

Report

Sustainability – NCC Section J Deemed to Satisfy

QANTAS FLIGHT TRAINING & SIMULATOR CENTRE

QANTAS Airways Limited

Report

CONFIDENTIAL

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1 EXECUTIVE SUMMARY

Norman Disney & Young (NDY) has been engaged to undertake an assessment of the proposed design for the Qantas Flight Training Centre against the Section J Deemed to Satisfy (DtS) requirements of the National Construction Code (NCC) 2016. Guidance is based on achieving compliance with Parts J1 – J3 as compliance with Parts J5 – J8 will be demonstrated separately by the appropriate consultants.

Advice is provided herein on the insulation, building sealing and glazing performance levels necessary to demonstrate compliance with Parts J1 – J3 of the NCC 2016.

See **Table 1** below for a summary of the thermal performance requirements to be achieved across the development. Mark-ups identifying the location of required insulation can be found in **Appendix A**.

Table 1: Thermal Performance Specifications

| Type | R-value* |
|---------------------------------------------------------------------------------------------------------------------------------|----------|
| External walls (North, East, West) | 2.8 |
| External walls (North, East, West) – heavy weight walls not less than 220 kg/m ² surface density | 2.8 |
| External walls (South) | 2.3 |
| Internal partitions to exposed unconditioned spaces (externally accessed store rooms, plant rooms) | 1.8 |
| Internal partitions to enclosed unconditioned spaces (internal lift shaft, fire stairs, fire corridors) | 1.0 |
| Floor or ceiling insulation to exposed unconditioned space (e.g. ceiling to plan room, floor to externally accessed store room) | 2.0 |
| Floor or ceiling insulation to enclosed unconditioned space (e.g. floor to fire corridors) | 1.0 |

*All R-values indicated are minimum overall system R-values that must be achieved by the overall construction.

Table 2 below summarises the performance specifications that glazing is required to achieve to satisfy the Section J DtS requirements.

Table 2: Glazing Performance Specifications

| Location | U-value** | SHGC** |
|--------------------------|-----------|--------|
| Glazing all orientations | 4.9 | 0.33 |
| Roof Lights | 5.7 | 0.83 |

** U-value and SHGC stated above refer to total system values, incorporating the performance of both the glass and the framing.

NDY note that it is the responsibility of the architect and the contractor to ensure that the advice provided herein is adopted in design and construction, any departure from the DtS requirements will require alternative solutions to be verified using the JV3 verification methodology.

2 BACKGROUND

2.1 Purpose

This report has been prepared to describe the assessment undertaken to demonstrate compliance of the proposed building design for the Qantas Flight Training Centre with the National Construction Code of 2016 Section J Energy Efficiency Performance Requirement JP1 using the method described in JV3 Verification Method Using a Reference Building. The advice has been prepared in line with the following:

- Training Facility (NCC Class 9b) – Section J1 – J3 Compliance
- Architectural drawings as supplied by Noxon Giffen:

| Drawing No. | Date | Title |
|----------------------|------------|------------------------------|
| NGA-S1822-DWG-DA3.01 | 11.04.2019 | Plan – Site and Ground Floor |
| NGA-S1822-DWG-DA3.02 | 11.04.2019 | Plan – Level 1 |
| NGA-S1822-DWG-DA3.03 | 11.04.2019 | Plan – Level 2 |
| NGA-S1822-DWG-DA3.04 | 11.04.2019 | Plan – Level 3 |
| NGA-S1822-DWG-DA3.25 | 11.04.2019 | Sections |
| NGA-S1822-DWG-DA3.26 | 11.04.2019 | Sections |

- The site is located at 297 King Street, Mascot, Sydney. In terms of the BCA climate zone, the project is located in climate zone 5, as shown in Figure 1.



Figure 1: Project location and climate zone

2.2 Authority

Authority to undertake this report was provided by Christine Maybury of Qantas Airways Limited.



2.3 Revision History

Table 3: Revision History

| | Date Issued | Comment |
|-----|------------------|---------------------------------------------------|
| 1.0 | 22 February 2019 | For Information |
| 2.0 | 14 April 2019 | For Information |
| 2.1 | 17 April 2019 | For Information – Update on Figure 4 and Figure 5 |

3 DEVELOPMENT DESCRIPTION

Normand Disney & Young has been commissioned by Qantas Airways Ltd (Qantas) to prepare this report in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs), and in support of the SSD 10154 for the development of a new flight training centre at 297 King Street, Mascot

3.1 Description of Site and Locality

The site is located at 297 King Street, Mascot and comprises land known as Lots 2-5 DP 234489, Lot 1 DP 202747, Lot B DP 164829 and Lot 133 DP 659434. The site is identified in Figure 1.

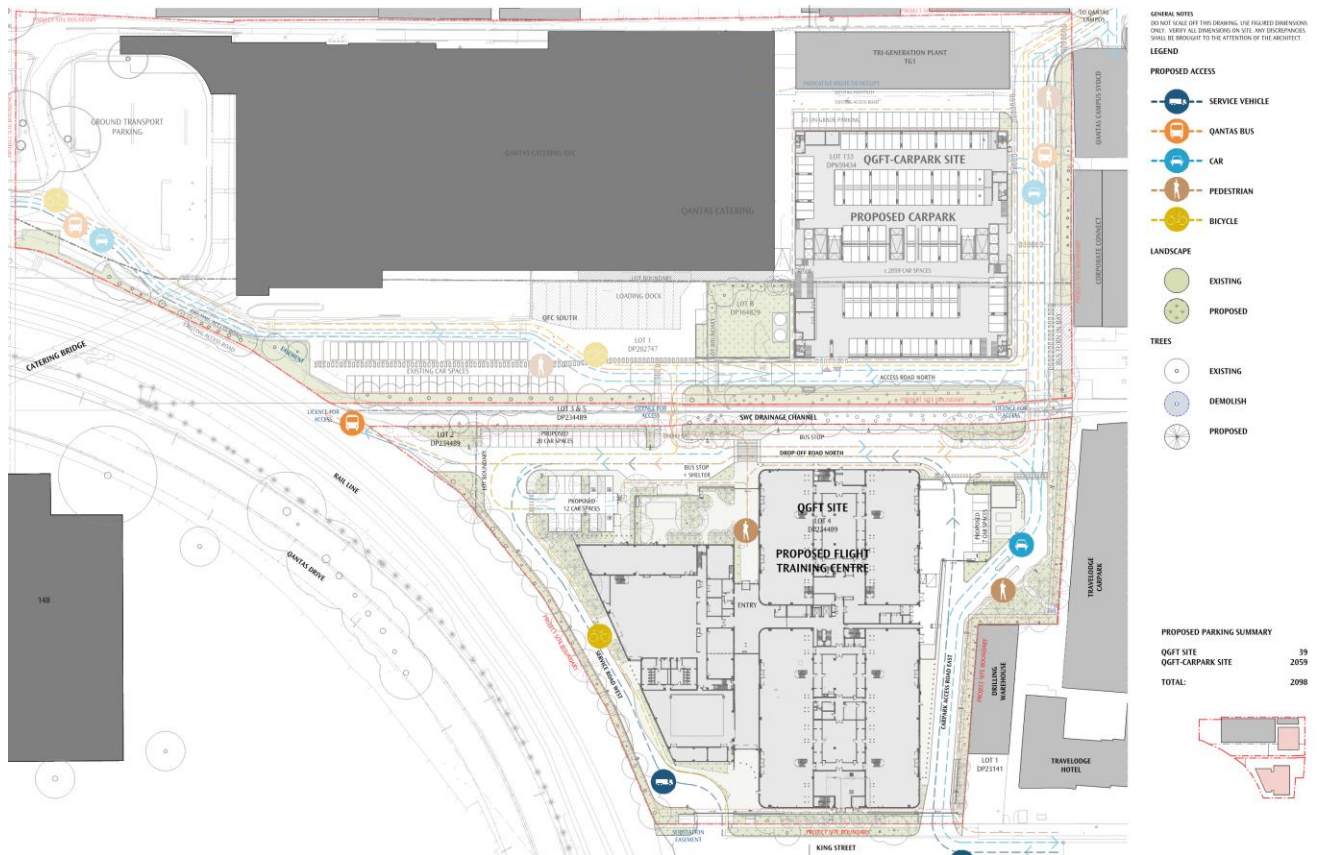
Key features of the site are as follows:

- The site is approximately 5.417ha and is an irregular shape. It is approximately 240m in length and maintains a variable width of between approximately 321m in the northern portion of the site and approximately 93m along the King Street frontage (refer to Figure 1).
- The site possesses a relatively level slope across the site. An open Sydney Water drainage channel bisects the northern portion of the site in an east-west direction. There are some isolated changes in level immediately adjacent to this channel. A Site Survey Plan accompanies the application which details the topographic characteristics of the site.
- Multiple mature Plane Trees are scattered throughout the site. A variety of native and exotic trees and vegetation also exist around the perimeter of the site which help screen the site from surrounding uses.
- Site improvements include at-grade car parking for Qantas staff, an industrial shed to store spare aviation parts, a substation, a disused gatehouse, a Sydney Water Asset with two driveways over it, the Qantas catering facility and Qantas tri-generation plant.
- The site forms part of a larger land holding under the ownership of Qantas that generally extends between Qantas Drive to the west, Ewan Street to the south, Coward Street to the north, with the Qantas "Corporate Campus" fronting Bourke Road.
- Vehicular access to the site from the local road network is available from King Street. The site has intra-campus connections along the northern boundary in the form of two connecting driveways in the north-eastern and north-western corner of the site along the northern boundary which link it to the broader Mascot Campus.
- The site is located within the Bayside LGA.

Key features of the locality are:

- **North:** The site is bounded to the north low scale industrial development, beyond which is Coward Street. Further north of the site is the Mascot Town Centre which is characterised by transport-oriented development including high density mixed-use development focussed around the Mascot Train Station.
- **East:** The site is bordered to the east by commercial development including a newly completed Travelodge hotel which includes a commercial car park. Additional commercial development to the east includes the Ibis Hotel and Pullman Sydney Airport fronting O'Riordan Street.
- **South:** The site is bounded to the south by King Street, beyond which is Qantas owned at-grade car parking and other industrial uses. Further south is the Botany Freight Rail Line and Qantas Drive beyond which is the Domestic Terminal at Sydney Airport.
- **West:** The site is bordered to the west by the Botany Freight Rail Line and Qantas Drive, beyond which lies Sydney Kingsford Smith Airport and the Qantas Jetbase (location of the current Flight Training Centre).

Figure 1: Site Plan



3.2 Project Description

Safety is Qantas' first priority. The flight training centre is a key pillar of this value. The facility enables pilots and flight crews to undertake periodic testing to meet regulatory requirements by simulating both aircraft and emergency procedural environments. The Project seeks consent for the construction and operation of a new flight training centre, and associated ancillary uses including a multi-deck car park. The Project is comprised of the following uses:

Flight Training Centre

The proposed flight training centre will occupy the southern portion of the site. It is a building that comprises 4 core elements as follows:

- An emergency procedures hall that contains;
 - cabin evacuation emergency trainers,
 - an evacuation training pool,
 - door trainers,
 - fire trainers
 - slide descent towers,
 - security room,
 - aviation medicine training and equipment rooms.
- A flight training centre that contains:



- a flight training hall with 14 bays that will house aircraft simulators,
- integrated procedures training rooms, computer rooms, a maintenance workshop, storerooms, multiple de-briefing and briefing rooms, pilot's lounge and a shared lounge.
- Teaching Space that contains
 - training rooms,
 - classrooms and two computer-based exam rooms.
- Office Space
 - Office space for staff and associated shared amenities including multiple small, medium and large meeting rooms think tank rooms, informal meeting spaces, a video room and lunch/tea room.
- Ancillary spaces including the reception area at the ground floor, toilets, roof plant and vertical circulation. The external ground floor layout will include a loading dock, at-grade car parking for approximately 35 spaces and a bus drop-off zone at the northern site boundary.

Carpark

The proposed multi-deck car park will be located to the north-east of the flight training centre and adjacent the existing Qantas catering facility and tri-generation plant. The car park is 13 levels and will provide 2,059 spaces for Qantas staff. Vehicle access to the car park will be provided via King Street, Kent Road and from Qantas Drive via the existing catering bridge.



4 GLOSSARY AND ABBREVIATIONS

4.1 Glossary

| Term | Definition |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The Site | Qantas Airways Limited owned land in Mascot to the north of Sydney Kingsford Smith Airport consisting of Lots 2-5 DP 234489, Lot 1 DP 202747, Lot B DP 164829 and Lot 133 DP 659434. Current site improvements include including at-grade car parking for Qantas staff, an industrial shed to store spare aviation parts, a substation, a disused gatehouse, a Sydney Water Asset with two driveways over it, the Qantas catering facility and Qantas tri-generation plant. |
| The Project | The construction of a new Flight Training Centre and ancillary uses to replace the existing facility on the Qantas Jetbase that will be impacted by RMS' Sydney Gateway Project. |
| Mascot Campus | Over 19ha of Qantas Airways Limited controlled land in Mascot to the north of Sydney Kingsford Smith Airport consisting of freehold and leased land. The following lots are owned by Qantas: Lot 133 DP 659434; Lots 4 & 5 DP 38594 Lot 23 DP 883548; Lots 1 & 2 DP 738342; Lot 3 DP 230355; Lot 4 DP 537339; Lots 2 & 4 DP 234489; Lot 4 234489; Lot 1 DP 81210; Lot 1 DP 202093; Lot 1 DP 721562; Lot 2 DP 510447; Lot 1 DP 445957; Lot B DP 164829 and Lot 1 DP 202747 and equates to 16.5ha of land. The following lots are leased by Qantas: Lot 14 DP 1199594 and Lot 2 DP 792885 and equates to 2.7ha of land. |
| Jetbase | Qantas leased land within the boundaries of Sydney Kingsford Smith Airport. |
| Sydney Gateway Project | A RMS Project including a road and rail component that is intended to increase capacity and improve connections to the ports to assist with growth in passenger, freight and commuter movements across the region, by expanding and improving the existing road and freight rail networks. |

4.2 Abbreviations

| Acronym | Definition |
|---------|---------------------------------------------------|
| NDY | Norman Disney & Young |
| SEARs | Secretary's Environmental Assessment Requirements |
| GHG | Greenhouse Gas |
| NCC | National Construction Code |
| JP | Section J Performance requirement |
| HVAC | Heating, Ventilation and Air-Conditioning |
| ABCB | Australian Building Codes Board |
| DtS | Deemed-to-Satisfy |
| kWh | Kilowatt-hours |
| Uv | U-Value |
| SHGC | Solar Heat Gain Coefficient |
| SA | Solar Absorptance |



5 SECTION J ENERGY EFFICIENCY

The objective of Section J is to reduce the greenhouse gas emissions produced by buildings. To that end Section J requires buildings to efficiently use energy and obtain their heating from a low intensity energy sources, on-site renewable energy or heat reclaimed from another process.

Performance requirement JP1 of the NCC Section J requires a building and its services to have, to the degree necessary, features that facilitate the efficient use of energy, appropriate to the function and use of the building and services, the internal environment, the geographic location, effects of nearby permanent features, solar radiation, sealing of the building envelope, utilisation of air movement and energy source of the services.

Performance requirement JP3 of the NCC Section J requires the heating for a conditioned space, to the degree necessary, be generated using a low intensity greenhouse gas source (not exceeding 100 g CO₂e/MJ of thermal energy load) or sourced from an on-site renewable energy source, or a reclaimed energy.

5.1 Application of Section J

As stipulated in part J0.1, the performance requirements of **JP1** and **JP3** for class 9b buildings are satisfied by complying with:

- For reducing the heating or cooling load
 - **Part J1** – Building fabric
 - **Part J2** – Glazing
 - **Part J3** – Building Sealing
- For air conditioning and ventilation, **Part J5** – Air Conditioning and Ventilation System
- For artificial lighting and power, **Part J6** – Artificial Lighting and Power
- For hot water supply, **Part J7** – Hot Water Supply and Swimming Pool and Spa pool Plant
- For facilities for monitoring – **Part J8** – Facilities for Energy Monitoring

5.2 Building Envelope

The Deemed to Satisfy (DtS) requirements of National Construction Code (NCC) Section J for reducing the heating and cooling load of a Class 2 to 9 building (Part **J1, J2, J3**) apply to building elements forming the envelope of the building. As such, defining the extent of the thermal envelope is crucial in determining the application of the DtS requirements of Part **J1, J2 and J3**.

For the purposes of Section J, **envelope** of the building is defined in the NCC as the parts of a building fabric that separate a conditioned space or habitable room from the exterior of the building or a non conditioned space. Further, a space is considered as “conditioned” in the event that such areas serve as return air path or exhaust air path for conditioned air from adjacent spaces.

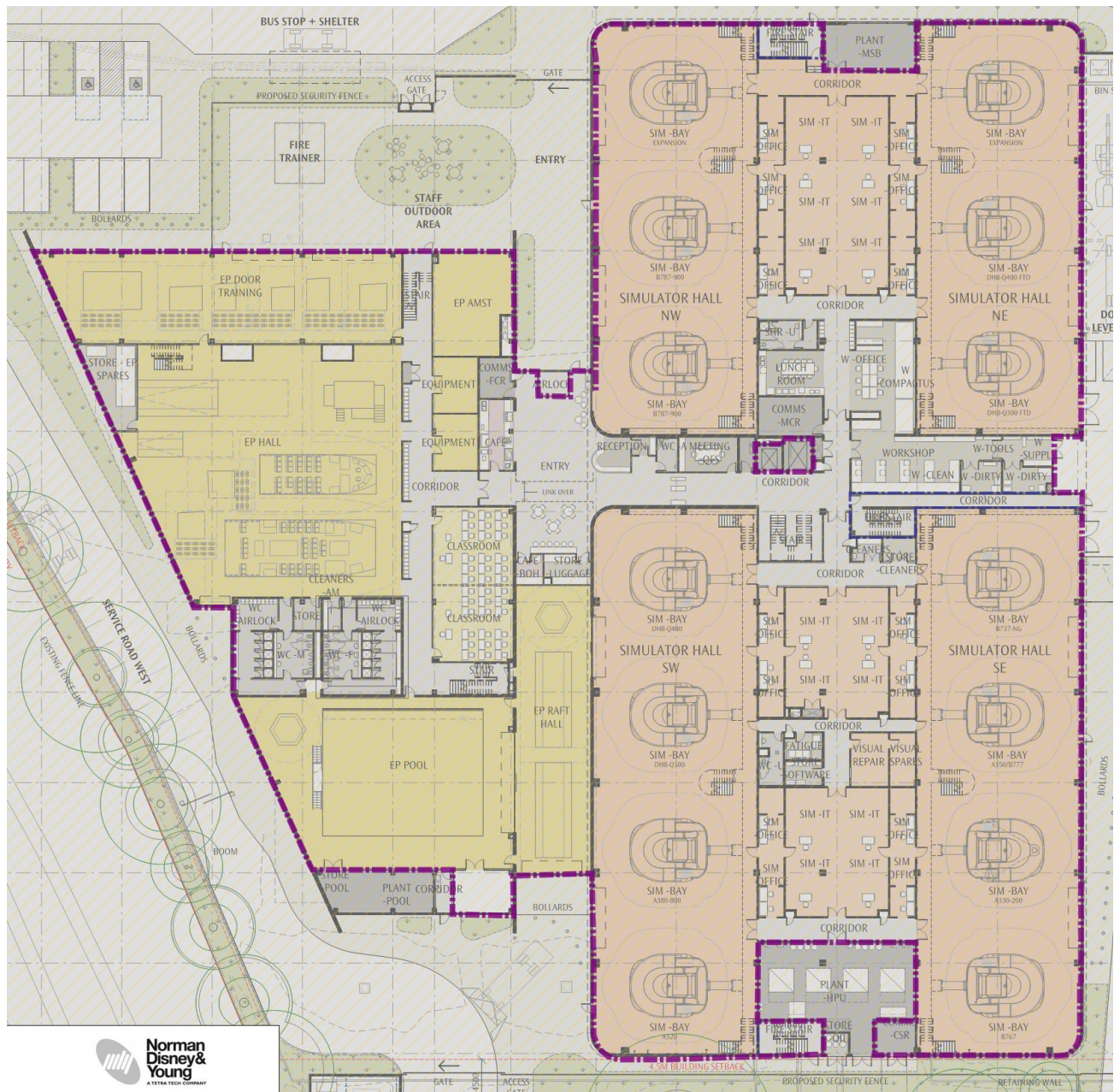
5.2.1 Application of Section J

The thermal envelope has been defined as per the area bound by purple lines as shown in the following diagrams (refer Figure 2 to Figure 6). It is only elements forming the thermal envelope boundary that must comply with the NCC Section J 2016 requirement.



Legend:

- THERMAL ENVELOPE
- THERMAL ENVELOPE - TREATMENT MOVED TO EXTERNAL LAYER

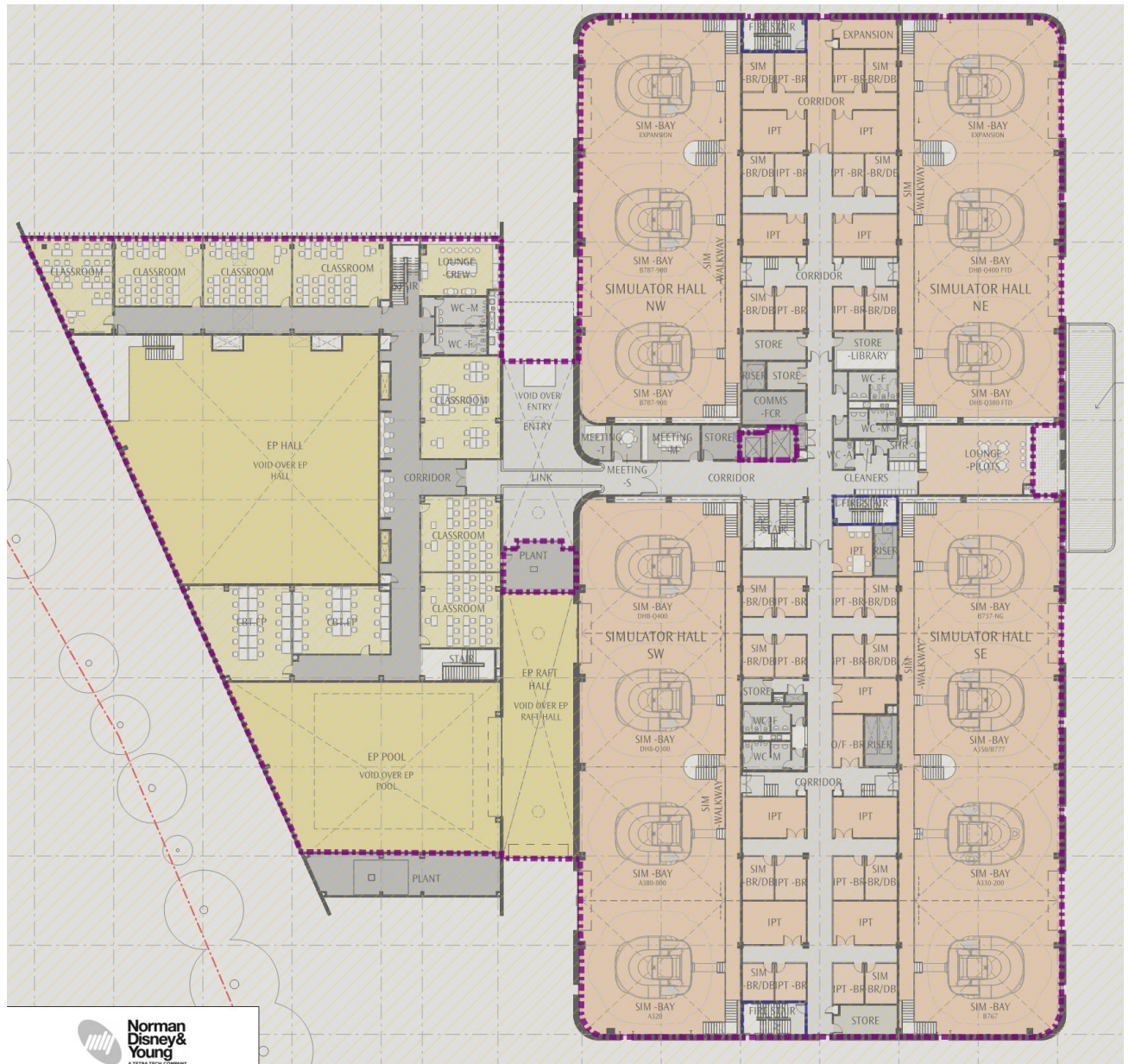


Ground Floor

Figure 2: Thermal Envelope – Extent of Part J1, J2, and J3 Requirements – GF Plan views

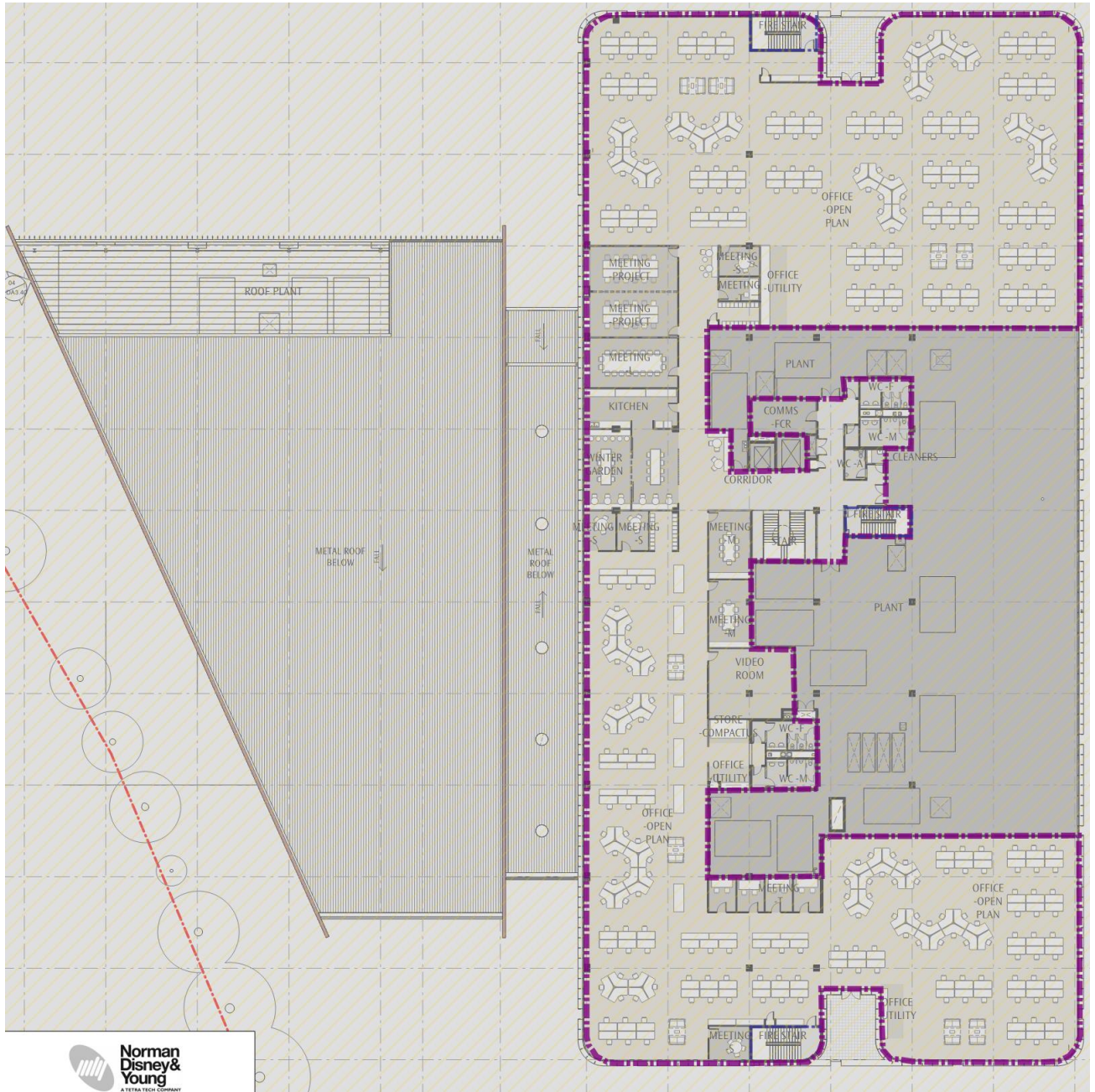
Legend:

- THERMAL ENVELOPE
- THERMAL ENVELOPE - TREATMENT MOVED TO EXTERNAL LAYER



Level 1

Figure 3: Thermal Envelope – Extent of Part J1, J2, and J3 Requirements – Level 1 Plan views

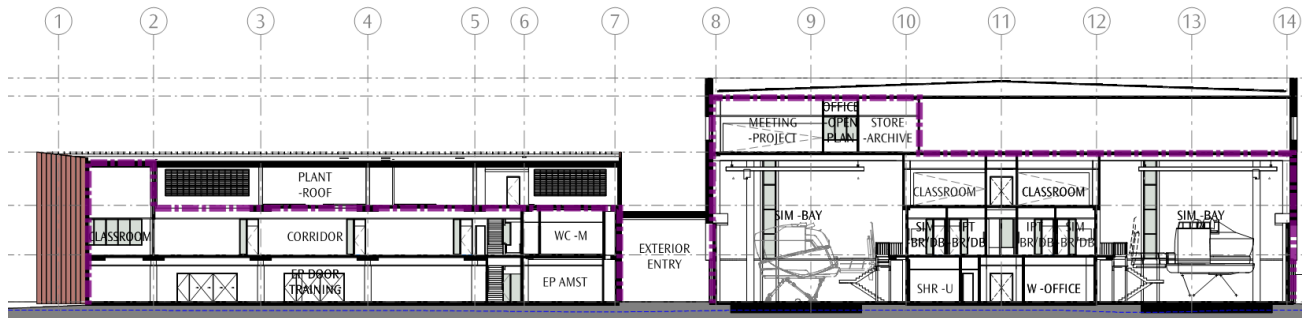


Level 3

Figure 5: Thermal Envelope – Extent of Part J1, J2, and J3 Requirements –Level 3 Plan views

Legend:

- THERMAL ENVELOPE
- THERMAL ENVELOPE - TREATMENT MOVED TO EXTERNAL LAYER



East-West Section A



North-South Section B

Figure 6: Thermal Envelope – Extent of Part J1, J2, and J3 Requirements – Section Views



6 PART J1 BUILDING FABRIC

Part J1 applies to all elements of the building that form part of the thermal envelope (see **Appendix D**). All elements that form part of the thermal envelope boundary must meet the thermal performance requirements as detailed in this report. Building fabric that falls outside this area is at the architect's discretion.

For details on general requirements for thermal construction refer to **Appendix A**.

6.1 Roof Construction

A roof that forms part of the thermal envelope must achieve the total R-value as specified in Table J1.3a. NCC 2016. For climate zone 5 (class 5 and 9b) the roof system needs to achieve at least a **minimum total R-value of 3.7** where solar absorptance value is not more than 0.6 and more than 0.4.

Solar absorptance value relates to roof colour. An industry recognised international standard for testing absorptance is ASTM E903. Typical thermal absorptance values using that standard are provided below. It is recommended that lighter coloured roof with lower solar absorptance value is selected to further reduce the cooling load to the air conditioning.

Table 4: Typical Absorptance Values (not more than 0.6 SA)

| Colour | Value |
|-------------------------|-------|
| Zincaluminium — dull | 0.55 |
| Galvanised steel — dull | 0.55 |
| Light grey | 0.45 |
| Off white | 0.35 |
| Light cream | 0.3 |

Table 5 below provides a summary of the total system R-value required to be achieved by the proposed roof system, typical roof construction build ups including required levels of insulation are provided in **Appendix B**. Refer to **Appendix E** for mark-ups detailing the location of roof insulation. Refer to **Appendix A** for general requirement of insulation including thermal break as well as compensating for loss of insulation area.

Table 5: Roof System Performance Specifications

| Type | R-value |
|-------------------------------------------------------------|------------|
| Exposed roof with solar absorptance value not more than 0.6 | 3.7 |

6.2 Roof Lights

Roof light that forms part of the thermal envelope must comply with Part J1.4 as detailed in Table J1.4. Table 6 provides a summary of total system U-value and Solar Heat Gain Coefficient (SHGC) to be achieved by roof lights based on the dimensions currently shown on the architectural drawings. Any changes to the design and any deviation from this performance will need to be reviewed prior to construction.

Table 6: Roof Light System Performance Specifications

| Type | U-value | SHGC |
|----------------------------------|------------|-------------|
| Roof lights to Level 2 corridors | 5.7 | 0.83 |



6.3 Wall and Partition Construction

Each part of a wall that forms part of the thermal envelope must satisfy the requirements stipulated in Part J1.5 – Walls. Exceptions are for opaque non-glazed openings such as doors, vents, penetrations, shutters and the like, earth retaining walls and glazing where compliance with Part J2 must be achieved (see Section 7).

6.3.1 External Walls

All external walls that form part of the thermal envelope must achieve thermal performance requirement as detailed in **Table 7**.

Table 7: External Walls Thermal Performance Specifications

| Type | R-value |
|------------------------------------------------------------------------------------------------------------|---------|
| External walls (North, East, West) – lightweight | 2.8 |
| External walls (North, East, West) – heavyweight wall, not less than 220 kg/m ² surface density | 2.3 |
| External walls (South) | 2.3 |

The external wall forming the new thermal envelope is part of an earth retaining wall, as such the requirement is as per the requirement for slab-on-ground in climate zone 5 (i.e. no Section J requirement). Should this change, NDY must be notified and DtS requirements will require to be reviewed.

6.3.2 Internal Walls / Partitions

Internal walls that form part of the thermal envelope must achieve a minimum total R-value in line with the below:

- R1.0 for partitions to non-conditioned spaces that are enclosed and have less than 1.5 air changes per hour of outside air (e.g. fire stairs, fire corridors, internal lift shafts).
- R1.8 for partitions to non-conditioned spaces other than the above. Examples of these non-conditioned spaces are plant rooms, mechanically ventilated storage areas where make-up air is supplied from outside/non-conditioned spaces.

Table 8 below provides a summary of the total system R-value required to be achieved by all internal partitions. Typical partition construction build-ups including required levels of insulation are provided in **Appendix B**. Refer to **Appendix E** for mark-ups detailing the location and performance requirements of internal partition insulation across the Qantas Flight Training Center.

Table 8: Internal Partition Thermal Performance Specifications

| Type | R-value* |
|---------------------------------------------------------------------------------------------------------|----------|
| Internal partitions to exposed unconditioned spaces (externally accessed store rooms, plant rooms) | 1.8 |
| Internal partitions to enclosed unconditioned spaces (internal lift shaft, fire stairs, fire corridors) | 1.0 |

Refer to **Appendix A** for general requirement of insulation including thermal break as well as compensating for loss of insulation area.



6.4 Floors and Ceilings

All suspended floors and ceilings that form part of the thermal envelope must achieve requirement of Part J1.6 Table J1.6. This includes requirement for suspended floors and ceilings to the outside, ceilings below plant rooms and other non-conditioned spaces.

The below floor requirement has been based on the floor having no in-slab heating or cooling system. Architect to notify if otherwise.

Table 9 below provides a summary of the total system R-value required to be achieved by all suspended floors and ceilings forming part of the thermal envelope. Typical floor and ceiling construction build ups including required levels of insulation are provided in **Appendix B**. Refer to **Appendix E** for mark-ups detailing the location of floor insulation.

Table 9: Floor and Ceiling Performance Specifications

| Type | R-value* |
|---------------------------------------------------------------------------------------------------------------------------------|----------|
| Floor or ceiling insulation to exposed unconditioned space (e.g. ceiling to plan room, floor to externally accessed store room) | 2.0 |
| Floor or ceiling insulation to enclosed unconditioned space (e.g. floor to fire corridors) | 1.0 |



7 PART J2 GLAZING

All glazing that forms part of the thermal envelope is required to comply with Part J2 of the NCC 2016 (Refer to **Appendix D** for a mark-up of the thermal envelope).

7.1 Glazing Performance Requirements

The glazing has been assessed in accordance with Part J2.4 so that the aggregate air conditioning energy value attributable to the glazing will not exceed the energy allowance from the facade area that is exposed to the conditioned space. The glazing calculator version 4 “GlazingCalc_2014_VolOne_Excel2013_v4-00.xls” produced by the Australian Building Code Board (ABCB) has been used in the assessment.

When assessed against the DtS requirement, the glazing per floor per orientation is required to achieve thermal performance as detailed in **Table 10**.

Table 10: Minimum Glazing Thermal Performance Specification

| Location | U-value | SHGC | Shading Coefficient |
|-----------|---------|------|---------------------|
| GF North | 5.8 | 0.35 | 0.4 |
| GF East | 7.0 | 0.93 | 1.07 |
| GF South | 7.0 | 0.93 | 1.07 |
| GF West | 7.0 | 0.93 | 1.07 |
| L01 North | 5.8 | 0.48 | 0.546 |
| L01 East | 7.0 | 0.93 | 1.07 |
| L01 South | 7.0 | 0.93 | 1.07 |
| L01 West | 7.0 | 0.93 | 1.07 |
| L02 North | 7.0 | 0.93 | 1.07 |
| L02 East | 7.0 | 0.93 | 1.07 |
| L02 South | 6.7 | 0.90 | 1.03 |
| L02 West | 7.0 | 0.93 | 1.07 |
| L03 North | 5.7 | 0.36 | 0.41 |
| L03 East | 5.7 | 0.33 | 0.38 |
| L03 South | 5.7 | 0.31 | 0.36 |
| L03 West | 5.7 | 0.31 | 0.36 |

In order to improve the fabric performance and achieve a uniform glazing performance, the following **Table 11** provide glazing performance specification that meets and exceeds requirement for all levels and orientations. It should be noted that the U-value and SHGC stated below refer to total system values, incorporating the performance of both the glass and the framing.

Table 11: Glazing Performance Specifications – All

| Location | U-value | SHGC |
|--------------------------|---------|--------|
| Glazing all orientations | ≤ 4.9 | ≤ 0.33 |

Please refer to **Appendix C** for completed glazing calculators.



The following illustrates the range of glazing available in the market that meets the requirement set in **Table 11**.

| Series ▾ | Glass ▾ | U _w | SHGC _w | V _{Tw} | Glazing | Cooling | Heating |
|----------|----------------------------------------------------------------------|----------------|-------------------|-----------------|---------|---------|---------|
| 650 | Aluminium Fixed Window 6mm Eclipse Advantage EverGreen Low-E | 4.90 | 0.33 | 0.40 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 650 | Aluminium Fixed Window 6mm Eclipse Advantage Arctic Blue Low-E | 4.90 | 0.33 | 0.33 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 450 | Aluminium Fixed Window 6mm Eclipse Advantage EverGreen Low-E | 4.80 | 0.32 | 0.40 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 450 | Aluminium Fixed Window 6mm Eclipse Advantage Arctic Blue Low-E | 4.80 | 0.32 | 0.32 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 425 | Aluminium Fixed Window 6mm Eclipse Advantage EverGreen Low-E | 4.60 | 0.33 | 0.41 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 450 | Aluminium Fixed Window 10.76mm Optilight HL719 Low E Laminate | 4.50 | 0.33 | 0.50 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 131 | Fixed Window 6mm Solar E Grey | 4.30 | 0.34 | 0.27 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 130 | Fixed Window 6mm Eclipse Advantage EverGreen Low-E | 4.10 | 0.34 | 0.44 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 130 | Fixed Window 6mm Eclipse Advantage Arctic Blue Low-E | 4.10 | 0.34 | 0.36 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 130 | Fixed Window 6mm Solar E Grey | 4.00 | 0.34 | 0.28 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 130 | Fixed Window 6mm SolTech Grey | 4.00 | 0.34 | 0.28 | Single | ★★★★★☆☆ | ★★★★★☆☆ |
| 451 | Aluminium Fixed Window 6mm Azuria / 12mm Air Gap / 6mm Clear | 3.80 | 0.34 | 0.51 | Double | ★★★★★☆☆ | ★★★★★☆☆ |
| 451 | Aluminium Fixed Window 6mm Azuria / 12mm Air Gap / 6mm Clear | 3.70 | 0.34 | 0.51 | Double | ★★★★★☆☆ | ★★★★★☆☆ |



8 PART J3 BUILDING SEALING

The Deemed to Satisfy provisions of Part J3 – Building Sealing apply to elements forming the thermal envelope of class 5 and 9b buildings.

- For areas of the buildings where mechanical ventilation provides sufficient pressurisation to prevent infiltration, the following provisions of Part J3 do not apply.
- For areas where positive pressure cannot be maintained e.g. areas served by a split air conditioning system with no outside air provisions, or the area is considered as a conditioned space from Section J perspective with make-up air coming from the adjacent conditioned space (toilet, store rooms, etc), then the Part J3 requirement is applicable.

The following table provides extracts from Part J3 – NCC 2016.

Table 12: Application of Part J3

| Clause | Requirement | Additional Notes |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| J3.2 Chimneys & Flues | An open solid-fuel burning appliance must be provided with a damper or flap that can be sealed to seal the chimney. | None have been noted in the development |
| J3.3 Roof Lights | A roof light must be sealed, or capable of being sealed when serving a conditioned space or a habitual room in climate zones 4, 5, 6, 7 or 8. | Applicable |
| J3.4 Windows and doors | Seals to be provided to each edge of a door, openable windows or the like that form part of envelope of conditioned space or external fabric of a habitable rooms or public area in climate zone 4,5,6,7 or 8 in accordance with NCC Section J (2016) clause J3.4. | Applicable. A draft protection device for the bottom edge of swing doors; and foam or rubber compression strip, fibrous seal or the like to edges of doors, and openable windows or other openings. |
| | Habitable rooms: | Habitable room means a room used for normal domestic activities, excludes bathroom, laundry, water closet, pantry, corridor, hall way, lobby, photographic dark room and other spaces of a specialised nature occupied neither frequently nor for extended period of time. External walls of the spaces that are occupied frequently or for an extended period of time need to be provided with seals. |
| | Exceptions to the above are for windows complying with AS2047, fire door/smoke | - |



| Clause | Requirement | Additional Notes |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | door, roller shutter/grille or other security door installed for security / out-of-hour security. | |
| | An entrance door leading to a conditioned space must include provision to minimise infiltration with an airlock, self-closing door, revolving door or similar. | Doors leading to conditioned spaces need to be self-closing or be fitted with a mechanism to prevent infiltration. Applicable to areas with no positive pressure from air conditioning system. |
| | | Exceptions for conditioned space with floor area less than 50m ² , or a cafe/restaurant /open front shop or the like that has a 3m deep unconditioned zone between the main entrance and the conditioned space while other entrance has self-closing door |
| J3.5 Exhaust Fans | Miscellaneous exhaust fans to be provided with a sealing device such as a self-closing damper. | Applicable to exhaust fans serving a conditioned space. |
| J3.6 Construction of roofs walls and floors | Building elements forming the envelope and external fabric of a habitable room or public area should be constructed to minimise air leakage. | Refer to NCC Section J (2016) clause J3.6 for details of requirements. |
| J3.7 Evaporative Coolers | Not applicable. | No evaporative coolers in building. Mechanical Engineer to notify otherwise. |



9 APPENDICES

9.1 Appendix A – General Requirements for Thermal Construction

9.1.1 Insulation - Detailing

Insulation must comply with AS/NZS 4859.1 and be installed to properly seal the thermal envelope as per the requirements of Section J1.2 below.

J1.2 Thermal Construction General

- (a) Where required, insulation must comply with AS/NZS 4859.1 and be installed so that -
 - i. Abuts or overlaps adjoining insulation other than at supporting member such as studs, noggings, joists, furring channels and the like where the insulation must be against the member; and
 - ii. Forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the thermal barrier; and
 - iii. Does not affect the safe or effective operation of a service or fitting.
- (b) Where required, reflective insulation must be installed with -
 - i. The necessary airspace to achieve the required R-value between a reflective side of the reflective insulation and a building lining or cladding; and
 - ii. The reflective insulation closely fitted against any penetration, door or window opening; and
 - iii. The reflective insulation adequately supported by framing members; and
 - iv. Each adjoining sheet of roll membrane being –
 - A. Overlapped not less than 50 mm; or
 - B. Taped together.
- (c) Where required, bulk insulation must be installed so that –
 - i. It maintains its position and thickness, other than where it is compressed between cladding and supporting members, water pipes, electrical cabling or the like; and
 - ii. In a ceiling, where there is no bulk insulation or reflective insulation in the wall beneath, it overlaps the wall by not less than 50 mm.
- (d) Roof, ceiling, wall and floor materials, and associated surfaces are deemed to have the thermal properties listed in specification J1.2.

9.1.2 Loss of Insulation

When there are a significant number of penetrations e.g. for flues, down lights or fans, parts of the required area of insulation may be lost. The area of reduced insulation must be kept below 0.5% of the total required insulated ceiling area. Otherwise the insulation performance must be increased for the remainder of the ceiling to compensate in accordance with **Table J1.3b** of the NCC (BCA) 2016 below.



Table 1.3b: Adjustment of Minimum R-Value for Loss of Ceiling Insulation

| Percentage of ceiling area uninsulated | Minimum R-Value of ceiling insulation required to satisfy J1.3(a) | | | | | | | | | | |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 |
| | Adjusted minimum R-Value of ceiling insulation required to compensate for loss of ceiling insulation area | | | | | | | | | | |
| 0.5% to less than 1.0 % | 1.0 | 1.6 | 2.2 | 2.8 | 3.4 | 4.0 | 4.7 | 5.4 | 6.2 | 6.9 | |
| 1.0 % to less than 1.5% | 1.1 | 1.7 | 2.3 | 2.9 | 3.6 | 4.4 | 5.2 | 6.1 | 7.0 | | |
| 1.5% to less than 2.0% | 1.1 | 1.7 | 2.4 | 3.1 | 3.9 | 4.8 | 5.8 | 6.8 | | | |
| 2.0% to less than 2.5% | 1.1 | 1.8 | 2.5 | 3.3 | 4.2 | 5.3 | 6.5 | | | | |
| 2.5% to less than 3.0% | 1.2 | 1.9 | 2.6 | 3.6 | 4.6 | 5.9 | | | | | |
| 3.0% to less than 4.0% | 1.2 | 2.0 | 3.0 | 4.2 | 5.7 | | | | | | |
| 4.0% to less than 5.0% | 1.3 | 2.2 | 3.4 | 5.0 | | | | | | | |
| 5.0% or more | | | | | | | | | | | |

Not Permitted

9.1.3 Thermal Break - Roof

Subclause J1.3(d) requires a thermal break in roofing systems where a single metal framing member connects both the outer cladding and the inner lining, or where there is no inner lining. Below is the relevant extract from section J1.3d of the NCC BCA.

J1.3d

A roof that –

- Is required to achieve a minimum Total R-Value; and
- Has metal sheet roofing fixed to metal purlins, metal rafters or metal battens; and
- Does not have a ceiling lining or has a ceiling lining fixed directly to those metal purlins, metal rafters or metal battens (see Specification J1.3 Figure 2(c) and (f)).

must have a thermal break, consisting of a material with an R-Value of not less than 0.2, installed between the metal sheet roofing and its supporting metal purlins, metal rafter or metal battens.

A thermal break may be provided by materials such as 20mm thick timber, or 12 mm thick expanded polystyrene strips, ply wood or bulk insulation that can achieve a total R-value of not less than R0.2.

9.1.4 Thermal Break - Wall

A thermal break is also required for a metal framed wall/ light weight wall where a metal framed wall member has the cladding directly on one side of the member and the lining directly on the other side of the same member. Below is the relevant extract from section J1.5(c) of the NCC BCA.

J1.5c

(a) A wall that -

- Is required to achieve a minimum Total R-Value; and



- ii. Has lightweight external cladding such as weatherboards, fibre-cement or metal sheeting fixed to a metal frame; and
- iii. Does not have a wall lining or has a wall lining that is fixed directly to the same metal frame,
Must have a thermal break, consisting of a material with an R-Value of not less than R0.2, installed between the external cladding and the metal frame.

A thermal break is required to separate the metal frame from the cladding and achieve an R-value of not less than 0.2. A thermal break may be provided by materials such as timber battens, plastic strips or polystyrene insulation sheeting.



9.2 Appendix B - Typical Constructions

Table 13: R2.8 Lightweight Metal Cladding Wall Considered Achieving R2.8

| Material Description | Thickness (mm) | k W/m.K | R (m2.K/W) |
|----------------------------------------------------------------------|-------------------|------------|---------------|
| Outdoor air film | | | 0.03 |
| Metal cladding - Alucobond | 1.2 | 210 | 0.000006 |
| Minimum insulation (thickness shown is for polystyrene k=0.032W/m.K) | 78 | 0.032 | 2.44 |
| Air gap 20mm | | | 0.15 |
| 13mm gypsum plasterboard | 13 | 0.17 | 0.08 |
| Indoor air film | | | 0.12 |
| R total | | | 2.82 |
| U=1/R_t | | | 0.355 |

The following bullet points list insulation options that can achieve the minimum total R-value:

- 90mm R2.5HD Pink Batts from Fletcher Insulation
- 100mm R2.5 Glasswool Building Blanket from Fletcher Insulation
- 90mm R2.5 Bradford Gold Wall Batts from Bradford Insulation
- 160mm R2.5 thermal batts from Tontine Insulation
- 65mm R2.9 Dow Tuff-R PIR board from Proctor Group

Note that if the actual construction layer does not allow a 20mm air gap then the insulation layer must achieve R2.6 (insulation only value).

Table 14: R2.8 Heavyweight Concrete Wall Considered Achieving R2.3

| Material Description | Thickness (mm) | Conductivity (k) W/m.K | R (m2.K/W) |
|----------------------------------------------------------------|-------------------|---------------------------|---------------|
| Outdoor air film | | | 0.03 |
| 150mm concrete wall | 150 | 1.44 | 0.10 |
| Minimum insulation (thickness shown is for mineral wool batts) | 92 | 0.045 | 2.04 |
| FC sheet | 9 | 0.53 | 0.016981 |
| Indoor air film | | | 0.12 |
| R total | | | 2.32 |
| U=1/R_t | | | 0.432 |

The following bullet points list insulation options that can achieve the minimum total R-value:



- 90mm R2.5HD Pink Batts from Fletcher Insulation
- 100mm R2.5 Glasswool Building Blanket from Fletcher Insulation
- 90mm R2.5 Bradford Gold Wall Batts from Bradford Insulation
- 160mm R2.5 thermal batts from Tontine Insulation
- 65mm R2.9 Dow Tuff-R PIR board from Proctor Group

Note that if the actual construction layer does not allow a 20mm air gap then the insulation layer must achieve R2.6 (insulation only value).

Table 15: Light weight (e.g. metal cladding) wall achieving R2.3

| Material Description | Thickness (mm) | k W/m.K | R (m ² .K/W) |
|----------------------------------------------------------------------|-------------------|------------|----------------------------|
| Outdoor air film | | | 0.03 |
| Metal cladding - Alucobond | 1.2 | 210 | 0.000006 |
| Minimum insulation (thickness shown is for polystyrene k=0.032W/m.K) | 64 | 0.032 | 2.00 |
| Air gap - 20mm | 13 | 0.17 | 0.15 |
| Internal Colourbond steel liner | 1.2 | 210 | 0.000006 |
| Indoor air film | | | 0.12 |
| R total | | | 2.30 |
| U=1/R_t | | | 0.435 |

The following bullet points list insulation options that can achieve the minimum total R-value:

- 90mm R2.0 Pink Batts from Fletcher Insulation
- 75mm R2.0 Bradford Gold Wall Batts from Bradford Insulation
- 90mm R2.0 thermal batts from Tontine Insulation
- 45mm R2.0 Dow Tuff-R PIR board from Proctor Group

Table 16: Typical Internal Wall Construction – Achieving R1.8

| Material Description | Thickness (mm) | k W/m.K | R (m ² .K/W) |
|----------------------------------------------------------------------|-------------------|------------|----------------------------|
| Indoor air film | | | 0.12 |
| 13mm gypsum plasterboard | 13 | 0.17 | 0.08 |
| Minimum insulation (thickness shown is for polystyrene k=0.032W/m.K) | 45 | 0.032 | 1.41 |
| 13mm gypsum plasterboard | 13 | 0.17 | 0.08 |
| Indoor air film | | | 0.12 |
| R total | | | 1.80 |
| U=1/R_t | | | 0.556 |

Alternative insulation options are:

- 65mm R1.5 Pink Batts from Fletcher Insulation
- 75mm R1.5 Bradford Gold Wall Batts

**Table 17: Typical Internal Wall Construction – Achieving R1.0**

| Material Description | Thickness | k | R |
|----------------------------------------------------------------|-----------|-------|-----------------------|
| | (mm) | W/m.K | (m ² .K/W) |
| Indoor air film | | | 0.12 |
| 13mm gypsum plasterboard | 13 | 0.17 | 0.08 |
| Minimum insulation (thickness shown is for mineral wool batts) | 28 | 0.045 | 0.62 |
| 13mm gypsum plasterboard | 13 | 0.17 | 0.08 |
| Indoor air film | | | 0.12 |
| R total | | | 1.02 |
| U=1/R_t | | | 0.985 |

Alternative insulation options are:

- 65mm R1.5 Pink Batts from Fletcher Insulation
- 75mm R1.5 Bradford Gold Wall Batts

Table 18: Typical Floor Construction – 200mm Concrete Slab Ceiling Achieving R2.0

| Material Description | Thickness | k | R |
|----------------------------------------------------------------------|-----------|-------|-----------------------|
| | (mm) | W/m.K | (m ² .K/W) |
| Indoor air film | | | 0.16 |
| 200mm concrete slab | 200 | 1.44 | 0.14 |
| Minimum insulation (thickness shown is for polystyrene k=0.032W/m.K) | 51 | 0.032 | 1.59 |
| Indoor air film | | | 0.16 |
| R total | | | 2.01 |
| U=1/R_t | | | 0.5 |

Alternative insulation options are:

- 35mm R2.05 Kooltherm K10 Soffit board from Kingspan
- 50mm R1.78 CGSODP Zero (Doeslife) – XPS Composite Global Solutions

Table 19: Typical Roof Construction – R3.7 not more than 0.6 Solar Absorptance value

| Material Description | Thickness | Conductivity (k) | R |
|----------------------------------------------------------------|-----------|------------------|-----------------------|
| | (mm) | W/m.K | (m ² .K/W) |
| Outdoor air film | | | 0.03 |
| Metal cladding | 1.2 | 210 | 0.000006 |
| Minimum insulation (thickness shown is for mineral wool batts) | 147 | 0.045 | 3.27 |
| 20mm air gap | | | 0.15 |
| 150mm concrete wall | 150 | 1.44 | 0.10 |
| Indoor air film | | | 0.16 |
| R total | | | 3.71 |



| Material Description | Thickness | Conductivity (k) | R |
|----------------------|-----------|------------------|-----------------------|
| | (mm) | W/m.K | (m ² .K/W) |
| U=1/R _t | | | 0.27 |

Alternative insulation options are:

- 165mm R3.5 Knauf Insulation



9.3 Appendix C – Glazing Calculators

Table 20: Glazing Calculator – Minimum Glazing Performance for GF

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility** Application: **other** Climate zone: **5**

Storey: **Ground Floor**

Facade areas:

| | N | NE | E | SE | S | SW | W | NW | internal |
|------------------|---------|----|---------|----|---------|----|---------|----|----------|
| Option A | 386.6m² | | 485.9m² | | 150.991 | | 315.058 | | |
| Option B | | | | | | | | | n/a |
| Glazing area (A) | 182m² | | 3.89m² | | 1.11m² | | 4.24m² | | |

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|-----------|-----------------------------|--------------------------|----------------------------------------------|-------|---------|-------|---------------------------|---------------------------|----------------|--------------------------------------|
| ID | Description (optional) | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes |
| | | Option A facades | Option B facades | Height (m) | Width (m) | Area (m²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _H) | Cooling (S _C) | Area used (m²) | Element share of % of allowance used |
| 1 | North | N | | | | 181.71 | 5.8 | 0.35 | | | | 0.00 | 1.00 | 1.00 | 181.71 | 100% of 99% |
| 2 | East | E | | | | 3.89 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 3.89 | 100% of 5% |
| 3 | South | S | | | | 1.11 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 1.11 | 100% of 2% |
| 4 | West | W | | | | 4.24 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 4.24 | 100% of 8% |

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if inputs are valid

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Table 21: Glazing Calculator – Minimum Glazing Performance for L01

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility** Application: **other** Climate zone: **5**

Storey: **Level 01**

Facade areas:

| | N | NE | E | SE | S | SW | W | NW | internal |
|------------------|---------|----|-------|----|---------|----|---------|----|----------|
| Option A | 385.4m² | | 434m² | | 159.913 | | 399.555 | | |
| Option B | | | | | | | | | n/a |
| Glazing area (A) | 122m² | | 35m² | | 18.9m² | | 18.1m² | | |

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|-----------|-----------------------------|--------------------------|----------------------------------------------|-------|---------|-------|---------------------------|---------------------------|----------------|--------------------------------------|
| ID | Description (optional) | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes |
| | | Option A facades | Option B facades | Height (m) | Width (m) | Area (m²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _H) | Cooling (S _C) | Area used (m²) | Element share of % of allowance used |
| 1 | North | N | | | | 122.06 | 5.8 | 0.48 | | | | 0.00 | 1.00 | 1.00 | 122.06 | 100% of 100% |
| 2 | East | E | | | | 35.04 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 35.04 | 100% of 49% |
| 3 | South | S | | | | 18.90 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 18.90 | 100% of 30% |
| 4 | West | W | | | | 18.14 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 18.14 | 100% of 25% |

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Table 22: Glazing Calculator – Minimum Glazing Performance for L02

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility**

Application: **other** Climate zone: **5**

Storey: **Level 02**

Facade areas:

| | N | NE | E | SE | S | SW | W | NW | internal |
|----------|---------------------|----|---------------------|----|---------|----|---------|----|----------|
| Option A | 157.1m ² | | 412.2m ² | | 126.905 | | 199.327 | | |
| Option B | | | | | | | | | n/a |

Glazing area (A): 19.3m² 33.31m² 52.61m² 14.28m²

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|------------------------|-----------------------------|--------------------------|---------------|---------|---------|----------------------------------------------|---------------------------|---------------------------|-----------------------------|--------------------------------------|--|
| Glazing element | | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes | |
| ID | Description (optional) | Option A facades | Option B facades | Height (m) | Width (m) | Area (m ²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _H) | Cooling (S _C) | Area used (m ²) | Element share of % of allowance used | |
| 1 | North | N | | | | 19.30 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 19.30 | 100% of 82% | |
| 2 | East | E | | | | 33.31 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 33.31 | 100% of 49% | |
| 3 | South | S | | | | 52.6 | 6.7 | 0.90 | | | | 0.00 | 1.00 | 1.00 | 52.61 | 100% of 99% | |
| 4 | West | W | | | | 14.28 | 7.0 | 0.93 | | | | 0.00 | 1.00 | 1.00 | 14.28 | 100% of 39% | |

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Table 23: Glazing Calculator – Minimum Glazing Performance for L03

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility**

Application: **other** Climate zone: **5**

Storey: **Level 03**

Facade areas:

| | N | NE | E | SE | S | SW | W | NW | internal |
|----------|-------------------|----|-------------------|----|---------|----|--------|----|----------|
| Option A | 221m ² | | 294m ² | | 219.705 | | 520.65 | | |
| Option B | | | | | | | | | n/a |

Glazing area (A): 101m² 136m² 101m² 240m²

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|------------------------|-----------------------------|--------------------------|---------------|---------|---------|----------------------------------------------|---------------------------|---------------------------|-----------------------------|--------------------------------------|--|
| Glazing element | | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes | |
| ID | Description (optional) | Option A facades | Option B facades | Height (m) | Width (m) | Area (m ²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _H) | Cooling (S _C) | Area used (m ²) | Element share of % of allowance used | |
| 1 | North | N | | | | 100.64 | 5.7 | 0.36 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 100% | |
| 2 | East | E | | | | 135.87 | 5.7 | 0.33 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 100% | |
| 3 | South | S | | | | 100.6 | 5.7 | 0.31 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 100% | |
| 4 | West | W | | | | 240.08 | 5.7 | 0.31 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 100% | |

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 The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

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Table 24: Glazing Calculator Uniform Solution – GF

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility** Application: **other** Climate zone: **5**

Storey: **Ground Floor**

| Facade areas | | N | NE | E | SE | S | SW | W | NW | Internal |
|------------------|--|-------------------|----|--------------------|----|--------------------|----|--------------------|----|----------|
| Option A | | 387m ² | | 486m ² | | 150.99 | | 315.06 | | |
| Option B | | | | | | | | | | n/a |
| Glazing area (A) | | 182m ² | | 3.89m ² | | 1.11m ² | | 4.24m ² | | |

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|------------------------|-----------------------------|--------------------------|---------------|---------|---------|----------------------------------------------|---------------------------|---------------------------|-----------------------------|--------------------------------------|--|
| Glazing element | | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes | |
| ID | Description (optional) | Option A facades | Option B facades | Height (m) | Width (m) | Area (m ²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _u) | Cooling (S _c) | Area used (m ²) | Element share of % of allowance used | |
| 1 | North | N | | | | 181.71 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 98% | |
| 2 | East | E | | | | 3.89 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 3.89 | 100% of 2% | |
| 3 | South | S | | | | 1.11 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 1.11 | 100% of 2% | |
| 4 | West | W | | | | 4.24 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 4.24 | 100% of 3% | |

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if inputs are valid

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Table 25: Glazing Calculator Uniform Solution – L01

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility** Application: **other** Climate zone: **5**

Storey: **Level 01**

| Facade areas | | N | NE | E | SE | S | SW | W | NW | Internal |
|------------------|--|-------------------|----|-------------------|----|--------------------|----|--------------------|----|----------|
| Option A | | 385m ² | | 434m ² | | 159.91 | | 399.55 | | |
| Option B | | | | | | | | | | n/a |
| Glazing area (A) | | 122m ² | | 35m ² | | 18.9m ² | | 18.1m ² | | |

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|------------------------|-----------------------------|--------------------------|---------------|---------|---------|----------------------------------------------|---------------------------|---------------------------|-----------------------------|--------------------------------------|--|
| Glazing element | | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes | |
| ID | Description (optional) | Option A facades | Option B facades | Height (m) | Width (m) | Area (m ²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _u) | Cooling (S _c) | Area used (m ²) | Element share of % of allowance used | |
| 1 | North | N | | | | 122.06 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 66% | |
| 2 | East | E | | | | 35.04 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 35.04 | 100% of 18% | |
| 3 | South | S | | | | 18.90 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 18.90 | 100% of 22% | |
| 4 | West | W | | | | 18.14 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 18.14 | 100% of 10% | |

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR
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if inputs are valid

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Table 26: Glazing Calculator Uniform Solution – L02

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility** Application: **other** Climate zone: **5**

Storey: **Level 02**

Facade areas:

| | N | NE | E | SE | S | SW | W | NW | Internal |
|------------------|---------------------|----|---------------------|----|--------------------|----|--------------------|----|----------|
| Option A | 157.1m ² | | 412.2m ² | | 126.905 | | 199.327 | | |
| Option B | | | | | | | | | n/a |
| Glazing area (A) | 19.3m ² | | 33.3m ² | | 52.6m ² | | 14.3m ² | | |

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|------------------------|-----------------------------|--------------------------|----------------------------------------------|-------|---------|-------|---------------------------|---------------------------|-----------------------------|--------------------------------------|
| Glazing element | | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes |
| ID | Description (optional) | Option A facades | Option B facades | Height (m) | Width (m) | Area (m ²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _a) | Cooling (S _c) | Area used (m ²) | Element share of % of allowance used |
| 1 | North | N | | | | 19.30 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 19.30 | 100% of 26% |
| 2 | East | E | | | | 33.31 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 33.31 | 100% of 18% |
| 3 | South | S | | | | 52.6 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 52.61 | 100% of 77% |
| 4 | West | W | | | | 14.28 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | 14.28 | 100% of 16% |
| 5 | | | | | | | | | | | | | | | | |

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if inputs are valid

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Table 27: Glazing Calculator Uniform Solution – L03

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: **Qantas Flight Training Facility** Application: **other** Climate zone: **5**

Storey: **Level 03**

Facade areas:

| | N | NE | E | SE | S | SW | W | NW | Internal |
|------------------|-------------------|----|-------------------|----|-------------------|----|-------------------|----|----------|
| Option A | 221m ² | | 294m ² | | 219.705 | | 520.65 | | |
| Option B | | | | | | | | | n/a |
| Glazing area (A) | 101m ² | | 136m ² | | 101m ² | | 240m ² | | |

Number of rows preferred in table below: **5** (as currently displayed)

| GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS | | | | | | | SHADING | | CALCULATED OUTCOMES OK (if inputs are valid) | | | | | | | |
|----------------------------------------------------------------------------|------------------------|------------------|------------------|------------|-----------|------------------------|-----------------------------|--------------------------|----------------------------------------------|-------|---------|-------|---------------------------|---------------------------|-----------------------------|--------------------------------------|
| Glazing element | | Facing sector | | Size | | | Performance | | P&H or device | | Shading | | Multipliers | | Size | Outcomes |
| ID | Description (optional) | Option A facades | Option B facades | Height (m) | Width (m) | Area (m ²) | Total System U-Value (AFRC) | Total System SHGC (AFRC) | P (m) | H (m) | P/H | G (m) | Heating (S _a) | Cooling (S _c) | Area used (m ²) | Element share of % of allowance used |
| 1 | North | N | | | | 100.64 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 95% |
| 2 | East | E | | | | 135.87 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 100% |
| 3 | South | S | | | | 100.6 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 85% |
| 4 | West | W | | | | 240.08 | 4.9 | 0.33 | | | | 0.00 | 1.00 | 1.00 | ##### | 100% of 100% |
| 5 | | | | | | | | | | | | | | | | |

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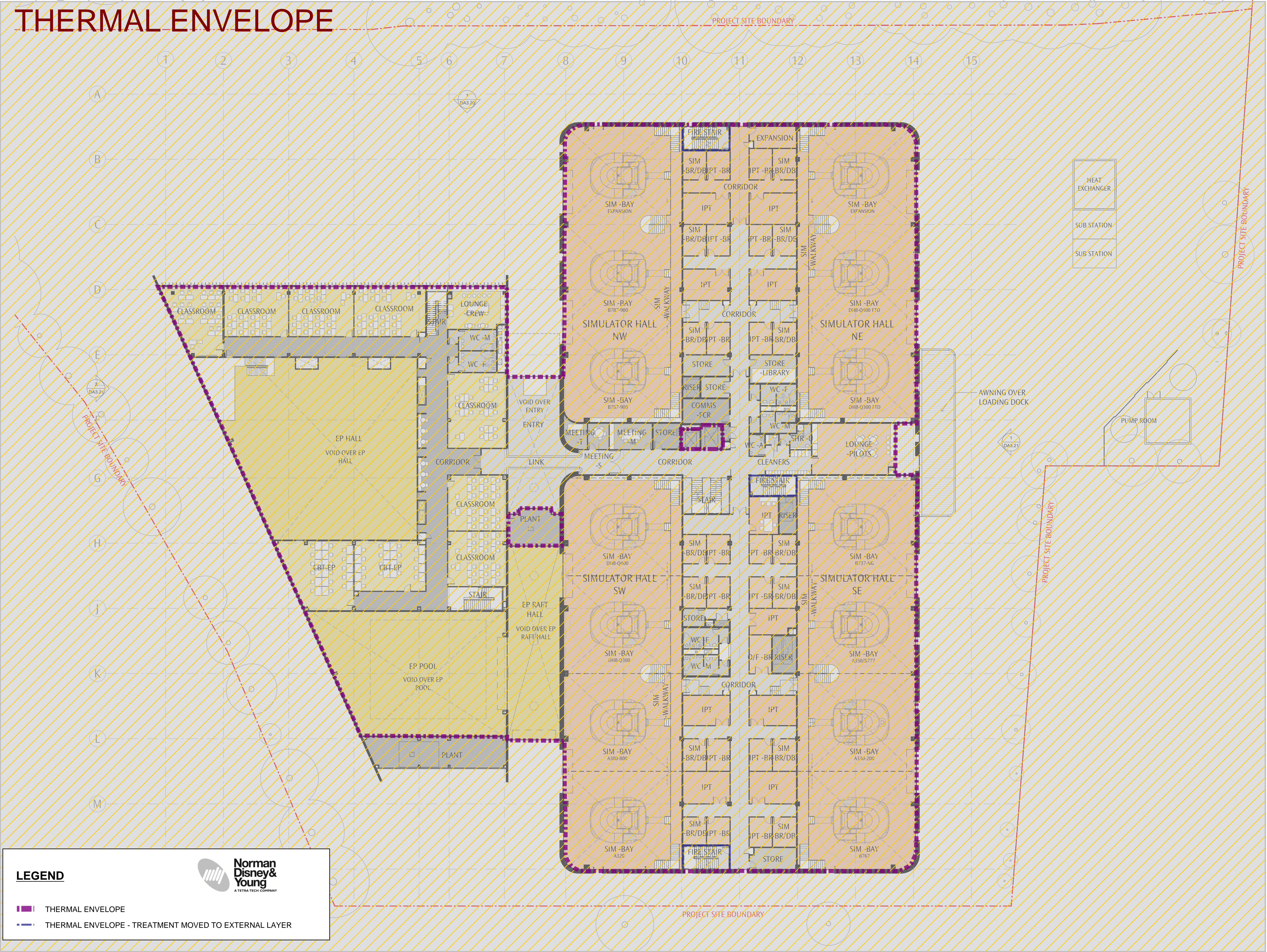
9.4 Appendix D – Thermal Envelope Mark-ups

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NGA-S1822-DWG-DA3.01

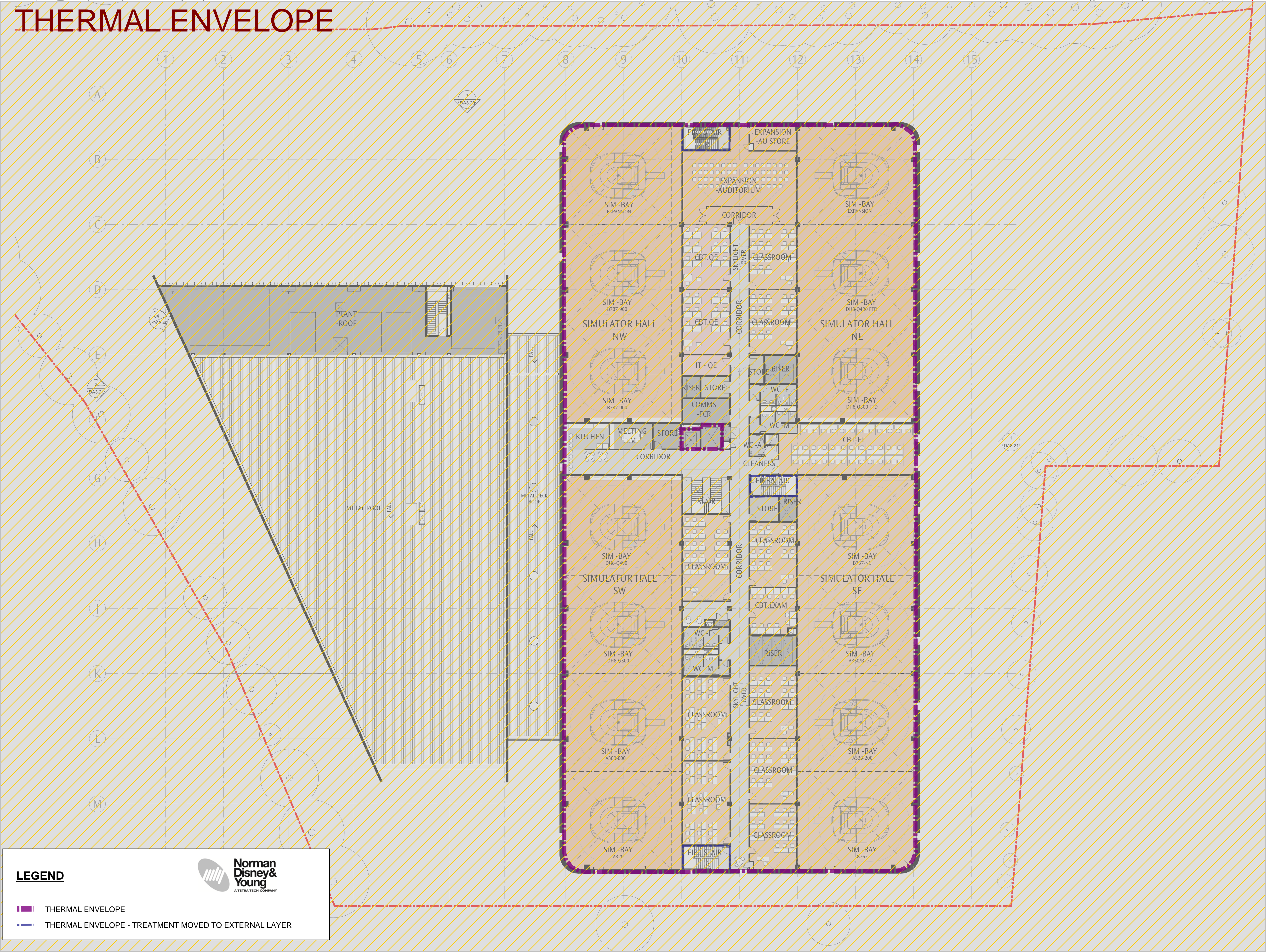
THERMAL ENVELOPE

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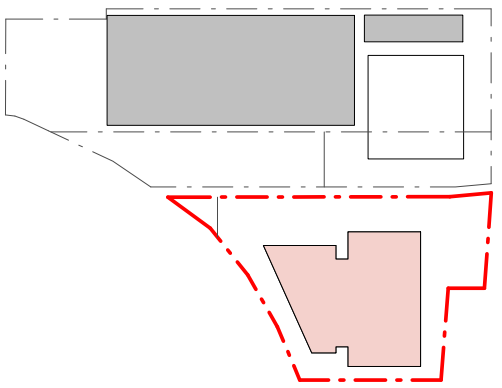


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| Title: THERMAL ENVELOPE - L02 | | | | |
| Document Number: NDY-ESD-SJ-TE003 | | | | |
| Project No: s25504-0148 | Drawn: NN | Date: 14/04/2019 | Scale: NTS | Rev: 1.0 |



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THERMAL ENVELOPE

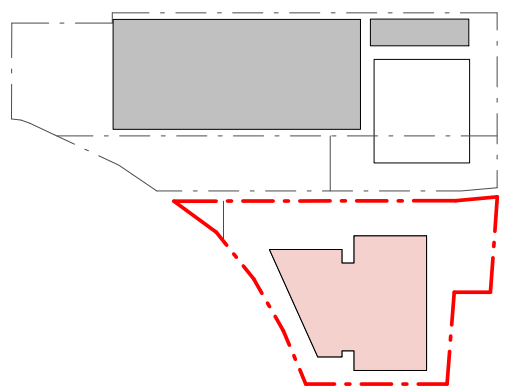
LEGEND

- THERMAL ENVELOPE
- THERMAL ENVELOPE - TREATMENT MOVED TO EXTERNAL LAYER

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The floor plan shows a building layout with a thermal envelope highlighted in purple. The envelope follows the perimeter of the main building footprint, including internal courtyards and service areas. Rooms labeled include: MEETING PROJECT, MEETING UTILITY, OFFICE OPEN PLAN, MEETING PROJECT, MEETING UTILITY, PLANT, COMMS + FCR, WC-F, WC-M, WC-A, CLEANERS, CORRIDOR, MEETING M, MEETING M, VIDEO ROOM, STORE COMPACTS, WC-F, WC-M, OFFICE UTILITY, OFFICE OPEN PLAN, MEETING, OFFICE UTILITY, and MEETING FIRE STAIR. Other features include a ROOF PLANT, KITCHEN, WINTER GARDEN, and METAL ROOF BELOW. A red dashed line indicates the thermal envelope boundary. A legend in the bottom left corner explains the symbols used.

| | | | | | | | | | | |
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| Document Number: NDY-ESD-SJ-TE004 | | | | | | | | | | |
| Project No: S25504-0148 | | | Drawn:NN | | Date:14/04/2019 | | Scale: NTS | | Rev: 1.0 | |



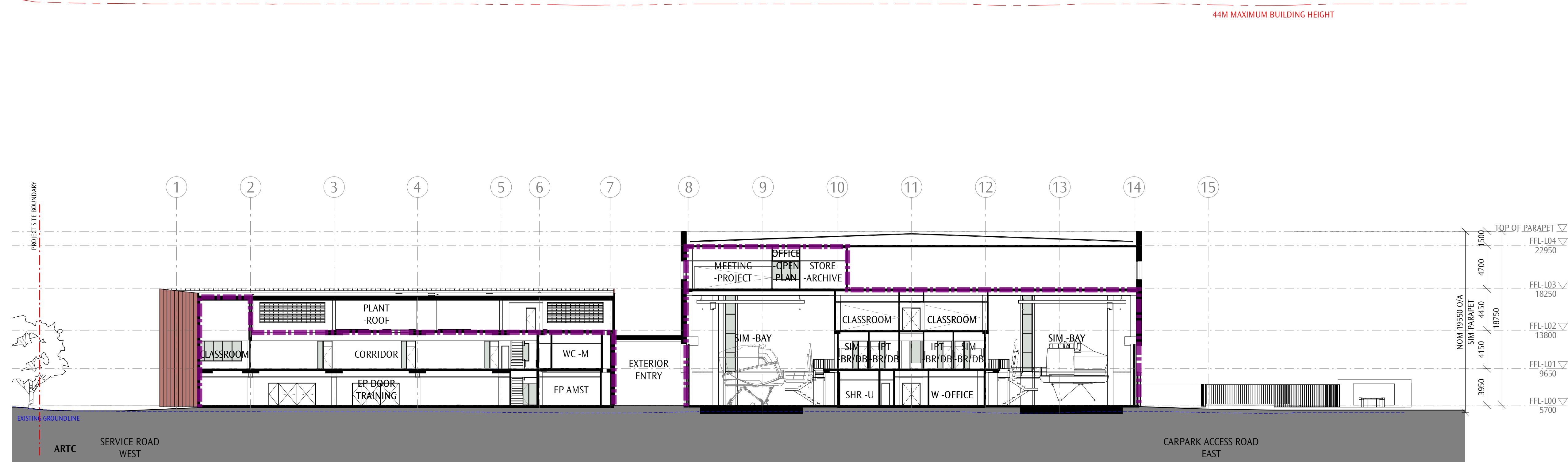
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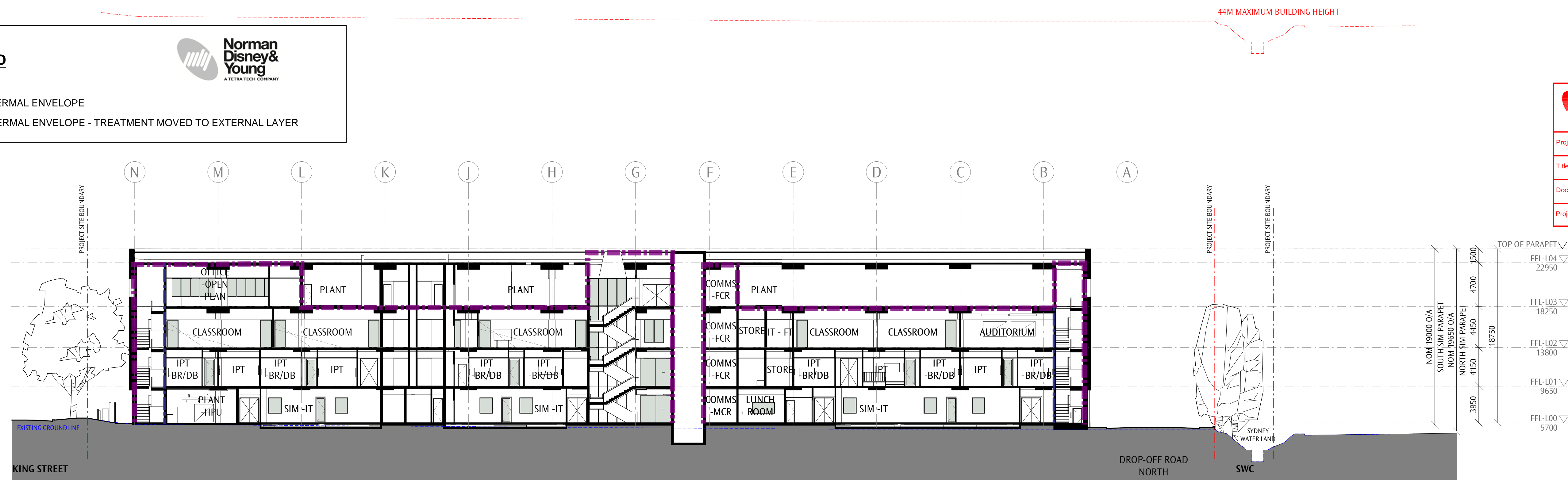


1 SECTION A
1 : 250

LEGEND

- THERMAL ENVELOPE
- THERMAL ENVELOPE - TREATMENT MOVED TO EXTERNAL LAYER

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2 SECTION B
1 : 250

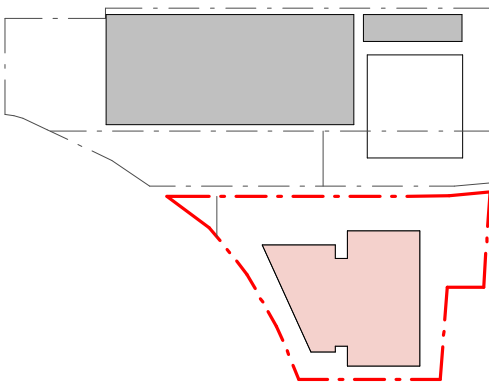
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Project: QANTAS FLIGHT TRAINING CENTRE

Title: THERMAL ENVELOPE - SECTION 1

Document Number: NDY-ESD-SJ-TE005

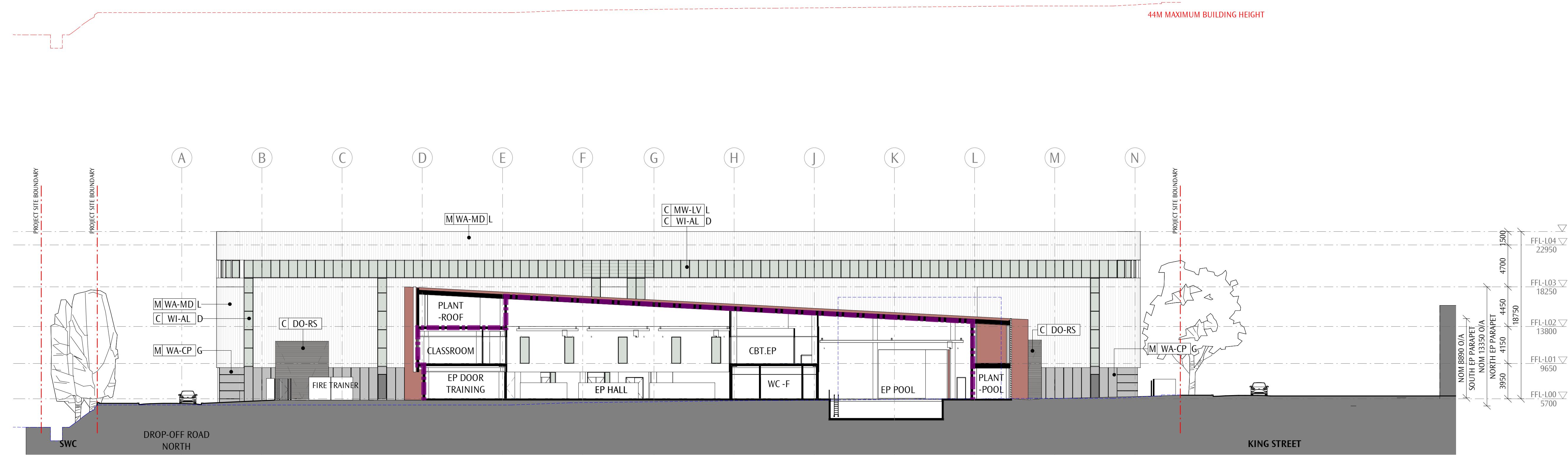
Project No: s25504-0148 Drawn: NN Date: 14/04/2019 Scale: NTS Rev: 1.0



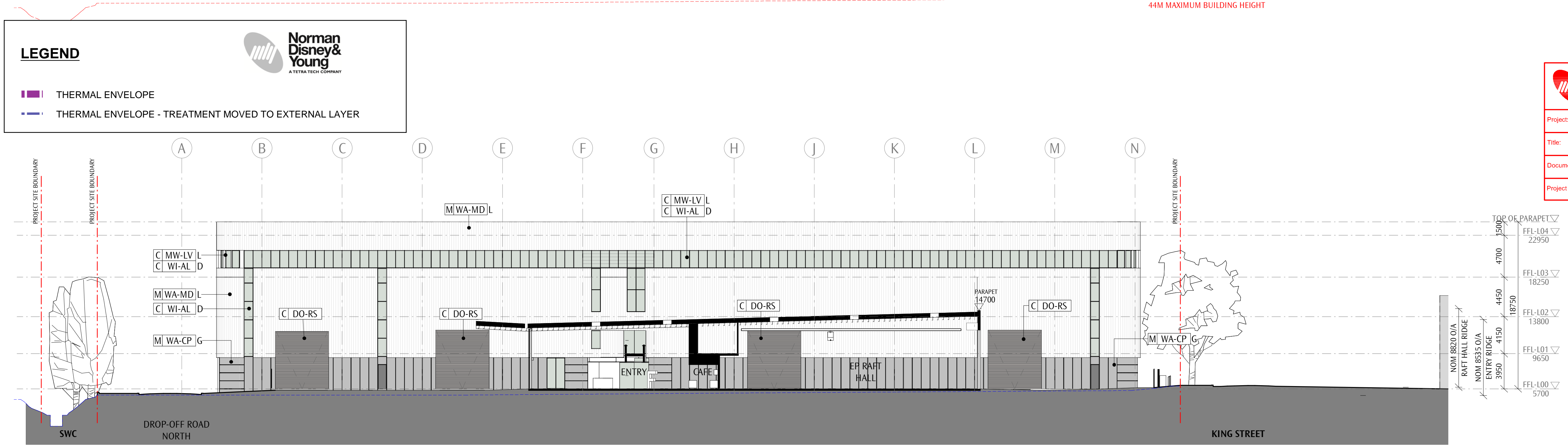
| A1 | SSD APPLICATION | 2019.04.11 |
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| REV | REASON FOR ISSUE | DATE |

THERMAL ENVELOPE

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3 SECTION C
1 : 250



4 SECTION D
1 : 250

LEGEND

- THERMAL ENVELOPE
- THERMAL ENVELOPE - TREATMENT MOVED TO EXTERNAL LAYER

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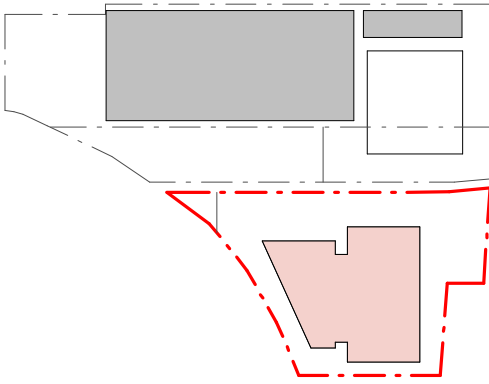
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Project: QANTAS FLIGHT TRAINING CENTRE

Title: THERMAL ENVELOPE - SECTION 2

Document Number: NDY-ESD-SJ-TE006

Project No: s25504-0148 | Drawn: NN | Date: 14/04/2019 | Scale: NTS | Rev: 1.0

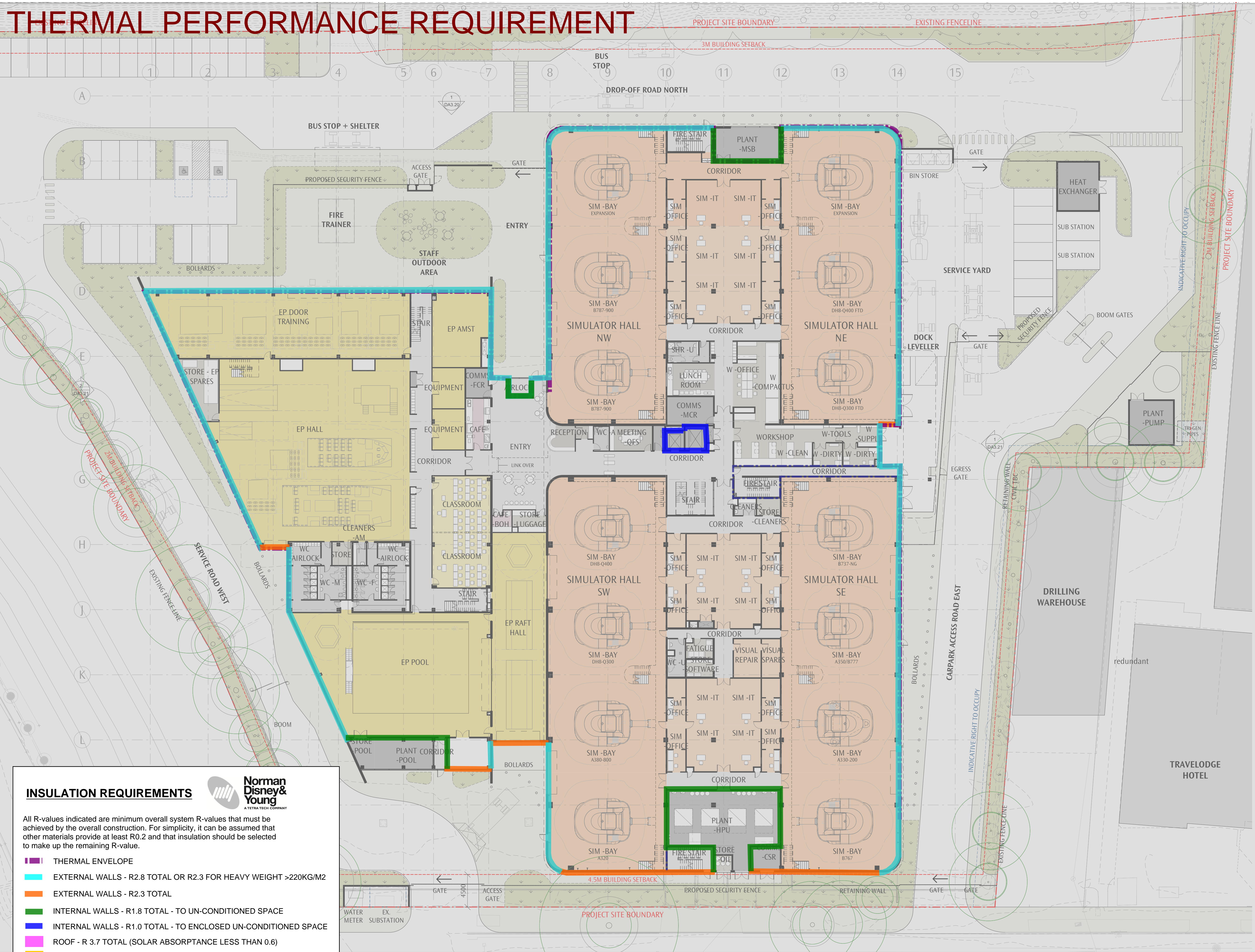


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| A1 | SSD APPLICATION | 2019.04.11 |
| REV | REASON FOR ISSUE | DATE |



9.5 Appendix E – Thermal Performance Requirement Mark-ups

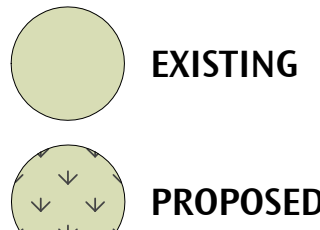
THERMAL PERFORMANCE REQUIREMENT



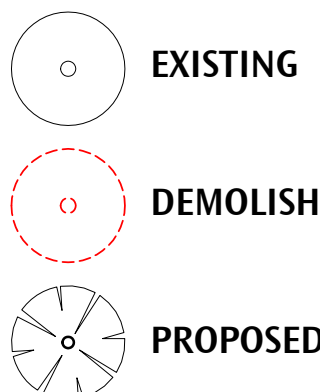
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LEGEND

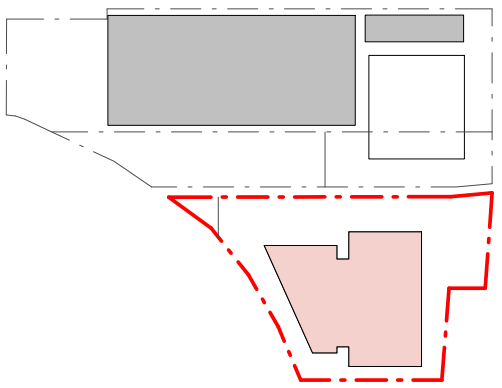
LANDSCAPE



TREES



| | | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------|------------|----------|
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| Project: QANTAS FLIGHT TRAINING CENTRE | | | | |
| Title: THERMAL PERFORMANCE REQUIREMENT -GF | | | | |
| Document Number: NDY-ESD-SJ-TP001 | | | | |
| Project No: s25504-0148 | Drawn: NN | Date: 14/04/2019 | Scale: NTS | Rev: 1.0 |



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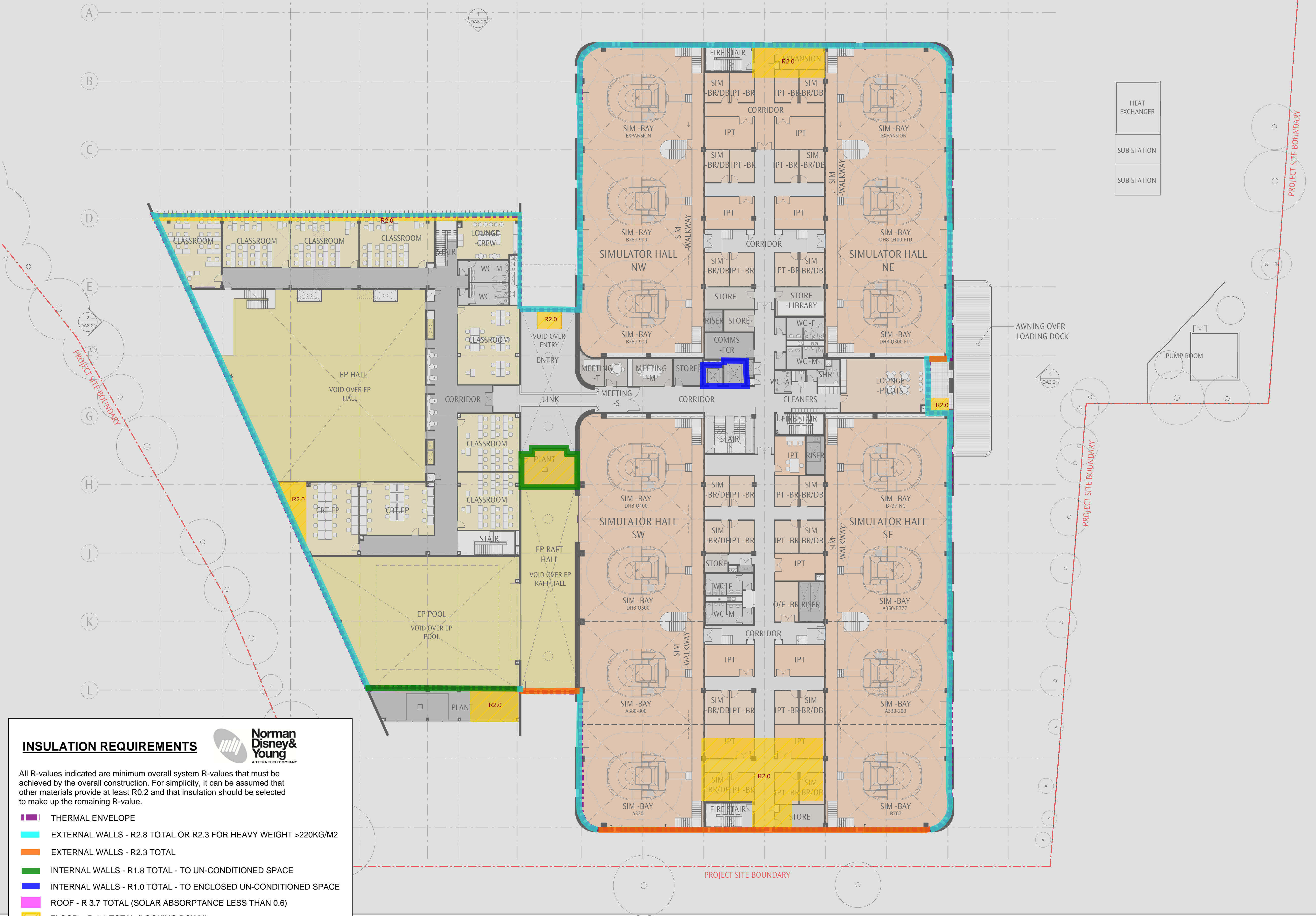
PRELIMINARY
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THERMAL PERFORMANCE REQUIREMENT

PROJECT SITE BOUNDARY

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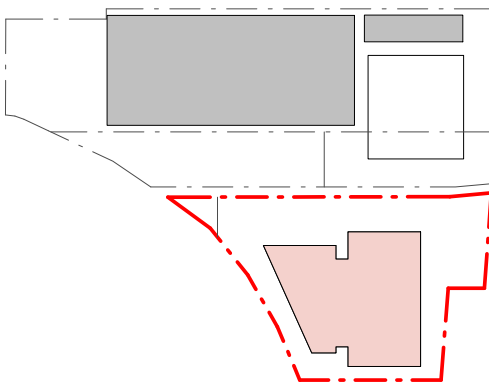
INSULATION REQUIREMENTS



All R-values indicated are minimum overall system R-values that must be achieved by the overall construction. For simplicity, it can be assumed that other materials provide at least R0.2 and that insulation should be selected to make up the remaining R-value.

- THERMAL ENVELOPE**
- EXTERNAL WALLS - R2.8 TOTAL OR R2.3 FOR HEAVY WEIGHT >220KG/M2
- EXTERNAL WALLS - R2.3 TOTAL
- INTERNAL WALLS - R1.8 TOTAL - TO UN-CONDITIONED SPACE
- INTERNAL WALLS - R1.0 TOTAL - TO ENCLOSED UN-CONDITIONED SPACE
- ROOF - R 3.7 TOTAL (SOLAR ABSORPTANCE LESS THAN 0.6)
- FLOOR - R 2.0 TOTAL (LOOKING DOWN)
- FLOOR - R 1.0 TOTAL (LOOKING DOWN)

| | | | | | |
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| Title: THERMAL PERFORMANCE REQUIREMENT - L01 | | | | | |
| Document Number: NDY-ESD-SJ-TP002 | | | | | |
| Project No: s25504-0148 | Drawn: NN | Date: 14/04/2019 | Scale: NTS | Rev: 1.0 | |

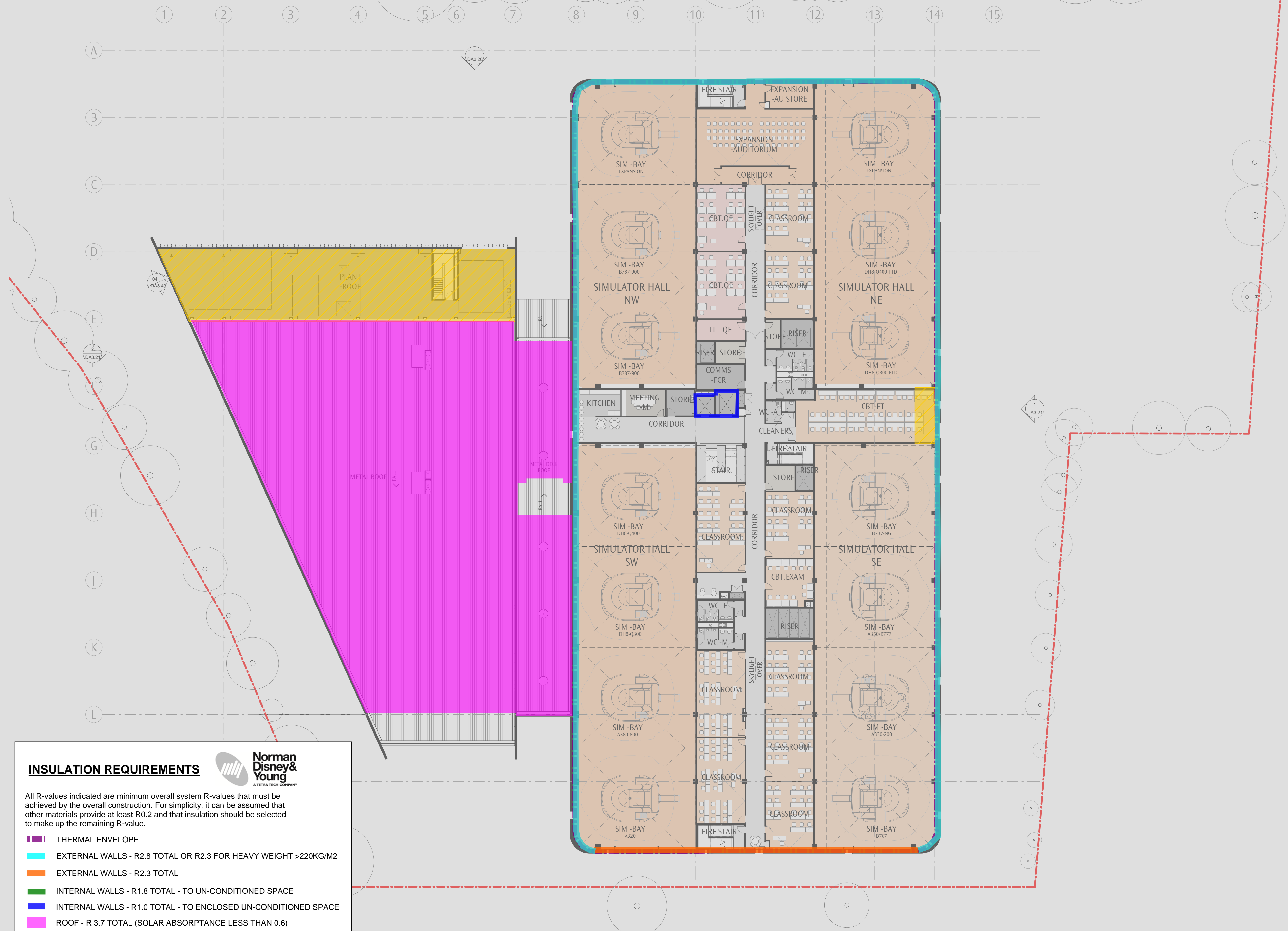


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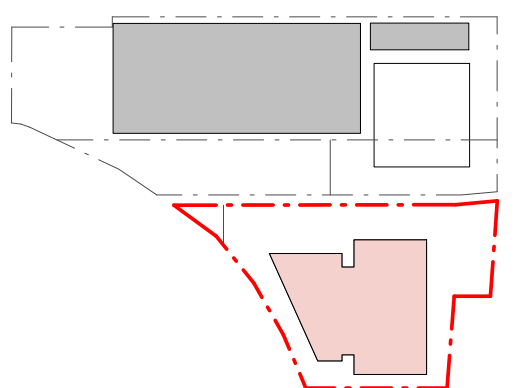


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All R-values indicated are minimum overall system R-values that must be achieved by the overall construction. For simplicity, it can be assumed that other materials provide at least R0.2 and that insulation should be selected to make up the remaining R-value.

- | | |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------|
|  | THERMAL ENVELOPE |
|  | EXTERNAL WALLS - R2.8 TOTAL OR R2.3 FOR HEAVY WEIGHT >220KG/M2 |
|  | EXTERNAL WALLS - R2.3 TOTAL |
|  | INTERNAL WALLS - R1.8 TOTAL - TO UN-CONDITIONED SPACE |
|  | INTERNAL WALLS - R1.0 TOTAL - TO ENCLOSED UN-CONDITIONED SPACE |
|  | ROOF - R 3.7 TOTAL (SOLAR ABSORPTANCE LESS THAN 0.6) |
|  | FLOOR - R 2.0 TOTAL (LOOKING DOWN) |
|  | FLOOR - R 1.0 TOTAL (LOOKING DOWN) |

| | | | |
|--------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------------------|-------------------|
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| Project: QANTAS FLIGHT TRAINING CENTRE | | | |
| Title: THERMAL PERFORMANCE REQUIREMENT - L02 | | | |
| Document Number: NDY-ESD-SJ-TP003 | | | |
| Project No: S25504-0148 | Drawn/NN | Date: 14/04/2019 | Scale: NTS |
| Rev: 1.0 | | | |




| | | |
|-----|-------------------|------------|
| D1 | FOR SEARS REQUEST | 2019.03.08 |
| REV | REASON FOR ISSUE | DATE |

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THERMAL PERFORMANCE REQUIREMENT

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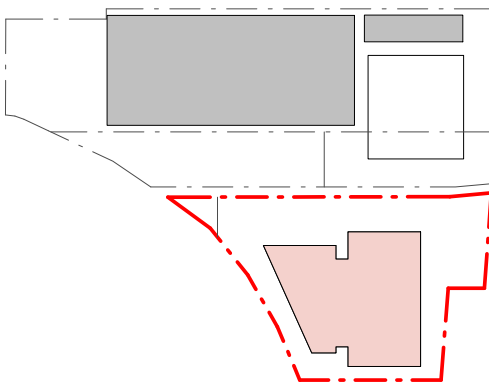
INSULATION REQUIREMENTS



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All R-values indicated are minimum overall system R-values that must be achieved by the overall construction. For simplicity, it can be assumed that other materials provide at least R0.2 and that insulation should be selected to make up the remaining R-value.

- THERMAL ENVELOPE
- EXTERNAL WALLS - R2.8 TOTAL OR R2.3 FOR HEAVY WEIGHT >220KG/M2
- EXTERNAL WALLS - R2.3 TOTAL
- INTERNAL WALLS - R1.8 TOTAL - TO UN-CONDITIONED SPACE
- INTERNAL WALLS - R1.0 TOTAL - TO ENCLOSED UN-CONDITIONED SPACE
- ROOF - R 3.7 TOTAL (SOLAR ABSORPTANCE LESS THAN 0.6)
- FLOOR - R 2.0 TOTAL (LOOKING DOWN)
- FLOOR - R 1.0 TOTAL (LOOKING DOWN)




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GENERAL NOTES
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INSULATION REQUIREMENTS

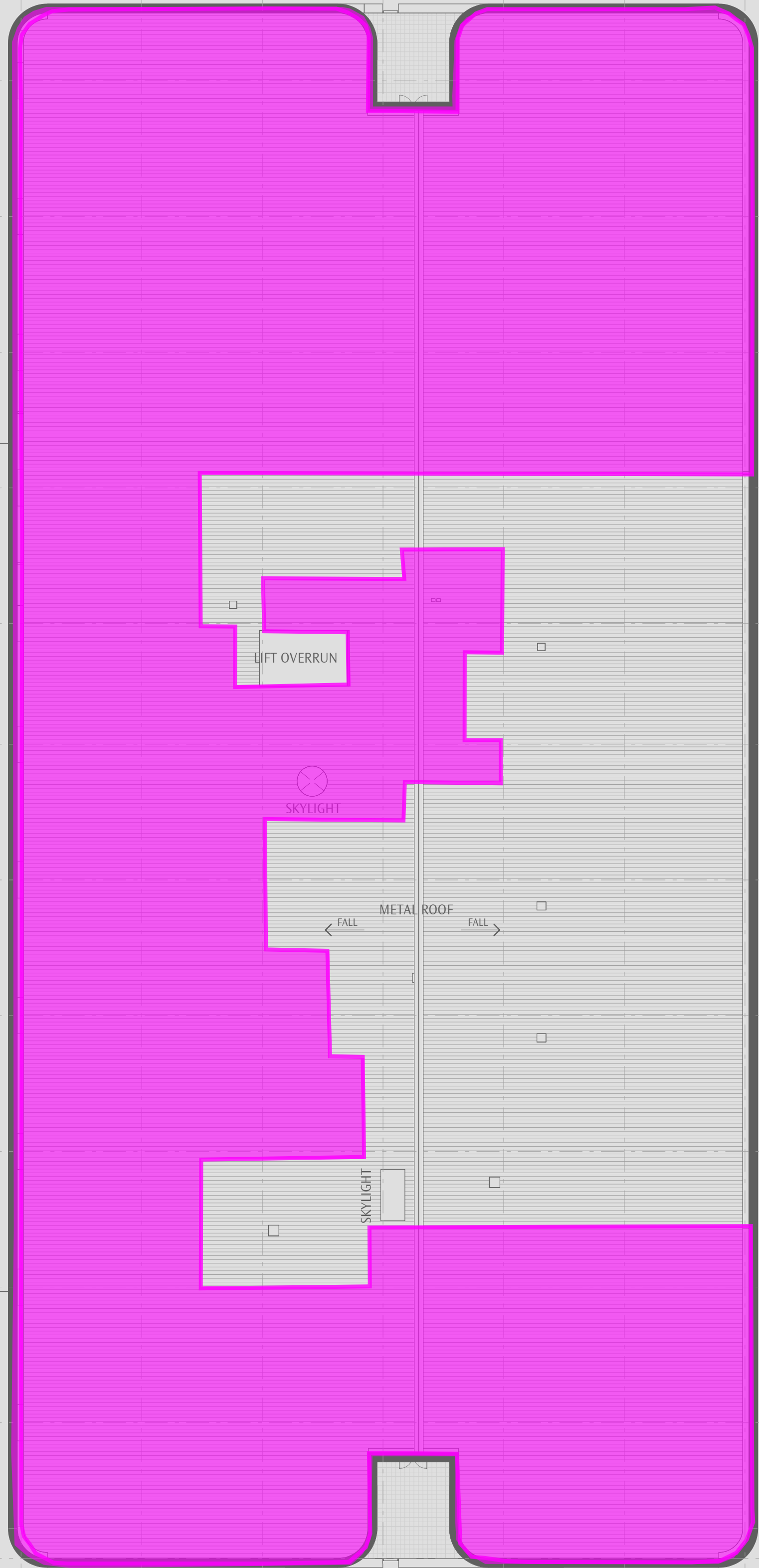



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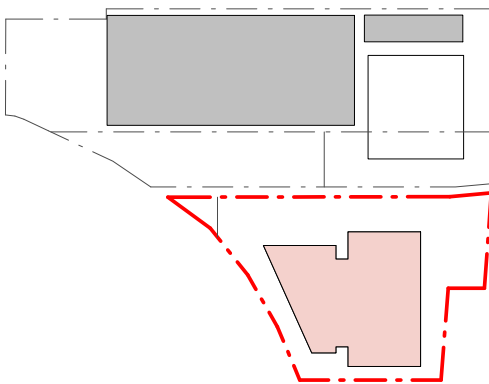
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| Project: QANTAS FLIGHT TRAINING CENTRE | | | | |
| Title: THERMAL PERFORMANCE REQUIREMENT - ROOF | | | | |
| Document Number: NDY-ESD-SJ-TP005 | | | | |
| Project No: s25504-0148 | Drawn: NN | Date: 14/04/2019 | Scale: NTS | Rev: 1.0 |

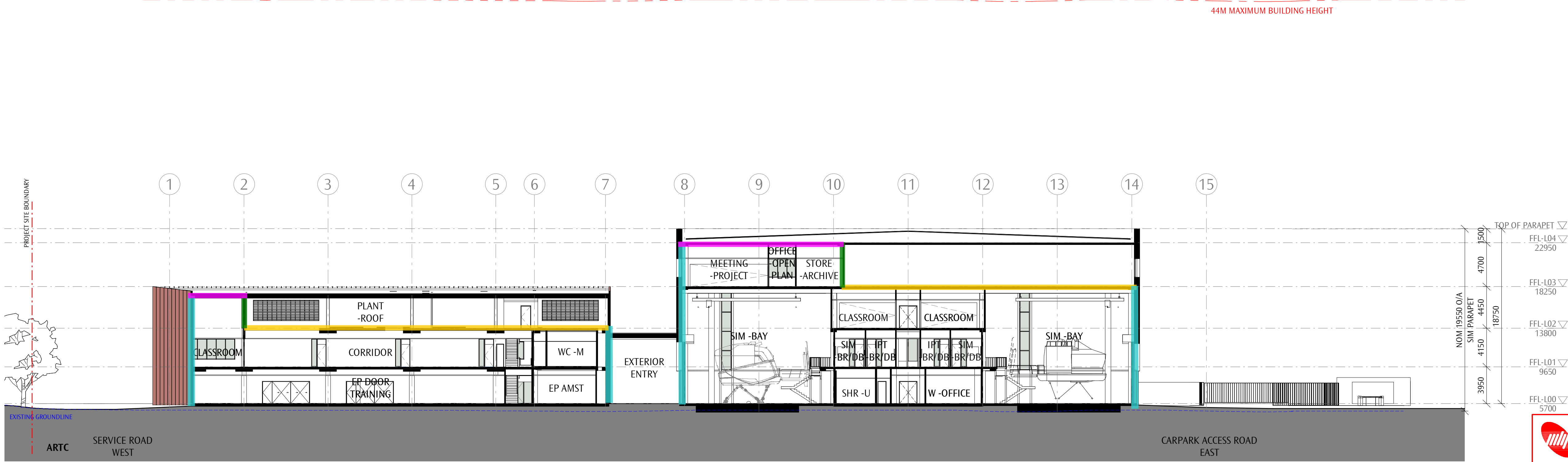


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1 SECTION A
1 : 250




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Project: QANTAS FLIGHT TRAINING CENTRE

Title: THERMAL PERFORMANCE REQUIREMENT - SECTION 1

Document Number: NDY-ESD-SJ-TP006

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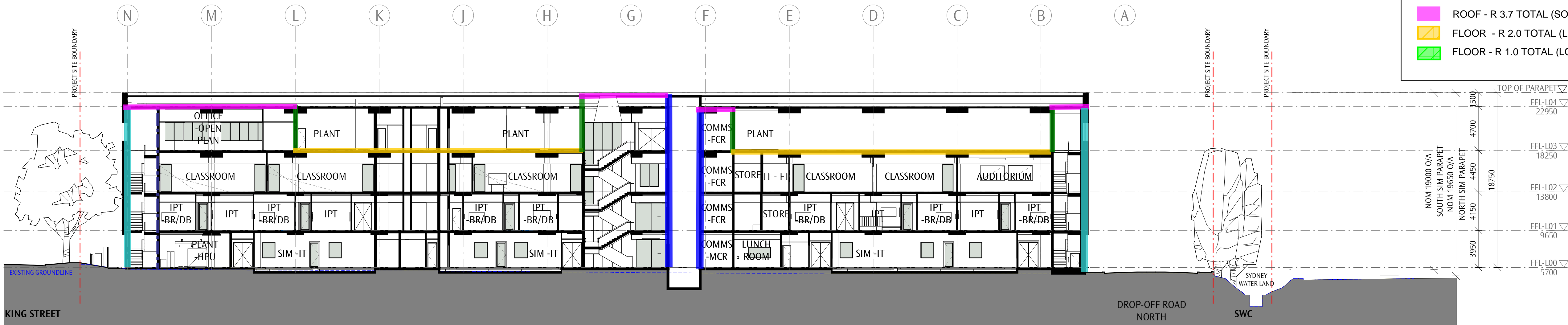


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INSULATION REQUIREMENTS

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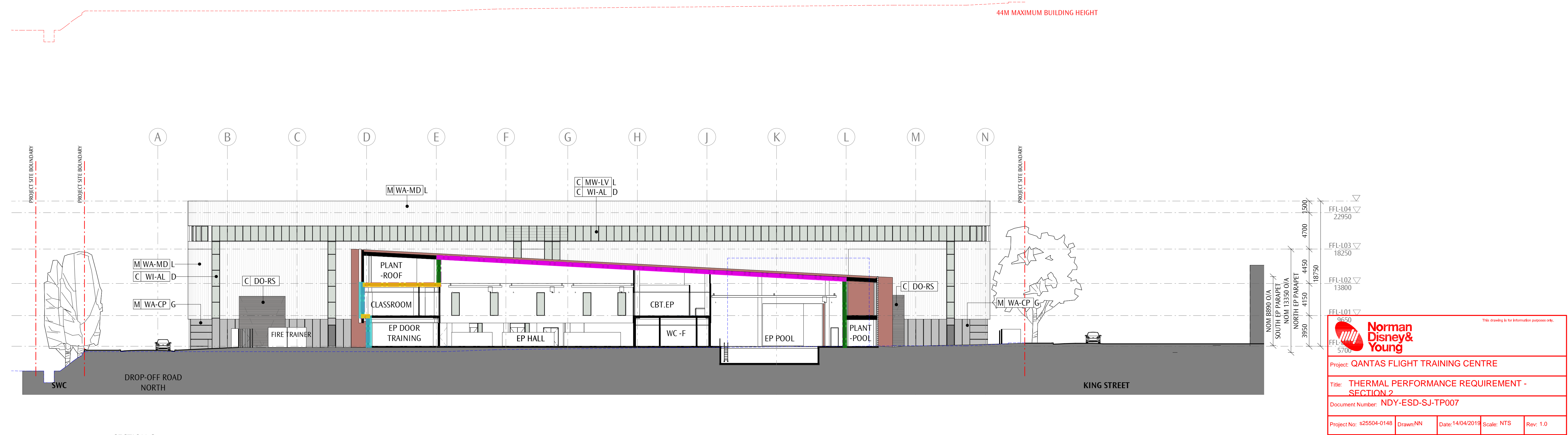


2 SECTION B
1 : 250

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| REV | REASON FOR ISSUE | DATE |

THERMAL PERFORMANCE REQUIREMENT

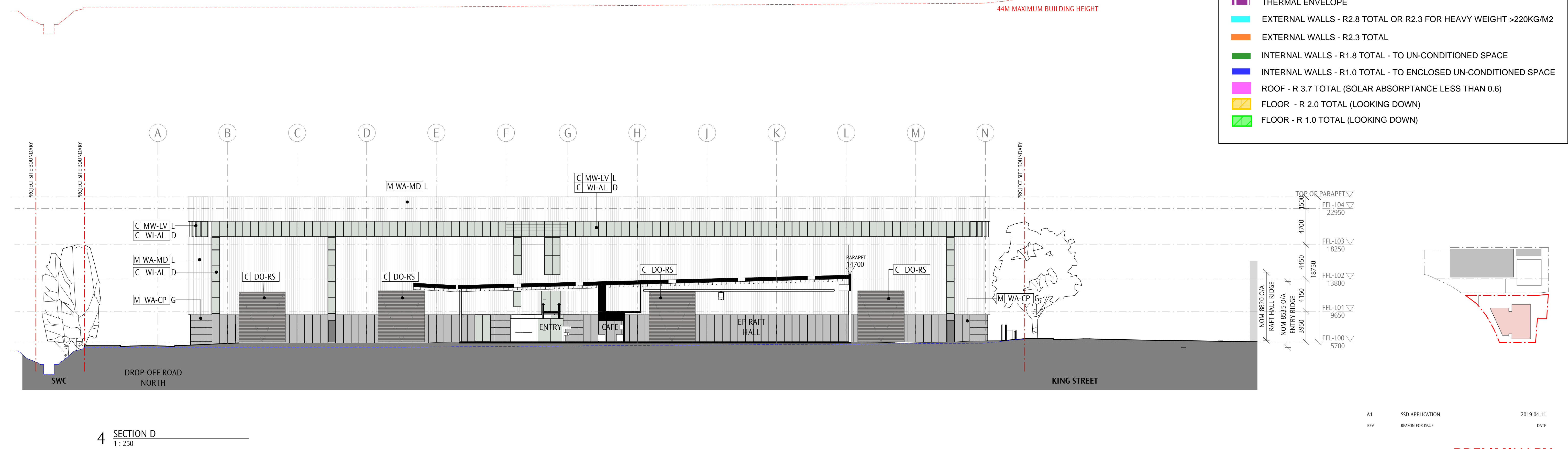
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| Revision Date: | 17 April 2019 |
| Reason Description: | For Information |
| File Location: | \\ndy.group\syd\WS255xx\S25504\148\G-124_Reports |
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| Project Leader: | Michael Lewis |
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