an alternative exit. Performance Solution 5 addresses extended travel distances in areas that are covered by the smoke exhaust system. For extended travel distances in areas not covered by smoke exhaust—such as all tenancies and back-of-house (BoH) areas—refer to Performance Solution 4 (Item 4 of Table 12).
9	Page 33 – Table 12 – Item 9	This non-compliance and associated performance solution should be re-considered. Fire hose reels provide an unlimited means of occupant first attack on fire where fire extinguishers provide a highly limited means of firefighting. Shopping centre occupants include centre management staff and security personnel who are likely to be some of the first responders to a fire initiation and are generally trained in the use of hose reels and will benefit from the use of hose reels (to attack a fire) than an extinguisher.	We acknowledge the peer review comments regarding the unlimited supply of suppressants offered by fire hose reels (FHRs). However, in the context of a shopping mall, several practical concerns must be considered. Shopping malls typically have a high number of power outlets, some of which may be recessed into the floor. Additionally, electrical forklifts and associated charging stations are often present. When an FHR is used, a large area may become wet,

No	BCA Report Reference	FEP Comments	BCA Consultant response
			and water can quickly pool on the floor. If this water comes into contact with live electrical equipment that is not adequately protected, it could pose a risk of electrocution to the operator or others nearby. Although power outlets are generally protected by Residual Current Devices (RCDs), failures in installation or malfunctioning RCDs could render the protection ineffective. In contrast, AB(E) type portable fire extinguishers do not pose a risk of electrocution and significantly reduce the extent of water discharge onto the floor. This also mitigates another concern: pooled water presenting a slipping hazard for patrons evacuating the centre. Furthermore, the deployment of FHRs can introduce trip hazards. Rubber hoses, particularly those that have been coiled on a reel for an extended period, often fail to lay flat when unwound. Instead, they tend to spiral or undulate, making them difficult for staff to manoeuvre and hazardous for patrons. Given that FHRs are typically located near exits or along egress paths, a hose stretched across the mall floor could impede occupants during evacuation. This hazard is further exacerbated by the possibility of patrons being distracted—such as by filming the incident with their phones—while moving toward the exits. The use of portable fire extinguishers eliminates the risk of hose-related trip hazards and the other issues associated with water-based suppression in retail environments. More qualitative deterministic analysis will be provided in the FSER.

No	BCA Report Reference	FEP Comments	BCA Consultant response
10	Page 34 – Item 7	It is assumed that the existing structure in the areas not highlighted in Figure 10 will meet the FRL required for Type A construction (unless Type B requirement confirmed by the Certifier). It must be noted that all structural elements, where proposed with reduced FRL, must be independent of the existing structure as BCA does not permit a higher FRL structural element to rely on support from a lower FRL element e.g. a 3 hour floor slab must not rely on support from a 2 hour structural column. Vicinity Centres to note that the reduction in FRL for specific element will introduce an inconsistency between the structural elements located alongside each other.	As per BCA Consultant's response to Item 1, the building surveyor has confirmed that the building is classified as Type B construction. Accordingly, it is assumed that the existing structure in the areas not highlighted in Figure 10 complies with the FRL requirements for Type B construction. New building construction will be in Type B construction (i.e. 2 storey) so new structure will be consistent with existing structure.
11	Page 36 – Item 10	A standard of performance should be specified for these walls such as Specification 11 of the BCA. It is difficult for the builder and the building manager to interpret what is the construction of a wall which prevents free passage of smoke i.e. is timber or glass (windows - openable or not) acceptable as construction of these walls?	Peer reviewer comments noted. Item 10 will be updated to clarify the performance requirements in the FSER.
12	Page 36 – Item 11	Whilst the smoke proof bounding construction is shown in Figure 11, JB Hi Fi is missing from the text in Item 11.	JB Hi-Fi tenancy is addressed in Item 10 not Item 11.
13	Page 36 – Item 12	A standard of performance should be specified for the corridor walls such as Specification 11 of the BCA. Notwithstanding, it is recommended that the construction of the corridor should be built to comply as a fire isolated exit. Any non-compliances with this fire isolated corridor should then be addressed as a performance solution.	This item relates to a non-fire isolated stair not a corridor. The non-fire-isolated stairwell is addressed in Performance Solution 7.
14	Page 36 – Item 13	A standard of performance should be specified for the corridor walls such as Specification 11 of the BCA.	Item 13 addresses the requirement to smoke-seal all service penetrations for all smoke separating separations and not related

No	BCA Report Reference	FEP Comments	BCA Consultant response
		Notwithstanding, it is recommended that the construction of the corridor should be built to comply as a fire isolated exit. Any non-compliances with this fire isolated corridor should then be addressed as a performance solution.	specifically to a corridor. The performance requirements for these smoke seals will be detailed in the FSER.
15	Page 36 – Item 14	Is there any internally lit signage proposed as part of the base building development works? These signs may contain combustible materials and may not comply with these requirements unless assessed as attachments under an additional performance solution.	Internally illuminated signage on the exterior of the building could not be identified during the FEB design phase. This will be reconfirmed with the design team during the FSER phase and incorporated into the assessment if confirmed.
16	Page 39 – Item 15	We understand that there are no combustible roof elements on this project.	Item 15 has been removed from the FEB, Rev. D. It is also our understanding that there are no combustible roof elements.
17	Page 39 – Item 19	Owing to the unreliability of smoke detectors, it is recommended that a doorway which allows secure entry but with a compliant hardware (single level downward action) in the direction of exit should be provided to the doorway.	Existing door hardware throughout the GSC has not been identified as non-compliant, and all new door hardware will comply with the BCA. The circumstances for this secure door may have changed during the design process and may not need inclusion in the performance solution. Notwithstanding the above, peer reviewer comments are noted, and a requirement will be included in the FSER stating that all door hardware shall comply with Clause D3D26 of the BCA, if required.
18	Page 40 – Item 25	Suitable protected path with appropriate weather resistant line markings is recommended where the discharge of fire isolated exits leads occupants via a non-compliant covered area such as a loading dock or a carpark.	Peer reviewer comments are noted. An additional requirement will be included in the FSER to provide appropriate weather-resistant line markings along occupant egress routes within the loading dock and carpark areas.
19	Page 41 – Item 27	See comments in Item 9 above.	See BCA Consultants response in Item 9 above.

No	BCA Report Reference	FEP Comments	BCA Consultant response
20	Page 42 – Item 28a	Consideration should be given to sprinkler protection below the skylights if fire load (tenancies, kiosks or brand spaces/displays) are to be located below the skylights. An uncontrolled fire scenario is expected to threaten the non-fire rated columns supporting the roof as well as result in fire spread and untenable conditions. Sprinkler installation is recommended to permit flexibility in the use of floor space below the skylights.	FDS modelling is proposed using an ultra-fast t-squared fire scenario located beneath the skylights, where sprinklers are omitted. The modelling will assess tenability conditions, including ambient temperatures in the vicinity of the fire. Temperature levels around structural columns will be monitored to evaluate the potential impact on non-loadbearing columns, if any. It is expected that both the loadbearing columns and the first floor slab will maintain structural stability for a sufficient duration to allow for fire brigade intervention.
21	Page 42 – Item 28b	Confirmation is required whether the non-sprinkler protected undercroft area highlighted in Figure 19 is to be fire separated from the sprinkler protected carpark by a construction achieving an FRL of 120/120/120 required by BCA DTS provisions with the exception of glazed sections as identified.	The undercroft which is proposed to omit fire sprinklers, which is below expanded first floor tenancies above, is open on three sides facing the open-air car park. The side facing the ground floor tenancies is enclosed with concrete walls achieving an FRL of 120/120/120, with no glazed sections provided.
22	Page 43 – Item 29	It is assumed that the travel distances via the non-fire isolated stairway (Stair M6) are compliant with BCA DTS provisions i.e. do not exceed 80m.	The extended travel distances from the first floor to Stair M6 have been addressed in the assessment under Performance Solution 5. Stair M6 is provided with sprinkler protection and constructed with walls that prevent the free passage of smoke. Occupants entering Stair M6 are therefore considered to have reached a place of intermediate safety, away from the effects of smoke. From this point, they can continue to egress from the building without further exposure.
23	Page 45 – Item 30	Smoke modelling must incorporate sprinkler controlled fire scenarios which incorporate an activation temperature of 93oC. Additionally, the RTI to be utilised for the modelling must be commensurate with the RTI of 93oC sprinkler heads located below the roof.	The use of sprinklers with an activation temperature of 93°C in areas that are not fully enclosed by external walls, and where ambient temperatures may exceed 40°C during summer, is consistent with the requirements of AS 2118.1-2017. This arrangement does not represent a deviation from the Building

No	BCA Report Reference	FEP Comments	BCA Consultant response
			Code, and therefore, additional smoke modelling is not considered necessary.
24	Page 45 – Item 30	Fire engineer to advise Vicinity Centres whether semi-recessed, fully recessed or flush mounted concealed sprinkler heads are permitted throughout the development areas. Consideration shall be given to Clause 10.4.1 of AS2118.1-2017 which does not permit the installation of sprinklers with different response characteristics (response type and RTI) within the same compartment.	Peer reviewer comments are noted. This requirement will be clarified in the fire safety strategy section of the FSER.
25	Page 49 – Item 44	This item appears to be a statement rather than a requirement. Where operation of multiple smoke zones is envisaged, the assessment will ensure adequate make-up air is available for the operation of multiple zones.	Item 44 provides a statement to explain why the report references smoke zones SZ-01 and SZ-04, despite them being outside the scope of this project. The intention is to verify that the building has adequate make-up air capacity to support the operation of multiple smoke exhaust zones.
26	Page 50 – Item 48	The smoke modelling is proposed to rely on the doorways automatically opening of the exit doors. Recent testing has shown that a number of doors within the building do not appear to have the ability to open automatically in a fire situation.	BCA Consultants has received confirmation from Vicinity Centres that the automatic sliding doors at the main entrance of the GSC retail malls will open upon fire alarm activation. Where doors do not currently open upon fire alarm activation, appropriate remedial actions shall be undertaken.
27	Page 50 – Item 49	The operation of AHUs in the fire affected smoke zone is likely to have a significant adverse impact on the smoke layer and therefore the AHUs serving the fire affected zones must be programmed to shut down.	Refer to BCA Consultants response to Item 3 above.
28	Page 59 – Smoke detector activation	The increase in temperature of 13^{o}C should be utilised for smoke detector activation for conservatism.	BCA Consultants are of the view that an increase of 13°C is overly conservative, and that the method developed by Heskestad over 40 years ago is outdated. Smoke detection technology has advanced significantly over the past four decades, with modern

No	BCA Report Reference	FEP Comments	BCA Consultant response
			detectors being far more reliable. In our opinion, the experimental data published by Bukowski 27 years ago is more recent and provides a more reliable basis for assessment.
29	Page 76 – non rated plant rooms and cabling	Consideration must be given to any plant rooms which house multiple AHUs and MSSBs which, in the event of a fire spread may render multiple AHUs inoperable as means of make up air supply.	We have identified all plant rooms and the number of AHUs housed within each. For the sensitivity fire scenario, it is proposed to simulate the failure of the plant room that contains multiple AHUs.
30	Page 83 – Extended distance to POC	The extended distance to a point of choice has been identified as relevant for some specialty shops in the development areas. Can these tenancies be identified in the PBDB and PSR?	Given that the fitout of each specialty shop is currently unknown, a conservative estimate of travel distance to a point of choice has been adopted. The design has allowed for travel distances of up to 30 metres from all specialty shops, acknowledging that not all tenancy fitouts will necessarily result in extended travel distances. In accordance with Section 9.3 of the FEB (Item 17), any tenancy within the scope of this project with travel distances exceeding 30 metres to a point of choice must be provided with an alternative exit. Fire engineers involved in the tenancy fitouts should be made aware of this requirement.
31	Page 92 – Fire scenario selection	The worst credible scenarios are considered to be those which result in largest plume entrainment. These are likely to be located in the specialty shops with the greatest depth. A minimum of two (2) fire scenarios, located within the specialty shops, are recommended to assess the robustness of the smoke management design. Uncontrolled fire scenarios must also be modelled in the malls (directly below the skylight and below the voids) for an assessment of tenability in the main egress paths along the malls unless kiosks are to be provided with sprinklered canopy or a restriction on the kiosk size is identified in the PBDB and PSR. Where a restriction on kiosk size is identified, an uncontrolled fire size	Page 94 of the FEB presents the proposed fire scenarios for the specialty shops. Four fire scenarios are outlined, each considering different floor-to-ceiling heights and varying fire growth rates. BCA Consultants consider the proposed assessment to be sufficiently robust. Performance Solution 5 describes three additional fire scenarios to be assessed using FDS modelling. Refer to Table 39 and Figure 62 of the FEB for the locations of these scenarios. All three fire scenarios are positioned directly beneath the skylights and voids to assess conditions during an uncontrolled fire. The smoke modelling will evaluate tenability conditions along the main egress paths within the mall.

No	BCA Report Reference	FEP Comments	BCA Consultant response
		(750kW/m2 as identified in the PBDB) may be used to calculate the maximum fire size for modelling.	
32	Page 98 – Discharge of fire isolated corridor on external balcony	The PBDB notes that there will be a FUTURE non-fire isolated stairway to serve the balcony. The stairway needs to form part of the current development otherwise there appears to be no egress out of the balcony. The assessment should also assess the impact of any unprotected glazing which may be located within 6m of the discharge point of the fire isolated exit.	The wording FUTURE will removed. The stair will be forming part of the current development.
33	Page 106 – Omission of fire hose reels	Refer to comments in Item 9 above. Consideration may be given to the use of 50m extended length hose reels to provide coverage and use of extinguishers for minor shortfalls.	Refer to BCA Consultants response in Item 9 above.
34	Page 109 – Omission of sprinkler protection below skylights	Refer to Item 31 of this Table. Since a fire separation cannot be provided between sprinkler protected mall and tenancy areas and non-sprinkler protected areas below the skylight, consideration should be given to the potential overwhelming of the sprinkler system once the uncontrolled large fire reaches and activates sprinklers in the areas which are provided with sprinkler protection. This could result in the failure of sprinkler system in controlling the fire which could then spread throughout the building.	The skylights are located approximately 17 to 20 metres above floor level. Due to their exposure to direct sunlight and proximity to the roof, higher temperature-rated sprinkler heads—such as 93°C heads—are typically required in these areas, as opposed to the standard 68°C heads commonly used in retail tenancies. This higher activation temperature, coupled with the significant installation height, will further delay sprinkler activation under the skylights. In practice, a fire would need to grow to a substantial size to activate a 93°C sprinkler head positioned 20 metres above the floor. By the time activation occurs, it is highly likely that the fire would have already spread horizontally into adjacent tenancies. It is, therefore, more likely that a fire originating in or near the skylight areas will first activate sprinklers in adjacent tenancies or the mall immediately outside tenancies that are fire sprinkler protected, where ceiling heights are generally between 3 to 4

No	BCA Report Reference	FEP Comments	BCA Consultant response
			metres and sprinkler heads are set to activate at 68°C. This suggests that the installation of sprinkler heads at 17 - 20 metres beneath skylights may offer limited benefit for effective fire control. It is worth noting that the skylights are located within the central circulation spaces of the mall, where the fuel load from kiosks or seasonal displays is inherently limited. These areas must remain clear for patron movement, which effectively confines combustible materials to specific zones. As a result, the risk of fire spread to adjacent tenancies during the early stages of a fire is considered low. In addition, security staff will be trained in the use of portable fire extinguishers and are expected to respond quickly to extinguish small fires before they escalate. Should a fire grow beyond initial containment, it is expected that the Department of Fire and Emergency Services (DFES) would already have been notified via the building's smoke detection system. The automatic fire sprinkler system and the fire detection and alarm system are both interfaced with the Fire Detection Control and Indicating Equipment (FDCIE) and are connected to DFES via the Direct Brigade Alarm (DBA). Smoke detection, which typically provides the earliest warning, will trigger an automatic call-out to DFES. Emergency response to the Galleria Shopping Centre is anticipated from Kiara Fire Station, approximately 5.0 km to the north-east, and Malaga Fire Station, approximately 5.9 km to the north. DFES is expected to arrive on-site within approximately 15 minutes.

Should you have any queries please do not hesitate to contact us

Yours faithfully,

AMY CHAO
Fire Safety Engineer
BCA Consultants (WA) Pty Ltd

42. Appendix P – "Performance-based Design Brief / Fire Engineering Brief FES Commissioner's Preliminary Advice" Letter

The following is a copy of the "Performance-based Design Brief / Fire Engineering Brief FES Commissioner's Preliminary Advice" letter (ref.: 72567\18\4, dated 23 October 2025) for Revision F of the Fire Engineering Brief report submitted by BCA Consultants to DFES on 22 August 2025.

The document is included in its entirety and the original page numbering is maintained.

Government of **Western Australia**
Department of **Fire & Emergency Services**

DFES
Department of Fire & Emergency Services

Our Ref 72567\18\4
Your Ref: 240380_FEB, Rev. F

Phone Enquiries: 9482 1771 Jia Khaw
Email: bebadmin@dfes.wa.gov.au

Attention: Alexander Alexandrovski

BCA Consultants
Suite 59, City West Centre 102 Railway Street
West Perth 6005
Sent via email: AAlexandrovski@bcagroup.com.au

Dear Sir,

PERFORMANCE-BASED DESIGN BRIEF / FIRE ENGINEERING BRIEF
FES COMMISSIONER'S PRELIMINARY ADVICE

Site Name:	GALLERIA SHOPPING CENTRE MORLEY
Project:	GALLERIA - MYER MALL ELP REDEVELOPEMENT
Address:	Lot 9000, 4 Collier Road, Morley
Documents Submitted:	Architectural, FEB (DFES Lodgement Ref: A1DAB6)

The Department of Fire and Emergency Services (DFES) and The Department of Mines, Industry Regulation and Safety - Building and Energy Division endorse the methodology of the Australian Fire Engineering Guidelines, including the production of a Performance-Based Design Brief (PBDB) or Fire Engineering Brief (FEB).

A PBDB/FEB for the above project has been submitted to the DFES Built Environment Branch, who has assessed it against the requirements of the National Construction Code Volume One (BCA 2022) insofar as they apply to the current FES Commissioner's Operational Requirements and provides the following preliminary advice.

PRELIMINARY ADVICE

Performance Solution 1 – Performance-based FRL of Loadbearing Structure
The following issues were identified in the assessment:

a) Full input parameters should be detailed in the FER, including the conversion factor (kb) and the dimensions used to calculate the ventilation factor (w_f).
b) Fire severity calculations intend to estimate the fire severity time for one specific fire compartment. It is unclear whether each assessed area corresponds to a separate fire compartment.
c) The FER should confirm the mathematical limits of the expression for αv have been satisfied (i.e. A_h/A_f is within 0.025 and 0.25).
d) It is also recommended to conduct a sensitivity assessment for 50% window breakage as part of the assessment to support the Performance Solution

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirement of the BCA (C1P1), and FES Commissioner's Operational Requirement (ORG 10).

Performance Solution 2 – Non-fire-rated Plant Rooms and Cabling to AHUs
The following issues were identified in the assessment:

a) Location of all non-compliant plant rooms, including the MSSBs and the relevant smoke zones they are located within should be clearly indicated on the plan in the FER.
b) Depending on the location of the MSSBs and the respective power sources for the smoke exhaust fans and AHUs, the modelling should assess fire scenarios where the smoke exhaust fans fail or operate at reduced capacity while the AHUs continue supplying make-up air, as well as scenarios where the AHUs fail or operate at reduced capacity while the smoke exhaust fans operate at either reduced or full capacity —whichever represents the worst case condition.
c) DFES recommend that all service penetrations through required fire rated walls be fire stopped accordingly.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (C1P2 and E2P2), and FES Commissioner's Operational Requirements (ORG 8 and 10).

Performance Solution 3 – Performance-based Non-fire-isolated Exits
The following issues were identified in the assessment:

a) The FER should provide further details on the provision of any additional measures (e.g. egress path floor markings at the car park, Management in Use plan to ensure no storage along egress path etc.) to support the Performance Solution.
b) Depending on the availability of alternate exits or egress paths, this Performance Solution may be required to be assessed in conjunction with Performance Solution 12 in a holistic manner to demonstrate that tenable conditions are available throughout the duration of the required occupant evacuation time.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P4 and E2P2), and FES Commissioner's Operational Requirement (ORG 10).

Performance Solution 5 – Performance-based Egress and Smoke Hazard Management
The following issues were identified in the assessment:

a) The assessment uses a soot yield value of 0.07 g/g. As per DFES GL-15, when an input for soot yields for fire modelling is required, it is considered that a minimum value of 0.1 g/g should be adopted.
b) Where fire locations fall within areas where sprinklers are omitted the design fire curve should reflect an unsprinklered growth rate.

c) To provide a robust assessment, the analysis should also consider a redundancy case where one or more (e.g. to support Performance Solution 2) of the smoke exhaust fans fail to function.
d) It is recommended to consider the activation time of second row sprinkler in the base case scenarios. This would provide a more robust value for the likely fire size(s) and capture any underestimation of additional fire growth.
e) To ensure the assessment remains robust, it is recommended that the fire growth rate remain consistent and not be reduced (e.g. fast to medium growth rate) throughout the assessment.
f) All input files used to run the fire/evacuation modelling and output files produced by the fire/evacuation modelling should be submitted in a usable format when the FER is submitted for review.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P4 and E2P2), and FES Commissioner's Operational Requirement (ORG 8).

Performance Solution 6 – Performance-based Access to Fire-Isolated Corridor 03

The following issue was identified in the assessment:

a) The assessment methodology lacks sufficient detail, and the strategy underpinning the Performance Solution is not clearly defined. Therefore, DFES is unable to provide further advice at this stage.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P5 and E2P2), and FES Commissioner's Operational Requirement (ORG 10).

Performance Solution 7 – Performance-based Discharge from Fire-Isolated Exits

The following issues were identified in the assessment:

a) It is unclear whether the dynamic signage to be provided to the access door into the First Floor fire-isolated Corridor 19 (1.BO.19) will be integrated with the Ground Level fire alarm zone, specifically, the zone covering tenancies near the proposed *'Future Non-fire-isolated Stair'* and its discharge point. This is to prevent First Floor occupants from using Corridor 19 and the non-fire-isolated stair to evacuate during a fire originating from nearby tenancies. This should be clarified in the FER.
b) The FER should clarify whether the covered loading dock will be provided with sprinkler coverage (if loading dock is a covered space).
c) The assessment methodology lacks sufficient detail, and the strategy underpinning the Performance Solution is not clearly defined. This limits DFES' ability to provide informed advice.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P5 and E2P2).

Performance Solution 8 – Performance-based Fire Hydrant System

The following issues were identified in the assessment:

a) Signage for 2 hose length requirements should be provided at the relevant internal hydrants.
b) Mud maps should also be provided within the fire-isolated stairwells and within internal hydrant cabinets/ enclosures.
c) Additional internal hydrant(s) should be provided in the north-east wing of the mall at Ground Level to improve hydrant coverage and support effective fire brigade operations.
d) It is recommended that the dual-head hydrants currently located within the stairwell, adjacent to the north-eastern undercover car park at Ground Level, be relocated outside the stairwell to enhance visibility and facilitate easier access for the attending fire brigade.
e) It should be confirmed in the FER that all external hydrants are dual-head units or will be upgraded to a dual-head configuration.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (E1P3), and FES Commissioner's Operational Requirements (ORG 4 and 5).

Performance Solution 9 – Performance-based Attack on Fire by Building Occupants

The following issue was identified in the assessment:

a) The position of the portable fire extinguishers should be in accordance with the requirements of AS 2444.

The FES Commissioner's advice above should be addressed by the relevant stakeholders

Performance Solution 10 – Omission of Sprinklers from Skylights and External Covered Area

The following issues were identified in the assessment:

a) Given the known benefits of a sprinkler system, it is DFES preference that sprinklers be retained within the mall.
b) To reduce the risk of an unsprinklered fire overwhelming the sprinkler system, it would be appropriate to introduce Management In Use measures to limit the placement of kiosks in mall areas where sprinklers are omitted. This should include quantification of permitted fuel loads to the mall.
c) Considering that the intent of the design is to omit sprinklers at the skylights, the ASET calculated for the base case scenario should be ASET≥1.5×RSET, in line with the acceptance criteria described in Section 15.7 of the PBDB.
d) The FER should clarify whether there will be any openings along the south-east façade below the First Floor tenancies expansion.
e) Signage should be provided at the area below the First Floor tenancies extension (where sprinklers are proposed to be omitted) indicating that the area should maintained as a sterile space, with no combustibles, no storage or the like.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the

Performance Requirements of the BCA (E1P4), and FES Commissioner's Operational Requirements (ORG 7).

Performance Solution 12 – Performance-based Separation between Sprinklered and Non-sprinklered Parts

The following issues were identified in the assessment:

a) The FER should clarify whether there is any compliant fire separation between the carpark and the area forming Loading Dock 05.
b) The assessment should also consider/ confirmed the following:
    i. The potential increase in the risk of smoke spreading via unprotected openings.
    ii. Tenable conditions remain throughout the required evacuation timing, (e.g. received radiation of <2.5kW/m^2), should the path adjacent to the unprotected openings forms part of the required egress path for occupants in the building. See advice provided for Performance Solution 3.
c) Notwithstanding the above, DFES recommend the sprinklers to be extended to the glazing, to provide some form of fire separation between the sprinklered and non-sprinklered parts of the building.

The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (E1P4 and C1P2), and FES Commissioner's Operational Requirements (ORG 7).

Performance Solution 13 – Performance-based Increased Air Velocity through Makeup Air Openings

The following issue was identified in the assessment:

a) The FER should also confirm whether the smoke exhaust fans in the subject tenancies will be capable of maintaining effective operation under actual conditions, considering the increased pressure loss caused by higher makeup air velocities.

The FES Commissioner's advice above should be addressed by the relevant stakeholders.

GENERAL ADVICE

Maintenance

Confirmation that all existing fire safety systems have been maintained and are fit for purpose should be appended to the Fire Engineering Report.

EWIS system

As discussed during the pre-PBDB stakeholder meeting with DFES, it was requested that the progress of upgrading the building's occupant warning system (EWIS) be clarified and communicated to DFES.

Electrical Vehicles (EVs)

Given the known concerns with controlling and extinguishing a battery fire, DFES request that where the building is proposed to contain Electric Vehicles (EV) and/or EV charging system/s in carparks the Building Surveyor considers the suitability of the minimum Deemed-to-Satisfy provisions and BCA Clauses E1D17 and E2D21 in providing adequate levels of protection for occupants and Fire Brigade intervention. For further guidance refer to BEB Info Note '*Electric Vehicles and charging facilities in and around Multi-storey Commercial and Residential Buildings*' and AFACs Guideline '*Electric Vehicles (EV) and EV charging equipment in the built environment*'.

DBA Notice
As the building is to be provided with a Direct Brigade Alarm (DBA), a Performance Solution notice is required at the Fire Detection Control and Indicating Equipment (FDCIE).
DFES considers the notice shall summarise all Performance Solutions and required fire safety measures for the building and shall be appended to the FER for future reference. Refer to the DFES DBA Connection Code for further information.

Inspection
It is considered appropriate that when the construction phase of the project has been completed, or at another suitable point, that the Building Surveyor's fire engineer inspects the building to verify that the fire safety measures, as specified in the Fire Engineering Report, have been installed, operate as intended and interact with other systems as required. This should ensure that the requirements of all assessments have been provided as proposed prior to the building being used for its intended purpose.

The following should be noted:

- The above advice is not final. Final advice will be provided at the Fire Engineering Report (FER) stage once the submission has been lodged to DFES in accordance with the Building Regulations 2012 (18B) and DFES Guideline GL-07.
- A response should be appended to a revised PBDB/FEB or form part of the FER submission.
- This advice letter is issued to the private/consultant fire engineer only and should be distributed to all stakeholders.

Should you require any further assistance with this project, please contact the undersigned to discuss.

Yours faithfully

Jia Khaw
Fire Engineering Technician
Built Environment Branch

23 October 2025

43. Appendix Q – BCA Consultants Response to DFES “Performance-based Design Brief / Fire Engineering Brief FES Commissioner’s Preliminary Advice” Letter

The following is a copy of the response to the “Performance-based Design Brief / Fire Engineering Brief FES Commissioner’s Preliminary Advice” letter (ref.: 72567\18\4, dated 23 October 2025) issued by BCA Consultants on 5 December 2025 (ref.: 20240380-E0203-OTH-0001).

The document is included in its entirety and the original page numbering is maintained.

CONSULTANTS

Our Ref: 20240380-E0203-OTH-0001
Enquiries to: aalexandrovski@bcagroup.com.au

2/12/2025

Department of Fire & Emergency Services
Emergency Services Complex
Built Environment Branch
20 Stockton Bend
COCKBURN CENTRAL WA 6164

Attention: FES Commissioner

Dear Sir

Re: Galleria – Myer Mall & ELP & Coles Expansion Projects
Response to "Performance-based Design Brief / Fire Engineering Brief – FES Commissioner's Preliminary Advice"

This letter is in response to the "Performance-based Design Brief / Fire Engineering Brief – FES Commissioner's Preliminary Advice" letter (DFES ref.: 72567\18\4, dated 23 October 2025) regarding Revision F of the Fire Engineering Brief (FEB) report prepared by BCA Consultants (WA) Pty Ltd (ref.: 250353_FEB, Rev. F, dated 22 August 2025).

Our response to DFES preliminary advice is provided below.

No	DFES advice	DFES advice incorporated	BCA Consultant response
PRELIMINARY ADVICE			
Performance Solution 1 – Performance-based FRL of Loadbearing Structure The following issues were identified in the assessment:			
a)	Full input parameters should be detailed in the FER, including the conversion factor (k_b) and the dimensions used to calculate the ventilation factor (w_f).	Yes	All input parameters are provided in the Assessment section of the FSER and the extracts from the spread sheet that calculates the equivalent fire severity are provided in the Appendix.
b)	Fire severity calculations intend to estimate the fire severity time for one specific fire compartment. It is unclear whether each assessed area corresponds to a separate fire compartment.	Noted	The assessed areas do not correspond to a separate fire compartment, but to a separate fire cell that is generally separated from other parts of the building with non-combustible walls that may or may not have unprotected openings. Unless the fire cell is lined with laminated timber, it is highly unlikely that once the fire load is consumed, the loadbearing structure will be exposed to critical temperatures for an extended period of time.

No	DFES advice	DFES advice incorporated	BCA Consultant response
c)	The FER should confirm the mathematical limits of the expression for αv have been satisfied (i.e. A_h/A_f is within 0.025 and 0.25).	Yes	All input parameters are provided in the Assessment section of the FSER and the extracts from the spread sheet that calculates the equivalent fire severity are provided in the Appendix.
d)	It is also recommended to conduct a sensitivity assessment for 50% window breakage as part of the assessment to support the Performance Solution	No	The assessment carried out in this Performance Solution is already a sensitivity assessment. The design fire scenario is a sprinkler controlled fire scenario during which temperatures at the exposed structure are not expected to exceed 100-200°C; hence there is no risk of structural failure.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirement of the BCA (C1P1), and FES Commissioner's Operational Requirement (ORG 10).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 2 – Non-fire-rated Plant Rooms and Cabling to AHUs The following issues were identified in the assessment:			
a)	Location of all non-compliant plant rooms, including the MSSBs and the relevant smoke zones they are located within should be clearly indicated on the plan in the FER.	Yes	A diagram will be provided in the FSER.
b)	Depending on the location of the MSSBs and the respective power sources for the smoke exhaust fans and AHUs, the modelling should assess fire scenarios where the smoke exhaust fans fail or operate at reduced capacity while the AHUs continue supplying make-up air, as well as scenarios where the AHUs fail or operate at reduced capacity while the smoke exhaust fans operate at either reduced or full capacity —whichever represents the worst case condition.	Yes	Redundancy fire scenarios are modelled where the largest fan in the fire-affected smoke zone fails to operate.
c)	DFES recommend that all service penetrations through required fire rated walls be fire stopped accordingly.	No	While minor penetrations in the fire-rated construction can be stopped; it is not practical to stop larger penetrations such as ducts.

No	DFES advice	DFES advice incorporated	BCA Consultant response
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (C1P2 and E2P2), and FES Commissioner's Operational Requirements (ORG 8 and 10).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 3 – Performance-based Non-fire-isolated Exits The following issues were identified in the assessment:			
a)	The FER should provide further details on the provision of any additional measures (e.g. egress path floor markings at the car park, Management in Use plan to ensure no storage along egress path etc.) to support the Performance Solution.	Yes	Floor markings and relevant Management in Use procedures have been included in the FSER.
b)	Depending on the availability of alternate exits or egress paths, this Performance Solution may be required to be assessed in conjunction with Performance Solution 12 in a holistic manner to demonstrate that tenable conditions are available throughout the duration of the required occupant evacuation time.	No	Performance Solution No. 12 deals with specific locations that may be affected by a fire. If a particular exit is not available due to a vehicle burning in front of it, multiple alternative exits are available that occupants can use to complete evacuation.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P4 and E2P2), and FES Commissioner's Operational Requirement (ORG 10).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 5 – Performance-based Egress and Smoke Hazard Management The following issues were identified in the assessment:			
a)	The assessment uses a soot yield value of 0.07 g/g. As per DFES GL-15, when an input for soot yields for fire modelling is required, it is considered that a minimum value of 0.1 g/g should be adopted.	No	Adequate justification for the use of a soot yield of 0.07 g/g is provided.
b)	Where fire locations fall within areas where sprinklers are omitted the design fire curve should reflect an unsprinklered growth rate.	Yes	Where fires are located under the roof that is not protected with sprinklers, the design fire curve reflects unsprinklered fire growth rate.

No	DFES advice	DFES advice incorporated	BCA Consultant response
c)	To provide a robust assessment, the analysis should also consider a redundancy case where one or more (e.g. to support Performance Solution 2) of the smoke exhaust fans fail to function.	Yes	Redundancy fire scenarios are modelled where the largest fan in the fire-affected smoke zone fails to operate.
d)	It is recommended to consider the activation time of second row sprinkler in the base case scenarios. This would provide a more robust value for the likely fire size(s) and capture any underestimation of additional fire growth.	No	Second row sprinkler activation is used to determine sprinkler activation time; however, activation of sprinklers on the first row will have an impact on the fire growth rate; therefore, the t-squared growth rate will not be continuous, i.e. it will change from fast to medium upon first sprinkler activation. Adequate justification for this approach is provided in the FSER.
e)	To ensure the assessment remains robust, it is recommended that the fire growth rate remain consistent and not be reduced (e.g. fast to medium growth rate) throughout the assessment.	No	
f)	All input files used to run the fire/evacuation modelling and output files produced by the fire/evacuation modelling should be submitted in a usable format when the FER is submitted for review.	Yes	Fire modelling input and output files will be provided with the FSER in electronic format for DFES review.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P4 and E2P2), and FES Commissioner's Operational Requirement (ORG 8).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 6 – Performance-based Access to Fire-Isolated Corridor 03 The following issue was identified in the assessment:			
a)	The assessment methodology lacks sufficient detail, and the strategy underpinning the Performance Solution is not clearly defined. Therefore, DFES is unable to provide further advice at this stage.	Noted	It is not clear why the assessment methodology lacks sufficient detail, as Section 16.6 (Assessment Methodology) in the FEB report clearly states that a fire safety strategy would be developed to ensure that occupants can evacuate via the fire-isolated corridor safely or avoid evacuating via the corridor altogether.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P5 and E2P2), and FES Commissioner's Operational Requirement (ORG 10).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	

No	DFES advice	DFES advice incorporated	BCA Consultant response
Performance Solution 7 – Performance-based Discharge from Fire-Isolated Exits The following issues were identified in the assessment:			
a)	It is unclear whether the dynamic signage to be provided to the access door into the First Floor fire-isolated Corridor 19 (1.BO.19) will be integrated with the Ground Level fire alarm zone, specifically, the zone covering tenancies near the proposed 'Future Non-fire-isolated Stair' and its discharge point. This is to prevent First Floor occupants from using Corridor 19 and the non-fire-isolated stair to evacuate during a fire originating from nearby tenancies. This should be clarified in the FER.	Yes	The dynamic exit sign above the door into First Floor fire-isolated corridor will be integrated with all relevant fire alarm zones both on Ground Level and First Floor.
b)	The FER should clarify whether the covered loading dock will be provided with sprinkler coverage (if loading dock is a covered space).	Yes	All covered loading docks are provided with sprinkler protection.
c)	The assessment methodology lacks sufficient detail, and the strategy underpinning the Performance Solution is not clearly defined. This limits DFES' ability to provide informed advice.	Noted	It is not clear why the assessment methodology lacks sufficient detail, as Section 17.6 (Assessment Methodology) in the FEB report clearly states that a fire safety strategy would be developed to ensure that occupants can evacuate via the fire-isolated corridor safely or avoid evacuating via the corridor altogether.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (D1P5 and E2P2).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 8 – Performance-based Fire Hydrant System The following issues were identified in the assessment:			
a)	Signage for 2 hose length requirements should be provided at the relevant internal hydrants.	Yes	Signage shall be provided at all relevant internal fire hydrants.
b)	Mud maps should also be provided within the fire-isolated stairwells and within internal hydrant cabinets/ enclosures.	Yes	Location plans as per Clause 11.6(e) of AS 2419.1 will be provided in fire-isolated stairwells and/or within internal fire hydrant cabinets.
c)	Additional internal hydrant(s) should be provided in the north-east wing of the mall at Ground Level to improve hydrant coverage and support effective fire brigade operations.	No	It is not clear why an additional internal hydrant is required on Ground Floor, as coverage to the north-east wing is provided from external hydrants location on either side of the building.

No	DFES advice	DFES advice incorporated	BCA Consultant response
d)	It is recommended that the dual-head hydrants currently located within the stairwell, adjacent to the north-eastern undercover car park at Ground Level, be relocated outside the stairwell to enhance visibility and facilitate easier access for the attending fire brigade.	Noted	The design team will be informed of this request.
e)	It should be confirmed in the FER that all external hydrants are dual-head units or will be upgraded to a dual-head configuration.	Yes	All external fire hydrants shall be upgraded to double-head configuration.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (E1P3), and FES Commissioner's Operational Requirements (ORG 4 and 5).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 9 – Performance-based Attack on Fire by Building Occupants The following issue was identified in the assessment:			
a)	The position of the portable fire extinguishers should be in accordance with the requirements of AS 2444.	Yes	Portable fire extinguishers will be located in accordance with the provisions of Clause 4.2.2 and Table 4.1 of AS 2444.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 10 – Omission of Sprinklers from Skylights and External Covered Area The following issues were identified in the assessment:			
a)	Given the known benefits of a sprinkler system, it is DFES preference that sprinklers be retained within the mall.	Noted	DFES preference is noted.
b)	To reduce the risk of an unsprinklered fire overwhelming the sprinkler system, it would be appropriate to introduce Management In Use measures to limit the placement of kiosks in mall areas where sprinklers are omitted. This should include quantification of permitted fuel loads to the mall.	Yes	The maximum size of kiosks that can be installed in the areas not protected with sprinklers will be limited.
c)	Considering that the intent of the design is to omit sprinklers at the skylights, the ASET calculated for the base case scenario should be $ASET \geq 1.5 \times RSET$, in line with the acceptance criteria described in Section 15.7 of the PBDB.	Yes	The assessment will demonstrate that the ASET is equal or greater that the RSET x 1.5 safety factor.

No	DFES advice	DFES advice incorporated	BCA Consultant response
d)	The FER should clarify whether there will be any openings along the south-east façade below the First Floor tenancies expansion.	Yes	The FSER will clarify that there will be no opening in the external walls in the south-east façade.
e)	Signage should be provided at the area below the First Floor tenancies extension (where sprinklers are proposed to be omitted) indicating that the area should maintained as a sterile space, with no combustibles, no storage or the like.	Yes	Management in Use procedures are developed for this area and incorporate appropriate signage.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (E1P4), and FES Commissioner's Operational Requirements (ORG 7).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
	Performance Solution 12 – Performance-based Separation between Sprinklered and Non-sprinklered Parts The following issues were identified in the assessment:		
a)	The FER should clarify whether there is any compliant fire separation between the carpark and the area forming Loading Dock 05.	No	Loading Dock 05 is open to sky, and it is bound by external walls only of the GSC on 3 sides and the open deck carpark on the 4^{th} side. There is no fire separation between the carpark and the loading dock.
b)	The assessment should also consider/ confirmed the following:	Noted	Please refer to responses provided below.
i.	The potential increase in the risk of smoke spreading via unprotected openings.	No	The glazed doors that are protected on a performance basis should remain closed. Also, the areas where the doors are located are either substantially open to the atmosphere or have slabs above that are located at least 1 m above the door heads. Significant smoke spread via this doors is therefore not expected to occur.
ii.	Tenable conditions remain throughout the required evacuation timing, (e.g. received radiation of $<2.5kW/m^2$), should the path adjacent to the unprotected openings forms part of the required egress path for occupants in the building. See advice provided for Performance Solution 3.	No	Occupants will be evacuating away from the doors if there is a vehicle fire on the other side of the doors. All other escape paths are located at least 10 m from the glazing and are considered not to be exposed.

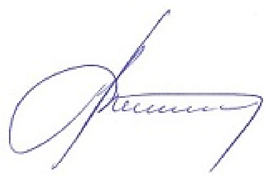
No	DFES advice	DFES advice incorporated	BCA Consultant response
c)	Notwithstanding the above, DFES recommend the sprinklers to be extended to the glazing, to provide some form of fire separation between the sprinklered and non-sprinklered parts of the building.	Yes	A row of sprinklers is provided under the bulkhead external to the glazed doors.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders; otherwise, the proposed Performance Solution does not meet the Performance Requirements of the BCA (E1P4 and C1P2), and FES Commissioner's Operational Requirements (ORG 7).	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
Performance Solution 13 – Performance-based Increased Air Velocity through Makeup Air Openings The following issue was identified in the assessment:			
a)	The FER should also confirm whether the smoke exhaust fans in the subject tenancies will be capable of maintaining effective operation under actual conditions, considering the increased pressure loss caused by higher makeup air velocities.	Yes	The mechanical consultant has confirmed that the selected fans should be able to maintain effective operation even if air velocity through the roller-shutter grilles is increased up to 3.5 m/s.
	The FES Commissioner's advice above should be addressed by the relevant stakeholders.	If you have any comments or require further clarifications, please do not hesitate to contact the undersigned.	
GENERAL ADVICE			
	Maintenance Confirmation that all existing fire safety systems have been maintained and are fit for purpose should be appended to the Fire Engineering Report.	Noted	The client will be informed of this request.
	EWIS system As discussed during the pre-PBDB stakeholder meeting with DFES, it was requested that the progress of upgrading the building's occupant warning system (EWIS) be clarified and communicated to DFES.	Yes	We have requested this information from Vicinity and awaiting their response. Confirmation of the progress of upgrading the EWIS will be communicated to DFES in due course.

No	DFES advice	DFES advice incorporated	BCA Consultant response
	Electrical Vehicles (EVs) Given the known concerns with controlling and extinguishing a battery fire, DFES request that where the building is proposed to contain Electric Vehicles (EV) and/or EV charging system/s in carparks the Building Surveyor considers the suitability of the minimum Deemed-to-Satisfy provisions and BCA Clauses E1D17 and E2D21 in providing adequate levels of protection for occupants and Fire Brigade intervention. For further guidance refer to BEB Info Note 'Electric Vehicles and charging facilities in and around Multi-storey Commercial and Residential Buildings' and AFACs Guideline 'Electric Vehicles (EV) and EV charging equipment in the built environment'.	Noted	This advice has been forwarded on to the building surveyor.
	DBA Notice As the building is to be provided with a Direct Brigade Alarm (DBA), a Performance Solution notice is required at the Fire Detection Control and Indicating Equipment (FDCIE). DFES considers the notice shall summarise all Performance Solutions and required fire safety measures for the building and shall be appended to the FER for future reference. Refer to the DFES DBA Connection Code for further information.	Yes	A copy of the FDCIE Notice (Building Subject to FSER Notice) is provided in the FSER.
	Inspection It is considered appropriate that when the construction phase of the project has been completed, or at another suitable point, that the Building Surveyor's fire engineer inspects the building to verify that the fire safety measures, as specified in the Fire Engineering Report, have been installed, operate as intended and interact with other systems as required. This should ensure that the requirements of all assessments have been provided as proposed prior to the building being used for its intended purpose.	Yes	BCA Consultants confirm that we have been engaged to inspect the completed works for compliance with the provisions of the approved Fire Safety Strategy and to provide Fire Safety Engineering – Project Completion Report (PCR) to the building surveyor before the building is handed over to the tenant.
The following should be noted:			

No	DFES advice	DFES advice incorporated	BCA Consultant response
	The above advice is not final. Final advice will be provided at the Fire Engineering Report (FER) stage once the submission has been lodged to DFES in accordance with the Building Regulations 2012 (18B) and DFES Guideline GL-07.	Noted	
	A response should be appended to a revised PBDB/FEB or form part of the FER submission.	Noted	The FSER was issued to the building surveyor on 19 August 2025, and it is understood that it has been lodged with DFES. If the FSER is revised in the future, the response to “Performance-based Design Brief / Fire Engineering Brief – FES Commissioner’s Preliminary Advice” will be appended to the FSER.
	This advice letter is issued to the private/consultant fire engineer only and should be distributed to all stakeholders.	Yes	“Performance-based Design Brief / Fire Engineering Brief – FES Commissioner’s Preliminary Advice” will be distributed to the relevant stakeholders.

Should you have any queries please do not hesitate to contact us.

Yours faithfully,



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Cc: Vicinity (Clare Gee, James Fudge, Les Gebauer, Ben Mah-Chut); Multiplex (Derek Chia, Kylie Judd, Liam Gayner, Josh Mack); Buchan Group (Vincent Chi; Alessandro Paladin); Link Engineering (Chris Bright); Firesafe (Rebecca Boston); BCA Consultants (Mark Viska, Chris Meisinger)