

Bradfield Development Authority

Building Two Advanced Manufacturing Research Facility

Section 4.55 Modification Report

Appendix L – Amended Ecologically Sustainable Development Report

21 November 2025

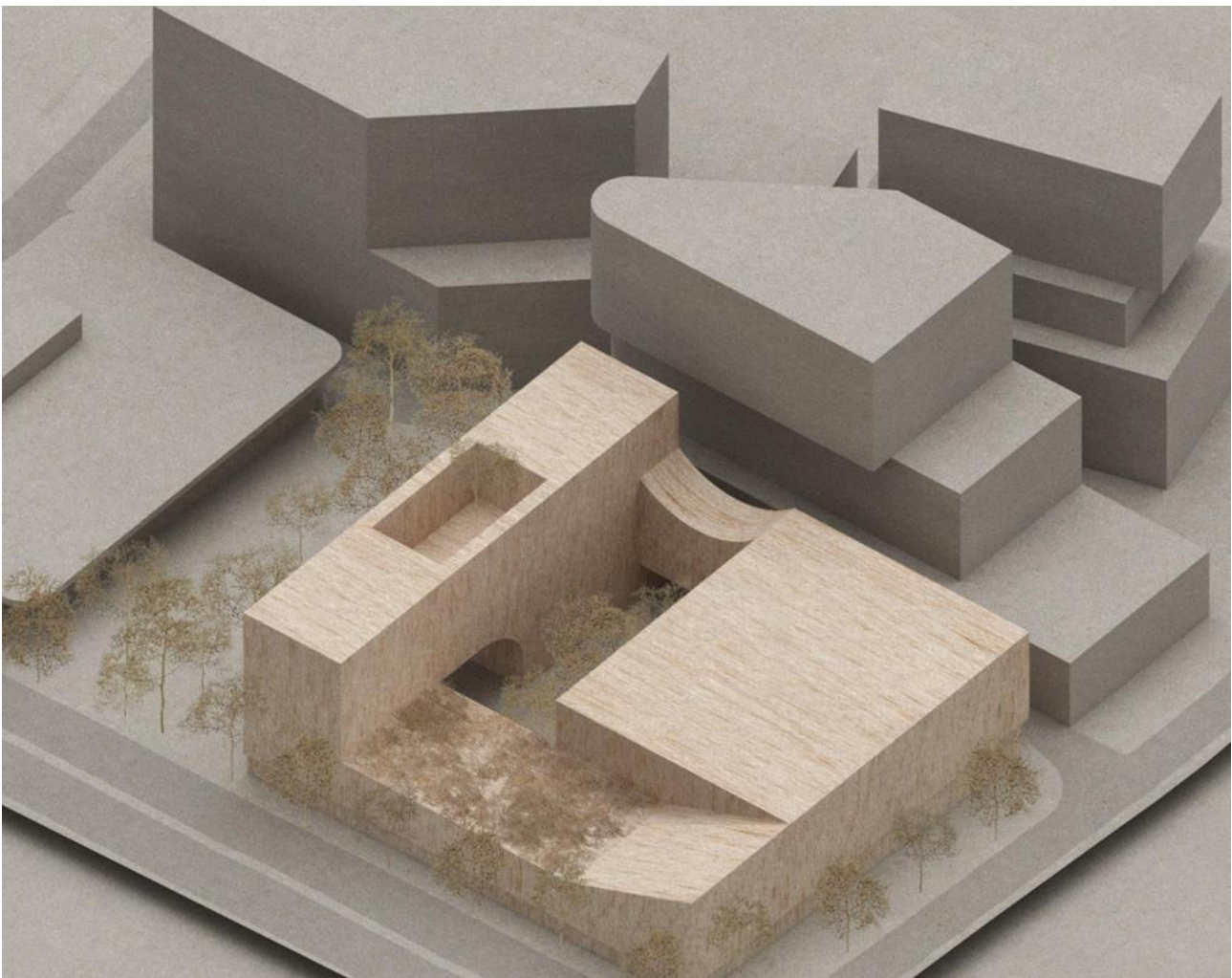
Bradfield Development Authority

Building Two, Advanced Manufacturing Readiness Facility (AMRF2)

State Significant Development Application (SSDA) - Ecologically Sustainable Development (ESD) Report

Reference: AMRFB2-ARU-REP-ES-00-00-01

5 | 21 November 2025



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1. Introduction

Development consent SSD-58591961 for the Advanced Manufacturing Readiness Facility Building Two (AMRF2) was granted on 7 April 2025 by the Minister for Planning and Public Spaces. The approved development comprises the construction and operation of a five-storey advanced manufacturing (“high technology industry”) facility incorporating a café, parking, and landscaping. The site is located at Lot 3101 DP 1282964, 215 Badgerys Creek Road, Bradfield, within the Liverpool Local Government Area and the Western Sydney Aerotropolis (the Aerotropolis).

This Section 4.55(1A) modification seeks removal of a basement level, deletion of basement car parking, introduction of staged delivery of the development into two stages and minor design changes resulting from staging and ongoing design development.

This Ecologically Sustainable Development (ESD) Report has been prepared by Arup to support the State Significant Development Application and has been updated for the Section 4.55(1A) modification to respond to the development changes. It highlights how staging is expected to deliver both an interim state after completion of the first stage and a final state responding to planning ESD requirements.

1.1 SEARs Requirements

This report has addressed the following matters within the Secretary’s Environmental Assessment Requirements (SEARs) issued for the SSDA on 14 June 2023.

Table 1: SEARs requirements

General Requirements	Issue and Assessment Requirements	Addressed within section of this ESD report
Ecologically Sustainable Development and Greenhouse Gas	A description of how the proposal will incorporate the principles of ecologically sustainable development in the design, construction and ongoing operation of the development	Section 5
	An assessment of the energy use of the proposal and all reasonable and feasible measures that would be implemented on site to minimise the proposal’s greenhouse gas emissions (reflecting the Government’s goal of net zero emissions by 2050)	Section 5.1
	Consideration of the use of green walls and green roofs in the design of the development	Section 5.3

1.2 Sustainable Buildings SEPP Requirements

The following requirements apply to DAs for non-residential development under Section 3.2 and 3.3 of the State Environmental Planning Policy (Sustainable Buildings) 2022 (Sustainable Buildings SEPP):

Table 2: Sustainable Buildings SEPP requirements

Issue and Assessment Requirements		Addressed within section of this ESD report
3.2 (1) Consideration of whether the design enables...	The minimisation of waste from associated demolition and construction, including by the choice and reuse of building materials	Section 5.6
	A reduction in peak demand for electricity, including through the use of energy efficient technology	Section 5.1
	A reduction in the reliance on artificial lighting and mechanical heating and cooling through passive design	Section 5.1
	The generation and storage of renewable energy	Section 5.1
	The metering and monitoring of energy consumption	Section 5.1
	The minimisation of the consumption of potable water	Section 5.3
3.2 (2) Quantification of the embodied emissions attributable to the development		By separate submission of NABERS Materials reporting template
3.3 (1) (applicable to office component only) Minimising the use of on-site fossil fuels		Section 5.2
3.3 (2) (applicable to office component only) Ability to achieve energy use in line with NABERS Energy 5.5 Stars performance for prescribed office premises.		Section 5.1
3.3 (2) (applicable to office component only) Ability to achieve water use in line with NABERS Water 3 Stars for large commercial developments.		Section 5.3

1.3 Requirements of other Sustainability Policies and Frameworks

Section 193 of the *Environmental Planning and Assessment Regulation 2021* outlines the principles of ecologically sustainable development that should be applied and considered for new developments, including:

- The precautionary principle – if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- Inter-generational equity – the present generation should ensure the health, diversity and productivity of the environment are maintained and enhanced for the benefit of future generations.
- Conservation of biological diversity and ecological integrity should be a fundamental consideration.
- Improved valuation, pricing and incentive mechanisms
 - Polluters pay, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, and
 - The users of goods and services should pay prices based on the full life cycle of the costs of providing the goods and services, including the use of natural resources and assets and the ultimate disposal of waste, and
 - Established environmental goals should be pursued in the most cost-effective way by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

Section 4.33 *Consideration of Design Excellence* of the *State Environmental Planning Policy (Precincts – Western Parkland City) 2021* requires new developments to have regard to the achievement of the principles of ecologically sustainable development.

Section 4.7 of *The Western Sydney Aerotropolis Precinct Plan* outlines the following sustainability and resilience requirements for new developments:

- Energy, water and waste systems are to use a circular economy approach to improve efficiency and result in low-carbon developments.
- Effectively use renewable energy supply including solar, wind, green hydrogen, and bio-energy.
- Plan for, and achieve, leading industry targets by 2025 and from 2026 beyond to achieve sustainable regenerative targets. For non-residential uses:
 - Target 2020 and 2025: Green Star – 5+ Stars
 - Target 2026 and beyond: Green Star – 6+ Stars
- Incorporate accessible Circular Economy Infrastructure into mixed use developments to ensure adequate opportunities for people to participate in reuse and recycling schemes.
- The façade and roof of the proposed buildings and paved surfaces are designed to reduce adverse effects of solar heat on the surrounding land, including open space and public domain, including a requirement for light-coloured roofs.
- The development accommodates tree canopy, pervious surfaces and landscape areas to minimise solar heat absorption and reflection by hard surfaces.

Section 2.12 of the *Western Sydney Aerotropolis Development Control Plan – Phase 2* outlines the objective for developments to minimise energy consumption and achieve net zero emissions by 2030. The following benchmark solutions are outlined:

- All developments demonstrate how 100% renewable energy supply can be achieved by 2030, whether on or off site.
- Where the net zero energy target cannot be accommodated on site, the proponent must provide an offset e.g. with a Power Purchase Agreement.

Bradfield aspires to lead in sustainability, as outlined in *The Bradfield City Centre Masterplan*, from the conservation and regeneration of natural systems to prioritising greenery to combat urban heat. The masterplan provides a blueprint for new developments within the Western Parkland City and outlines the following sustainability design principles:

- Minimise energy, water and waste and promote circular economy initiatives.
- Integrate a multi-utility approach to deliver the lowest carbon outcome.
- Integrate smart city technology for safety, equity and connectivity.
- Integrate sustainability principles for water, waste, energy and heat.
- Embed smart technologies within buildings.
- Building envelopes support green strategies with building orientations that prioritise passive means for reduction of energy consumption.

The principles and considerations outlined in the above sustainability frameworks and policies are embedded within the Green Star Buildings v1 rating tool and SEARs requirements. AMRF Building 2 is targeting a minimum 5 Star Green Star rating, as outlined in Section 4.1. A description of how Green Star credits and SEARs requirements are satisfied that cover the above principles and considerations is provided throughout Section 5.

2. Project Site

The development is located in the Liverpool local government area at 215 Badgerys Creek Road (Lot 101 DP 1282949), Bradfield (the site), as highlighted in Figure 1. Bradfield City Centre is located 45km Southwest of the Sydney CBD, between the Blue Mountains National Park and Nepean River to the West and the Georges River and Dharwal National Park to the East. The proposed AMRF Building 2 is located directly South of the existing AMRF Building 1.

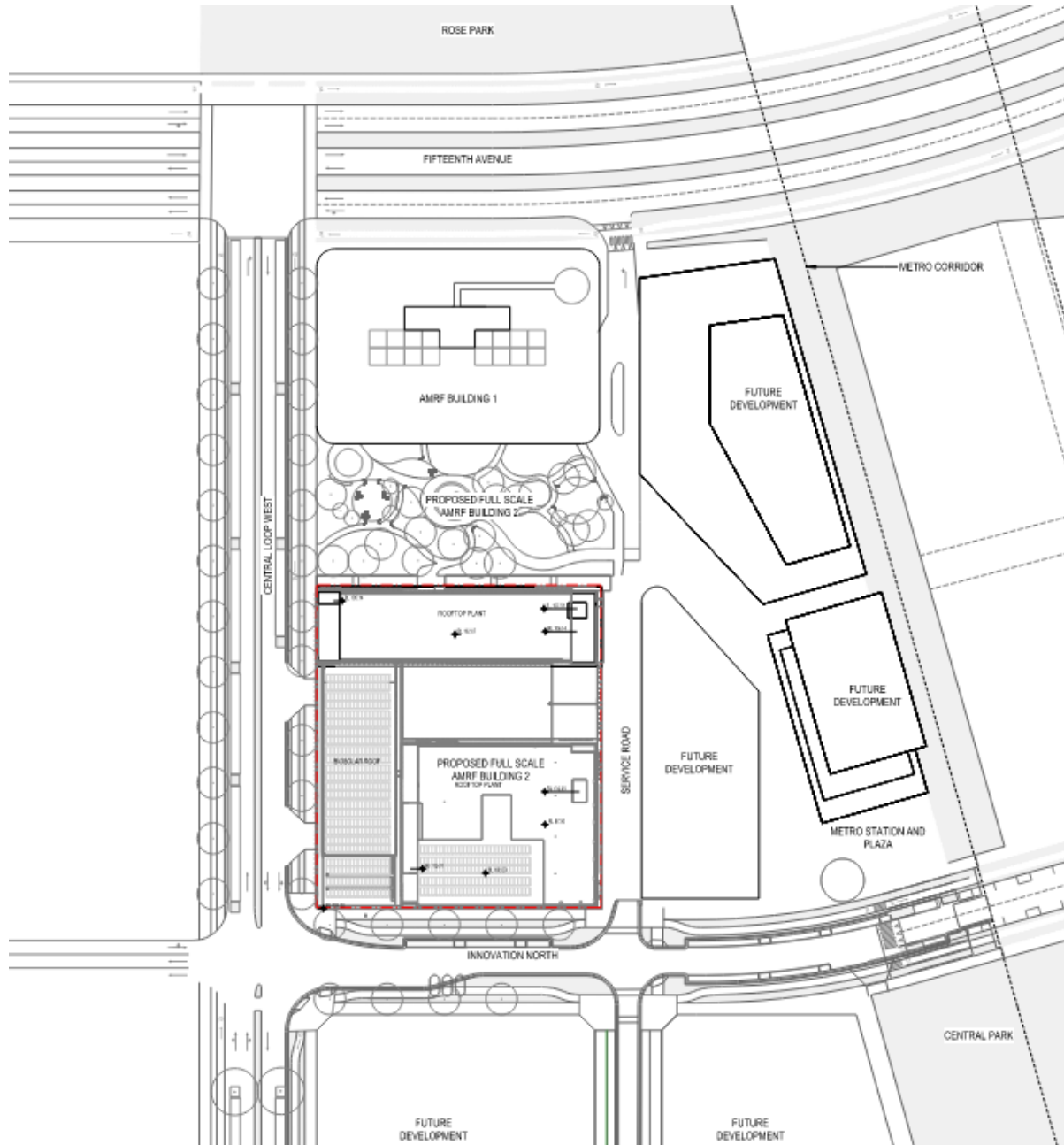


Figure 1: Site Plan

3. Overall ESD Strategy

To address the SEARs and Sustainable Buildings SEPP targets, the project has developed a comprehensive ESD strategy. The following areas are the focus of the design team:

- Energy – Incorporate energy efficient designs and technological strategies to reduce energy use and greenhouse gas emissions.
- Water – Reduce consumption of potable water and install water efficient systems.
- Biodiversity – Enhance biodiversity through the use of biosolar roof area and courtyard deep soil planting.
- Resilience – Design considering the building’s urban heat impact and future-proof against climate change.
- Materials – Optimise the use of resources while minimising waste throughout the whole life cycle of the building. Reduce material embodied impacts through structurally optimal design and dematerialisation, low carbon building materials and recycled content.

The strategy is reflected in a registration for a Green Star Buildings third-party certification, with a minimum rating target of 5 Stars. This target performance is considered "Australian Excellence" level by the Green Building Council of Australia (GBCA).

While the NABERS scheme does not apply to the building typology of the majority of the development, BDA has entered an Agreement to Rate with NABERS for the office tenancy area. Further, the project intends to target performance within the relevant Green Star categories deemed by the project team to be in line with NABERS Energy 5.5 Star and Water 3 Star performance:

- Energy – minimum 20% improvement compared to an NCC compliant reference building.
- Water – targeting 15% - 45% (with recycled water connection) reduction compared to a reference building, based on Green Star water calculator.

Decarbonisation including consideration of Scope 3 emissions (emissions indirect emissions generated in the wider economy, for goods and services) is a key consideration for the project, with the intent to achieve net zero with low reliance on offsets to support Climate Active Carbon Neutral certification targeted for Bradfield City Centre. This includes embodied carbon in building and fit-out materials including end-of-life impacts.

The Section 4.55(1A) modification includes introduction of staged delivery of the development. The staged delivery will affect the timing of ratings:

- Green Star certification is to be obtained within 2 years after Stage 1 completion, with a further certification after Stage 2 completion that will need to be agreed with GBCA at commencement of Stage 2.
- NABERS Rating of the office area under the Agreement to Rate is to occur after Stage 1 occupation, with extension of scope once Stage 2 is occupied.

Thus, verification of the strategy aims within the above rating processes to address the SEARs and Sustainable Buildings SEPP targets will also be obtained for the interim state at Stage 1 completion, rather than be deferred by the staged approach.

This document outlines the ESD initiatives that are being considered within the building’s design to achieve the above aims and targets and identifies where these are fully delivered within Stage 1 or where they are distributed over Stage 1 and 2.

4. Rating Targets

4.1 Green Star

The project is registered with the Green Building Council (GBCA) under the Green Star Buildings v1 rating tool and is being designed to a minimum Green Star 5-Star rating. Formal certification will be achieved after completion of construction.

A Green Star strategy has been developed for the final building as at completion of Stage 2. During design finalisation, this will be developed into a strategy enabling a rating after the completion of Stage 1.

The Green Star strategy for the final building targets points as per the summary in Table 3, including the credits referenced in Section 5; however credits may be added, removed, or substituted in the further design development while retaining a target rating of minimum 5 Stars.

Table 3: Green Star Buildings v1 strategy - points targeted

Green Star Credits			5-Star		5-Star Plus	
Category	#	Name	Target level	Points	Target level	Points
Responsible	1	Industry Development	CA	1	CA	1
	2	Responsible Construction	CA	1	CA	1
	3	Verification + Handover	CA	1	CA	1
	4	Responsible Resource Management	ME	0	ME	0
	5	Responsible Procurement	n/t	1	n/t	1
	6	Responsible Structure	CA	3	CA	3
	7	Responsible Envelope	n/t	0	n/t	0
	8	Responsible Systems	n/t	0	n/t	0
	9	Responsible Finishes	n/t	0	n/t	0
Healthy	10	Clean Air	ME	0	ME	0
	11	Light Quality	ME	0	ME	0
	12	Acoustic Comfort	ME	0	ME	0
	13	Exposure to Toxins	ME	0	ME	0
	14	Amenity and comfort	n/t	0	n/t	0
	15	Connection to Nature	n/t	0	n/t	0
Resilient	16	Climate Change Resilience	CA	1	CA	1
	17	Operations Resilience	CA	2	CA	2
	18	Community Resilience	CA	1	CA	1
	19	Heat Resilience	CA	1	CA	1
	20	Grid Resilience	n/t	0	n/t	0
Positive	21	Upfront Carbon Emissions	CA	3	CA	3
	22	Energy Use	CA	3	CA	3
	23	Energy Source	EP	6	EP	6
	24	Other Carbon Emissions	CA	2	CA	2
	25	Water Use	CA	3	CA	3
	26	Life cycle Impacts	n/t	0	n/t	0
Places	27	Movement and Place	ME	0	ME	0
	28	Enjoyable Places	n/t	0	CA	2
	29	Contribution to Place	CA	2	CA	2
	30	Culture, Heritage, Identity	n/t	0	CA	1
People	31	Inclusive Construction Practices	CA	1	CA	1
	32	Indigenous Inclusion	n/t	0	CA	2
	33	Procurement and Workforce Inclusion	CA	2	CA	2
	34	Design for Inclusion	n/t	0	CA	2
Nature	35	Impacts to Nature	CA	2	CA	2
	36	Biodiversity Enhancement	CA	2	CA	2
	37	Nature Connectivity	n/t	0	n/t	0
	38	Nature Stewardship	n/t	0	n/t	0
	39	Waterway Protection	CA	2	CA	2
L/M T	40	Market Transformation	n/t	0	n/t	0
	41	Leadership Challenges	1	1	1	1
Sector	S1	Sector - Collaborative Leasing	CA	1	CA	1
	S2	Sector - Upfront Fitout Emissions	n/t	0	n/t	0
	S3	Sector - Tenant Energy Source	EP	5	EP	5
Total			incl. buffer	47		54

5. ESD Initiatives

5.1 Energy

This section is describing the measures incorporated and being considered in the development's design to minimise the proposal's operational greenhouse gas emissions, in line with the Government's goal of net zero emissions by 2050 as noted in the SEARs.

The project has committed to a minimum 5-Star rating under Green Star to help drive achievement of energy emissions reduction in several ways. Within the Green Star rating framework, the development is targeting the following benchmarks for energy, subject to further development of the rating:

- Green Star Credit 3 Verification & Handover – as a Minimum Expectation for the Green Star rating, the building must provide metering for all common uses, major uses, and major sources.
- Green Star Credit 22 Energy Use – As a minimum requirement for a rating of 5 Stars or more as targeted by the development, the building's energy must be at least 20% less than a reference building.

It is essential to ensure the development is designed and built to minimise energy consumption and reduce greenhouse gas emissions to the atmosphere. Strategies in the design of AMRF2 to satisfy the requirements outlined above include:

- (Stage 1 & 2) Envelope design using insulation, high performance selective glazing and external shading (including recessed glazing, external shading screens, fins) on appropriate elevations targeting 10% improvement over Section J envelope minimum compliance, balanced with allowing daylight into workspaces. While the envelope performance will be further guided and refined by building energy modelling for Green Star and NCC J1V2 or J1V3 solutions, a preliminary assessment against Section J4 envelope performance is attached in Appendix A.
- (Stage 1) For tightly controlled research spaces, recirculation will be maximised, with outside air provided to the extent of providing pressurisation. A plenum system is proposed for cleanroom air filtration to minimise filtration pressure drop. Predictive maintenance is considered for the control strategy to limit HEPA filter loading.
- (Stage 1) Lab services will be optimised with heat recovery, direct extraction of process heat where feasible to reduce heat loads impacting HVAC, and use of manifolds where suitable.
- (Stage 1 & 2) Efficient LED lighting throughout.
- (Stage 1 & 2) Solar photovoltaic generation across rooftop areas where area is available. This includes a bio-solar roof over the manufacturing hall. The full PV capacity will be located on the Stage 1 roof, so that there will be no delay to generation from the staged approach, and initially an even higher percentage of building energy use can be provided by local generation. The total solar PV capacity is expected to be above 180 kW.
- (Stage 1) Provision for future installation of a battery energy storage system on Level 4 for peak energy shifting of PV generated power.
- (Stage 1 & 2) Envelope design responding to internal thermal zoning. Workplace vision glazing concentrated on south and north with external shading to north facades.

Energy modelling of the building has indicated compliance with Green Star Credit 22 Energy Use "Credit Achievement" level. Detailed energy models of Stage 1 in isolation and the revised final building will be prepared during the design finalisation phase to demonstrate compliance with this level of achievement at the conclusion of both delivery stages proposed under the S4.55(1A) modification.

While the Green Star NABERS pathway is not applicable to the whole building, it is noted that the Green Star rating tool recognises NABERS Energy Commitment Agreement of 5.5 Stars as equivalent to "Minimum Requirement" performance (Green Star Buildings Submission Guidelines v1 Rev. C r1, Energy

Use – NABERS Pathway). Under the targeted Reference Building Pathway, the “Minimum Requirement” is a 10% reduction of energy use of the building compared to a minimum NCC Section J compliant reference building, via building and services design only and without consideration of renewable energy generation. The proposed solar PV capacity is expected to generate >180,000 kWh/a. When attributed to the office tenancy area, it is expected that this will exceed the 5.5 Star NABERS Energy standard.

5.2 Net Zero Strategy

Refer to the separate Net Zero Statement.

In line with the Government's goal of net zero emissions by 2050, the development is designed to minimise use of on-site fossil fuels.

The project has committed to a minimum 5-Star rating under Green Star to help drive achievement of energy emissions reduction in several ways. Within the Green Star rating framework, the development is targeting the following benchmarks for energy source, subject to further development of the rating:

- Green Star Credit 23 Energy Source – As a minimum requirement for a rating of 5 Stars or more as targeted by the development, the building must be all-electric (with the exception of emergency generation), and 100% of the building’s energy must be from renewables.
- Green Star Sector Credit Tenant Energy Source (targeted at Credit Achievement level) – The building owner actively assists tenants in procuring renewable energy.

The building is briefed to support Bradfield City Centre in achieving Net Zero certification under Climate Active Standard by 2030, ahead of the NSW Government goal of net-zero emissions by 2050. Strategies in the design of AMRF2 to satisfy the requirements outlined above include:

- Strategies to reduce energy use as noted in Section 5.1.
- (Stage 1 & 2) All-electric building with heat pumps for heating and hot water. No ongoing use of fossil fuels on site, except for emergency power generation. Emergency power generation systems will consider operability with alternatives to fossil fuels.
- (Stage 1, with renewed contract duration from Stage 2 completion) BDA will purchase electricity from renewable sources, in line with Green Star credit requirements.

5.3 Water

The project has committed to a rating under Green Star to help drive achievement of potable water use reduction in several ways. Within the Green Star rating framework, the development is targeting the following benchmarks for water, subject to further development of the rating:

- Green Star Credit 25 Water Use (targeted at Credit Achievement level) – As a minimum requirement for a Green Star rating, the building’s potable water consumption must be at least 15% less compared to a reference building as defined by the Green Star water calculator. The project is currently targeting to exceed this and achieve a 45% reduction.
- Green Star Credit 39 Waterway Protection (targeted at Credit Achievement level) – A project specific Technical Query has been approved by the Green Building Council of Australia which will accept that the building complies with the intent of this credit when it is shown to comply with Western Sydney Aerotropolis Development Control Plan 2022 Section 2.3.2, by providing a minimum pervious area, gross pollutant traps to stormwater collection, passively irrigated street trees and connecting to the regional stormwater system. The building is designed to comply with this section.

Strategies to satisfy the requirements outlined above in the design of AMRF2 include:

- (Stage 1 & 2) Efficient fixtures and fittings.
- (Stage 1 & 2) Rainwater collection from the roof to 20kl tank, for cooling tower water top-up and irrigation.

- (Stage 1 & 2) Use of native low water need species in landscaping.
- (Stage 1 & 2) Dual piping for future connection to recycled water infrastructure once established in Bradfield City Centre.
- (Stage 1 & 2) Using bio-solar roofs and landscaping for stormwater retention.
- (Stage 1 & 2) Prioritise permeable finishes and paving.

NABERS Water is a rating in operation and is strongly dependent on tenant behaviour. There is no NABERS endorsed calculation approach to predicting Water ratings in design. However, in our experience the NABERS Water consumption allowance for 3 Stars is comparable to the 15% percent minimum reduction target under the Green Star calculation assumptions, which will be exceeded by the project under Green Star calculation assumptions.

5.4 Biodiversity

The development aims to provide for biodiversity and will implement green roof area in the design along with ground level landscaping in line with the SEARs. It targets the following credits under the Green Star rating, subject to further development of the rating:

- Green Star Credit 35 Impacts to Nature – The project will assess the ecological value of the site in line with Green Star requirements to confirm no high ecological value site is significantly impacted. Light pollution will be minimised. The building's design and construction further aims to conserve existing natural soil, hydrological flows and vegetation elements following ecological assessment.
- Green Star Credit 36 Biodiversity Enhancement (targeted at Credit Achievement level) – The building's site includes an appropriate landscape area of at least 15% of the site area, hosting a diversity of climate-resilient and indigenous species. The project team targets development of a site-specific Biodiversity Management Plan.
- Green Star Credit 37 Nature Connectivity – The project provides a significant percentage of footprint as habitat area including green roof area, aiming to meet the 25% requirement of the credit, and will integrate with the green and blue grid strategy. It will review how species connectivity can be encouraged through the site, and to adjacent sites, within this context.

Strategies in the design of AMRF2 to satisfy the requirements outlined above include:

- Integrated strategy for landscaping and biosolar roofs.
- Bio-solar roof (solar photovoltaic modules above green roof planting) on the manufacturing hall roof component – approx. 1,100m² on Stage 1, approx. 690 m² after construction of Stage 2.
- (Stage 1) approx. 900m² of the northern site for trees in a 'nursery' concept, which allows the site to benefit from extensive tree cover before Stage 2 is constructed. The trees on the northern part of the site will mature there, and once Stage 2 construction commences, they can be relocated with minimised disruption to the trees to other sites in the Bradfield area constructed in the meantime.
- (Stage 1 & 2) Approximately 330m² deep soil planting plus 190m² planting over structure in the courtyard and undercroft zones, providing for pocket forests that can provide habitat equivalent to two nesting trees when mature.

5.5 Resilience

As effects of climate change accelerate, there is greater need for buildings with long design life to be adaptable to these impacts on the local environment. A thorough understanding should be developed by the design team to understand potential climate-related risks, including damage or failure of building and system components, reduced operational capacity, hazardous conditions and surround areas.

The development is targeting resilience review processes under the guidance of the Green Star rating system, including, subject to further development of the rating:

- Green Star Credit 16 Climate Change Resilience – the project team develops a project-specific climate change risk and adaptation assessment for the building, and strategies to address any extreme and high risks identified. Risks have been reviewed for the combined development and informed the design.
- Green Star Credit 19 Heat Resilience – At least 75% of the whole site area comprises of one or a combination of strategies that reduce the urban heat island effect as laid out by Green Star.

Strategies in the design of AMRF2 to satisfy the requirements outlined above include:

- (Stage 1 & 2) Mechanical design to account for future climate projections to IPCC RCP8.5 2050 scenario.
- (Stage 1 & 2) Courtyard planting, bio-solar roof greening, and Stage 1 interim tree planting to the northern site to reduce storage of solar heat and provide evapotranspiration.
- (Stage 1 & 2) High albedo materials to reduce Heat Island Effect, including high Solar Reflectance Index ‘cool roof’ cladding materials and paving. Solar photovoltaic panels are also used and exempt from the area requirement under Green Star; while not high albedo, they provide low heat generation energy for building operations.
- (Stage 1) A Climate Change Resilience and Adaptation workshop has been carried out in the design stage with the building owner and management and design team representatives, to identify risks and plan for mitigation in design. Identified mitigation is to be reviewed for the staged approach, to ensure that risks are appropriately mitigated including during the interim state after completion of Stage 1.
- (Stage 1 & 2) On-site solar photovoltaic energy generation and provision for future battery storage to support grid resilience.
- (Stage 1 & 2) Passive design and energy and water efficiency strategies as nominated elsewhere, to reduce pressures and reliance on supply grids for comfort and continued operations.

5.6 Materials

As buildings become more efficient and the energy that they use comes from an increasingly decarbonised grid, the upfront embodied carbon impact of construction materials becomes a larger factor in a building’s overall carbon footprint. It is estimated to be responsible for half of the entire carbon footprint of new developments between now and 2050.

AMRF2 is being designed with reduction of materials impacts as a key intent, for upfront carbon as well as over the full building lifecycle. It targets the following credits under the Green Star rating, subject to further development of the rating:

- Green Star Credit 2 Responsible Construction (targeted at Credit Achievement level) – 90% of construction and demolition waste is diverted from landfill.
- Green Star Credits 6, 7, 8 and 9 for Responsible Materials (structure, envelope, systems, finishes) – the project targets at least achievement of the credit for responsible structure, and will review opportunities to meet further responsible materials credits, by selection of suitable percentage of materials out of the nominated categories with a Responsible Product Value (RPV) score meeting the Green Star credit requirements.
- Green Star Credit 21 Upfront Carbon (targeted at Credit Achievement level) – As a minimum requirement for a rating of 5 Stars or more as targeted by the development, the building’s upfront carbon emissions must be at least 20% less than those of a reference building.
- Green Star Credit 24 Other Carbon Emissions (targeted at Credit Achievement level) – As a minimum requirement for a rating of 5 Stars or more as targeted by the development, the project must eliminate or offset emissions from refrigerants.

Strategies in the design of AMRF2 to satisfy the requirements outlined above include:

- (Stage 1 & 2) Specification of low carbon, high Portland cement replacement concrete and/or potentially carbon neutral certified concrete for concrete elements, arc furnace produced steel, high recycled content lower embodied carbon aluminium for glazing systems.
- (Stage 1) Structural optimisation of column grid in laboratory structure, considering dematerialisation against material carbon impacts.
- (Stage 2) Structure developed around enabling low carbon materials, with extensive use of mass timber where structurally efficient (Stage 2 northern building component).
- (Stage 1) Provision of on-site separation of waste streams to maximise diversion from landfill.

6. Conclusion

An ESD strategy has been developed to align with the SEARs assessment and Sustainable Buildings SEPP requirements, as well as the objectives and considerations outlined in other applicable sustainability frameworks and policies that are referenced in Section 1.3.

These sustainability requirements are embedded within the Green Star Buildings v1 rating tool. The Green Star rating for which the project is registered with a minimum 5-Star target will provide a clear framework on how to satisfy these requirements and which best practice sustainable building principles can be applied to the further design, construction and ongoing operations of the development.

The Energy and Water targets associated with the Green Star rating requirements set clear levels of performance expectation for the operation of the development, which guide the design. The strategy will ensure the building is high performing environmentally, reduces local ecological impact, minimises energy use and greenhouse gas emissions, and implements climate resilience measures.

These strategies will be realised through focused ESD initiatives involving building design that considers optimised energy generation, reduced potable water usage, enhanced biodiversity, building and operational resilience and reduced materials impacts.

These initiatives will be implemented across Stage 1 and Stage 2 of the proposed staged delivery. Verification of the strategy via Green Star rating will be obtained for the interim state at Stage 1 completion, and separately for a future end state after Stage 2 completion, rather than be deferred by the staged approach.

Appendix A

Preliminary NCC Section J4 envelope performance assessment

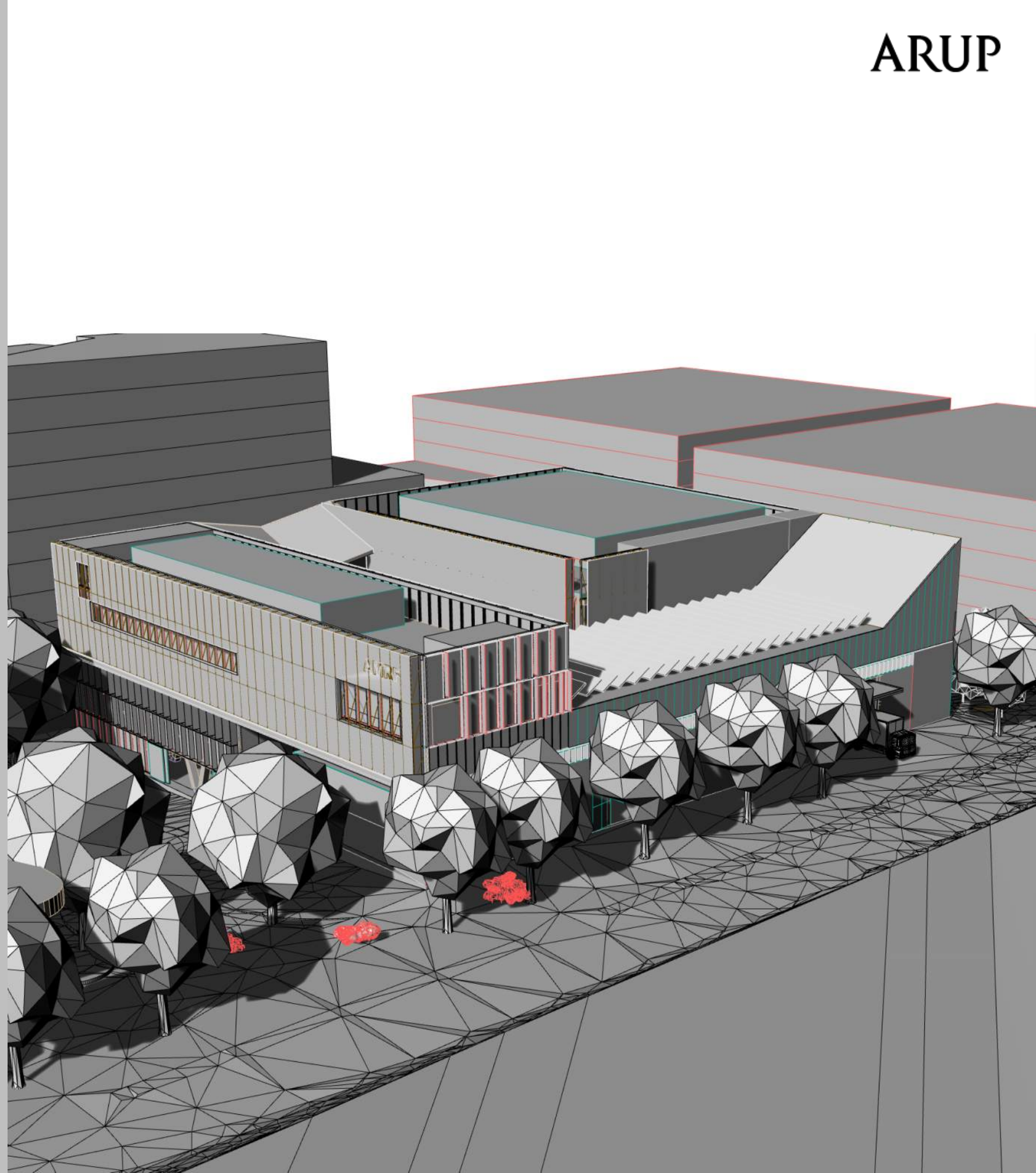
AMRF Building 2

Bradford Development Authority

Preliminary Section J Report

v06

21st November 2025



Overview

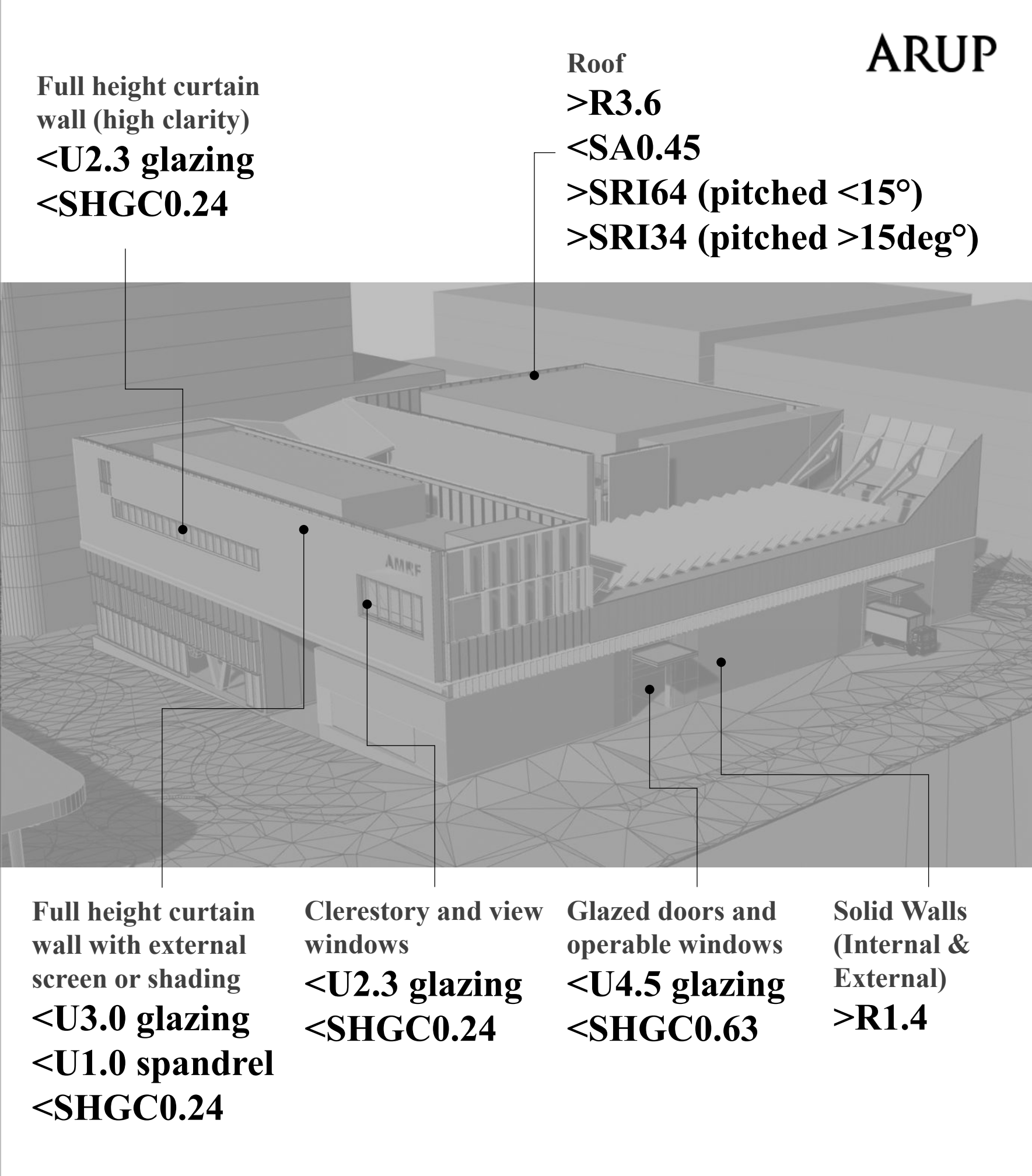
The proposed AMRF Building 2 is required to comply with the minimum envelope thermal performance requirements of NCC 2022 Section J. Note: a requirement to comply with NCC 2025 Section J with expected significantly higher stringency may be triggered if timing of Construction Certificate is delayed (deadlines have not yet been nominated, but CC in 2026 may require compliance).

Preliminary modelling of annual energy use is underway for Green Star. An energy model will allow cross verification of Section J compliance via J1V2 modelled performance pathway in the future.

This document aims to provide guidance on the thermal envelope requirements, based on the simplified assessment per NCC Deemed-to-Satisfy approach, under Part J4 (envelope) only. Window to wall ratios, insulation levels, shading and glazing specification intent have been considered based on general arrangement plans and elevations by Architectus dated 3/11/2025.

This report has been updated to capture compliance for the proposed staging of the project into a Stage 1 encompassing the lab building, manufacturing hall and tenancy above these, and a final state with Stages 1 & 2 complete. This document is reporting on thermal performance requirements that will meet Section J compliance both after Stage 1 completion and in the final state. The staging strategy has also resulted in minor internal layout changes and adjustments to façade areas and types captured in updated calculations.

Calculations are to be revisited in Design Finalisation to account for final design.



Full height curtain wall (high clarity)
<U2.3 glazing
<SHGC0.24

Roof
>R3.6
<SA0.45
>SRI64 (pitched <15°)
>SRI34 (pitched >15deg°)

Full height curtain wall with external screen or shading
<U3.0 glazing
<U1.0 spandrel
<SHGC0.24

Clerestory and view windows
<U2.3 glazing
<SHGC0.24

Glazed doors and operable windows
<U4.5 glazing
<SHGC0.63

Solid Walls (Internal & External)
>R1.4

Introduction

The proposed AMRF Building 2 has been assessed according to the following:

- National Construction Code (NCC) 2022 Section J4.
- NCC Climate zone 6
- NCC Building Classifications, as per BCA Report by MBC Group (MBC Ref 23000119, 14 July 2023):
 - Class 5 – Office research workplace & office tenancy
 - Class 7a – Carpark, loading dock and storage
 - Class 8 – Laboratory & production (manufacturing hall)
 - Class 9b – Seminar spaces

Other parts of the NCC, including Part J5 sealing, and J6 to J9 for services, are not covered in this report and are assumed to be compliant, covered by the relevant designers and engineers.



National Construction Code 2022

NCC 2022 Section J

The National Construction Code (NCC) Section J was updated significantly in 2019 with increased requirements for façade design and has been maintained through to the latest version in 2022.

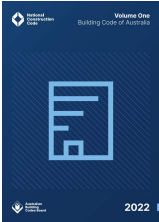
The windows and wall are considered together (J4D6) and the solar and thermal performance of the building envelope must achieve compliance individually unless pursuing alternative verification methods.

Although more onerous than previous version of the NCC, the requirements broadly align with good practice, and the changes have amended several inconsistencies and gaps in the NCC.

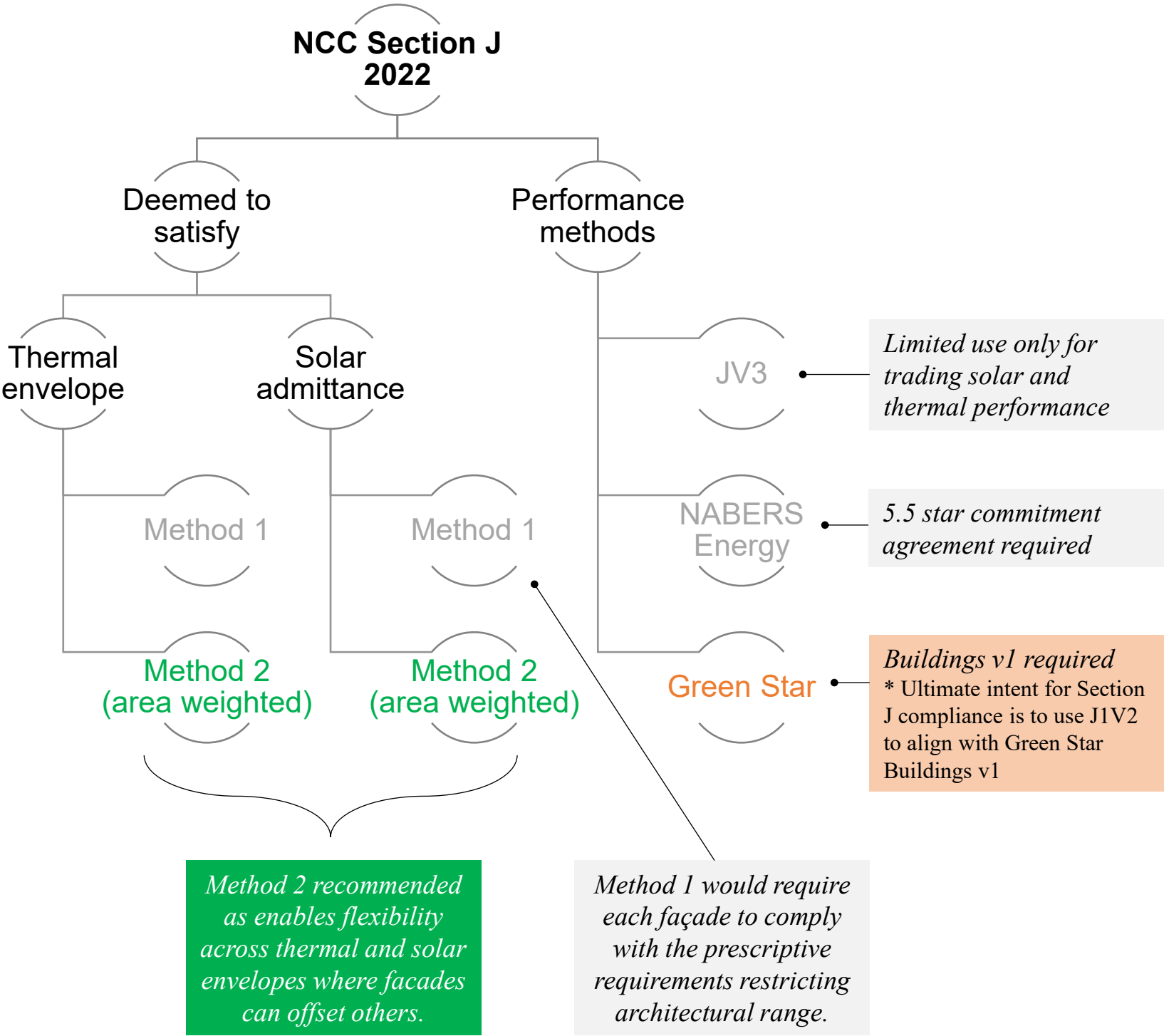
The prescriptive deemed to satisfy (DTS) methods provided enable a degree of flexibility (Method 2) that more closely aligns with the outcomes of modelled performance solutions including J1V2 and J1V3.

Method 2 effectively enables compliant areas of the façade to offset non-compliant areas using area-weightings, so ultimately overall the facade complies. This flexibility allows fully glazed areas that would be non-compliant if considered in isolation to be offset by other areas of the building.

To inform the project at this stage, the DTS Method 2 pathway will be utilised due to its flexibility. Initial modelled assessment under J1V2 is scheduled for the next phase of the project.



NCC Section J for 2022 with combined window and wall requirements



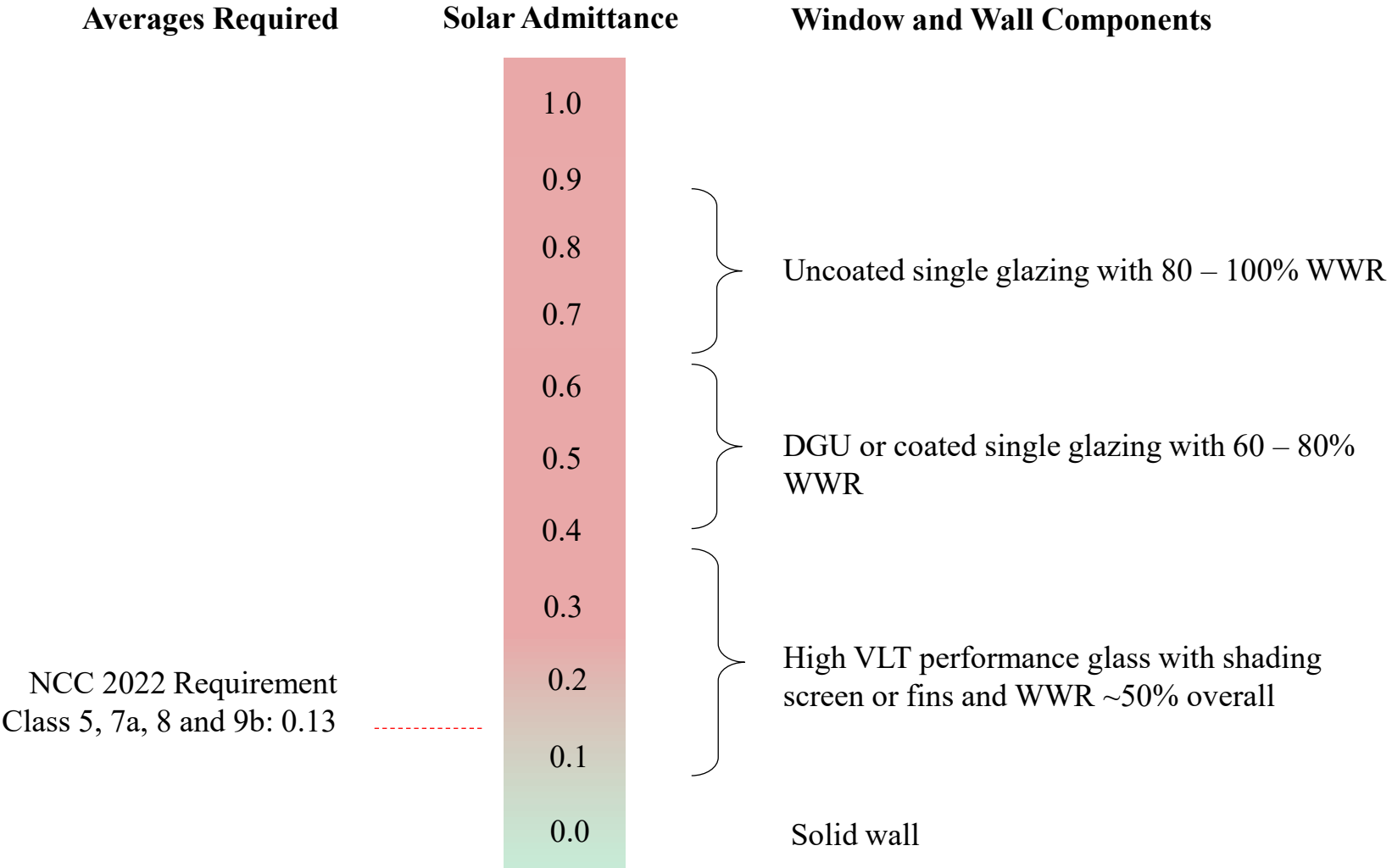
Solar Envelope

To begin exploring façade options, the NCC Section J4D6 DTS criteria is proposed.

This approach considers the entire window/wall system and requires that the system as a whole achieves an admittance of 0.13 or less.

Solar admittance, as defined by the National Construction Code, is the fraction of incident irradiance on a *wall-glazing* construction that adds heat to a building’s space. Note that this differs from the Solar Heat Gain Coefficient (SHGC), which is the fraction of incident irradiance on *glazing* that adds heat to a building’s space.

The figure inset provides an indication of how the requirement compares to various extents of window/wall coverage – window to total wall ratio (WWR). This demonstrates that clear glazing covering 50% or greater wall coverage will not achieve compliance.



NCC 2022 Section J4D6 Windows and Walls – Solar Envelope Compliance

Thermal Envelope

The building’s overall thermal performance is dictated by the construction of the building’s walls and windows.

An overall maximum U-value of 2.0 W/m².K (energy flow per area per degree Celsius in difference in the temperature between indoor and outdoor) is defined by the National Construction Code.

The performance of the glass and walls must be considered together.

Thermal bridging in the curtain walls must also be considered in the NCC which has been taken into account with the advised insulation values.

		R-value	U-value		
NCC 2022 Requirement (<U2.0) (Average across windows and walls)	-----	0.14	7.0	{	Single glazing
		0.17	6.0		
		0.2	5.0		
		0.25	4.0	{	Double glazing
		0.33	3.0		
		0.5	2.0	{	Triple glazing
		1.0	1.0		
		1.3	0.75	{	Curtain Wall Spandrel
		2.0	0.5		
		4.0	0.25	{	Insulated Wall

Design Guidance

This table provides a summary of glazing, wall and shading design guidance. Two levels of performance have been provided, including the minimum required to comply with the NCC 2022, and the recommended values by Arup for consideration for AMRF Building 2 to achieve approximate 10% higher than minimum NCC 2022 requirements.

The NCC minimum design results in 100% of the allowable solar and thermal loads being applied to the building. These loads can be passively reduced by a considerable amount by specifying a higher performing façade, such as those recommended.

The NCC minimum design results in 100% of the allowable solar and thermal loads being applied to the building. These loads can be passively reduced by a considerable amount by specifying a higher performing façade, such as those recommended.

The benefits of opting for a higher performing façade includes:

- Reduced operational energy consumption and associated emissions
- Increased thermal comfort
- Decreased glare for visual comfort

This assessment was made using a fixed openness factor for the metal mesh screens. Directionality of opening area for the actual preferred stretched metal product is expected to slightly improve shading against higher angle sun and is part of the intended passive performance improvement over the minimum compliance. Shading is assumed to be applied as per the Architectus elevations referenced.

Please refer to **Appendix A** for additional requirements relating to general thermal construction (particularly accounting for thermal bridging in system R-values and U-values), sourced from the NCC requirements for your information. These requirements must be accounted for in the design documentation.

Appendix B contains the NCC Wall Glazing calculators, including wall and glazing area inputs and glazing thermal requirements , for both the Stage 1 state and the final building after Stage 2 completion.

Refer to **Appendix C** for thermal envelope markups indicating where the tabled requirements apply, for both the Stage 1 state and the final building after Stage 2 completion.

NCC 2022 – Minimum required

	SHGC	U-value (glazing)	U-value (spandrel)	Screen openness
Full height curtain wall with external screen or shading	<0.28	<3.1	<1.5	53%
Full height curtain wall marked as high clarity (courtyard, foyer)	<0.28	<2.9	<1.5	n/a
Clerestory and view windows (shading as in model)	<0.63	<4.6	n/a	n/a
Glazed doors	<0.63	<3.0	n/a	n/a
Solid walls	0	>R1.0 (wall < 80%) >R1.4 (wall ≥ 80%)		n/a
Roof	0	R>3.2, SA<0.45		n/a

AMRF2 Design values – allowing for passive improvement of energy performance beyond NCC compliance

	SHGC	U-value (glazing)	U-value (spandrel)	Approx. VLT (glass)	Screen openness
Full height curtain wall with external screen or shading	<0.24	<3.0	1.0	50%	53% (at normal)
Full height curtain wall marked as high clarity (courtyard, foyer)	<0.24	<2.3	1.0	50%	n/a
Clerestory and view windows (shading as in model)	<0.24	<2.3	n/a	50%	n/a
Glazed doors	<0.63	<4.5	n/a	50%	n/a
Solid walls	0	Wall U<0.71 / R>1.4		n/a	n/a
Roof	0	R>3.6, SA<0.45 SRI>64 (pitched <15°) SRI>34 (pitched >15deg°)		n/a	n/a

- Notes:
- The above applies to the thermal envelope.
 - All values are whole of system, i.e. for the glazing this includes effects of the glass and framing.
 - Wall R-value minimum depends on if the wall-glazing construction is more or less than 20% glazed, refer to the markup in Appendix C.
 - Slab-on-ground without in-slab heating or cooling is considered to achieve a Total R-value of R2.0 for this Climate Zone as per NCC 2022 J4D7, therefore insulation is not required. Insulation will be required for suspended slabs.
 - The R-value for floors is based on downward heat flow and the R-value for roof/ceiling is based on downward heat flow in this Climate Zone as per NCC 2022 Table J4D7 and Section J4D4
 - Glass VLT is an estimate of achievable values for the given SHGC using high selectivity glass. It is not a performance requirement to meet Section J.
 - This assessment excludes condensation management, and other issues such as acoustic and fire etc have not been reviewed within Section J report scope. A vapour control strategy is recommended for freezer and cold rooms to mitigate risk of interstitial condensation in constructions.

About Us

The report for this project was undertaken by Arup's Sustainable Building Team who have significant experience with undertaking environmental assessments of buildings.

The following team members and roles are acknowledged:

- Jorg Kramer, Associate
- Parth Bawane, Graduate Sustainability Consultant

References + Standards

To complete the assessment, a series of standards and design documents were reviewed and considered as part of the process.

The following standards were used as references:

- NCC 2022 Volume 1, release 22/12/2022

The following design documents were referred to:

- Architectus G.A. Plans – Basement 2 to Roof, ARMFB2-ARC-AR-S2-200100 to ARMFB2-ARC-AR-S2-210500 and Architectus elevations North/East/South/West and courtyard, ARMFB2-ARC-AR-S2-300101 to ARMFB2-ARC-AR-S2-300102, draft issue 3rd November 2025

Next Steps

This document provides design stage guidance for the project team to review and consider.

Where assumptions made in this report are subject to change, these changes should be highlighted to the Arup ESD team in order to understand potentially more onerous requirements.

Where further information is required, please contact jorg.kramer@arup.com.

Appendix A – Additional NCC Requirements

The following sections are requirements from NCC 2022, and the design and construction must comply with these. Of particular note is the requirement to account for thermal bridging when determining system R-values and system U-values.

J4D3 Thermal Constructions – General

- (1) Where required, insulation must comply with AS/NZS 4859.1 and be installed so that it—
 - a) abuts or overlaps adjoining insulation other than at supporting members such as studs, noggings, joists, furring channels and the like where the insulation must be against the member; and
 - b) forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the thermal barrier; and
 - c) does not affect the safe or effective operation of a service or fitting.
- (2) Where required, reflective insulation must be installed with—
 - a) the necessary airspace to achieve the required R-Value between a reflective side of the reflective insulation and a building lining or cladding; and
 - b) the reflective insulation closely fitted against any penetration, door or window opening; and
 - c) the reflective insulation adequately supported by framing members; and
 - d) each adjoining sheet of roll membrane being—
 - i. overlapped not less than 50 mm; or
 - ii. taped together.
- (3) Where required, bulk insulation must be installed so that—
 - a) 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
 - b) 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.
- (4) Roof, ceiling, wall and floor materials, and associated surfaces are deemed to have the thermal properties listed in Specification 36.
- (5) The required Total R-Value and Total System U-Value, including allowance for thermal bridging, must be—
 - a) calculated in accordance with AS/NZS 4859.2 for a roof or floor; or
 - b) determined in accordance with Specification 37 for wall-glazing construction; or
 - c) determined in accordance with Specification 39 or Section 3.5 of CIBSE Guide A for soil or sub-floor spaces.

Appendix B – NCC Wall–Glazing Calculators

Note: ‘Wall Element Requirements’ are not met because an allowance for curtain wall spandrel is made in the ‘walls’ section. By reference to NCC Section J Specification 38 Spandrel panel thermal performance, we understand curtain wall spandrel panels are not expected to meet wall minimum R-Value requirements as per NCC J4D6(4).

Appendix B1 – NCC Wall–Glazing Calculator – Stage 1

See following pages.

NCC 2022 Wall-Glazing Calculator (Open-source)

Wall and glazing energy efficiency in Class 2-9 buildings - Specification S37C4 (Method 2), NCC 2022

Building name and description

AMRF Building 2

Classification

Other

Climate Zone

6

Calculated Area-Weighted U-Value

1.87

Allowable Area-Weighted U-Value

2.00

Building total U-Value allowance met

94%

Calculated Representative Air-Conditioning Energy Value

936.7

Allowable Representative Air-Conditioning Energy Value

1127.2

Building total SHGC allowance met

84%

Check Values

Visible

Wall Element Requirements

Met

Display Glazing Element Requirements

-

Use of this calculator does not guarantee compliance with the NCC. The disclaimer and a version update check are available at the bottom of the page.

Element Description					U-Value		SHGC and Shading				
ID	Description (optional)	Element Type	Facing Sector	Area (m ²)	U-Value	U-Value Element share of allowance used	SHGC	Glazing Height (m)	Shading Height (m)	Shading Projection (m)	SHGC Element share of allowance used
1	Nb5s	Glazing	North	49	3.00	1% of building total	0.24				1% of building total
2	Na12f	Glazing	North	42	2.30	1% of building total	0.24				2% of building total
3	Nf18	Wall	North	146	0.71	1% of building total	0				Not counted
4	Na19	Glazing	North	34	2.30	1% of building total	0.24				2% of building total
5	Ne20	Wall	North	50	1.00	0% of building total	0				Not counted
6	Nb20.1	Glazing	North	80	3.00	2% of building total	0.24				4% of building total
7	Nb21s	Glazing	North	35	3.00	1% of building total	0.24				1% of building total
8	Nd22s	Wall	North	66	0.71	0% of building total	0				Not counted
9	Ne23	Wall	North	49	1.00	0% of building total	0				Not counted
10	Nb24s	Glazing	North	36	3.00	1% of building total	0.24				1% of building total
11	Nb25f	Glazing	North	79	3.00	2% of building total	0.24				4% of building total
12	Ne26	Wall	North	46	1.00	0% of building total	0				Not counted
13	Nb27f	Glazing	North	165	3.00	5% of building total	0.24				9% of building total
14	Nb28	Glazing	North	70	3.00	2% of building total	0.24				4% of building total
15	Na29	Glazing	North	15	2.30	0% of building total	0.24				1% of building total
16	Nf30	Wall	North	96	0.71	1% of building total	0				Not counted
17	Ee1	Wall	East	54	1.00	1% of building total	0				Not counted
18	Ed5	Wall	East	125	0.71	1% of building total	0				Not counted
19	Ee6	Wall	East	54	1.00	1% of building total	0				Not counted

20	Ed7	Wall	East	16	0.71	0% of building total	0	Not counted
21	Eb8s	Glazing	East	7	3.00	0% of building total	0.24	0% of building total
22	Ed9	Wall	East	21	0.71	0% of building total	0	Not counted
23	Eb10s	Glazing	East	7	3.00	0% of building total	0.24	0% of building total
24	Ed11	Wall	East	7	0.71	0% of building total	0	Not counted
25	Eb12s	Glazing	East	7	3.00	0% of building total	0.24	0% of building total
26	Ed13	Wall	East	22	0.71	0% of building total	0	Not counted
27	Eb14s	Glazing	East	19	3.00	1% of building total	0.24	0% of building total
28	Ed14.1	Wall	East	7	0.71	0% of building total	0	Not counted
29	Eb15f	Glazing	East	61	3.00	2% of building total	0.24	3% of building total
30	Eb16	Glazing	East	8	3.00	0% of building total	0.24	0% of building total
31	Ed17	Wall	East	23	0.71	0% of building total	0	Not counted
32	Eb18	Glazing	East	8	3.00	0% of building total	0.24	0% of building total
33	Ed19	Wall	East	8	0.71	0% of building total	0	Not counted
34	Eb20	Glazing	East	8	3.00	0% of building total	0.24	0% of building total
35	Ed21	Wall	East	25	0.71	0% of building total	0	Not counted
36	Eb22	Glazing	East	21	3.00	1% of building total	0.24	1% of building total
37	Ed22.1	Wall	East	8	0.71	0% of building total	0	Not counted
38	Ef25	Wall	East	321	0.71	2% of building total	0	Not counted
39	Ee26	Wall	East	33	1.00	0% of building total	0	Not counted
40	Eb26.1s	Glazing	East	118	3.00	3% of building total	0.24	3% of building total
41	Eb27	Glazing	East	75	3.00	2% of building total	0.24	3% of building total
42	Ef28	Wall	East	310	0.71	2% of building total	0	Not counted
43	Ea29	Glazing	East	40	2.30	1% of building total	0.24	2% of building total
44	Sd1	Wall	South	163	0.71	1% of building total	0	Not counted
45	Sd2	Wall	South	43	0.71	0% of building total	0	Not counted
46	Sb3	Glazing	South	67	3.00	2% of building total	0.24	2% of building total
47	Sb4s	Glazing	South	196	3.00	6% of building total	0.24	3% of building total
48	Se5	Wall	South	27	1.00	0% of building total	0	Not counted
49	Sb6s	Glazing	South	95	3.00	3% of building total	0.24	1% of building total
50	Sb6.1	Glazing	South	75	3.00	2% of building total	0.24	2% of building total
51	Sb7	Glazing	South	68	3.00	2% of building total	0.24	2% of building total
52	Sd8	Wall	South	22	0.71	0% of building total	0	Not counted
53	Se9	Wall	South	25	1.00	0% of building total	0	Not counted
54	Sb9.1s	Glazing	South	37	3.00	1% of building total	0.24	0% of building total
55	Sb10f	Glazing	South	48	3.00	1% of building total	0.24	1% of building total
56	Sd11	Wall	South	39	0.71	0% of building total	0	Not counted
57	Sf12	Wall	South	171	0.71	1% of building total	0	Not counted
58	Sd13	Wall	South	12	0.71	0% of building total	0	Not counted
59	Sb14	Glazing	South	22	3.00	1% of building total	0.24	1% of building total
60	Sf15	Wall	South	77	0.71	1% of building total	0	Not counted

61	Se16	Wall	South	27	1.00	0% of building total	0	Not counted
62	Sb17f	Glazing	South	84	3.00	2% of building total	0.24	2% of building total
63	Se18	Wall	South	27	1.00	0% of building total	0	Not counted
64	Sb19	Glazing	South	73	3.00	2% of building total	0.24	2% of building total
65	Sf20	Wall	South	139	0.71	1% of building total	0	Not counted
66	Wd1	Wall	West	20	0.71	0% of building total	0	Not counted
67	Wb4s	Glazing	West	336	3.00	10% of building total	0.24	8% of building total
68	Wb6f	Glazing	West	113	3.00	3% of building total	0.24	5% of building total
69	Wb6.1f	Glazing	West	45	3.00	1% of building total	0.24	2% of building total
70	Wf7	Wall	West	190	0.71	1% of building total	0	Not counted
71	Wc8	Glazing	West	36	4.50	2% of building total	0.63	4% of building total
72	Wf9	Wall	West	225	0.71	2% of building total	0	Not counted
73	Wc10	Glazing	West	43	4.50	2% of building total	0.63	5% of building total
74	Wf11	Wall	West	111	0.71	1% of building total	0	Not counted
75	Wb12f	Glazing	West	206	3.00	6% of building total	0.24	9% of building total
76	Wb13	Glazing	West	236	3.00	7% of building total	0.24	10% of building total
77								
78								

Disclaimer:

This calculator has been developed to assist in developing a better understanding of the glazing energy efficiency parameters of NCC 2019. While the author believes that the calculator, if used correctly, is likely to 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 this calculator is entirely at your own risk and the author accepts no liability of any kind.

[Based on the Wall-Glazing Calculator v3.0 made by Alex Zeller \(available at this link\)](#)

Appendix B2 – NCC Wall–Glazing Calculator – Stage 1&2

See following pages.

NCC 2022 Wall-Glazing Calculator (Open-source)

Wall and glazing energy efficiency in Class 2-9 buildings - Specification S37C4 (Method 2), NCC 2022

Building name and description

AMRF Building 2

Classification

Other

Climate Zone

6

Calculated Area-Weighted U-Value

1.90

Allowable Area-Weighted U-Value

2.00

Building total U-Value allowance met

95%

Calculated Representative Air-Conditioning Energy Value

1389.7

Allowable Representative Air-Conditioning Energy Value

1637.1

Building total SHGC allowance met

85%

Check Values

Visible

Wall Element

Requirements

Met

Display Glazing Element Requirements

-

Use of this calculator does not guarantee compliance with the NCC. The disclaimer and a version update check are available at the bottom of the page.

Element Description					U-Value		SHGC and Shading				
ID	Description (optional)	Element Type	Facing Sector	Area (m ²)	U-Value	U-Value Element share of allowance used	SHGC	Glazing Height (m)	Shading Height (m)	Shading Projection (m)	SHGC Element share of allowance used
1	Nd1	Wall	North	73	0.71	0% of building total	0				Not counted
2	Ne2	Wall	North	82	1.00	1% of building total	0				Not counted
3	Nb3	Glazing	North	62	3.00	1% of building total	0.24				2% of building total
4	Nb4s	Glazing	North	74	3.00	1% of building total	0.24				1% of building total
5	Na5	Glazing	North	77	2.30	1% of building total	0.24				3% of building total
6	Nf6	Wall	North	44	0.71	0% of building total	0				Not counted
7	Ne7	Wall	North	57	1.00	0% of building total	0				Not counted
8	Nb8s	Glazing	North	58	3.00	1% of building total	0.24				1% of building total
9	Nb9s	Glazing	North	95	3.00	2% of building total	0.24				2% of building total
10	Ne10	Wall	North	82	1.00	1% of building total	0				Not counted
11	Nb11f	Glazing	North	94	3.00	2% of building total	0.24				3% of building total
12	Na12f	Glazing	North	42	2.30	1% of building total	0.24				2% of building total
13	Ne13	Wall	North	41	1.00	0% of building total	0				Not counted
14	Ne14	Wall	North	63	1.00	0% of building total	0				Not counted
15	Nb15f	Glazing	North	109	3.00	2% of building total	0.24				4% of building total
16	Ne16	Wall	North	20	1.00	0% of building total	0				Not counted
17	Nb17	Glazing	North	123	3.00	2% of building total	0.24				5% of building total
18	Nf18	Wall	North	146	0.71	1% of building total	0				Not counted
19	Na19	Glazing	North	34	2.30	1% of building total	0.24				1% of building total

20	Ne20	Wall	North	50	1.00	0% of building total	0	Not counted
21	Nb20.1	Glazing	North	80	3.00	2% of building total	0.24	3% of building total
22	Nb21s	Glazing	North	35	3.00	1% of building total	0.24	1% of building total
23	Nd22s	Wall	North	65	0.71	0% of building total	0	Not counted
24	Ne23	Wall	North	49	1.00	0% of building total	0	Not counted
25	Nb24s	Glazing	North	36	3.00	1% of building total	0.24	1% of building total
26	Nb25f	Glazing	North	77	3.00	2% of building total	0.24	3% of building total
27	Ne26	Wall	North	46	1.00	0% of building total	0	Not counted
28	Nb27f	Glazing	North	165	3.00	3% of building total	0.24	6% of building total
29	Nb28	Glazing	North	70	3.00	1% of building total	0.24	3% of building total
30	Na29	Glazing	North	15	2.30	0% of building total	0.24	1% of building total
31	Nf30	Wall	North	96	0.71	0% of building total	0	Not counted
32	Ee1	Wall	East	78	1.00	1% of building total	0	Not counted
33	Ee2	Wall	East	16	1.00	0% of building total	0	Not counted
34	Eb3s	Glazing	East	52	3.00	1% of building total	0.24	1% of building total
35	Ed4	Wall	East	219	0.71	1% of building total	0	Not counted
36	Ed5	Wall	East	121	0.71	1% of building total	0	Not counted
37	Eb5.1s	Glazing	East	60	3.00	1% of building total	0.24	1% of building total
37	Ee6	Wall	East	78	1.00	1% of building total	0	Not counted
38	Ed7	Wall	East	16	0.71	0% of building total	0	Not counted
39	Eb8s	Glazing	East	7	3.00	0% of building total	0.24	0% of building total
40	Ed9	Wall	East	21	0.71	0% of building total	0	Not counted
41	Eb10s	Glazing	East	7	3.00	0% of building total	0.24	0% of building total
42	Ed11	Wall	East	7	0.71	0% of building total	0	Not counted
43	Eb12s	Glazing	East	7	3.00	0% of building total	0.24	0% of building total
44	Ed13	Wall	East	22	0.71	0% of building total	0	Not counted
45	Eb14s	Glazing	East	19	3.00	0% of building total	0.24	0% of building total
45	Ed14.1	Wall	East	7	0.71	0% of building total	0	Not counted
46	Eb15f	Glazing	East	61	3.00	1% of building total	0.24	2% of building total
47	Eb16	Glazing	East	8	3.00	0% of building total	0.24	0% of building total
48	Ed17	Wall	East	23	0.71	0% of building total	0	Not counted
49	Eb18	Glazing	East	8	3.00	0% of building total	0.24	0% of building total
50	Ed19	Wall	East	8	0.71	0% of building total	0	Not counted
51	Eb20	Glazing	East	8	3.00	0% of building total	0.24	0% of building total
52	Ed21	Wall	East	25	0.71	0% of building total	0	Not counted
53	Eb22	Glazing	East	21	3.00	0% of building total	0.24	1% of building total
53	Ed22.1	Wall	East	8	0.71	0% of building total	0	Not counted
54	Eb23f	Glazing	East	67	3.00	1% of building total	0.24	2% of building total
55	Ef24	Wall	East	231	0.71	1% of building total	0	Not counted
56	Ef25	Wall	East	323	0.71	2% of building total	0	Not counted
57	Ed25.1	Wall	North	34	0.71	0% of building total	0	Not counted

58	Ee26	Wall	East	18	1.00	0% of building total	0	Not counted
59	Eb26.1s	Glazing	East	63	3.00	1% of building total	0.24	1% of building total
60	Eb27	Glazing	East	40	3.00	1% of building total	0.24	1% of building total
61	Ef28	Wall	East	135	0.71	1% of building total	0	Not counted
62	Ea29	Glazing	East	40	2.30	1% of building total	0.24	1% of building total
63	Eb30s	Glazing	East	12	3.00	0% of building total	0.24	0% of building total
64	Sd1	Wall	South	163	0.71	1% of building total	0	Not counted
65	Sd2	Wall	South	43	0.71	0% of building total	0	Not counted
66	Sb3	Glazing	South	67	3.00	1% of building total	0.24	1% of building total
67	Se5	Wall	South	27	1.00	0% of building total	0	Not counted
68	Sb6s	Glazing	South	95	3.00	2% of building total	0.24	1% of building total
69	Sb6.1	Glazing	South	75	3.00	2% of building total	0.24	1% of building total
70	Sb7	Glazing	South	68	3.00	1% of building total	0.24	1% of building total
71	Sd8	Wall	South	22	0.71	0% of building total	0	Not counted
72	Se9	Wall	South	25	1.00	0% of building total	0	Not counted
73	Sb9.1s	Glazing	South	37	3.00	1% of building total	0.24	0% of building total
74	Sb10f	Glazing	South	48	3.00	1% of building total	0.24	1% of building total
75	Sd11	Wall	South	39	0.71	0% of building total	0	Not counted
76	Sf12	Wall	South	171	0.71	1% of building total	0	Not counted
77	Sd13	Wall	South	12	0.71	0% of building total	0	Not counted
78	Sb14	Glazing	South	22	3.00	0% of building total	0.24	0% of building total
79	Sf15	Wall	South	77	0.71	0% of building total	0	Not counted
80	Se16	Wall	South	27	1.00	0% of building total	0	Not counted
81	Sb17f	Glazing	South	84	3.00	2% of building total	0.24	1% of building total
82	Se18	Wall	South	27	1.00	0% of building total	0	Not counted
83	Sb19	Glazing	South	73	3.00	1% of building total	0.24	1% of building total
84	Sf20	Wall	South	139	0.71	1% of building total	0	Not counted
85	Se21	Wall	South	83	1.00	1% of building total	0	Not counted
86	Sd22	Wall	South	13	0.71	0% of building total	0	Not counted
87	Sb23f	Glazing	South	172	3.00	3% of building total	0.24	3% of building total
88	Se24	Wall	South	51	1.00	0% of building total	0	Not counted
89	Sb25f	Glazing	South	126	3.00	3% of building total	0.24	2% of building total
90	Sa26	Glazing	South	25	2.30	0% of building total	0.24	0% of building total
91	Sa27	Glazing	South	25	2.30	0% of building total	0.24	0% of building total
92	Se28	Wall	South	46	1.00	0% of building total	0	Not counted
93	Sb29	Glazing	South	321	3.00	6% of building total	0.24	6% of building total
94	Wd1	Wall	West	43	0.71	0% of building total	0	Not counted
95	Wb2	Glazing	West	11	3.00	0% of building total	0.24	0% of building total
96	Wd3	Wall	West	57	0.71	0% of building total	0	Not counted
97	Wb4s	Glazing	West	340	3.00	7% of building total	0.24	5% of building total
98	Wb6f	Glazing	West	113	3.00	2% of building total	0.24	3% of building total

99	Wb6.1f	Glazing	West	45	3.00	1% of building total	0.24	1% of building total
100	Wf7	Wall	West	190	0.71	1% of building total	0	Not counted
101	Wc8	Glazing	West	36	4.50	1% of building total	0.63	3% of building total
102	Wf9	Wall	West	225	0.71	1% of building total	0	Not counted
103	Wc10	Glazing	West	43	4.50	1% of building total	0.63	3% of building total
104	Wf11	Wall	West	111	0.71	1% of building total	0	Not counted
105	Wb12f	Glazing	West	206	3.00	4% of building total	0.24	6% of building total
106	Wb13	Glazing	West	236	3.00	5% of building total	0.24	7% of building total
107	Wb14	Glazing	West	12	3.00	0% of building total	0.24	0% of building total
108								

Disclaimer:

This calculator has been developed to assist in developing a better understanding of the glazing energy efficiency parameters of NCC 2019. While the author believes that the calculator, if used correctly, is likely to 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 this calculator is entirely at your own risk and the author accepts no liability of any kind.

[Based on the Wall-Glazing Calculator v3.0 made by Alex Zeller \(available at this link\)](#)

Appendix C – Section J Thermal Envelope Markups

Appendix C1 – Section J Thermal Envelope Markups – Stage 1

See following pages.

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STAGE 1.S4.55 PLANS

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Envelope Thermal Requirements

Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R as per elevation mark-up

R > 2.0 m2K/W

R > 2.0 m2K/W

R > 3.6 m2K/W

SA < 0.45

SRI < 64 (if pitched < 15 deg)

SRI > 34 (if pitched > 15 deg)

General Notes:

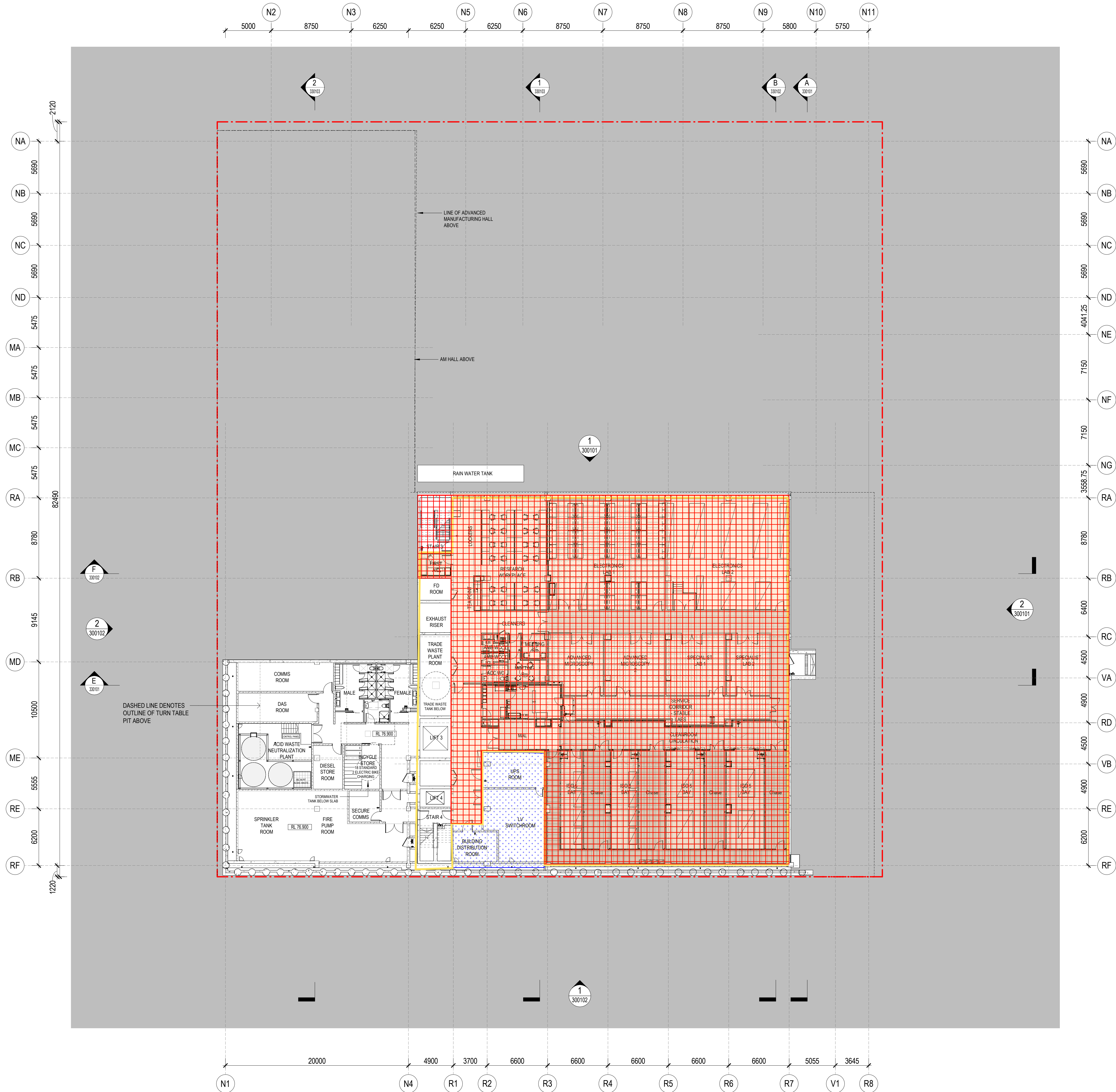
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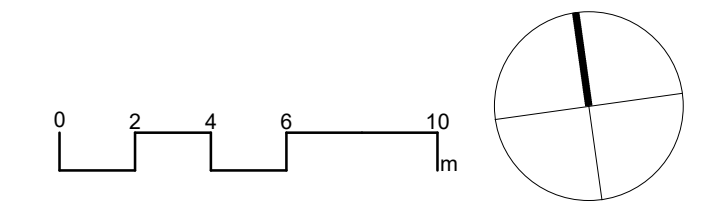
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Collaborating Architect: Aileen Sage

Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD
Drawing
GENERAL ARRANGEMENT PLANS
- BASEMENT 1

Scale 1 : 200 @B1 Project no 220479

Drawing No. AMRFB2-ARC-AR-S2-200100

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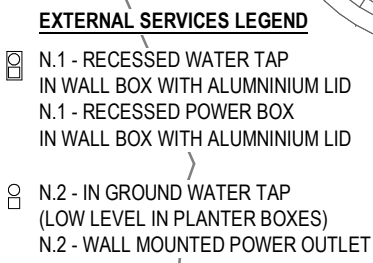
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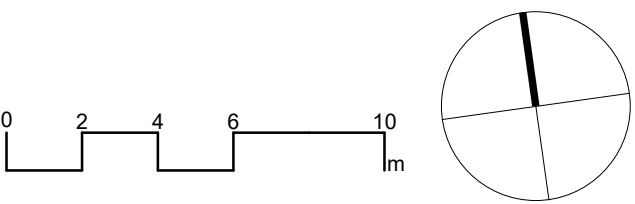
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FULL SCALE AMRF

BUILDING 2

Drawing

GENERAL ARRANGEMENT PLANS

- GROUND FLOOR

Scale	1 : 200@B1	Project no	22047
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Drawing No. _____

AMRFB2-ARC-AR-S2-210000

Prepared by: LRJ Date: 11/10/2015 Page: 10 of 10

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STAGE 1.S4.55 PLANS
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Envelope Thermal Requirements
Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R as per elevation mark-up

R > 2.0 m2K/W

R > 2.0 m2K/W

R > 3.6 m2K/W
SA < 0.45
SRI < 64 (if pitched < 15 deg)
SRI > 34 (if pitched > 15 deg)

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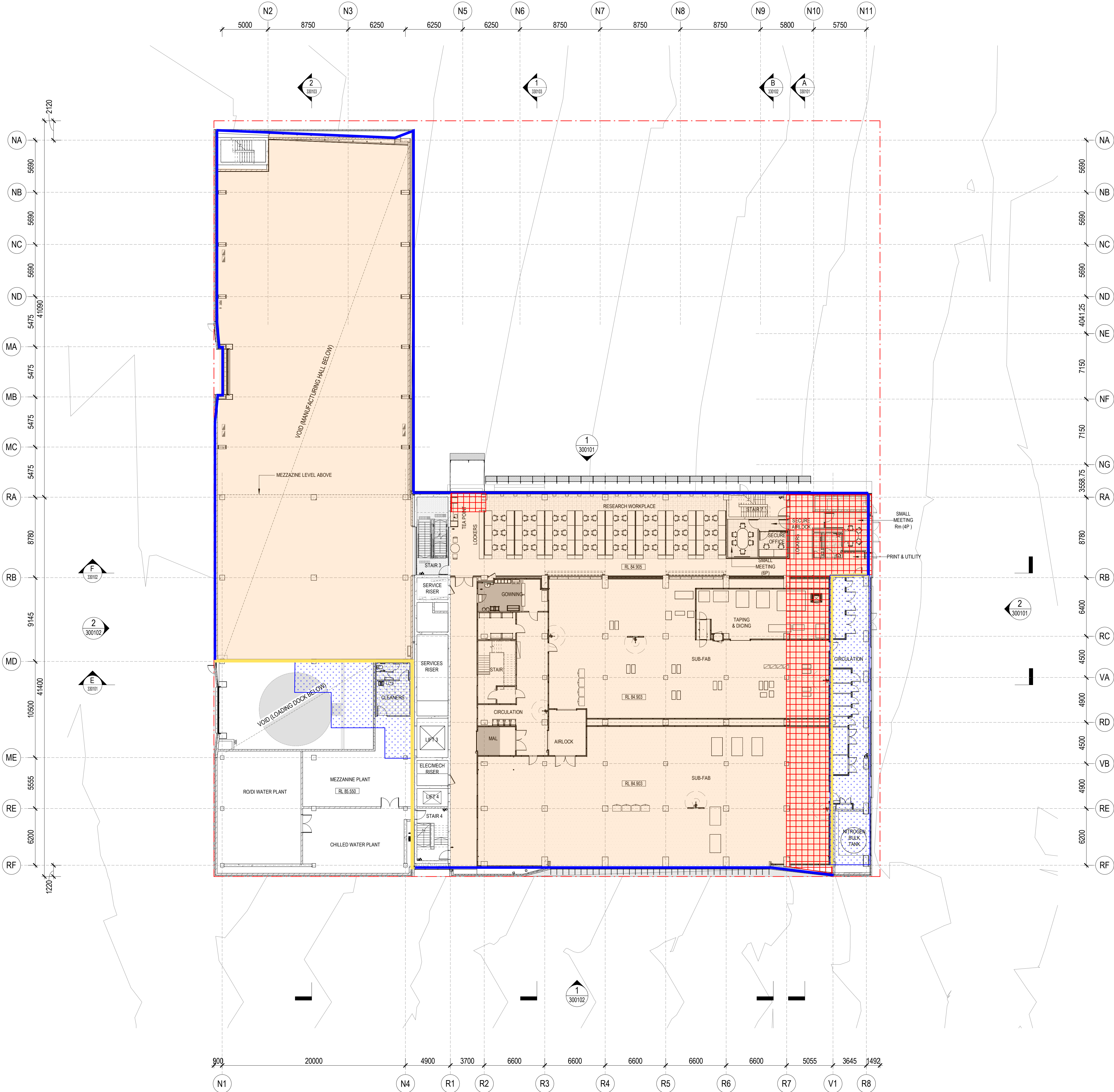
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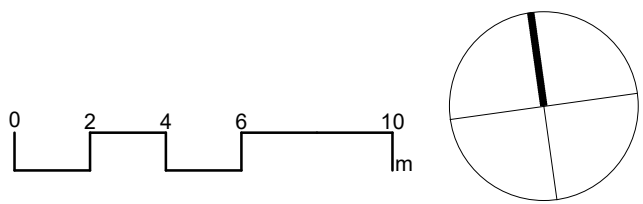
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Collaborating Architect:

Aileen Sage

Lab Design Consultant:

Jacobs

Project

FULL SCALE AMRF BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing

GENERAL ARRANGEMENT PLANS - LEVEL 1

Scale

1 : 200 @B1

Project no

220479

Drawing No.

AMRFB2-ARC-AR-S2-210100

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LRJ

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STAGE 1.S4.55 PLANS

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Envelope Thermal Requirements

Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R as per elevation mark-up

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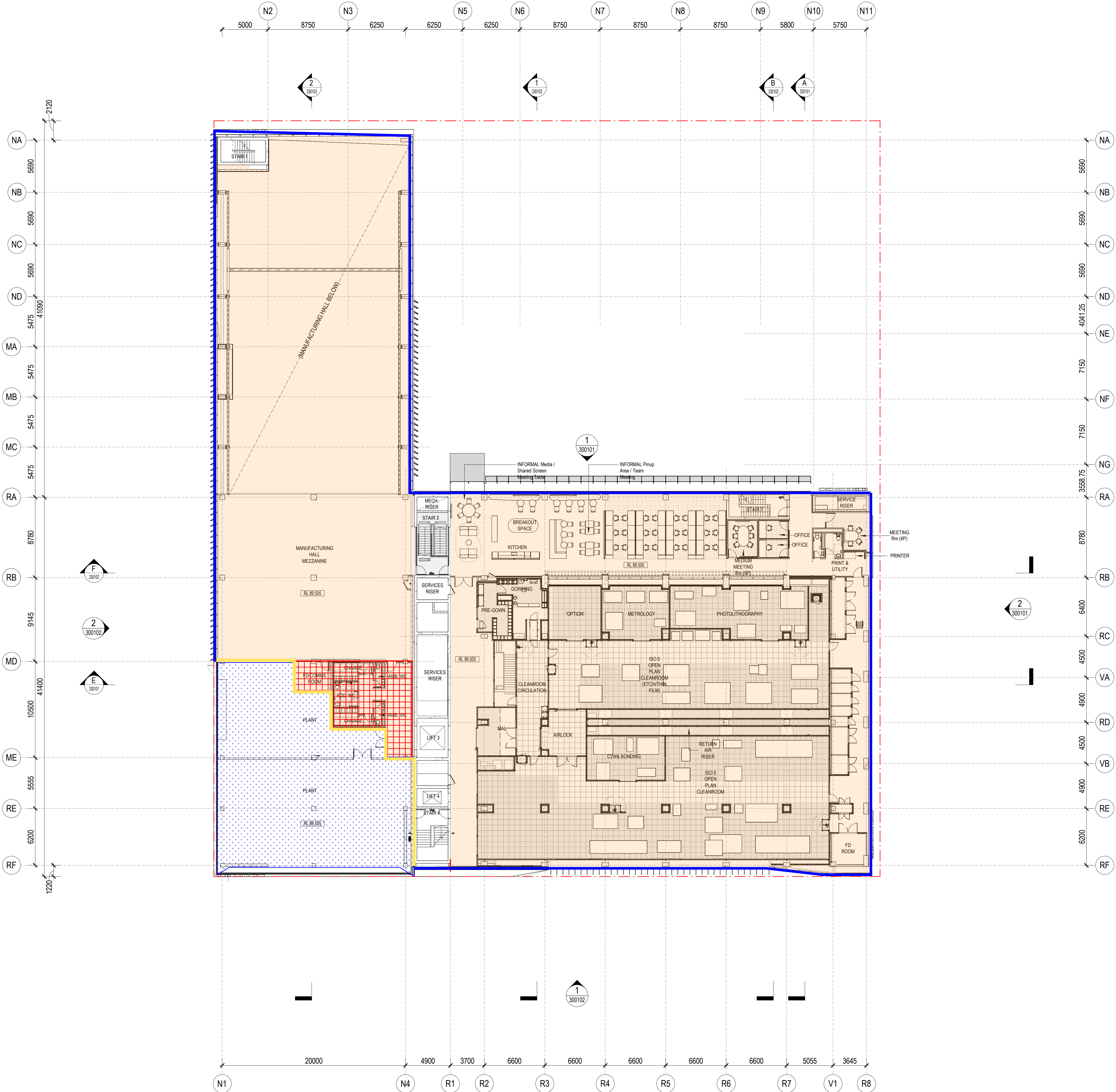
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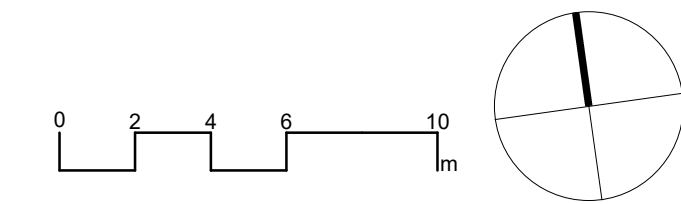
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ABN 90 131 245 684

Collaborating Architect: Aileen Sage

Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD
Drawing
GENERAL ARRANGEMENT PLANS
- LEVEL 2

Scale	1 : 200 @B1	Project no	220479
Drawing No.	AMRFB2-ARC-AR-S2-210200		
Prepared	LRJ	revision	
Approved	BR		T02

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TENDER

ARCHITECTUS
3.11.25
STAGE 1.S4.55 PLANS
DRAFT

Envelope Thermal Requirements
Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R as per elevation mark-up

R > 2.0 m2K/W

R > 2.0 m2K/W

R > 3.6 m2K/W
SA < 0.45
SRI < 64 (if pitched < 15 deg)
SRI > 34 (if pitched > 15 deg)

General Notes:

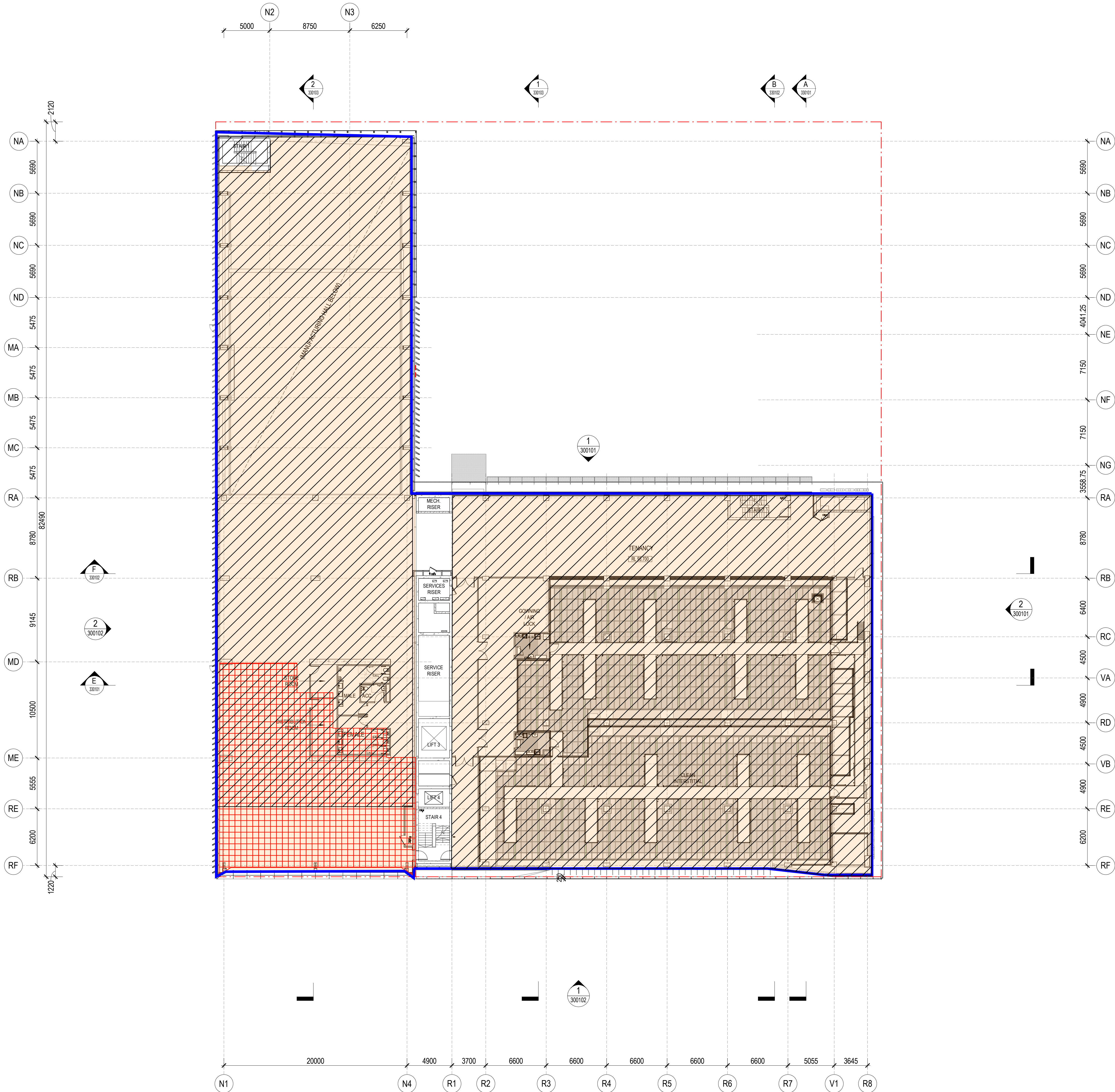
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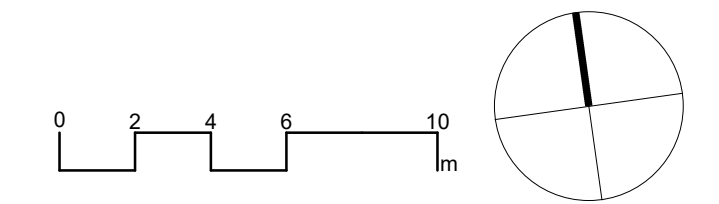
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Ray Brown, NSWARB 6359

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revision	purpose of issue	date
T02	FOR TENDER	24.10.25

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Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD
Drawing
GENERAL ARRANGEMENT PLANS
- LEVEL 3

Scale 1 : 200 @B1 Project no 220479

Drawing No. AMRFB2-ARC-AR-S2-210300

Prepared LRJ revision
Approved BR T02

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TENDER

ARCHITECTUS

3.11.25

STAGE 1.S4.55 PLANS

DRAFT

Envelope Thermal Requirements

Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R > 2.0 m2K/W

R as per elevation mark-up

R > 2.0 m2K/W

R > 2.0 m2K/W

R > 3.6 m2K/W

SA < 0.45

SRI < 64 (if pitched < 15 deg)

SRI > 34 (if pitched > 15 deg)

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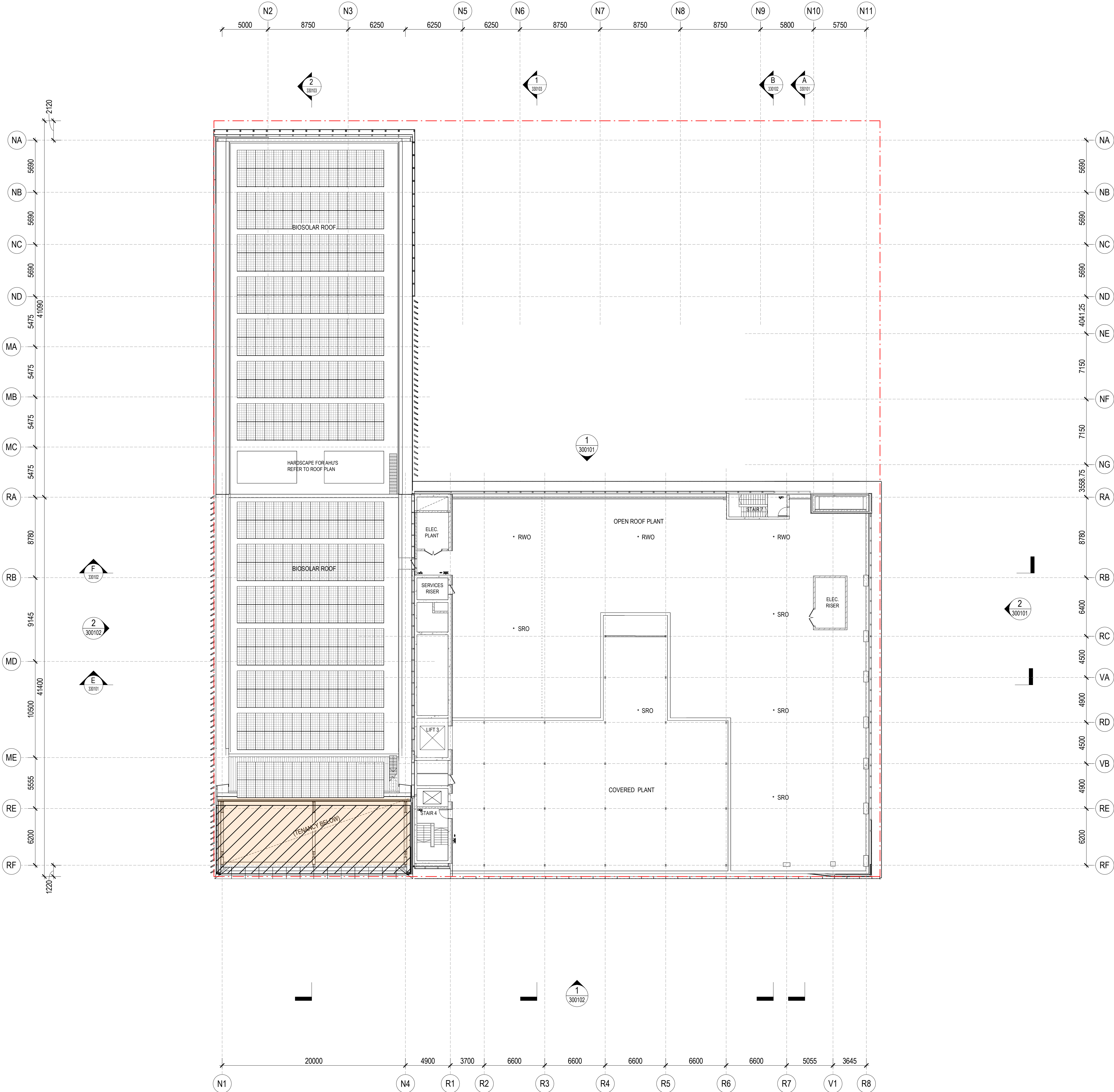
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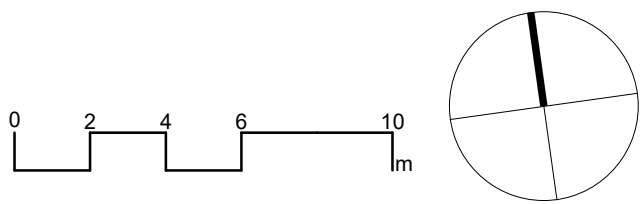
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Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing

GENERAL ARRANGEMENT PLANS
- LEVEL 4

Scale 1 : 200 @B1 Project no 220479

Drawing No.

AMRFB2-ARC-AR-S2-210400

Prepared LRJ revision

Approved BR T02

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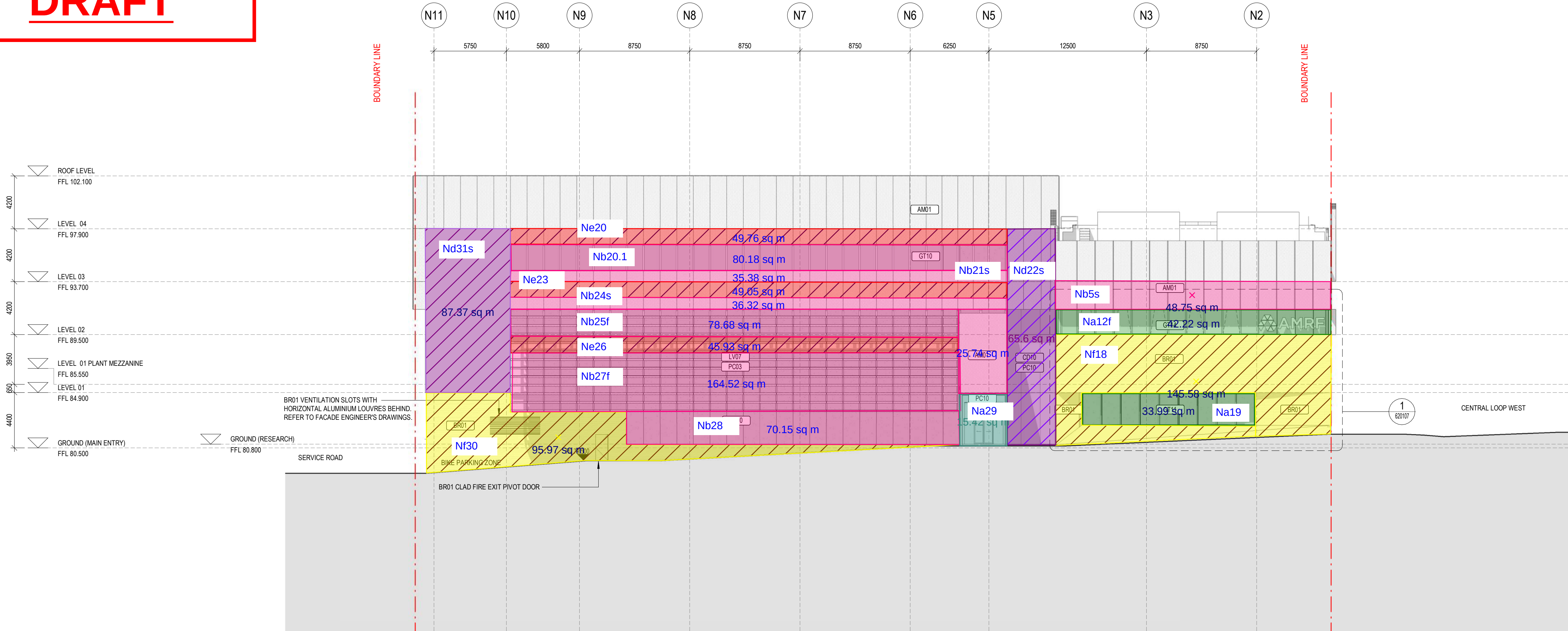
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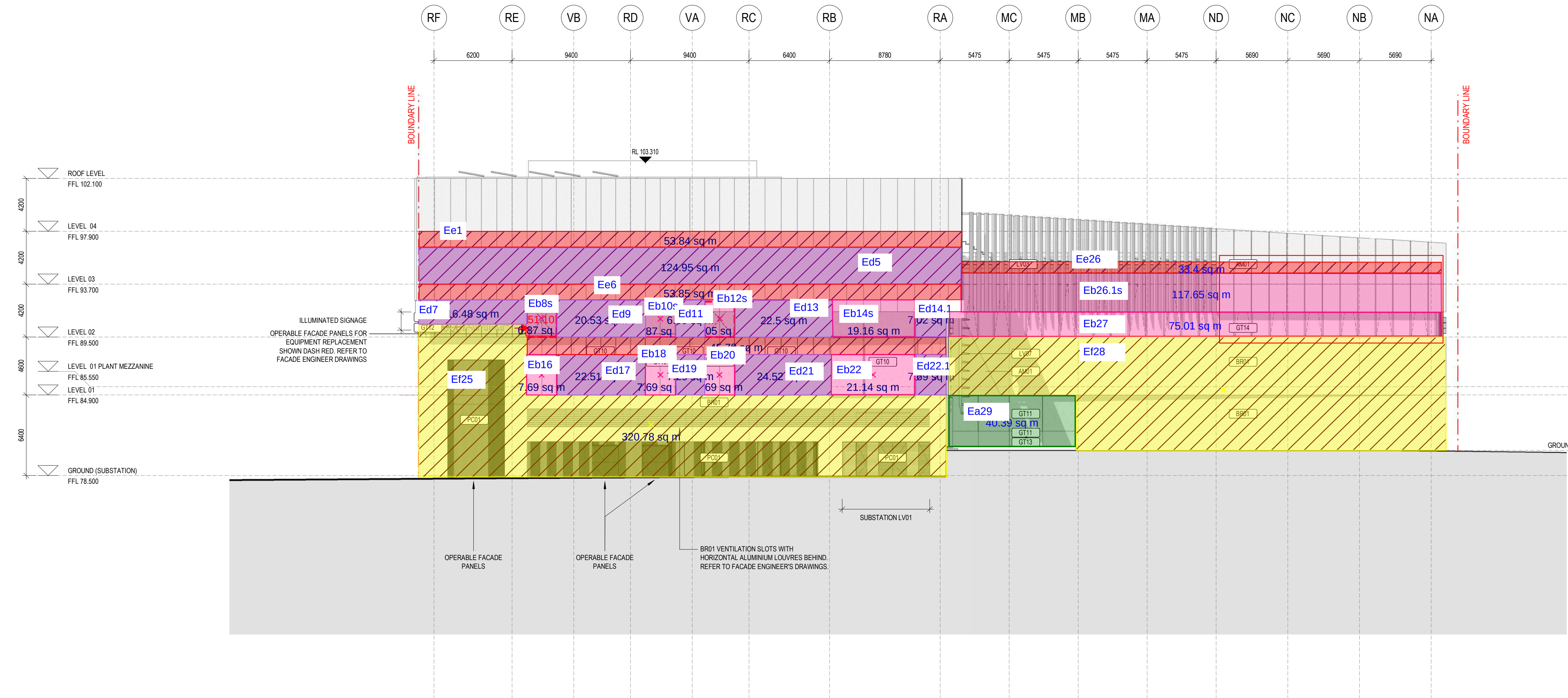
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STAGE 1.S4.55 PLANS

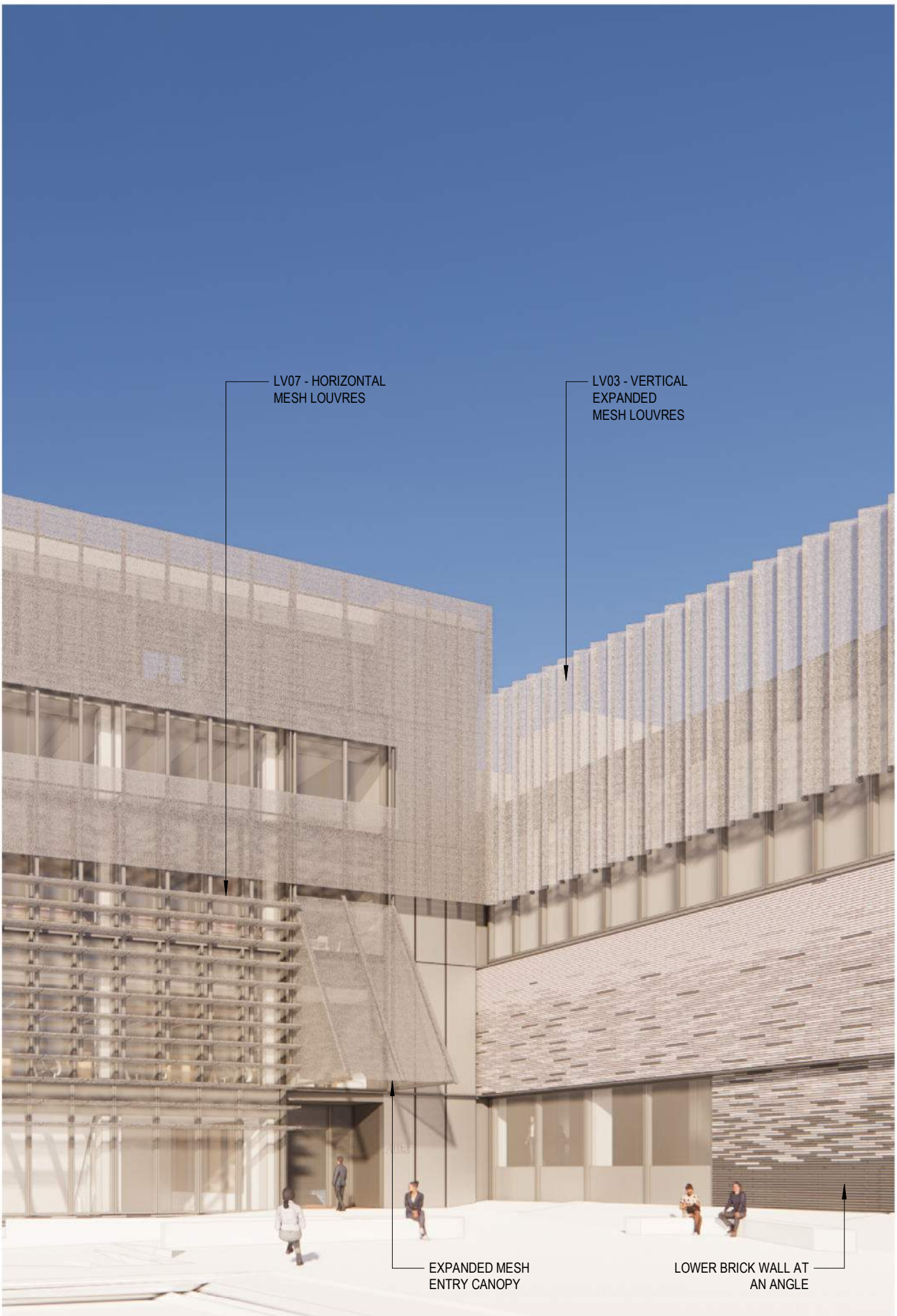
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1 NORTH ELEVATION
SCALE: 1 : 200



2 EAST ELEVATION
SCALE: 1 : 200



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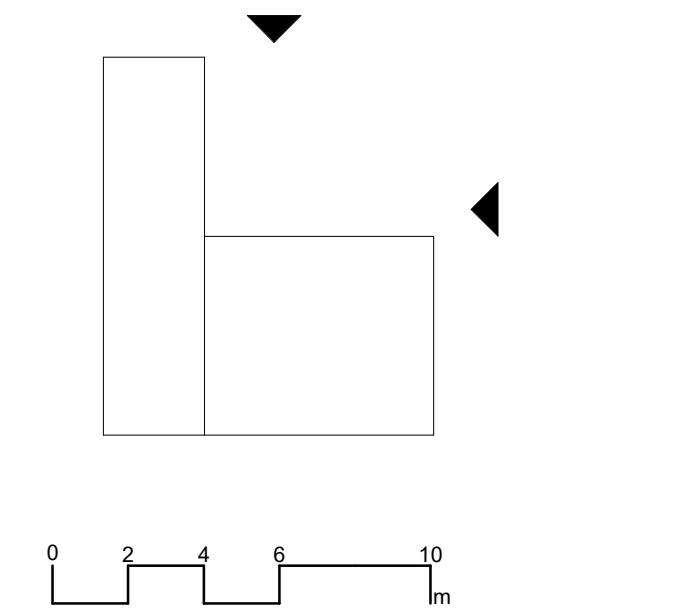
revision	purpose of issue	date
T02	FOR TENDER	24.10.25

CODE LEGEND	
CODE	DESCRIPTION
AM01	EXPANDED METAL MESH
BR01	HANDMADE CUSTOM BRICKS
CD10	SOLID ALUMINUM CASSETTE CLADDING
GT10	CLEAR GLASS
GT11	CLEAR GLASS
GT12	COLOURBACK GLASS
GT13	COLOURBACK GLASS
GT14	TRANSLUCENT GLASS
LV03	EXPANDED MESH VERTICAL SUNSHADING LOUVRES
LV07	EXPANDED MESH HORIZONTAL SUNSHADING LOUVRES
PC01	POWDERCOAT
PC03	POWDERCOAT
PC10	PVDF COATING

Thermal performance requirements for Section J compliance and passive energy performance
Arup/JK 21/11/2025

- U-value: Nom. <2.3 W/m².K / SGHC (glass) <0.24
- U-value: Nom. 3.0 W/m².K / SGHC (glass) <0.24
- U-value: Nom. 4.5 W/m².K / SGHC (glass) <0.63
- R-value: Nom. >1.4 m².K/W
- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.4 m².K/W

Key Plan



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Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing

BUILDING ELEVATIONS - NORTH & EAST

Scale 1 : 200 @B1 Project no 220479

Drawing No.

AMRFB2-ARC-AR-S2-300101

Prepared LB revision

Approved BR T02

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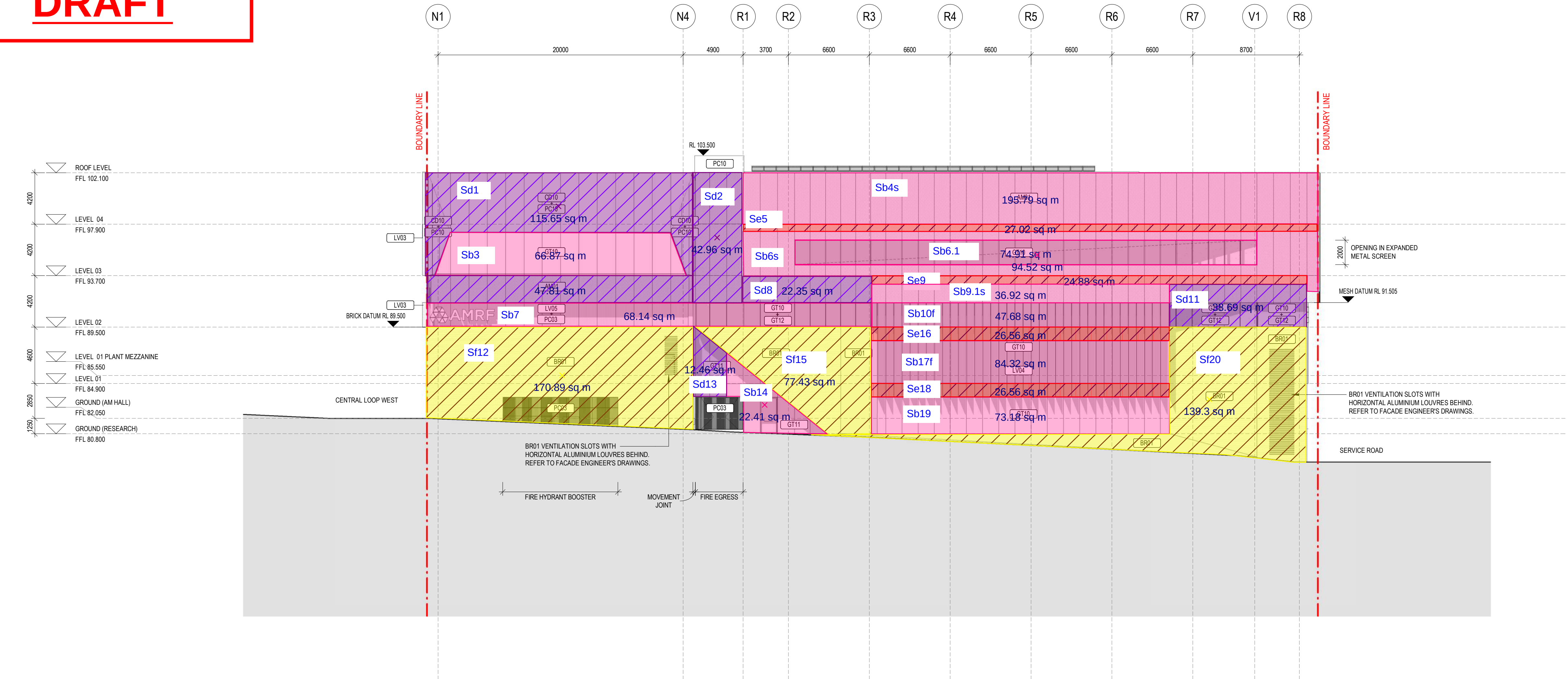
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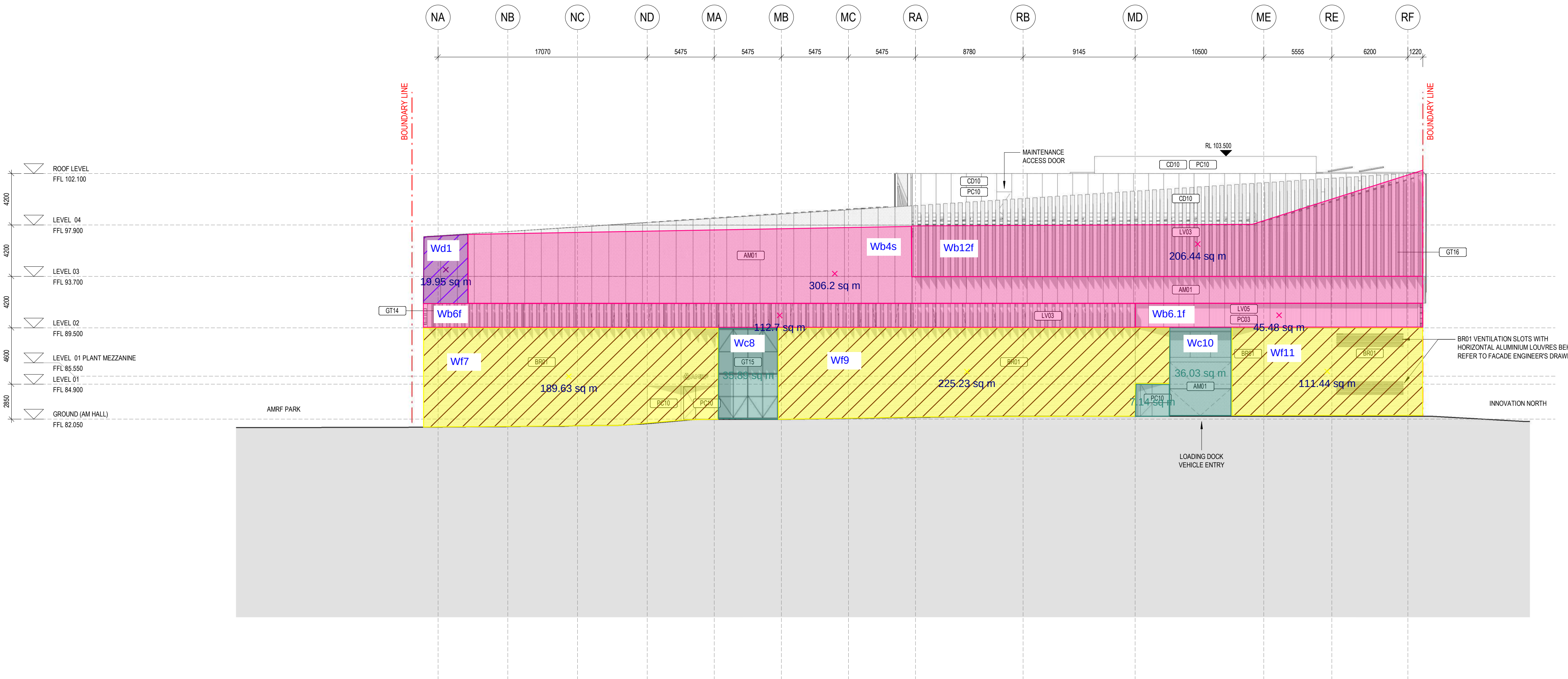
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STAGE 1.S4.55 PLANS

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1 SOUTH ELEVATION
SCALE: 1 : 200



2 WEST ELEVATION
SCALE: 1 : 200



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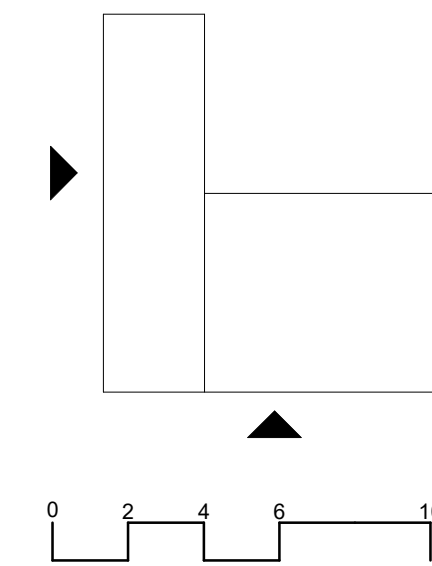
revision	purpose of issue	date
T02	FOR TENDER	24.10.25

CODE LEGEND	
CODE	DESCRIPTION
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BR01	HANDMADE CUSTOM BRICKS
CD10	SOLID ALUMINUM CASSETTE CLADDING
GT10	CLEAR GLASS
GT11	CLEAR GLASS
GT12	COLORBACK GLASS
GT14	TRANSLUCENT GLASS
GT15	CERAMIC FRIT GLASS
GT16	CLEAR GLASS
LV03	EXPANDED MESH VERTICAL SUNSHADING LOUVRES
LV04	VERTICAL SUNSHADING LOUVRES
LV05	CONCEALED FRAME VERTICAL PLANT ROOM LOUVRES
PC03	POWDERCOAT
PC10	PRIME COATING

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Arup/JK 21/11/2025

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- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.4 m².K/W

Key Plan



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Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing

BUILDING ELEVATIONS - SOUTH & WEST

Scale 1 : 200 @B1 Project no 220479

Drawing No.

AMRFB2-ARC-AR-S2-300102

Prepared LB revision

Approved BR T02

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TENDER

Appendix C2 – Section J Thermal Envelope Markups – Stage 1&2

See following pages.

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3.11.25

STAGE 2.S4.55 PLANS

DRAFT

Envelope Thermal Requirements

Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

ARCHITECTUS

3.11.25

STAGE 2.S4.55 PLANS

DRAFT

Envelope Thermal Requirements

Mark-up Arup / PB 20/11/2025

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R > 3.6 m2K/W

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SRI > 34 (if pitched > 15 deg)

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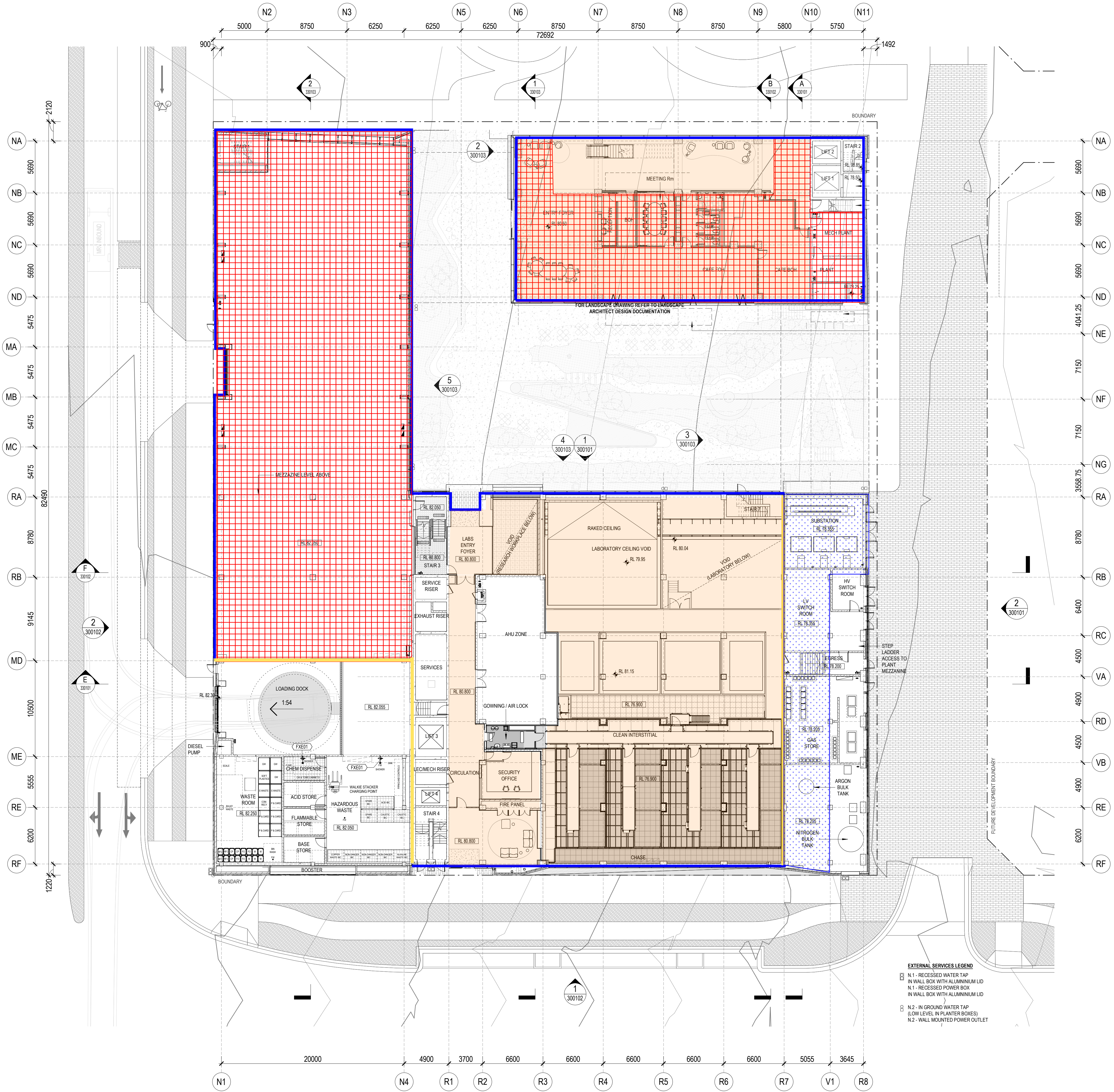
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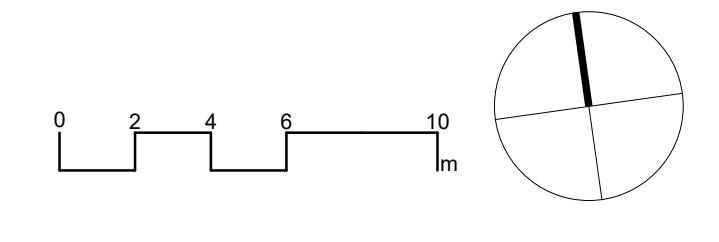
Nominated Architect
Ray Brown, NSWARB 6359

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revision	purpose of issue	date
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Collaborating Architect: **Aileen Sage**

Lab Design Consultant: **Jacobs**

Project
FULL SCALE AMRF BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD
Drawing
GENERAL ARRANGEMENT PLANS - GROUND FLOOR

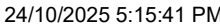
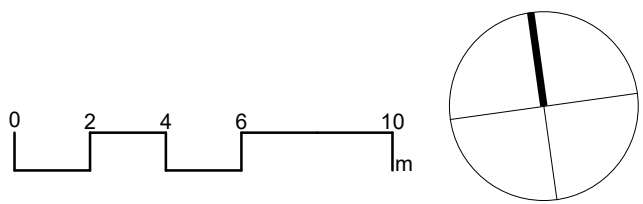
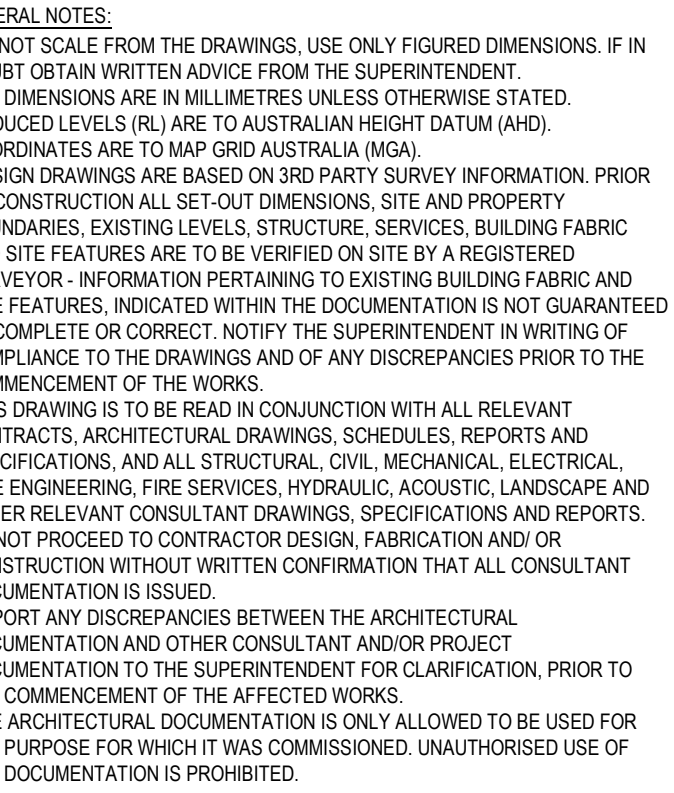
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Prepared	LRJ	revision	
Approved	BR		T02

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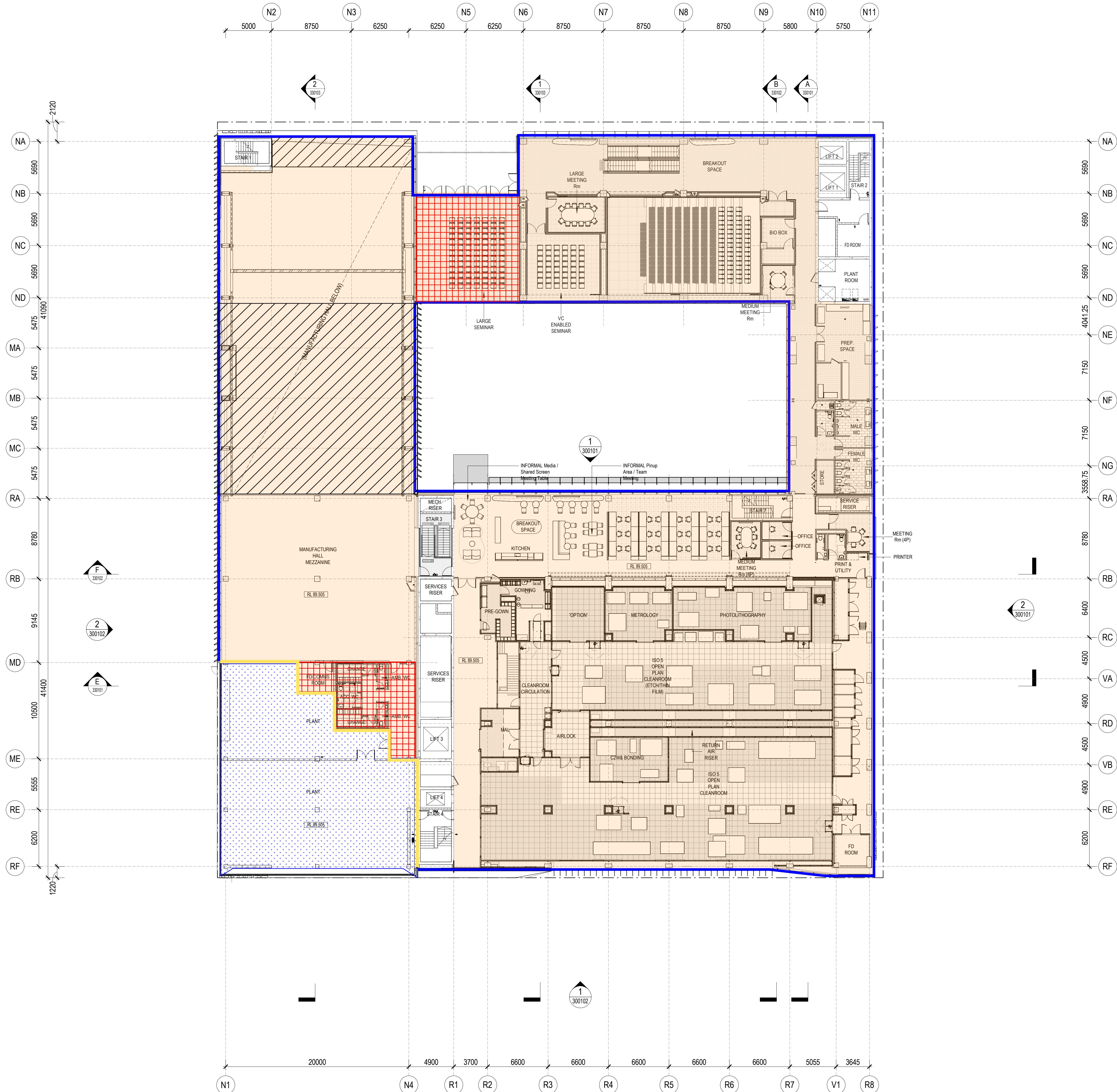
3.11.25
STAGE 2.S4.55 PLANS
DRAFT

Mark-up Arup / PB 20/11/2025

- | | | |
|--|------------------------------------|--|
|  | Conditioned Space | |
|  | Internal & Below Grade Solid Walls | R > 1.4 m2K/W |
|  | External Facade | R as per elevation mark-up |
|  | Floor Insulation | R > 2.0 m2K/W |
|  | Ceiling Insulation | R > 2.0 m2K/W |
|  | Roof Insulation | R > 3.6 m2K/W
SA < 0.45
SRI < 64 (if pitched < 15 deg)
SRI > 34 (if pitched > 15 deg) |

General Notes:

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- R-value for floors is based on downward head flow and the R-value for roofclipping is based on downward heat flow in this Climate Zone as per NCC 2022 Table J4D7 and Section J4D4.
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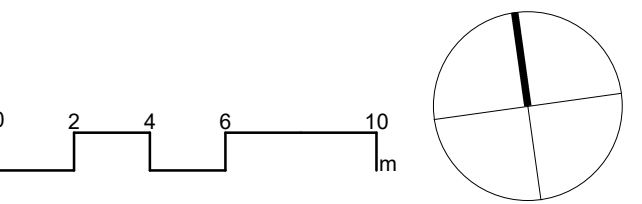
Nominated Architect
Ray Brown, NSWARB 6359

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revision	purpose of issue	date
T02	FOR TENDER	24.10.25

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Collaborating Architect:

Aileen Sage

Lab Design Consultant:

Jacobs

Project FULL SCALE AMRF BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing

GENERAL ARRANGEMENT PLANS

- LEVEL 2

Scale	1 : 200@B1	Project no	220479
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Drawing No.

AMRFB2-ARC-AR-S2-210200

Prepared	LRJ	revision
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Approved BR T02

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TENDER

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3.11.25

STAGE 2.S4.55 PLANS

DRAFT

Envelope Thermal Requirements

Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R > 2.0 m2K/W

R as per elevation mark-up

R > 2.0 m2K/W

R > 2.0 m2K/W

R > 3.6 m2K/W

SA < 0.45

SRI < 64 (if pitched < 15 deg)

SRI > 34 (if pitched > 15 deg)

General Notes:

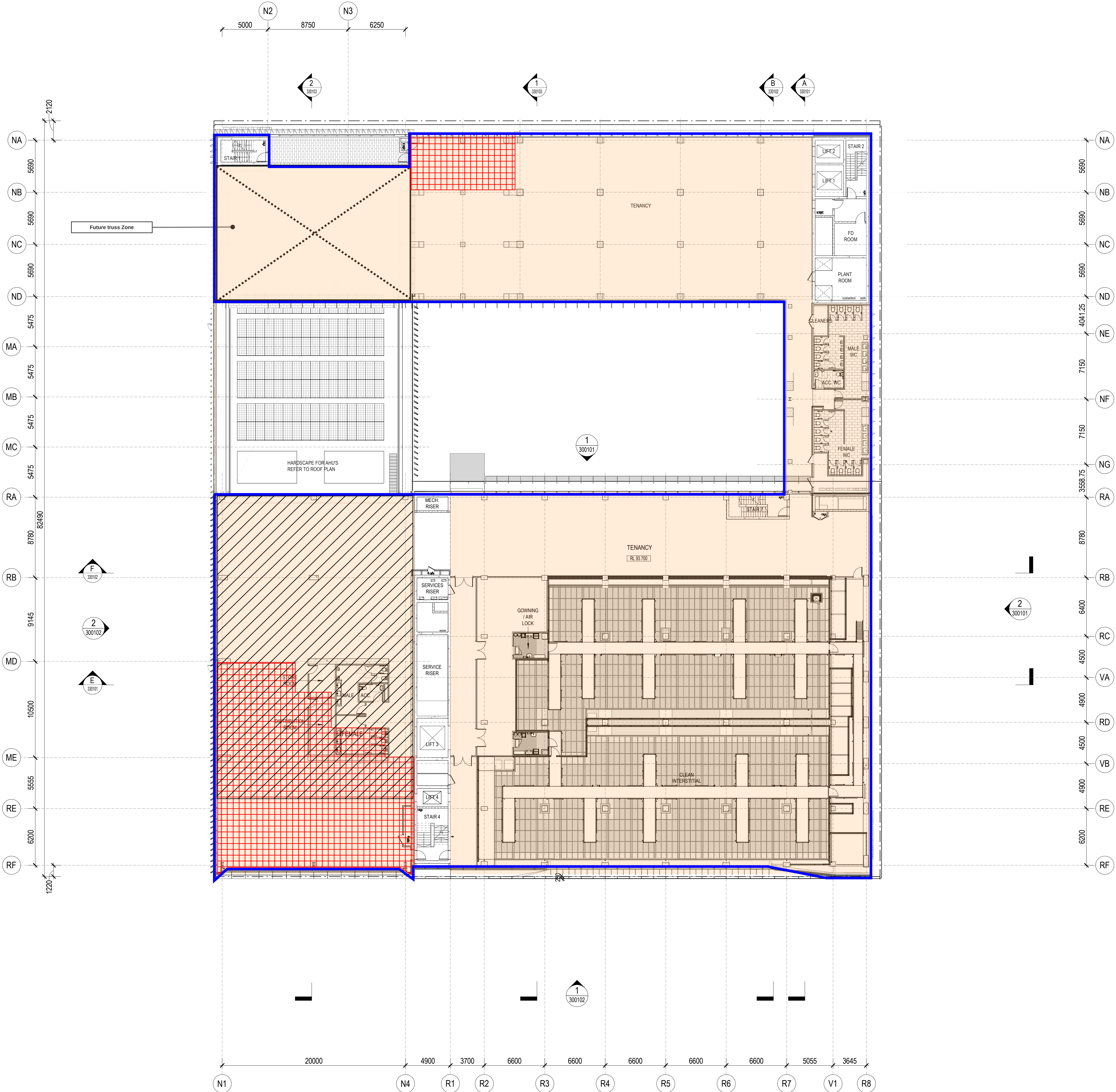
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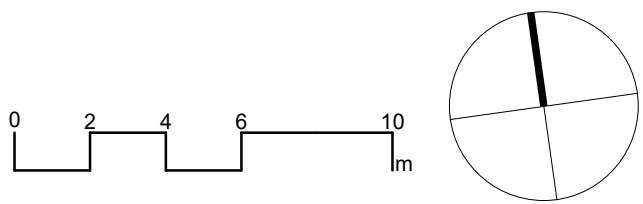
Nominated Architect
Ray Brown, NSWARB 6359

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revision	purpose of issue	date
T02	FOR TENDER	24.10.25

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Collaborating Architect: Aileen Sage

Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD
Drawing

GENERAL ARRANGEMENT PLANS
- LEVEL 3

Scale 1 : 200 @B1 Project no 220479

Drawing No.

AMRFB2-ARC-AR-S2-210300

Prepared LRJ revision

Approved BR T02

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TENDER

ARCHITECTUS

3.11.25

STAGE 2.S4.55 PLANS

DRAFT

Envelope Thermal Requirements

Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R > 2.0 m2K/W

R as per elevation mark-up

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SRI > 34 (if pitched > 15 deg)

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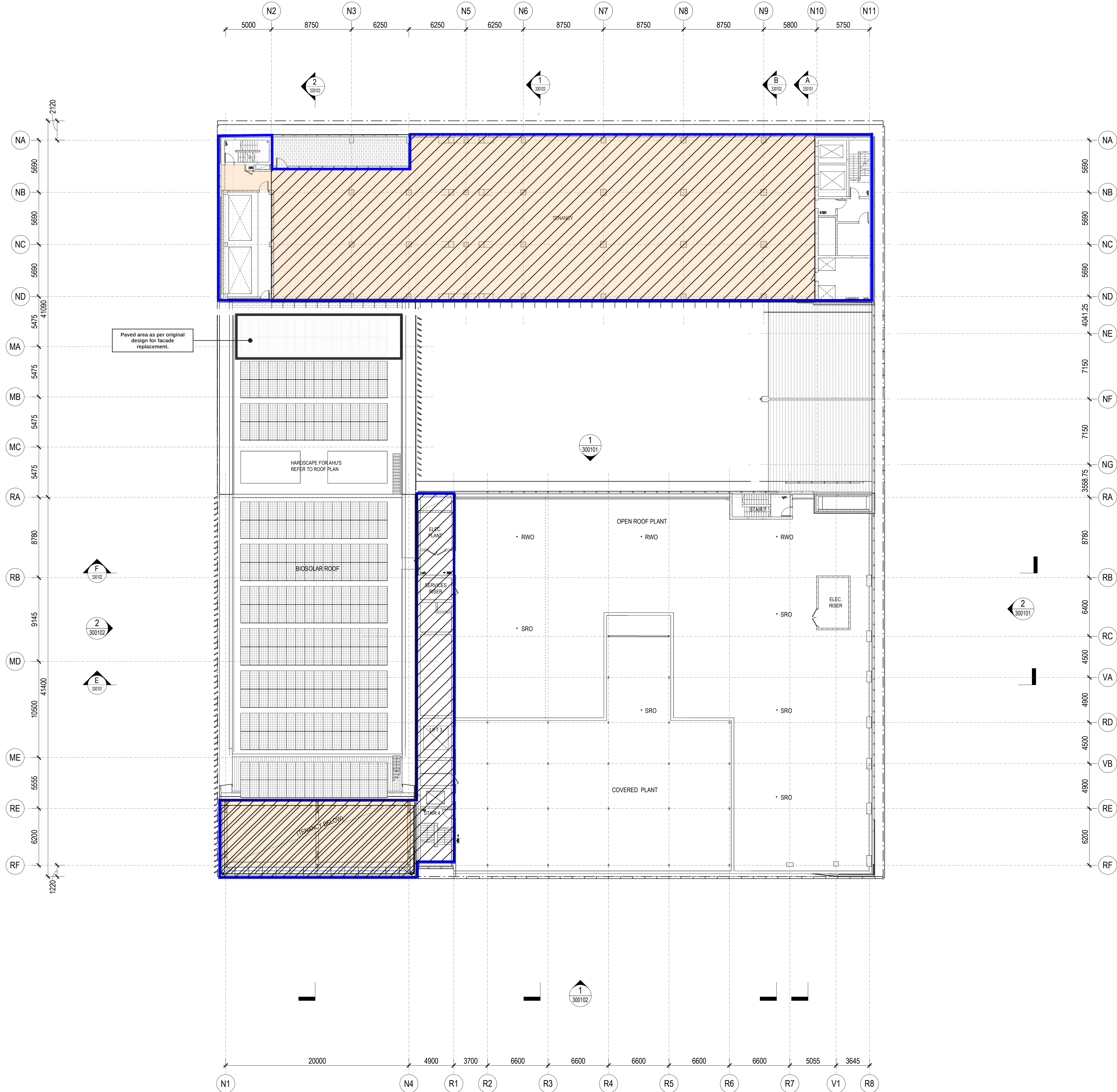
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Collaborating Architect: Aileen Sage

Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing
GENERAL ARRANGEMENT PLANS
- LEVEL 4

Scale 1 : 200 @B1 Project no 220479

Drawing No.
AMRFB2-ARC-AR-S2-210400

Prepared LRJ revision

Approved BR T02

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TENDER

ARCHITECTUS
3.11.25
STAGE 2.S4.55 PLANS
DRAFT

Envelope Thermal Requirements
Mark-up Arup / PB 20/11/2025

Conditioned Space

Internal & Below Grade Solid Walls

External Facade

Floor Insulation

Ceiling Insulation

Roof Insulation

R > 1.4 m2K/W

R > 2.0 m2K/W

R as per elevation mark-up

R > 2.0 m2K/W

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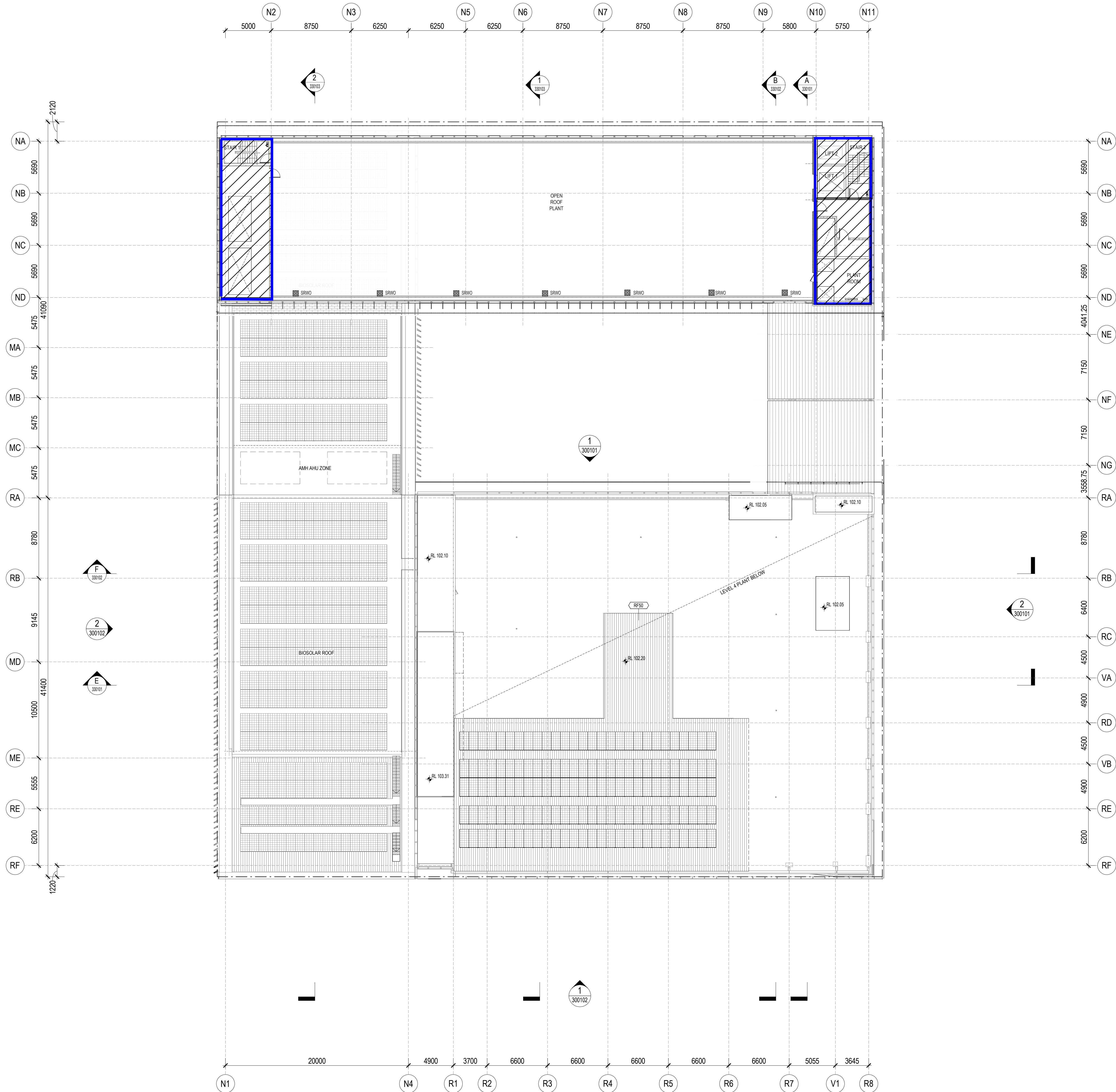
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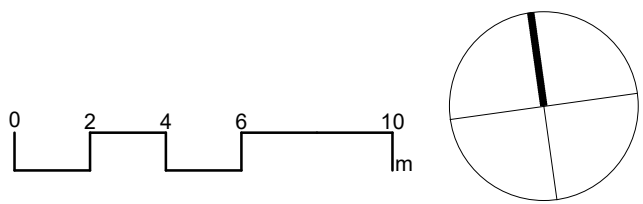
Nominated Architect
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Lab Design Consultant: Jacobs

Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD
Drawing
GENERAL ARRANGEMENT PLANS
- ROOF

Scale 1 : 200 @B1 Project no 220479

Drawing No. AMRFB2-ARC-AR-S2-210500

Prepared LRJ revision
Approved BR T02

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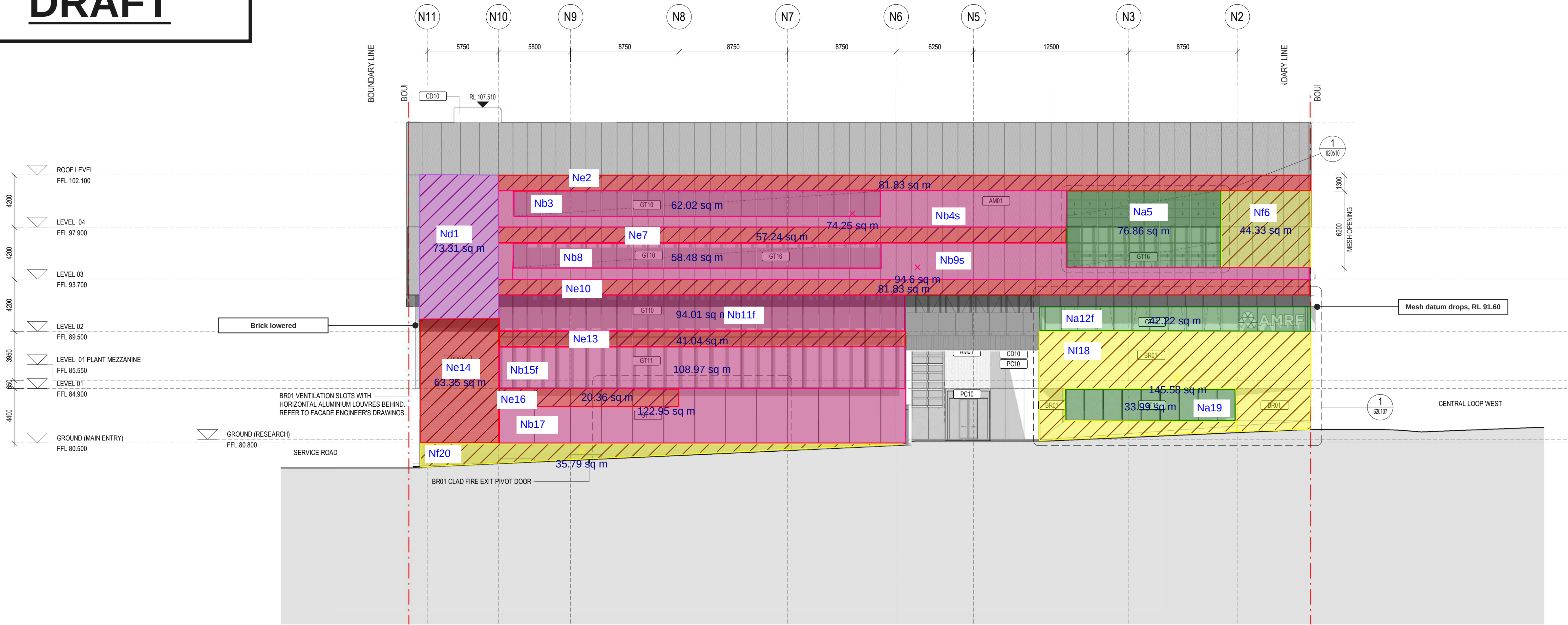
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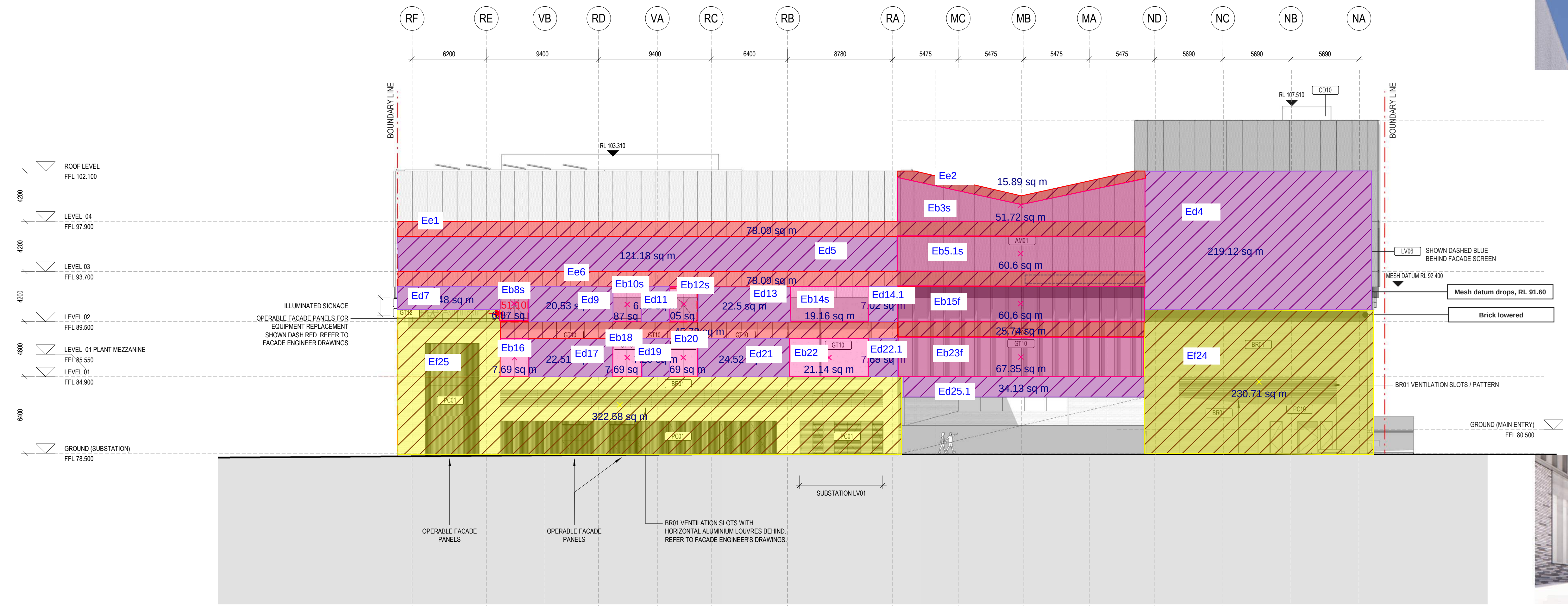
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STAGE 2.S4.55 PLANS

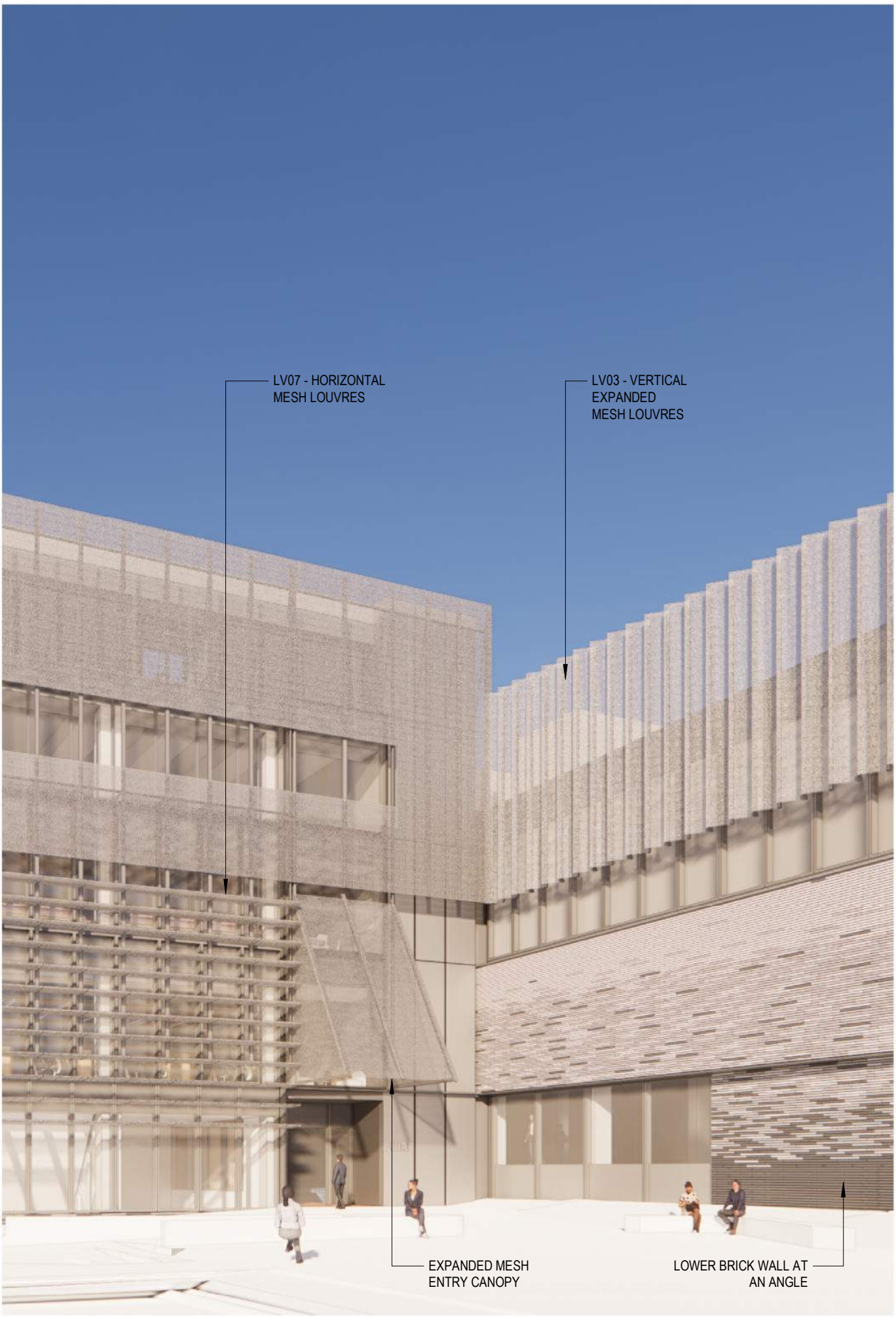
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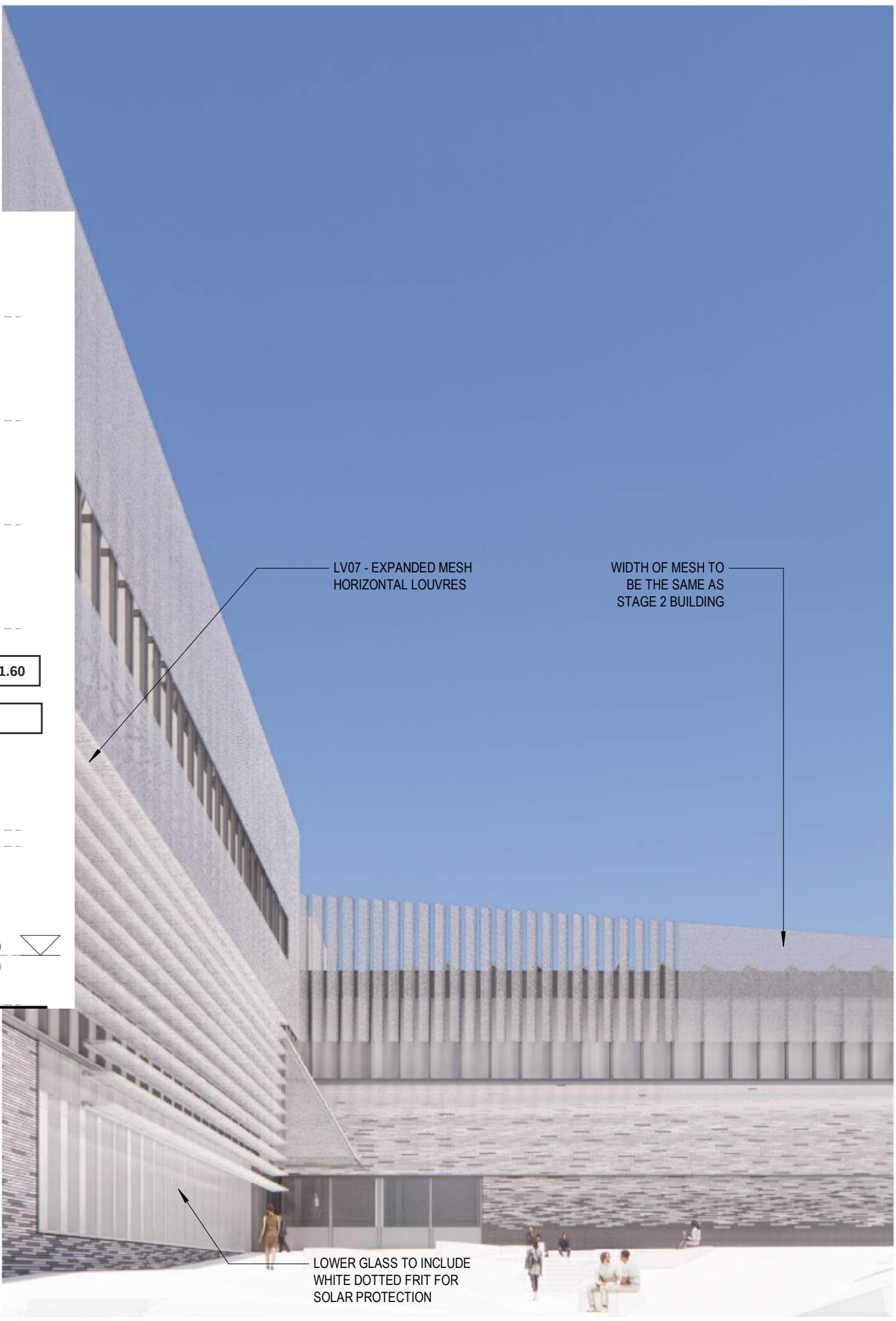
1 NORTH ELEVATION
SCALE: 1 : 200



2 EAST ELEVATION
SCALE: 1 : 200



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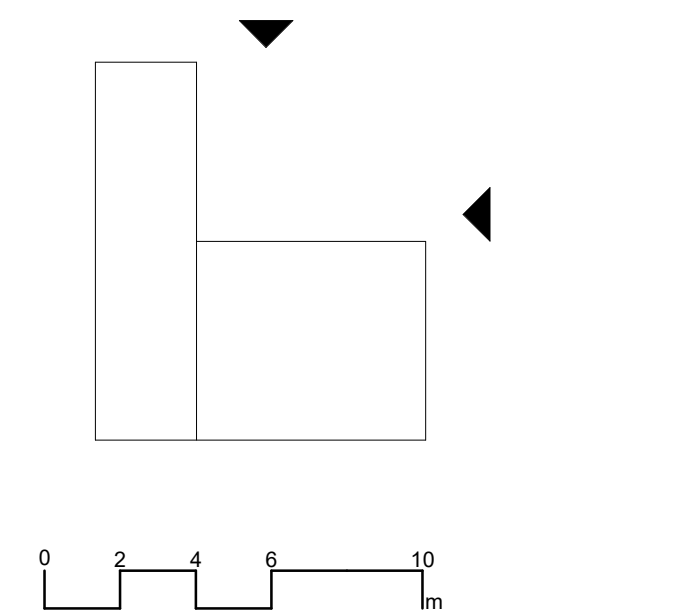
revision	purpose of issue	date
T02	FOR TENDER	24.10.25

CODE LEGEND	
CODE	DESCRIPTION
AM01	EXPANDED METAL MESH
BR01	HANDMADE CUSTOM BRICKS
CD10	SOLID ALUMINIUM CASSETTE CLADDING
GT10	CLEAR GLASS
GT11	CLEAR GLASS
GT12	COLOURBACK GLASS
GT13	COLOURBACK GLASS
GT14	TRANSLUCENT GLASS
LV03	EXPANDED MESH VERTICAL SUNSHADING LOUVRES
LV07	EXPANDED MESH HORIZONTAL SUNSHADING LOUVRES
PC01	POWDERCOAT
PC03	POWDERCOAT
PC10	PVDF COATING

Thermal performance requirements for Section J compliance and passive energy performance
Arup/JK 21/11/2025

- U-value: Nom. <2.3 W/m².K / SGHC (glass) <0.24
- U-value: Nom. 3.0 W/m².K / SGHC (glass) <0.24
- U-value: Nom. 4.5 W/m².K / SGHC (glass) <0.63
- R-value: Nom. >1.4 m².K/W
- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.4 m².K/W

Key Plan



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Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing

BUILDING ELEVATIONS - NORTH & EAST

Scale 1 : 200 @B1 Project no 220479

Drawing No.

AMRFB2-ARC-AR-S2-300101

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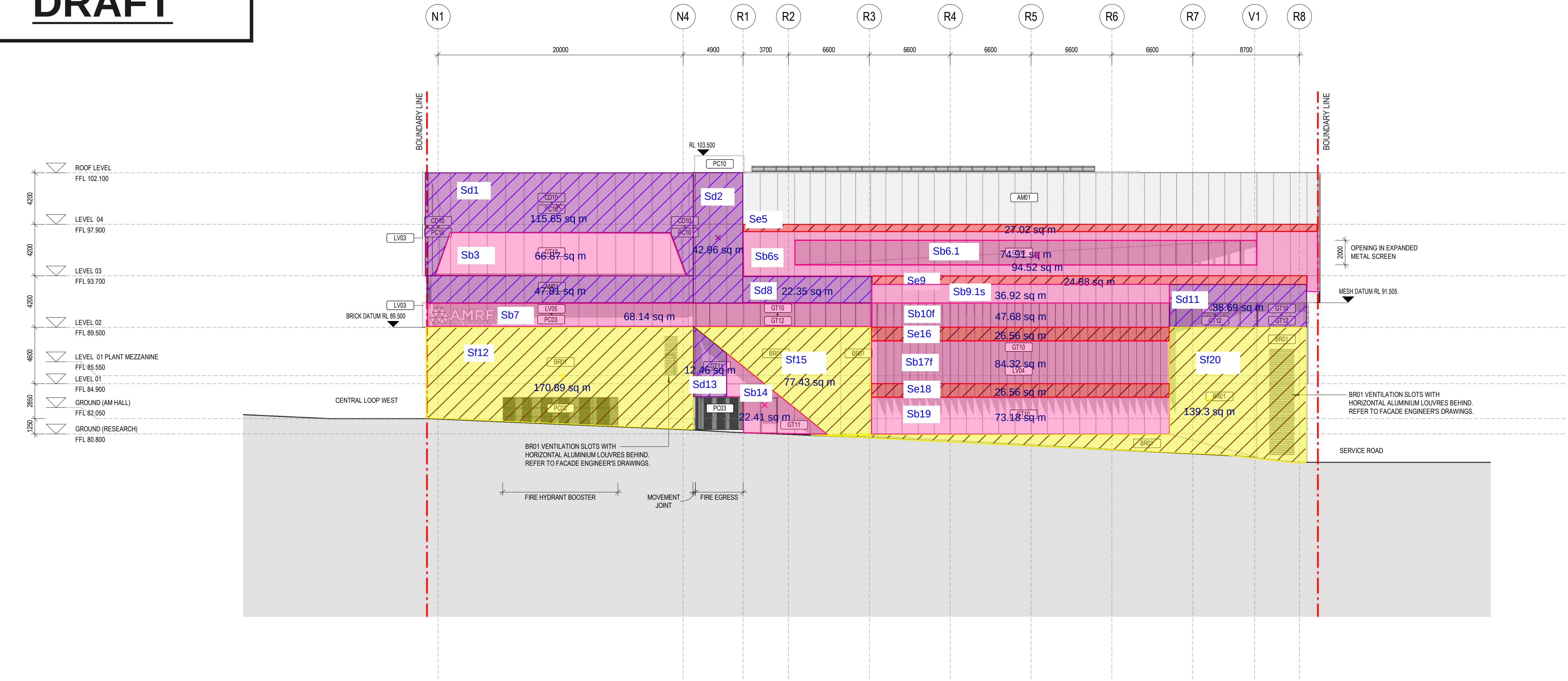
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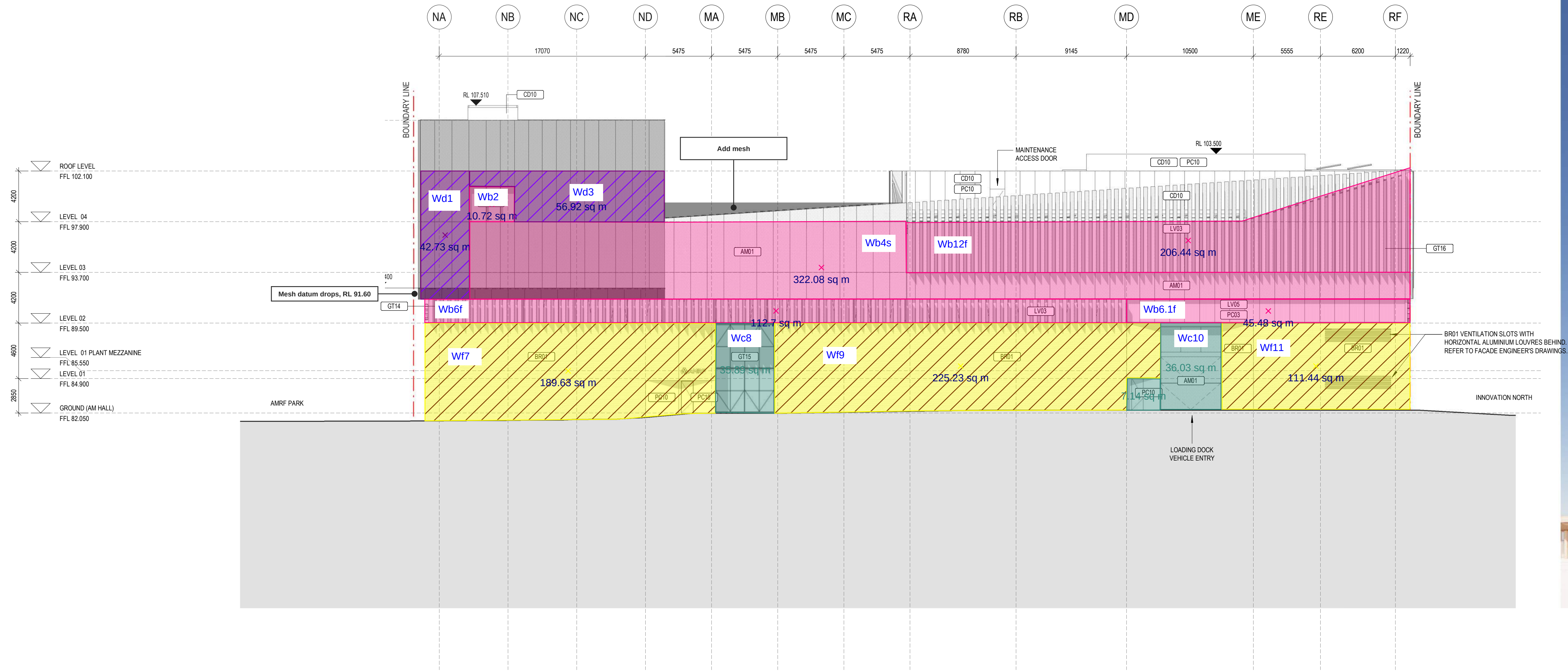
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STAGE 2.S4.55 PLANS

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1 SOUTH ELEVATION
SCALE: 1 : 200



2 WEST ELEVATION
SCALE: 1 : 200



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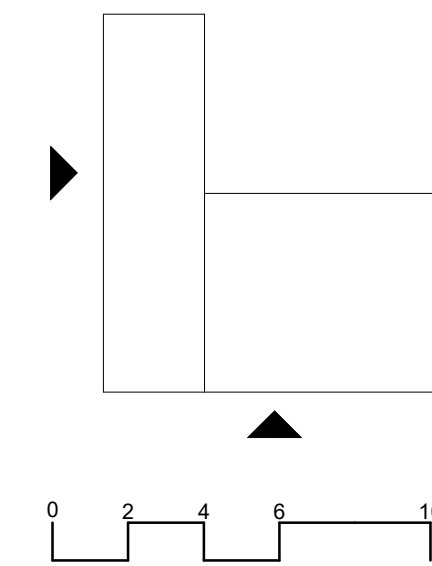
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T02	FOR TENDER	24.10.25

CODE LEGEND	
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GT15	CERAMIC FRIT GLASS
GT16	CLEAR GLASS
LV03	EXPANDED MESH VERTICAL SUNSHADING LOUVRES
LV04	VERTICAL SUNSHADING LOUVRES
LV05	CONCEALED FRAME VERTICAL PLANT ROOM LOUVRES
PC03	POWDERCOAT
PC10	PRIME COATING

Thermal performance requirements for Section J compliance and passive energy performance
Arup/JK 21/11/2025

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Key Plan



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Project
FULL SCALE AMRF
BUILDING 2

215 BADGERYS CREEK ROAD, BRADFIELD

Drawing

BUILDING ELEVATIONS - SOUTH & WEST

Scale 1 : 200 @B1 Project no 220479

Drawing No.

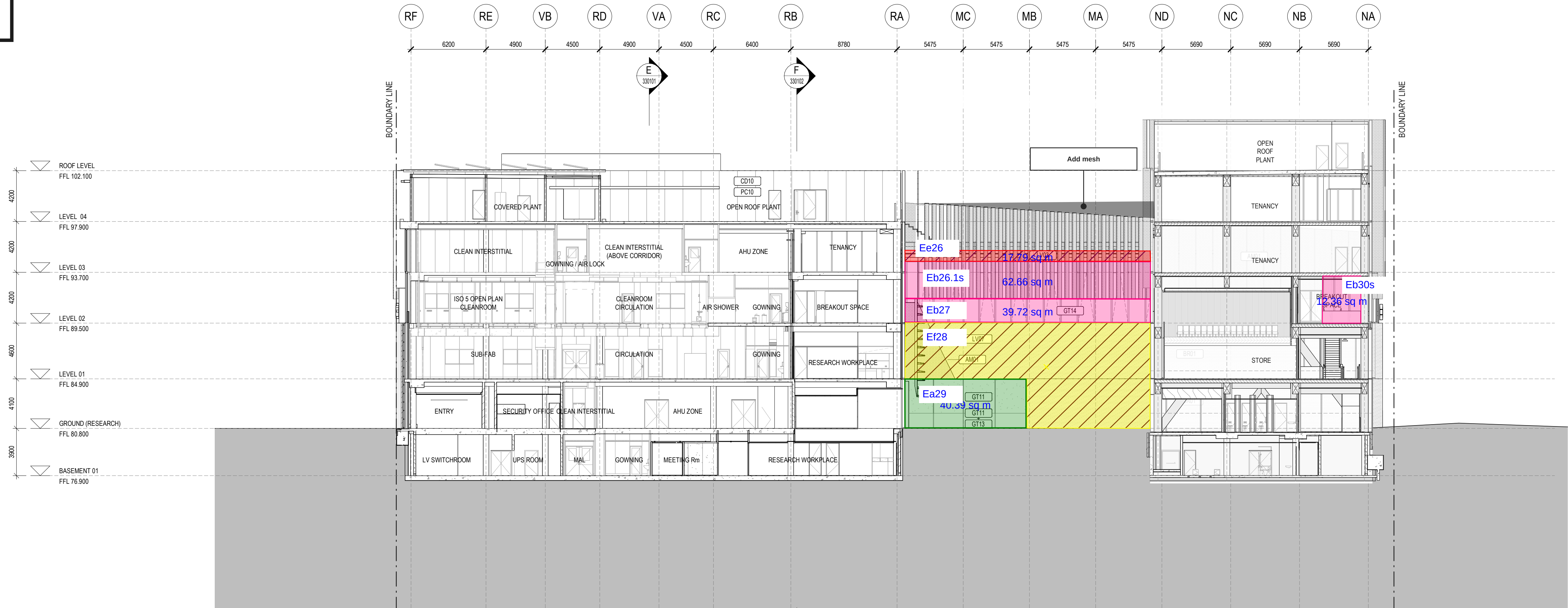
AMRFB2-ARC-AR-S2-300102

Prepared LB revision

Approved BR T02

24/10/2025 5:56:35 PM

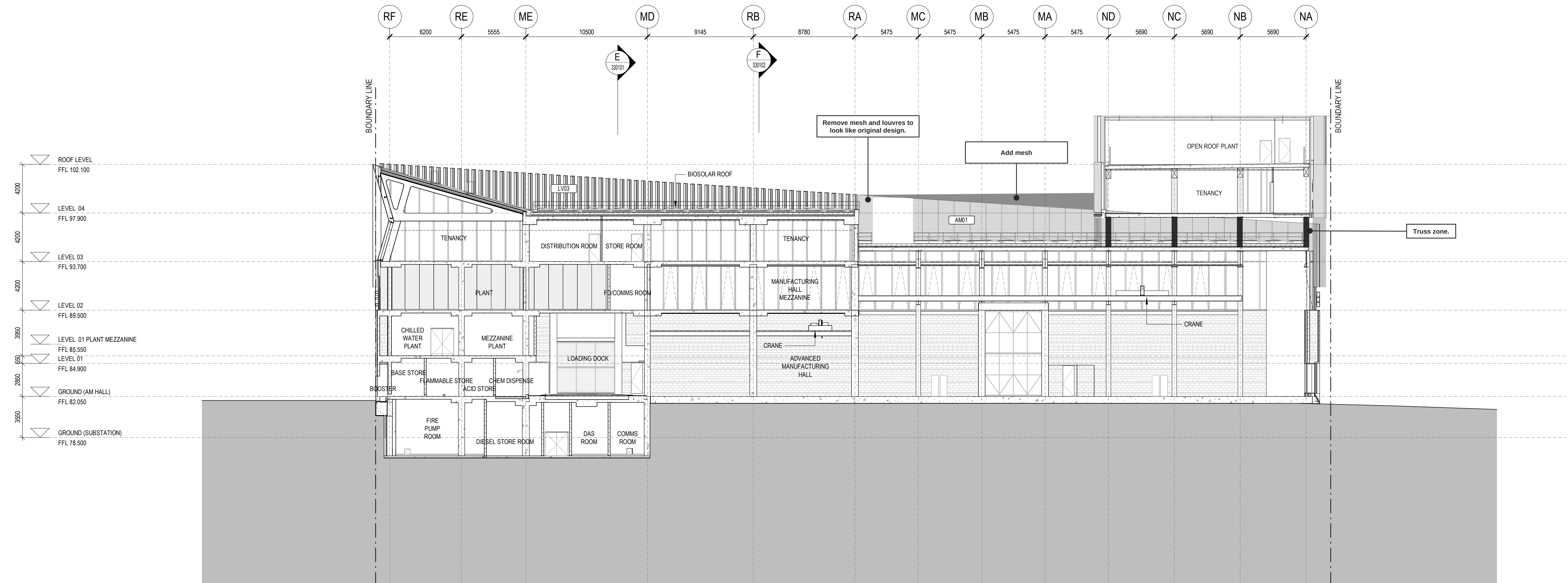
TENDER



1 SECTION C
SCALE: 1 : 200

Thermal performance requirements for Section J compliance and passive energy performance
Arup/JK 21/11/2025

- U-value: Nom. <2.3 W/m².K / SGHC (glass) <0.24
- U-value: Nom. 3.0 W/m².K / SGHC (glass) <0.24
- U-value: Nom. 4.5 W/m².K / SGHC (glass) <0.63
- R-value: Nom. >1.4 m².K/W
- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.0 m².K/W
- R-value: Nom. >1.4 m².K/W



2 SECTION D
SCALE: 1 : 200

