



**Project: MOE – FLS Reference
Designs for Standard Classroom
Upgrade – Formula Block**
Fire Engineering Report

Project No. 246313
Prepared for: Ministry of
Education
Report ref: Rev A
29 October 2015

Document Control Record

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Report Title		Fire Engineering Report					
Document ID		Rev A	Project Number		246313		
File Path		P:\246313\03 Project Delivery\Reports\Fire\Formula					
Client		Ministry of Education	Client Contact				
Rev	Date	Revision Details/Status	Prepared by	Author	Verifier	Approver	
A	29 October 2015	For information	F Wee	F Wee	T Gazley	J Martins	
Current Revision		A					

Approval			
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MOE – FLS Reference Designs for Standard Classroom Upgrade – Formula Block

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1 Executive Summary

The standard single-storey, four-classroom Formula Block of Ministry of Education (MOE) is a standard classroom block constructed at various schools throughout New Zealand between 1962 and 1970. Construction consists of a light-weight timber frame with weatherboard or brick façade and corrugated iron roofing. Typically, existing Formula Blocks consisted of four classrooms with shared cloakroom and toilets.

The proposed work is to upgrade the existing standard four-classroom Formula Block to become a “Flexible Learning Space (FLS)” upgrade of MOE, previously referred to as “Modern Learning Environment (MLE)”. Three options of a similar layout have been considered for the Formula Block FLS upgrade - Options 1, 2 and 3.

Option 1 consists of four interconnected classrooms equivalent in size with three breakout rooms, two existing toilets remaining as is, a shared wet area and two small group areas.

Option 2 is similar to Option 1, also consisting of four interconnected classrooms equivalent in size with three breakout rooms, two existing toilets remaining as is, a shared wet area and two small group areas, but with less partitions.

Option 3 consists of four interconnected classrooms equivalent in size with three breakout rooms, one of which is being converted from one of the two existing toilets; two small group areas and a new toilet.

This fire engineering report has assessed compliance of Options 1 to 3 in respect to the fire safety clauses C1 to C6 ‘Protection from Fire’ of the New Zealand Building Code (NZBC). Acceptable Solutions C/AS4 amendment 3 has been used as the design basis for this report.

Ministry of Education Requirements

Within this report comments have been included in shaded boxes similar to this that review the building against the Ministry of Education (MOE) Fire and Safety Design Requirements for Schools 2008. The MOE Fire and Safety Design Requirements for Schools 2008 generally require fire safety provisions and features that are more onerous than those of NZBC C/AS1 and specifically relate to property protection. The M.O.E Designing Schools in New Zealand- Requirements and Guidelines (v. 1.0) October 2015 has also been referenced wherever applicable.

Where applicable the Fire Safety Precautions as governed by the MOE Fire and Safety Design Requirements for Schools 2008 and/or M.O.E Designing Schools in New Zealand- Requirements and Guidelines (v. 1.0) October 2015 are noted throughout this report for the Schools information are noted throughout this report for the Schools information.

It is to be noted that the MOE requirements are not required for New Zealand Building Code compliance.

The design is considered to comply with the Building Code fire safety clauses, and the MOE requirements, subject to the following requirements which are detailed in section 2 Scope of Works.

2 Scope of Works

The following scope of works is a general description of the active, passive and egress systems. It is not a specification of works.

2.1 Active Fire Safety Systems and Fire Fighting

2.1.1 Type 2 Manual Fire Alarm System

Install a Type 2 manual fire alarm system consisting of manual call points and sounders throughout the Formula Block. The system shall be designed, installed and comply with the Standard NZS 4512:2010 "Fire detection and alarm systems in buildings".

Where there is an existing fire alarm system installed it shall be inspected for compliance with NZS 4512 and be upgraded if required.

The fire alarm should be interfaced with the school alarm system and on activation of any detector or call point shall sound a school-wide evacuation. The alarm system need not be connected to the Fire Service.

The fire alarm system shall be subject to FPIS (or equivalent) inspection and certification.

2.2 Passive Fire Safety Systems

2.2.1 Internal Surface Finishes

New surface finish requirements for walls, ceilings, ducts and insulation are as specified in Table 1, tested to ISO 9705:1993 "Fire tests: Full-scale room test for surface products".

Table 1: Internal surface finishes

Area of building	Maximum permitted group number
Internal surfaces of duct for HVAC systems	1S
New wall and ceiling linings in crowd spaces 1.2 m or more above floor level (classrooms and breakout rooms)	2S
External surfaces of duct for HVAC systems	3
New wall in crowd spaces less than 1.2 m above floor level (classrooms and breakout rooms)	
Walls and ceilings in all other occupied spaces	

If foamed plastics building materials or exposed combustible insulating materials form part of a wall, ceiling or roof system, the completed system shall achieve requirements as specified in Table 1 and the foamed plastics shall comply with the flame propagation criteria as specified in AS 1366 for the material being used.

Surface finish requirements do not apply to:

- Small areas of non-conforming product within a firecell with a total aggregate surface area of not more than 5.0 m²;
- Electrical switches, outlets, cover plates and similar small discontinuous areas;
- Pipes and cables used to distribute power or services;

- Handrails and general decorative trim such as architraves, skirtings and window components including reveals, provided these do not exceed 5 % of the surface area of the wall or ceiling they are part from;
- Damp-proof courses, seals, caulking, flashings, thermal breaks and ground moisture barriers;
- Timber joinery and structural timber building elements constructed from solid wood, glulam or laminated veneer lumber. This includes heavy timber columns, beams, portals and shear walls not more than 3.0 m wide, but does not include exposed timber panels or permanent formwork on the underside of floor/ceiling systems;
- Individual doorsets; and
- Continuous areas of permanently installed openable wall partitions having a surface area of not more than 25% of the divided room floor area or 5.0 m², whichever is less;
- Uniformly distributed roof lights where
 - The total area does not exceed 15 % of the ceiling area (in plan), and
 - The minimum floor to ceiling height is not less than 6 m, and
 - The roof lights achieve a Group Number not greater than 3.

2.2.2 Flooring

Floor surfaces throughout the building are required to either be non-combustible or have a critical radiant flux of no less than 1.2 kW/m², tested to ISO 9239 Part 1:2010 “Determination of the burning behaviour using a radiant heat source”. This applies to flexible finishes such as carpets, vinyl sheet or tiles, and to finished or unfinished floor surfaces.

2.2.3 Suspended Flexible Fabrics

Suspended flexible fabrics shall have a flammability index of no less than 12, tested to AS 1530 Part 2.

2.3 Egress Systems

2.3.1 Egress Routes

Escape routes are to be kept clear at all times and not obstructed by goods or building contents.

2.3.2 Egress Door

An external egress door is required for egress from the possible presentation / breakout room. Door shown on fire drawings is indicative only. The additional door may be on other location on external wall of this classroom but NOT from the small breakout area.

2.3.3 Egress Height Requirements

Minimum height requirements are as follows:

- Clear height of escape route = 2100 mm;
- Clear height of door within escape route = 1955 mm.
-

2.3.4 Egress Width Requirements

The following escape route widths are required for the building:

Table 2: Egress width requirements

Escape route	Minimum width required (mm)
Open path	850 (1200 for accessible route)
Open path doors	600 (760 for accessible route)



2.3.5 Locking Devices

Locking devices (when the building is legally occupied) shall:

- Be clearly visible, located where such a device would be normally expected, designed to easily operate without a key and allow the door to open in the normal manner. If the operation of a locking device is unusual, such as the pressing of a button close to the door, it shall have signage that complies with NZBC F8.3.1, and
- If of an electromagnetic type, in the event of a power failure or door malfunction or fire alarm activation, either:
 - Automatically switch to the unlocked (failsafe) condition, or
 - Be readily opened by an alternative method satisfying the requirements of the above.

2.3.6 Simple Fastenings

Doors on escape routes (whether or not the doors are fire doors) shall be fitted with simple fastenings that can be easily operated from the direction from which people approach when making their escape.

2.3.7 Signs

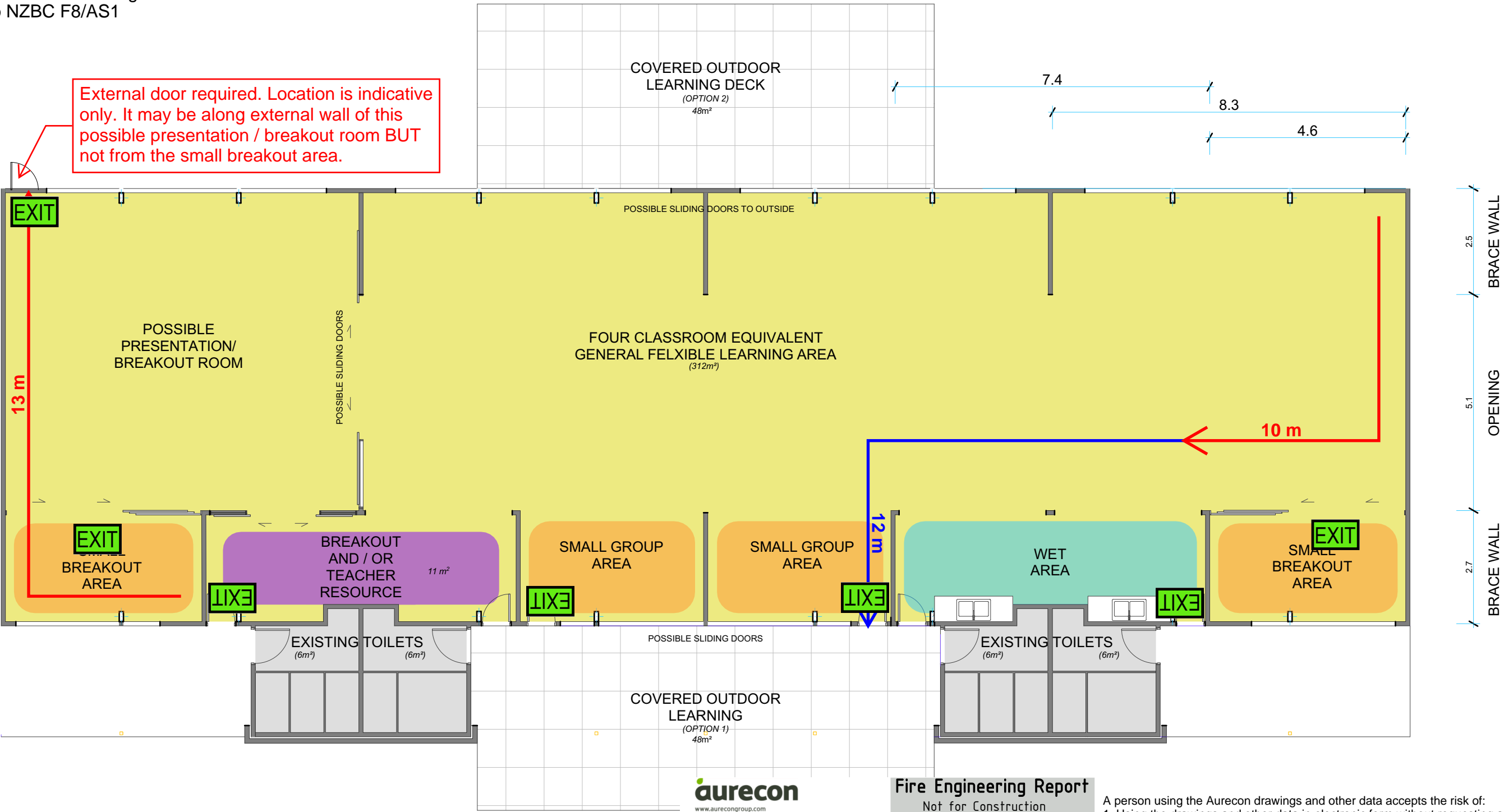
Install illuminated EXIT signs (where not already existing) in accordance with F8/AS1 and AS/NZS 2293-3:1995. Indicative exit sign locations are provided in fire drawings in section 3.



3 Fire Drawings

- Dead end open path
- Total open path
- EXIT

Indicative illuminated exit signs
locations to NZBC F8/AS1



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PROJECT

MOE Nationwide ILS Upgrades

TITLE

Formula Block Proposed Floor Plan
Option 1

DESIGNED

F WEE

DRAWN

F WEE

PROJECT No.

246313

SIZE

A3

SCALE

AS SHOWN

DATE

22.10.15

SKETCH No.

FSD-001

REV

B

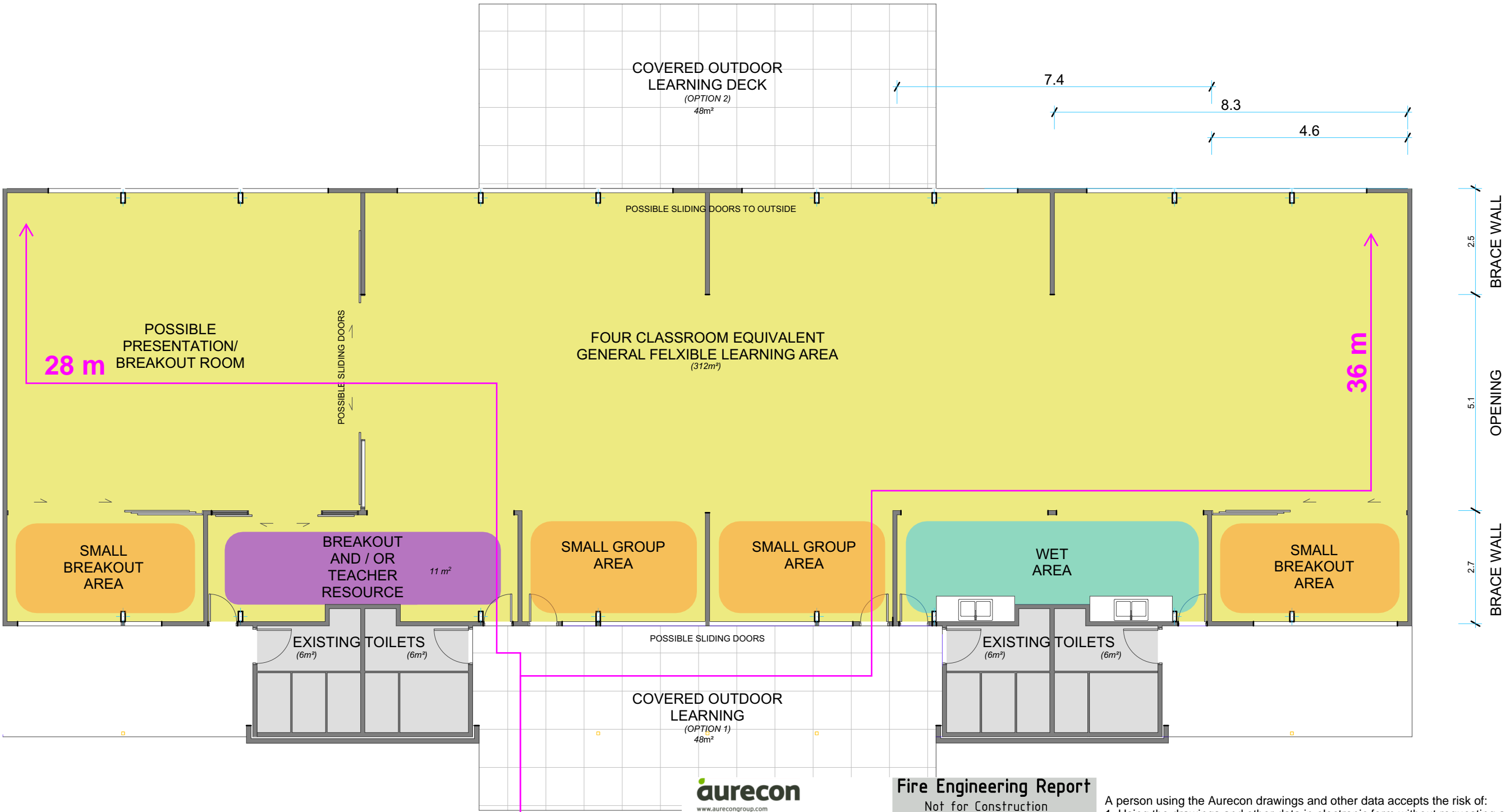
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3. The drawings should not be relied upon for detailed construction of the fire safety features. These will be covered in other trades. i.e. Passive fire ratings covered in architectural documentation, emergency lighting and signage covered in electrical engineers documentation.
4. Drawing backgrounds are taken from architectural documentation. No information from these backgrounds should be relied upon for construction - refer to original architectural drawings.

ARCHITECT	CLIENT	PROJECT	DRAWING TITLE	DRAWING INFO	JOB No.	DRAWING No.	REV.
Ph +64 9 303 1821 512 Canterbury Arcade 47 High Street AUCKLAND 1010 NEW ZEALAND BREWER DAVIDSON architecture & urban design BrewerDavidson Architects Ltd	Ministry of Education	FORMULA BLOCK	MLE UPGRADE: OPTION 1	Drawn 1:100 Date 8/06/2015 Original Scale (A3) 0 10 20 30 40	1501	F003	B

NZFS hose run

NZFS access point



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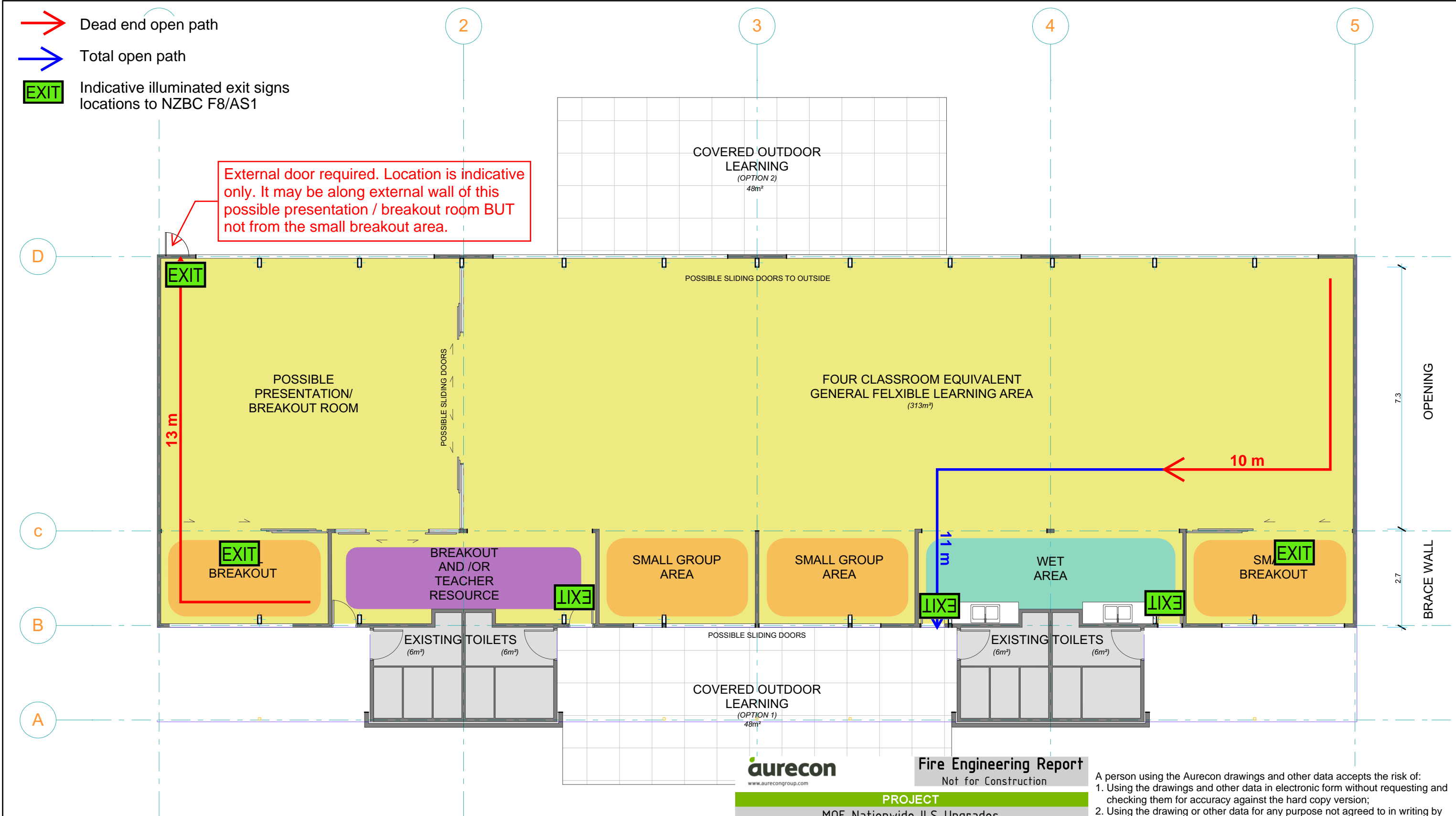
Fire Engineering Report
Not for Construction

PROJECT			
MOE Nationwide ILS Upgrades			
TITLE			
Formula Block Option 1 NZFS Access			
DESIGNED	DRAWN	PROJECT No.	SIZE
F WEE	F WEE	246313	A3
SCALE	DATE	SKETCH No.	REV
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4. Drawing backgrounds are taken from architectural documentation. No information from these backgrounds should be relied upon for construction - refer to original architectural drawings.

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NETT:

- Teaching and learning: 312m² (78m² per classroom equivalent including)
- Teacher resource: 18m²
- Toilets and cloakroom: 24m²




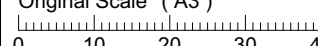
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PROJECT			
MOE Nationwide ILS Upgrades			
TITLE			
Formula Block Proposed Floor Plan Option 2			
DESIGNED	DRAWN	PROJECT No.	SIZE
F WEE	F WEE	246313	A3
SCALE	DATE	SKETCH No.	REV
AS SHOWN	22.10.15	FSD-003	B

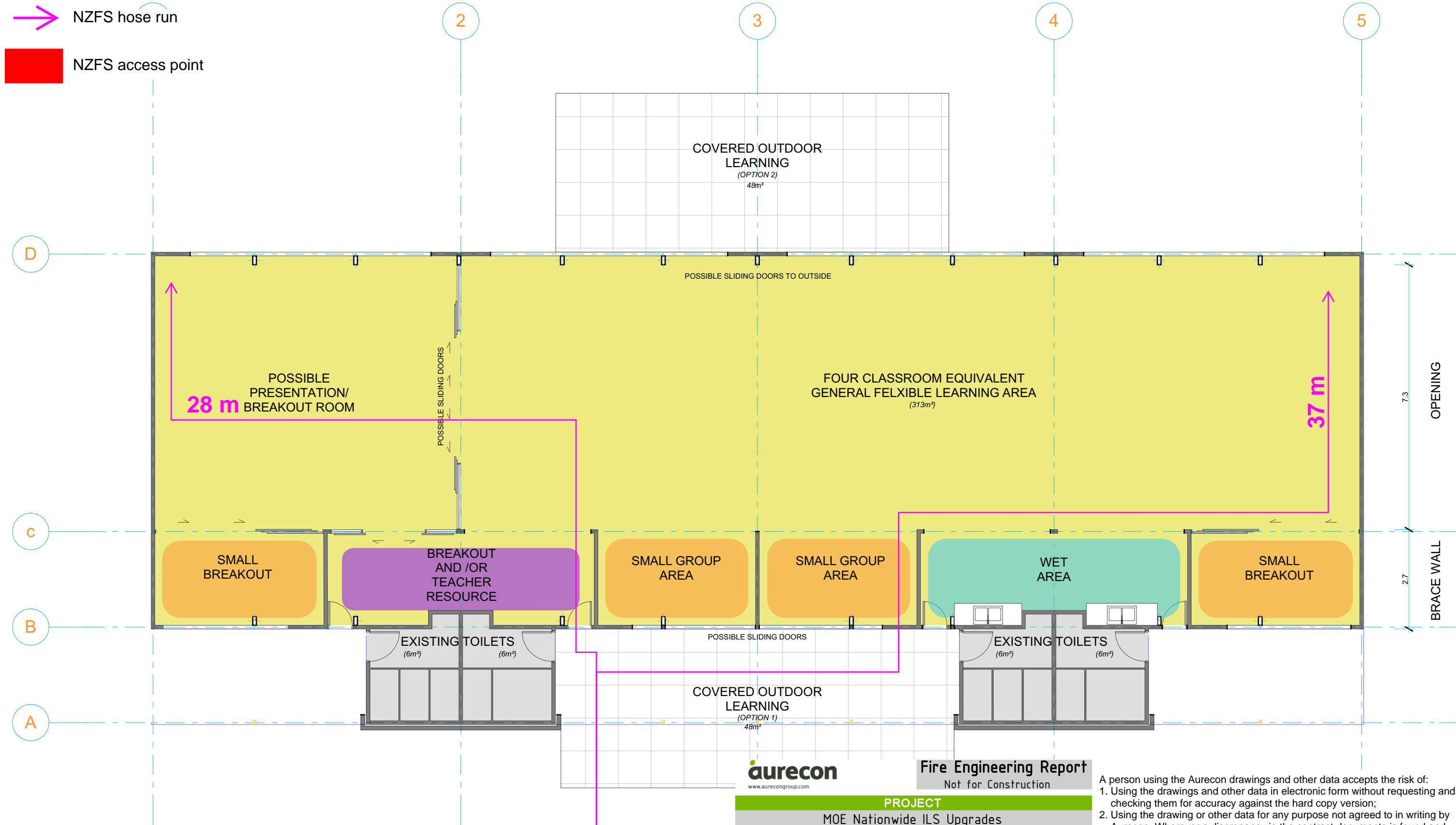
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→ NZFS hose run

NZFS access point



NETT:

- Teaching and learning: 312m² (78m² per classroom equivalent including)
- Teacher resource: 18m²
- Toilets and cloakroom: 24m²




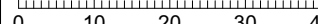
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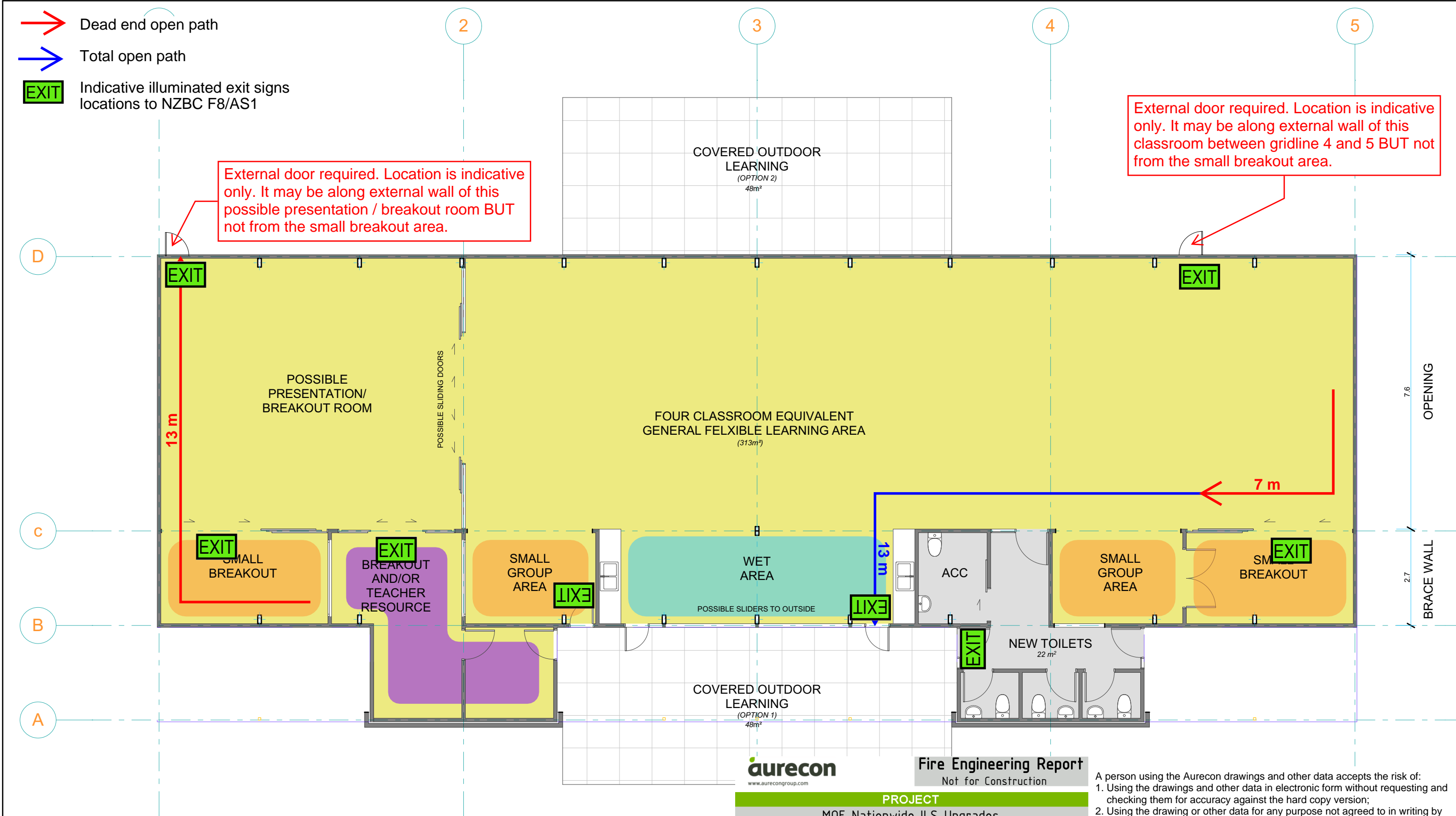
Fire Engineering Report
Not for Construction

PROJECT			
MOE Nationwide ILS Upgrades			
TITLE			
Formula Block Option 2 NZFS Access			
DESIGNED	DRAWN	PROJECT No.	SIZE
F WEE	F WEE	246313	A3
SCALE	DATE	SKETCH No.	REV
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NETT:

- Teaching and learning: 313m² (78m² per classroom equivalent including)
- Teacher resource: 22m²
- Toilets and cloakroom: 22m²




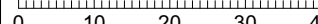
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PROJECT			
MOE Nationwide ILS Upgrades			
TITLE			
Formula Block Proposed Floor Plan Option 3			
DESIGNED	DRAWN	PROJECT No.	SIZE
F WEE	F WEE	232603	A3
SCALE	DATE	SKETCH No.	REV
AS SHOWN	22.10.15	FSD-003	B

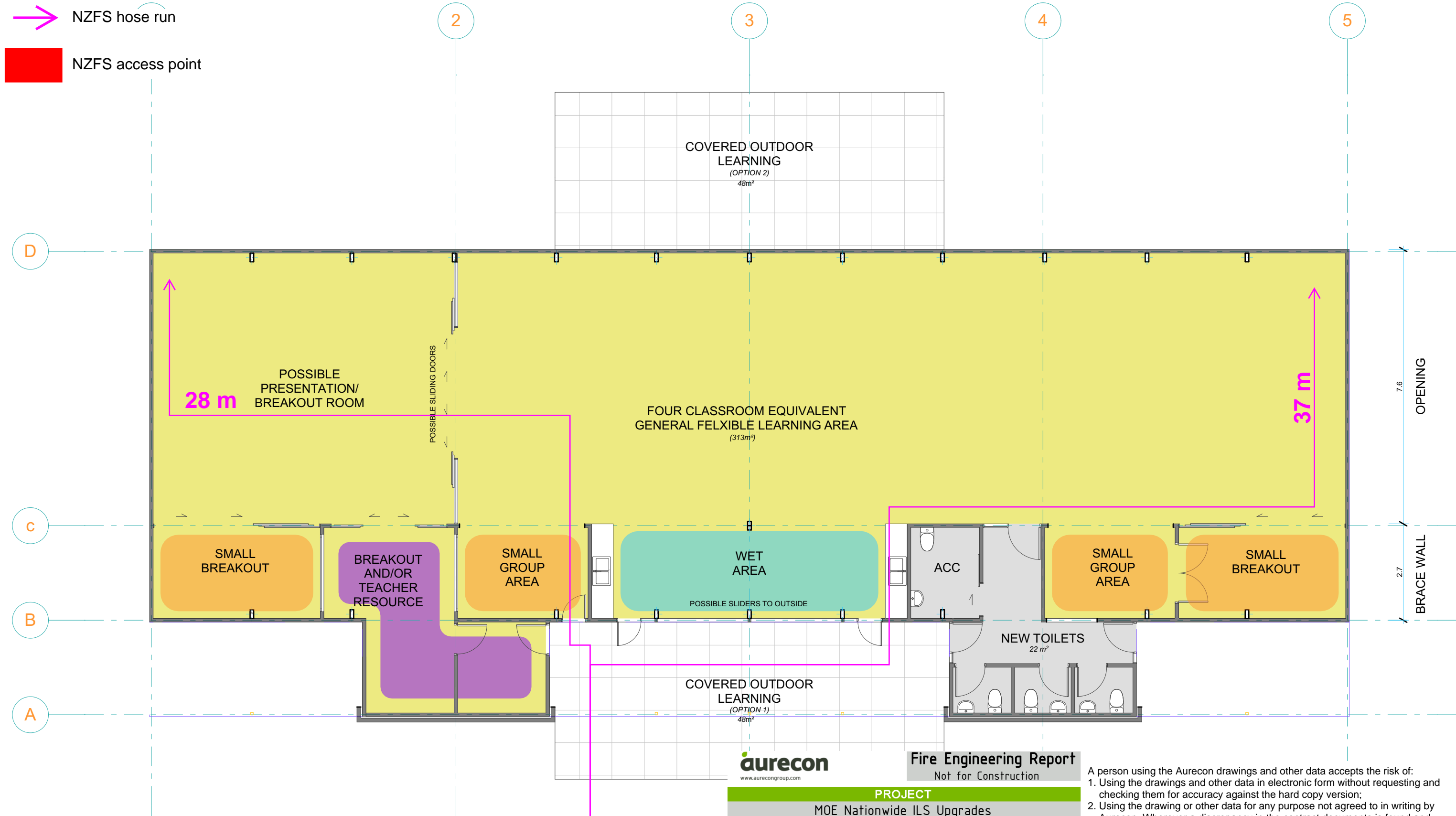
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→ NZFS hose run

NZFS access point



NETT:

- Teaching and learning: 313m² (78m² per classroom equivalent including)
- Teacher resource: 22m²
- Toilets and cloakroom: 22m²

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PROJECT MOE Nationwide ILS Upgrades			
TITLE Formula Block Option 3 NZFS Access			
DESIGNED F WEE	DRAWN F WEE	PROJECT No. 246313	SIZE A3
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4 Design Philosophy

4.1 Legal Environment

The building work is internal alterations only and is therefore alterations to an existing building, and as such is required by section 112 of the Building Act: 2004 to comply with the relevant Building Code (NZBC) requirements for means of escape from fire, and to continue to comply with the other provisions of the Building Code to at least the same extent as before the alterations.

This report addresses the fire safety requirements of NZBC Clauses C1 to C6 Protection from Fire, and additionally the requirements of the MOE Fire and Safety Design Requirements for Schools 2008 and M.O.E Designing Schools in New Zealand- Requirements and Guidelines (v. 1.0) October 2015.

4.2 Design Philosophy

4.2.1 Design Intent and Method

The design philosophy is to consider the proposal against the Acceptable Solution C/AS4 amendment 3 in demonstrating compliance with NZBC C1 to C6 'Protection from Fire'.

4.2.2 Duty of Care

The emphases of the fire safety provisions of the NZBC are those of health and safety and protection of other property. These emphases do not include for amenity or protection of one's own property.

4.3 Information Reviewed

This report is based on drawings by Brewer Davidson Architects Ltd.

Table 3: Reviewed drawings

Drawing Title	Drawing No.	Rev.	Date
Formula Block MLE Upgrade Option 1	1501-F003	B	8/06/2015
Formula Block MLE Upgrade Option 2	1501-F004	B	8/06/2015
Formula Block MLE Upgrade Option 3	1501-F005	B	8/06/2015

4.4 Distribution

The requirements of this report affect many aspects of the building design. We recommend that this report be distributed to all relevant parties for their review and implementation as appropriate. The distribution list should typically include, but not be limited to, the following parties.

- Building owner / developer
- Project manager
- Architect / designer
- Structural engineer
- HVAC engineer
- Electrical engineer
- Fire protection engineer
- Building contractor and relevant subcontractors.

5 Building Description and Use

5.1 Introduction and Description of Proposal

The standard single-storey, four-classroom Formula Block of Ministry of Education (MOE) is a standard classroom block constructed at various schools throughout New Zealand between 1962 and 1970. Construction consists of a light-weight timber frame with weatherboard or brick façade and corrugated iron roofing. Typically, existing Formula Blocks consisted of four classrooms with shared cloakroom and toilets.

The proposed work is to upgrade the existing standard four-classroom Formula Block to become a “Flexible Learning Space (FLS)” upgrade of MOE, previously referred to as “Modern Learning Environment (MLE). Three options of similar layout have been considered for the Formula Block FLS upgrade - Options 1, 2 and 3.

Option 1 consists of four interconnected classrooms equivalent in size with three breakout rooms, two existing toilets remaining as is, a shared wet area and two small group areas.

Option 2 is similar to Option 1 but with less partitions.

Option 3 consists of four interconnected classrooms equivalent in size with three breakout rooms, one of which is being converted from one of the two existing toilets; two small group areas and a new toilet.



Figure 1: Front elevation of an existing Formula Block.

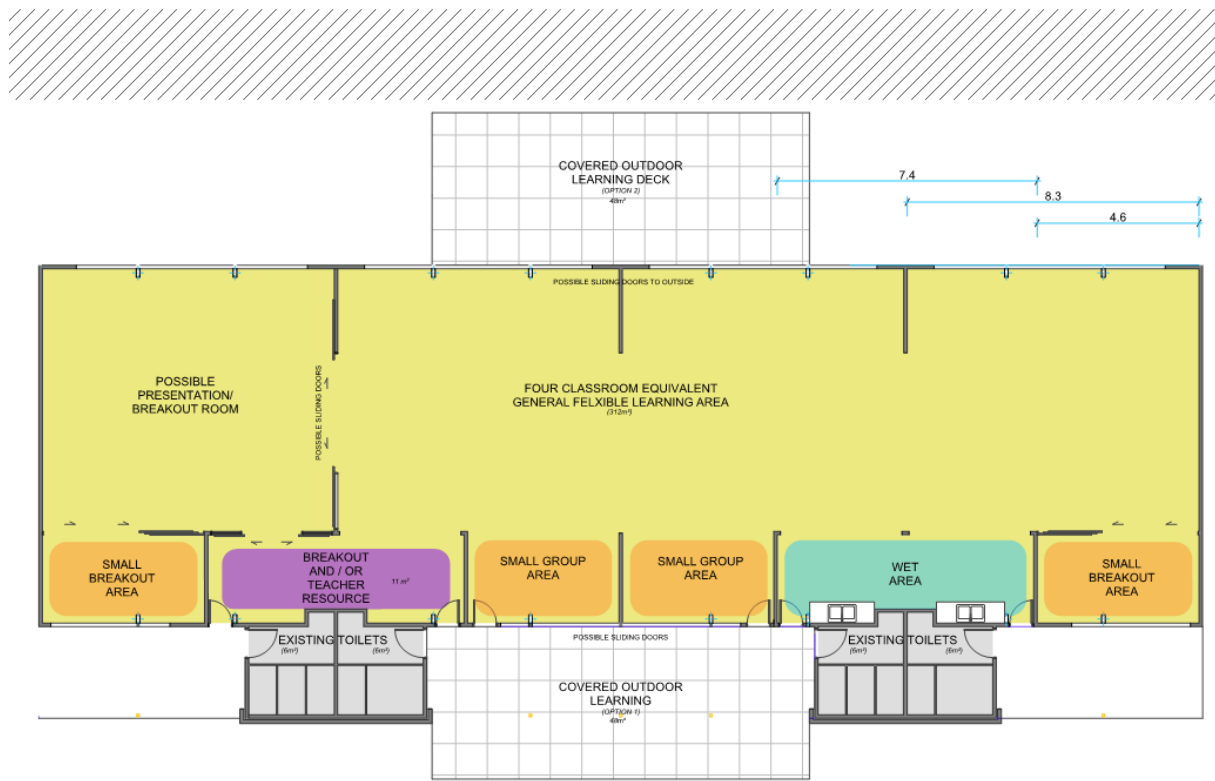


Figure 2: Formula Block FLS upgrade Option 1

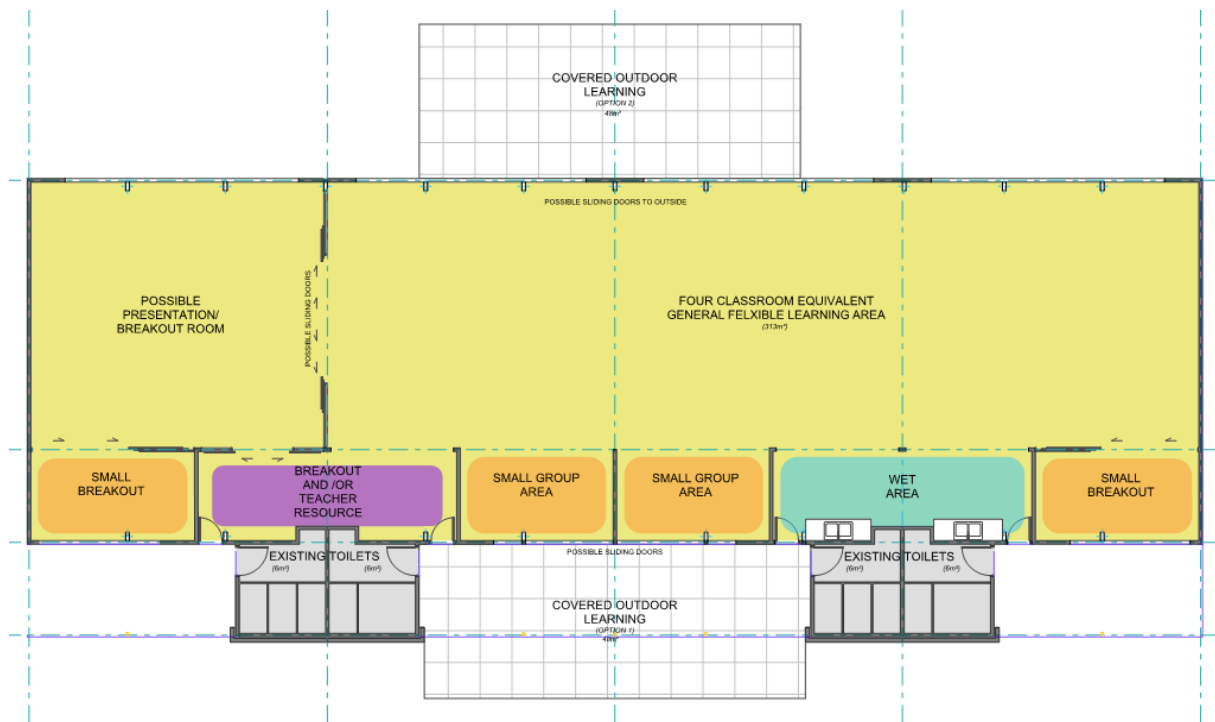


Figure 3: Formula Block FLS upgrade Option 2

6 Fire Safety Assessment

6.1 Building Importance Level

The Formula Block has an **Importance Level of 2** as defined in the NZBC Clause A3. The buildings are considered to pose a normal level of risk to human life, the environment and economic loss should the building fail. Therefore no special requirements need to be considered beyond that required by the NZBC.

6.2 Evacuation Scheme

The building is to operate on a school-wide all-out evacuation scheme.

6.3 Occupant Assessment

6.3.1 General

The building will contain students and staff who are expected to be familiar with the building layout and fire evacuation procedures.

6.3.2 Occupant Load

Occupant load of the building is given in Table 4 below.

Table 4: Occupancy assessment

Option	Location	Risk Group	Escape height (m)	Occupant Density [m ² /person]	Area [m ²]	Occupancy [p]
1	4 x classroom	CA	0	2	60 per classroom	30 per classroom
	Breakout rooms	CA		2	42	21 ^[1]
	Small group areas	CA		2	25	13 ^[1]
	Wet area	CA		2	20	10 ^[1]
Total for option 1						120
2	4 x classroom	CA	0	2	60 per classroom	30 per classroom
	Breakout rooms	CA		2	42	21 ^[1]
	Small group areas	CA		2	25	13 ^[1]
	Wet area	CA		2	20	10 ^[1]
Total for option 2						120
3	4 x classroom	CA	0	2	60 per classroom	30 per classroom
	Breakout rooms	CA		2	45	23 ^[1]
	Small group areas	CA		2	20	10 ^[1]
	Wet area	CA		2	20	10 ^[1]
Total for option 3						120

^[1] The occupant load in the breakout rooms, small group areas and wet area does not count towards the total occupants load as they are already included as occupants from the classrooms and not counted twice.

6.4 Fire Safety Systems and Fire Resistance Ratings

6.4.1 Provision of Firecells

For all options the Formula Block is considered as one firecell with a building footprint approximately 370 m². There are no Building Code requirements to provide internal fire separations to limit the floor area of firecells unless the total floor area of the building exceeds 5,000 m².

Under the requirements of the MOE Fire and Safety Design Requirements for Schools 2008 2.8/3(a): 'It is a Ministry of Education requirement (not a Building Code requirement) that except where sprinklered, school blocks should be divided into firecells with fire separations of (60)/60/60, containing not more than three classrooms (with associated corridor space) to limit the firecell size to approximately 270 m²'. However, refer to MOE Designing Schools in New Zealand- Requirements and Guidelines (v. 1.0) October 2015 part 7.12, it is anticipated that firecells of up to four classroom equivalent spaces will be accepted in the upcoming change to the existing MOE Fire and Safety Design Requirements for Schools 2008 2.8/3(a). Therefore the single firecell with four classroom equivalent spaces proposed is expected to be acceptable.

6.4.2 Overall Fire Safety Systems

Table 5 outlines the required fire safety systems in the building.

Table 5: Minimum fire safety Systems (FSSs) requirement

Option	Firecell	Escape height (m)	Risk Group	Occupant load [p]	Required Fire safety systems	Required Fire Resistance Ratings
1	Classroom	0	CA	120	2	Life rating 60 Property rating 120
2	Classroom	0	CA	120		
3	Classroom	0	CA	120		

For Options 1, 2 or 3, the following fire safety systems are required to be installed to comply with C/AS4 2.2:

- Type 2 manual fire alarm system with call points and sounders to NZS 4512: 2010 (or to the standard to which they were installed if an existing Type 2 alarm system). A direct connection with the NZFS is not required on the basis that a phone is available for emergency calls.
- The Fire Service hose run distance from the likely point of Fire Service vehicular access to any point within the building is less than 75 m, hence a building fire hydrant system is not required.
- There are no C/AS4 (Building Code) requirements for internal fire separations. Ministry of Education fire ratings are discussed in section 6.6 below.
- Emergency lighting is not required within the classrooms as the escape path lengths are less than 20 m and there are no changes in level as discussed in 6.5.7 below.

6.5 Means of Escape

6.5.1 Number and Location of Escape Routes

Refer to C/AS4 3.2 'number of escape routes' and Table 3.1.

Single means of escape for the possible presentation / breakout room for either Option 1, 2 or 3 meets the single means of escape requirements as follows:

- The open path length does not exceed the allowable travel distance as specified in Table 7;
- The total occupant load of each classroom is no greater than 50;
- There are no pre-school children;
- The escape height is no greater than 10 m (0 m); and
- There is no basement level below ground.

The remaining three classrooms (in each option) have two means of escape either directly to the outside or via adjacent classrooms. Escape via adjacent classrooms is permitted as it meets C/AS4 3.6.3 requirements as follows:

- The number of occupants in each classroom does not exceed 100 (30 people); and
- The escape route does not pass a space which may be locked.

6.5.2 Escape Route Heights

The height of an escape route is to be a minimum of 2,100 mm, and any doors are required to have a minimum clear height of 1,955mm (C/AS4 3.3.1).

6.5.3 Escape Route Widths

Refer to C/AS4 3.3.2.

Table 6 below details the minimum widths of escape routes in the building.

Table 6: Individual escape route width requirements

Location	Minimum width (mm)
Open paths	850 (1200 for accessible route)
Final exit doors	760

6.5.4 Escape Route Lengths

Refer to C/AS4 3.4 and Table 3.2.

Worst case escape route lengths (as indicated on the fire drawings) are assessed to comply with the travel distance requirements.

Table 7: Maximum permitted escape route lengths

Option	Location	Travel Distances			
		Permitted DEOP (m)	Actual DEOP (m)	Permitted TOP (m)	Actual TOP (m)
1	Small breakout room of possible presentation / breakout room	20	13	50	13
	Classroom	20	10	50	22
2	Small breakout room of possible presentation / breakout room	20	13	50	13
	Classroom	20	10	50	21
3	Small breakout room of possible presentation / breakout room	20	13	50	13

	Classroom	20	7	50	20
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6.5.5 Door Opening and Locking devices

Direction of opening

Doors on escape routes are required to open in the direction of escape if there are more than 50 occupants using the doors (C/AS4 /3.15.3). Doors in the building comply with this requirement.

Refer to C/AS4 3.15.1, a manual sliding door serving the small breakout room is permitted as the number of occupants is less than 20.

Locking devices

Locking devices (when the building is legally occupied) shall:

- Be clearly visible, located where such a device would be normally expected, designed to easily operate without a key and allow the door to open in the normal manner. If the operation of a locking device is unusual, such as the pressing of a button close to the door, it shall have signage that complies with NZBC F8.3.1, and
- If of an electromagnetic type, in the event of a power failure or door malfunction or fire alarm activation, either:
 - Automatically switch to the unlocked (failsafe) condition, or
 - Be readily opened by an alternative method satisfying the requirements of the above.

6.5.6 Exit Signage

Install illuminated EXIT signs in accordance with F8/AS1 and AS/NZS 2293-3:1995. Indicative exit sign locations are provided on the fire drawings in section 3.

6.5.7 Emergency Lighting

Emergency lighting is not required within the classrooms as the escape path lengths are less than 20 m and there are no changes in level.

At some school sites the Formula Block may have a step from the terrace to ground level. However given that the step is effectively outside the building, and that the classrooms are normally only occupied during daylight hours then we propose that emergency lighting need not be provided.

6.6 Internal Spread of Fire and Smoke

6.6.1 Fire/Smoke Separations

6.6.1.1 MOE requirements

The building is proposed as one firecell and acceptable to the M.O.E Designing Schools in New Zealand- Requirements and Guidelines (v. 1.0) October 2015. Refer to 6.4.1.

6.6.2 Surface Finishes

New surface finishes within the building are required to meet the requirements of C/AS4 Table 4.1. Refer to Scope of Works sections 2.2.1, 2.2.2 and 2.2.3.



6.7 External Fire Spread

6.7.1 Horizontal Fire Spread

Where a building is undergoing internal alterations only, the Building Code does not require that external fire spread be considered.

Notwithstanding the above there are MOE requirements for minimum separation distances between buildings on a school site. Given that the distance between buildings on any particular site varies from school to school, and that after the proposed work being internal alteration only the likelihood of fire spread between adjacent buildings will be no worse than before the alterations then the separation distances between buildings need not be addressed further.

6.7.2 External Surface Finishes

Exterior surface finishes will not be affected by the proposed works due to being internal alterations only, therefore existing finishes may remain as is.

6.8 Fire Fighting

6.8.1 Fire Service Vehicular Access

The proposed work involves internal alterations only to an existing building and Fire Service vehicular access need not be assessed.

6.9 Conclusion

This fire engineering report has assessed NZBC compliance in respect to the fire safety clauses C1 to C6 of the NZBC, by using the Acceptable Solution C/AS4 amendment 3, and the MOE 'Fire Safety and Design Requirements for Schools (July 2008)'.

This report demonstrates that Options 1, 2 and 3 for the proposed FLS upgrade of Formula Blocks at various Ministry of Education schools throughout New Zealand will be in compliance with the objectives of the NZBC C1 to C6 'Protection from Fire' to the extent required by the Building Act, the MOE Fire and Safety Design Requirements for Schools 2008 and M.O.E Designing Schools in New Zealand- Requirements and Guidelines (v. 1.0) October 2015, based on implementation of the Scope of Works described in this report.



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