ESD Design Report

University of New South Wales

B22 Building

Revision 5, November 2019

atelier ten

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Contents

Introduction

The University of New South Wales B22 Building will stand as an exemplar of sustainability achievement within the University, across Australia, and for global higher education peers.

This SSDA seeks approval for the redevelopment of the existing Chancellery building for the purposes of a new mixed-use Building (B22) at UNSW's Kensington Campus.

The site comprises an area of 9,430 sqm and includes the existing four-to-five storey building known as The Chancellery, which houses the administrative offices and functions of the University, the Chancellery carpark, substation C21 and utility room B21.

UNSW has undertaken a voluntary international design competition, together with a significant program of consultation with the NSW Government Architect in arriving at the proposed scheme. B22 is proposed to be the ceremonial and civic heart of the University, delivering a renewed public realm experience that integrates student and academic life.

The development will involve the construction of a 59.88 metre building over a five-storey podium, comprising approximately 18,392 sqm of GFA and accommodating the following functions:

- Centralised teaching and learning facilities referred to as Learning Environments (or CATS).
- Common student facilities referred to as Student Led Space.
- Event and Exhibition Space.
- Workplace accommodating the university's core administrative functions and a modern chancellery.
- Retail space servicing the building and broader Campus (in the form of small-scale food and beverage tenancy options distributed throughout the ground plane); and
- Supporting and ancillary facilities.

The building is designed to readily adapt to the changing demands of an evolving and growing university campus, with floor plates providing flexibility for different uses into the future.

Site establishment works such as building demolition, services augmentation and associated tree removal, together with the Gate 9 forecourt landscape works have been addressed via separate approval processes.

Report Structure

This report provides an overall framework for how sustainability is proposed to be addressed for the B22 building at the University of New South Wales and what the sustainability principals for the site encompass.

The report is structured to provide a brief overview followed by reference to the SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS) and how the project is addressing these and the other regulatory requirements. The later sections of the report outline specific design responses structured to provide;

- Principals - overarching objectives for the site, categorised under the key objectives of:
  - Campus ready for the future
  - Carbon positive campus
  - Water conscious campus
  - Circular economy approach
  - Health campus community
- Targets - quantified and measurable targets which respond to the objectives
- Design response - design elements within the site that facilitate these targets.

Sustainability Brief

This sustainability vision document for the new UNSW B22 building begins the process of developing the ambitious requirements set out in the competition brief into a series of tangible actions for the project team. This vision aligns with the University's draftmasterplan framework and incorporates objectives from the endorsed Environmental Sustainability Plan 2019-21.

Guiding the entire B22 development are the project goals that the building will be Global, Iconic, Altruistic, Adaptable and Connected.

Campus Context

The UNSW masterplan sustainability strategy and the project competition brief further identify that project sustainability objectives will be achieving a:

- Campus ready for the future
- Carbon positive campus
- Water conscious campus
- Circular economy approach
- Health campus community

Further to these, the forthcoming Environmental Sustainability Plan 2019-21 for UNSW sets out key policies that relate to B22. Commitments are relevant to:

1. Climate Action:
    a. Transition to renewable energy and reduce net greenhouse gas emissions
    b. Ensure that our campuses and operations are resilient to future climate risks.
2. Buildings & Campus:
    a. Embed leading environmental sustainability principles and practices throughout the planning and operation of our buildings and campuses.
3. Energy & Water Efficiency:
    a. Continually improve energy efficiency and electrify our campuses.
    b. Reduce potable water use and return water to the hydrological cycle.
4. Waste & Recycling
    a. Close the loop by minimising waste, improving resource efficiency and managing waste responsibly.
5. Travel & Transport
    a. Ensure that our campuses are easily accessible by multiple transport modes and our community are supported to make active and sustainable transport choices.
6. Goods & Services
    a. Integrate sustainability principles and ‹circular economy› thinking into procurement practices.
7. Investments
    a. Integrate best practice environmental, social and governance principles within our investment activities. Assess and mitigate investment climate risks and invest in solutions to climate change.
8. Engagement & Integration
    a. Build a community of environmental awareness and good practice. Integrate this plan across university decision-making, planning and management processes.
9. Learning & Teaching
    a. Offer learning and teaching programs that inspire students to contribute to a sustainable world. Provide leading interdisciplinary education in environmental management.
10. Research & Advocacy
    a. Support researchers to develop solutions to global environmental challenges. Be a leading advocate for a sustainable world by advancing policy discussion and debate

Our document is organized into chapters as follows:

- Project vision, which introduces a broader reading of the already ambitious goals and objectives established in the project competition briefing.
- Design team response, which is organized into major headings following the brief, and within each section arranged into
    - Principles underpinning the topic
    - Performance targets for assessing achievement of principals
    - Design responds to the performance targets..
- Envelope Design, highlighting key design features in the envelope to provide a code compliant and high performance building envelope

1 Project Vision

UNSW envisage a vibrant building precinct and working environment. In achieving these goals for the University our vision encompasses the design that:

- Showcases the University as a respectful and inclusive environment, acknowledging being custodians and reviving the ecology of the site, the biodiversity and water flows.
- Which facilitates teaching excellence through a design which prioritises world class indoor environmental quality
- Is at the forefront of building technology and design by providing opportunities for teaching and research to be integrated into the design.
- Provides a ground plane design that is inviting and encourages people to linger and connect using landscape, massing and materials in the design to help facilitate this.
- Minimises it's global footprint by sequentially minimising demand, supplying efficiently, utilising site resources, and then finally offsetting where needed to achieve carbon positive operation.
- Uses the Universities procurement and maintenance strategies to leverage products that help identify and target products that minimise environmental impact and foster product stewardship, following circular economy principals.

Finally, by the use of benchmarking tools such as Green Star, WELL and Living Building Challenge, the University will be able to assess, communicate, and compare the effectiveness of their environmental commitments.

2 Regulatory Compliance

2.1 Secretary's Environmental Assessment Requirements (SEARS)

The SEARs requirements for the project are detailed below including the relevant sections of this report that responds to the requirements. The requiremetns are:

- Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation) will be incorporated in the design and ongoing operation phases of the development. Specifically this includes:

  a. Precautionary principal – namely, that 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.

  – The project has undergone a review of known hazardous materials in the existing building site and will ensure the safe removal. Further, the removal of any hazardous material found during excavations which may be resulting in leachates will help in the remediation of the site.

  – The use of refrigerants and their environmental impacts will be reviewed to assess alternatives beyond the currently standard R410a, while the use of sniffer system will be instigated to minimise the risk of leaks.

  – The University will also use the project as an opportunity to review products which avoids the use of environmentally persistent and accumulative chemicals during the building operation and maintenance, while a review of 'Red List' materials in line with the Living Building Challenge materials petal will be considered.

  – Beyond these points, further initiatives, are incorporated in sections 3.4 Circular economy approach (considering materials including the upstream impacts of those products), and 3.5 Healthy campus and community (considering the local environment and avoidance of local impacts).

  b. inter-generational equity namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generation

  – All efforts to improve effluents from the building are being undertaken to minimise impacts on resources, and where possible, provide a positive and regenerative impact to the site and upstream and downstream impacts.

  – The building has been designed to prioritise passive envelope design designed to be beyond NCC2019 in their performance minimising operational carbon, while also reducing water demand. Water demand will further be reduced though best in class water fittings within the building. Storm and rain-water systems will be linked to the University wide capture and treatment system, which seeks to maximise the water re-charge into the Botany sand aquifer. The avoidance of combustion of site and Installation of local power generation to offset will work in chorus to reduce the operational carbon while also minimising local air quality degradation.

  – Where possible, use recycled or recovered materials in recognition of not only the local impacts of the building but the far reaching impacts involved with the manufacture and supply of construction materials to the site.

  – Beyond these points, further detail and initiatives, are identified in sections 3.1 Campus ready for the future, 3.2 Carbon positive campus, 3.4 Circular economy approach, and 3.5 Healthy campus and community.

  c. conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration

- All efforts are being undertaken to maintain the existing ecological infrastructure of the site, including the retention of all significant trees in the vicinity. Further, water shed recharge, working to provide a balance of water inflow and outflow to the Botany sand aquifer, negating detrimental impacts to the aquifer and downstream impacts associated with the Universities water extract licence.
- Use of native and local plant species which promotes environmental health and the continued support of local eco-systems.
- Beyond these points, further detail and initiatives, are identified in sections 3.3 Water conscious campus, 3.4 Circular economy approach, and 3.5 Healthy campus and community.

d. Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services,

- The University is committed to a low carbon future and has already invested in a power purchase agreement which seeks to offset all carbon from the campus. Further, there is an extensive Photovoltaics installation program at the university, which this building will support in providing infrastructure for the PV array. Both of these initiatives recognise the added value in investing in low carbon electricity.
- Further, the application of a circular economy approach and targeting of materials which have a lower environmental impact both up and down-stream recognise the value of these products and leverages the Universities significant purchasing power to provide clear signal to the market on what types of products and services are required by their clients.
- As an early adopter, the University will likely incur costs, but will help to drive the market in recognition of the longer term value these products and services bring.
- Beyond these points, further detail and initiatives, are identified in sections 3.2 Carbon positive campus, and 3.4 Circular economy approach.

• Include a framework for how the future development will be designed to consider and reflect national best practice sustainable building principles to improve environmental performance and reduce ecological impact. This should be based on a materiality assessment and include
  - Reduction design measures (See section 3.4 Circular economy approach)
  - Future proofing (See section 3.1 Campus ready for the future)
  - Use of sustainable and low carbon materials (see section 3.2 Carbon positive campus, and section 3.4 Circular economy approach)
  - Energy and water efficient design (including water sensitive urban design) and technology and use of renewable energy (see sections 3.2 Carbon positive campus, and section 3.3 Water conscious campus)
• Include preliminary consideration of building performance and mitigation of climate change (see section 3.1 Campus ready for the future)
• Consideration of Green Star Performance (see section 3.7 Benchmarking)
• Provide a statement regarding how the design of the future development is responsive to the CSIRO projected impacts of climate change (see section 5 CSIRO Climate Change Response)

The Sustainability Framework meets the SSDA and SEARs requirements as a suitable assessment scheme and meets industry best practice.

2.2 NCC Section J

Section J of the National Construction Code (NCC) stipulates the minimum energy efficiency requirements for buildings within all states and territories of Australia where Section J has been mandated.

Section J is comprised of eight parts, each specifically outlining minimum deemed-to-satisfy criteria. Those sections that are applicable within New South Wales cover the performance of the building fabric, glazing, building sealing, HVAC systems, artificial lighting and power and access for maintenance.

Compliance may be demonstrated via the Deemed-to-Satisfy or performance verification (JV3 modelling).

- Building B22 will meet and exceed the requirements of section J of the NCC 2019 where the building will follow performance modelling approach to demonstrate compliance. Further details on envelope performance are provided in section 4 of this report.

3 Environmental Design Response

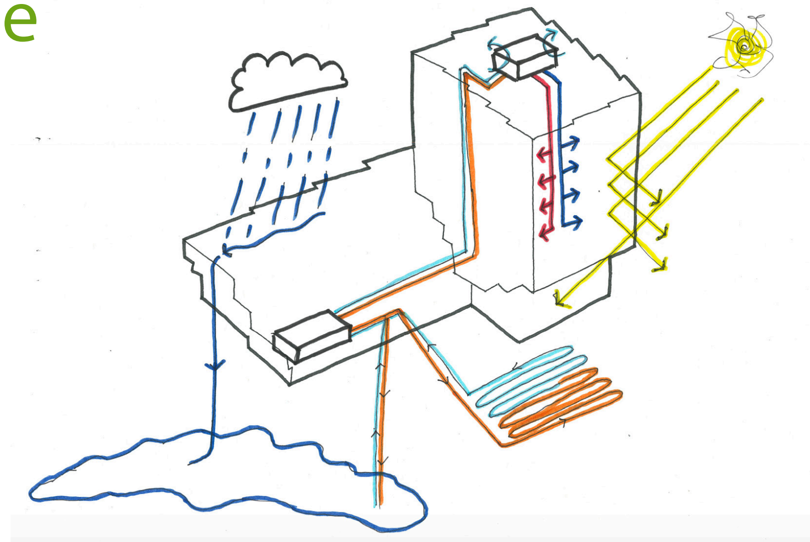


Figure 3.1 Integrated building services together position the SAAB for resilience, sustainable running, and adaptability

3.1 Campus ready for the future

3.1.1 Principles

- Resilience to short term shocks (extreme weather, utility failures), and long term stresses (climate change, reporting and regulatory changes).
- Flexibility to accommodate changing learning and working practices, changing program uses.

3.1.2 Targets

- Demonstrate alignment with Resilient Sydney — A Strategy for City Resilience 2018.
- Demonstrate alignment with emerging building Resilience rating systems (ICA Resilience Tool, RELi).
- Assess outdoor comfort using UTCI for both current and future weather conditions.
- Maintain world leadership environmental relevance over the building's design life.
- Demonstrate flexibility to accommodate changing working and teaching practices.
- Demonstrate ability to reconfigure and building services.

3.1.3 Design responses, resilience

- Undertake project resilience assessment.
- Passive climate control through facade tuned for maintaining indoor thermal comfort.
- Building systems configured to accommodate extreme storm events (probable maximum flood, extreme wind) and consequent water flows and winds.
- Building services sized to accommodate future weather (increased peak temperatures, decreased night cooling).
- All critical building electrical and mechanical services are protected from flood waters.
- Natural lighting provided to access stairs.
- Landscape cooled naturally through substantial vegetation, especially trees with substantial canopy coverage

3.1.4 Design responses, future-proofing

- Provide plant space allowances in central services, risers and ceiling spaces to facilitate plant reconfiguration, expansion, and replacement.
- Plug and play services design to speed reconfiguration and reduced material waste during churn.
- Services use flex connections on terminals to facilitate repositioning.
- Achieve top sustainability ratings and position building for future participation in operational ratings like Green Star Performance, or NABERS Indoor Environment.

3.2 Carbon positive campus

3.2.1 Principles

- Building construction minimises embedded greenhouse gas emissions
- Building operation minimises greenhouse gas emissions
- Pursue climate positive operations through a strategic hierarchy of reducing carbon demand, supplying services efficiently, harvesting resources renewably on-site
- All energy flows are metered and reported to the BMS for real-time monitoring.

3.2.2 Targets

- Generate renewable energy on site through the provision of roof area suitable for solar PV integration.
- Target a substantial reduction in embedded carbon, relative to BAU, through careful design and procurement.
- Procure operating energy from renewable sources.

3.2.3 Design responses, embedded carbon

- Choose low embodied carbon materials and products for top ten building systems by mass (structure, facade, major finishes, etc.)
- Prioritise timber and other plant-based materials that sequester carbon in their growth and use in the building.

3.2.4 Design responses, operational carbon

- Tune façades to provide high quality, low glare daylight to all perimeter areas.
- Use LED lighting with daylight and vacancy controls.
- Tune building façades to maximise passive thermal comfort conditioning throughout building.

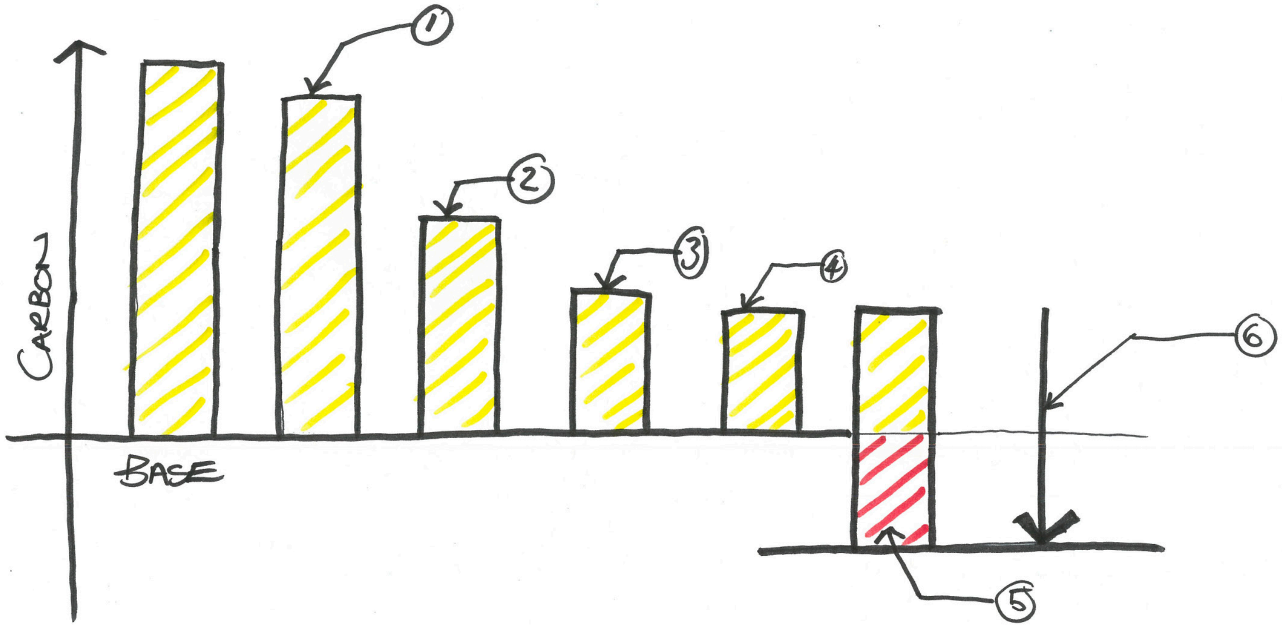


Figure 3.2 Carbon reduction hierarchy:
1:reduce resource use loads
2: improve building envelope
3: supply resources efficiently
4: generate renewable resources on-site
5: purchase renewable power / offset residual emissions
6: net zero greenhouse gas emissions

- Passive cooling and ventilation integrated at ground plane and adjacent spaces.
- Maximise the free cooling provided by outdoor air and mechanical ventilation air-side "economiser" mode.
- Maximize energy recovery in the mechanical ventilation systems through the use of heat and enthalpy recovery systems on air handlers, including bypasses when not in use.
- Low-energy mechanical ventilation systems.
- High efficiency, central thermal plant for space heating and cooling and domestic water heating..
- Consolidate any small data centres with large, efficient off-site data centres for more efficient cooling and lower Power Use Intensity.

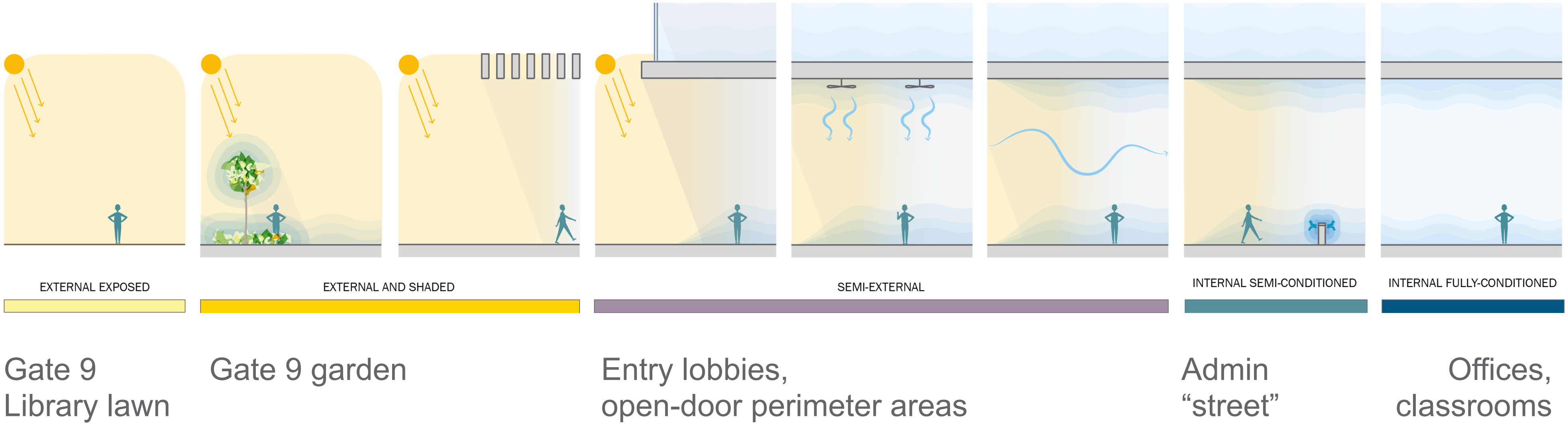


Figure 3.3 Adaptive comfort design strategy, using tempered spaces like atria and ground plane to transition from ambient to conditioned areas of the building.

3.3 Water conscious campus

3.3.1 Principles

- Re-establish natural water cycles and flows.
- Celebrate and manage water as a vital resource.
- Minimise water use, especially potable.
- Fit out building with separate non-potable supply (purple-pipe) wherever uses allow.
- Capture water on site, treat, and reuse wherever practical.
- All water flows are metered and reported to the BMS for real-time monitoring.

3.3.2 Targets

- Achieve pre-settlement rainwater flows to aquifer, off site.
- Visible expression of rain water, site water.
- No potable water supplied to non-potable uses.
- High WELS ratings for fixtures

3.3.3 Design responses

- Water sensitive urban design (WSUD) including permeable surfaces and swales to maximise local infiltration and aquifer recharge.
- Native vegetation for a substantial portion of landscape.
- Soil monitoring to control irrigation.
- Water channels, swales, and other landscape features retain stormwater for infiltration.
- Limit green (vegetated) walls to lower levels with highest visibility and most direct cooling effects.
- Building heat rejection into waste water flows to reduce or eliminate water use in cooling tower.
- Non-potable supplied evaporative cooling towers, for peak load heat rejection.
- Provide a water leak detection system and report to BMS
- Use high efficiency, high WELS rated water fixtures
- Fit out building with non-potable water supply (purple pipe) to all non-potable water end uses.
- Supply non-potable water from bore water, as bore supply allows.

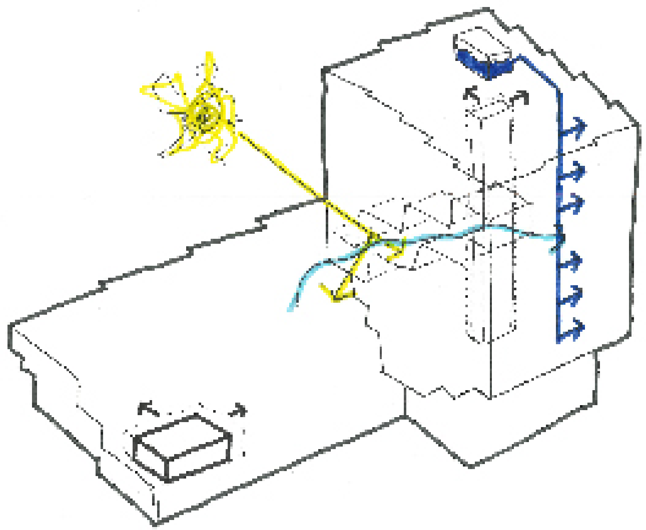


Figure 3.4 On-site non-potable water supply using harvested rainwater and possibly filtered greywater.

3.4 Circular economy approach

3.4.1 Principals

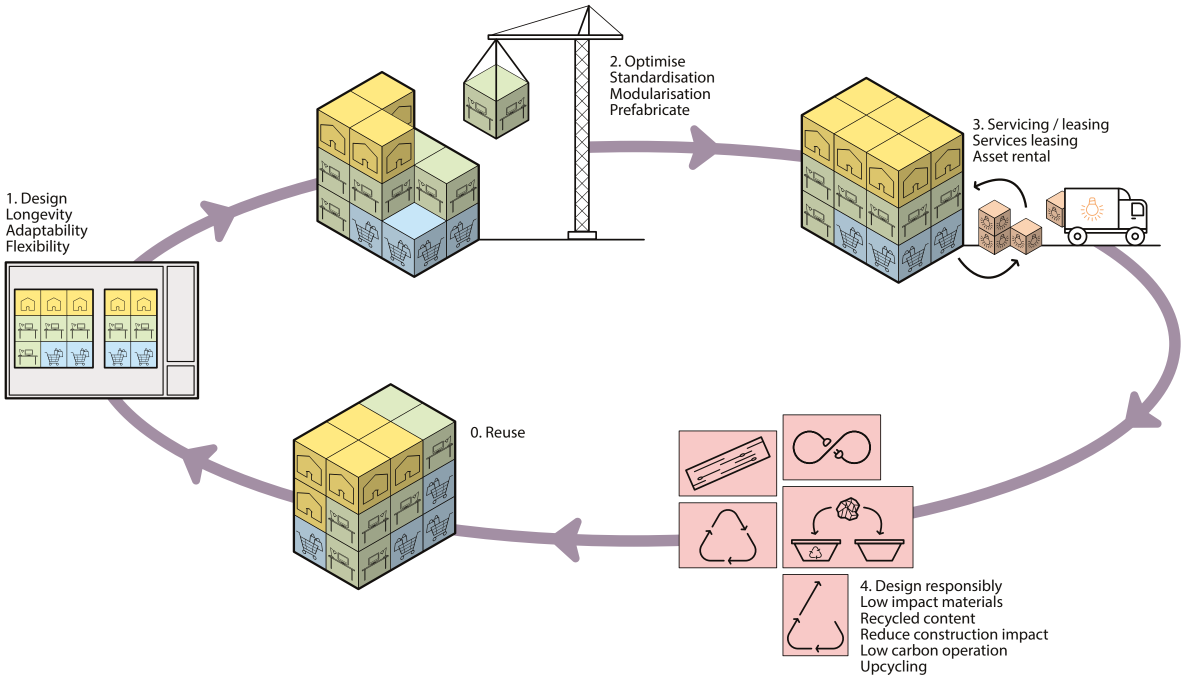
- Reduce material use through design where possible.
- Procure materials and products which support best practice environmental outcomes throughout product lifetime.
- Design building for disassembly and reuse: replace single-use products and materials with recyclable or upcyclable ones.
- Facilitate best practice waste management policies though design, construction and operation.

3.4.2 Targets

- 90% construction waste diversion from landfill.
- Achieve Green Star Design & As Built operational waste credits, sustainable sourcing credits (number TBD).
- Operational organic waste capture for diversion from landfill.
- Substantial portion (% TBD) of building materials derived from post-industrial recycled sources.
- Align construction procurement with ISO 20400 principles.

3.4.3 Design responses

- Optimise structure, rather than over-engineer for future flexibility; provide options for future additional structure.
- Optimise facade performance through right-sizing glazing to eliminate unnecessary external shading.
- Right-size building services, provide flexibility by allowing future expansion capacity where needed rather than over-sizing initial systems.
- Look for products, like carpets, that might be procured as a service rather than purchased.
- Specify rapidly renewable natural materials.
- Specify high post-consumer recycled content materials and products.
- Specify materials and products that can be disassembled, recycled, or upcycled.
- Specify previously used products and materials where appropriate.
- Stamp all major building components with product details to facilitate future reuse.
- Avoid single-use products and materials, choose alternatives that can be recycled or up-cycled at end of useful life in building.
- Include equipment to capture organic waste from kitchens, F&B service areas, and space to store organic waste before transfer to off-site compost facility.
- Include space for recyclable collection and storage before removal from site..



3.5 Healthy campus and community

3.5.1 Principles

- Create a diverse range of healthy, pleasing working and learning environments
- Provide a biophilic environment, full of connections to nature
- Eliminate direct polluting product and materials, and eliminate those that generate toxic pollutants through the manufacturing or extraction process.
- Facilitate human-powered living through end-of-trip facilities, attractive and usefully located stairs
- Facilitate other elements of a healthy lifestyle
- Celebrate natural and cultural heritage and diversity
- Ensure building and landscape are connected to Country

3.5.2 Targets

- Achieve a Useful Daylight Index (UDI) for regularly occupied spaces adjacent to façades.
- Achieve indoor thermal comfort aligned with Adaptive Thermal Comfort tool (ASHRAE Standard 55).
- Provide ample outdoor air throughout the building, no less than Australian Standard 1668 and where practical up to full outdoor air.
- Provision of End of Trip facilities

3.5.3 Design responses, healthy building

- Select glazing with good colour rendering index
- Provide frequent, attractive (daylit) access stairs throughout building.
- Integration of atria, allowing line of sight to building activities and colleagues
- Mechanical ventilation systems supplied and installed to avoid the ingress of dust and pollutants
- Locate mechanical system fresh air intake locations away from pollution sources.
- Provide high volume of outside air levels to help dilute indoor pollutants.
- Design ventilation systems for easy cleaning and filter washing or replacement.
- Specify low or no VOC emitting finish materials and products.
- Select finishes and systems that can be cleaned and maintained using healthy, low- or no-emitting cleaners that protect indoor air quality.
- Provide end of trip facilities at a minimum for building staff, size for current FTE.
- Provide end of trip facilities for students and visitors,
- Provide Healthy food options through retail F&B
- Enable the provision of healthy eating and food preparation for staff and students.

3.5.4 Design responses, healthy community

- Use stakeholder engagement processes during design and construction to help build a healthier campus community.
- Ensure landscape and building are welcoming to visitors and campus community members from a diverse range of backgrounds and cultures.
- Celebrate indigenous culture and history through building and landscape elements.
- Celebrate UNSW culture and history through building and landscape elements.
- Integrate areas of productive indigenous landscape.
- Include Aboriginal and Torres Strait Islander people in the project design and delivery teams.

3.6 Research and learning

3.6.1 Principles

- Actively and continuously learn from B22 project to help subsequent developments achieve substantially higher sustainability outcomes
- Implement UNSW generated innovative materials, products, or services within building and landscape.
- Enable continuous innovation by enabling areas within B22 to act as Living Labs.
- Position building and landscape for future Green Star Performance or other operational rating systems.

3.6.2 Targets

- A clear measure of before and after environmental conditions, health, and perceived productivity for a representative sample of B22 occupants .
- Implement at least one UNSW developed building product or service innovation in prototype or development phase.
- Beyond the BAS, implement a best-in-class building performance monitoring
- Provide for additional sensor locations throughout building to enable future in situ research using B22 facility and occupant populations.

3.6.3 Design responses

- Install open BAS that allows interaction with external data tracking, display, and control systems.
- Implement Soft Landings type building start-up and performance tuning program through initial few years of building operations.
- Pursue whole-of-life studies for key building materials, products, and services to ascertain best value options for project.
- Partner with University research office to identify any researchers that could engage with B22 design, delivery, or operation to support ongoing, viable research projects.
- Provide a limited number of additional sensor location points (screw-in support points, power and data access) in select building and landscape areas that will enable future in situ research in and around B22

3.7 Benchmarking

3.7.1 Principles

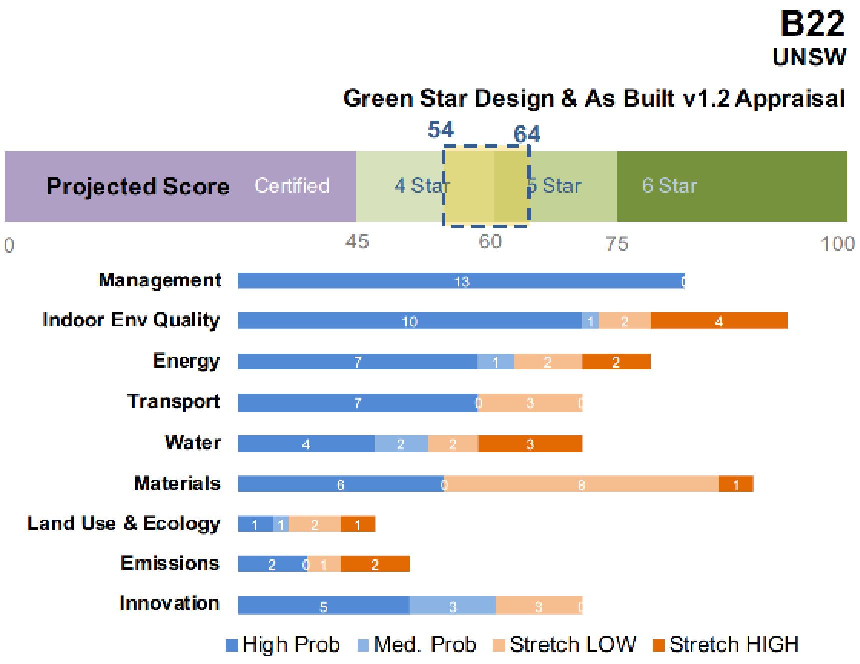
- Achieve performance against conventional green building rating tools like Green Star and NABERS
- Use the benchmarking process as a Quality Assurance process for implementing and delivering sustainability.

3.7.2 Targets

- NABERS 4.5 Star Energy (Equivalent for whole building)
- NABERS 3.5 Star Water (Equivalent)
- Green Star Design & As Built 4 Star equivalent with stretch target of 5 Star equivalent rating. (a preliminary assessment of a stretched target 5 Star Green Star strategy has been included as an appendix to this document)

3.7.3 Design responses

- Explore supporting ratings, including JUST building rating.
- Pursue innovation credits, especially those around financial transparency and use of multiple rating systems.
- Test applicability of other benchmarking systems, like RELi Resilient Building tool, to inform design and learn whether the tool is valuable for UNSW.
- Conduct energy use, water use, and other performance simulations early; share results in a way that promotes collaborative and integrated design team responses.



4 Building Envelope

4.1 Passive Design

The building envelope has been designed to prioritise the use of passive design to maximise comfort, while minimising demand on active environmental control measures. By minimising demand on servicing, the building will achieve outstanding energy performance, beyond NCC 2019 Section J1 & J2 compliance.

Code compliance against Section J1, J2 and J3 will be demonstrated using an Alternative Method, using energy modelling to demonstrate that the building envelope performs better than the code requirements.

The ground plane of the building will provide an open facade design, helping to promote connection through the building while ensuring passive cooling through natural ventilation will enable the conditioning systems to the foyer to remain off for substantial portions of the year.

The combination of high performance glazing system, which selectively allows daylight in, while excluding solar heat has been used in combination with an external shading system. The shades have been tuned for building orientation, while it is envisaged that shades with some visual transparency will allow views from within the building, outward.

- High performance glazing which selectively allows in daylight and excludes heat gains
- Facade system which insulates the building, and minimises energy loss though air infiltration.
- An off-site manufactured curtain wall system that helps maintain manufacture quality and hence longevity of performance
- Integrated shading that is tuned to building orientation for solar protection while maintaining views and daylight
- Operable ground plane facade to facilitate mixed-mode ventilation, maximising connectivity
- High clarity glazing to foster connection between key internal spaces and the outdoors.
- Opaque envelope areas will integrate insulation to provide thermal separation between outdoors and indoors when desirable including exposed roof areas, opaque façades, and exposed, suspended floors. Insulation levels will achieve an energy performance beyond NCC 2019 compliance.

5 CSIRO Climate Change Response

5.1 CSIRO Projected Impacts of Climate Change

This project will within it's life-time see the impacts of climate change on an unprecedented basis. The CSIRO predicts a range of environmental impacts as noted below with some commentary on how the project is responding to these. .

- Further increase in temperatures, with more extremely hot days and fewer extremely cool days.
  - Building envelope designed to provide high levels of solar shading, improving energy performance and limiting thermal stress of occupants
  - Use of tree canopy and thermal mass to external spaces to improve microclimate conditions around the building and thermal stress to external pedestrians
  - The existing tree canopy to the exposed north and eastern edges of the building will be maintained. These provide extensive shading to the surrounding streets and the building providing summer respite
  - The stepped facade of the building will create solar protection to the areas immediately adjacent to the building (a modern take on the Australian verandah). This will provide moments of respite as people navigate through and around the building.
- Gustier wind conditions are anticipated
  - Library lawn is known as a windy location around the UNSW. The B22 project is undertaking environmental wind assessments around the site to provide advice on how best to mitigate wind pressure driven impacts within the building, but also mitigation measures to the surrounding pedestrian areas.
  - This is anticipated to incorporate tree canopy and potentially additional landscape features to help mitigate high wind conditions
- A decrease in cool-season rainfall across many regions of southern Australia, with more time spent in drought.
  - Fixtures and fittings throughout the building selected as high efficiency, low flow fittings
  - High performance HVAC systems, integrated with a high performance facade limiting heat rejection requirements
  - Consideration given to remove or reduce evaporation based heat-rejections systems for the building
- More intense heavy rainfall throughout Australia, particularly for short-duration extreme rainfall events.
  - Stormwater systems integrate overland flows into landscape features which allow for increasing storm events and manage water safely.
  - Building rainwater systems will be sized to consider future storm events including hail, to stop internal flooding and damage.
  - Building essential systems will be located to stop damage during flooding events, ensuring continuity of operation.

6 Appendix A - Green Star Summary

Green Star Design & As Built v1.2 — APPRAISAL Rev 01_SSDA

1300 SAAB — Wednesday, 31 July 2019

Achievability

Four Star 45 to 59 points   Five Star 60 to 74 points   Six Star 75 or more points

Achievability rating: Hi = 90%, Med = 60%, Low = 10%, NP = not possible.

Hi	Med	Low	No	Total	
55	6	1	0	62	**Projected Points**
###	50%	10%	0%		% prob
55	12	13	18	98	Subtotals
Hi	Med	Low	No	Poss-ible	

Management

Hi	Med	Low	No	Poss-ible	Category	Aim	No.	Credit	Explanation
13	0	0	1	14	Management				Explanation
1				1	Green Star Accredited Professional	To recognise the appointment and active involvement of a Green Star Accredited Professional in order to ensure that the rating tool is applied effectively and as intended.	1.1	Accredited Professional	Green Star Accredited Professional active in all stages of project.
Y	-	-	-	-	Commissioning and Tuning	To encourage and recognise commissioning, handover and tuning initiatives that ensure all building services operate to their full potential.	2.0	Environmental Performance Targets	Establish and documented project evironmental performance targets
1				1			2.1	Services and Maintainability Review	Perform comprehensive design review of services, maintainability, etc
1				1			2.2	Building Commissioning	Comprehensively pre-commission and commission nominated building systems
1				1			2.3	Building Systems Tuning	Commit to perform building systems tuning for no less than one year after occupancy
1				1			2.4	Independent Commissioning Agent	Engage independent Commissioning Agent to oversee commissioning process
2				2	Adaptation and Resilience	To encourage and recognise projects that are resilient to the impacts of a changing climate and natural disasters.	3.0	Climate Adaptation Plan	A project specific climate adaptation plan has been developed in accordance with a recognized standard
1				1	Building Information	To recognise the development and provision of information that facilitates operator and user understanding of Building systems, their operation and maintenance requirements, and their environmental targets, to enable optimised performance.	4.1	Building Information	Make current building user information is available to all relevant stakeholders
1				1	Commitment to Performance	To recognise practices that encourage building owners, building occupants and facilities management teams to set targets and monitor environmental performance in a collaborative way.	5.1	Environmental Building Reporting	Commit to reporting building environmental performance metrics over two years;
			1	1			5.2	End of Life Waste Management	Commit to measurably reducing construction waste building upgrades and tenant end of Building
Y	-	-	-	-	Metering and Monitoring	To recognise the implementation of effective energy and water metering and monitoring systems.	6.0	Metering Strategy	Provide water and energy meters for all major end users or uses
1				1			6.1	Monitoring Strategy	Provide monitoring strategy to capture and process metered energy and water use
Y	-	-	-	-	Construction Environmental Management	To reward projects that use best practice formal environmental management procedures during construction.	7.0	Environmental Management Plan	Comprehensive Environmental Management Plan in place for construction
1				1			7.1	Formalised Environmental Management System	Environmental Management System from EMP used through all stages of design and construction
1				1			7.2	High Quality Staff Support	Staff support practices are in place that; promote positive mental and phyisical health and knowledge of sustainable practices
1				1	Operational Waste	To recognise projects that implement waste management plans that facilitate the re-use, upcycling to reduce the quantity of outgoing waste	8.1	Waste in Operations	Provide facilities to collect, process, and store multiple waste streams

Hi Med Low No Poss-ible

10	1	4	1	17	Indoor Environment Quality				Explanation
		1		1	Quality of Indoor Air	To recognise projects that provide high air quality to occupants.	9.1	Ventilation System Attributes	Outdoor pollutants mitigated; ventilation system designed for cleaning + maintenance; ventilation system cleaned prior to use
1		1		2			9.2	Provision of Outside Air	Provide 50-100% additional outdoor air, or maintain CO2 levels at 800-700 PPM. Natural ventilation spaces must comply with AS1668.2 for 2 pts
1				1			9.3	Exhaust or Elimination of Pollutants	Direct exhaust kitchens, photocopier areas, other pollution point source zones
1				1	Acoustic Comfort	To reward projects that provide appropriate and comfortable acoustic conditions for occupants.	10.0	Internal Noise Levels	Internal ambient noise levels, including outside and building systems sources, are suitable for activities
	1			1			10.1	Reverberation	Reverberation levels meet AS/NZ 2107:200 Reverberation Time tables
		1		1			10.2	Acoustic Separation	Reduce crosstalk between nominated spaces to weighted sound reduction index (Rw) of 45
Y	-	-	-	-	Lighting Comfort	To encourage and recognise well-lit spaces that provide a high degree of comfort to users.	11.0	Minimum Lighting Comfort	Flicker free and high color rendition lighting
1				1			11.1	General Illuminance and Glare Reduction	Lighting levels and quality comply with best practice; glare is eliminated
			1	1			11.2	Surface Illuminance	Improve lighting uniformity through fixture type and surface properties
1				1			11.3	Localised control	Occupants provided individual control of lighting
Y	-	-	-	-	Visual Comfort	To recognise the delivery of well-lit spaces that provide high levels of visual comfort to building occupants.	12.0	Glare Reduction	Fixed shares or blinds minimize direct sunlight into building
1				2			12.1	Daylight	40% / 60% of nominated area receives high daylight levels during 80% of day
1				1			12.2	Views	Direct line of sight to high quality internal or external views
1				1	Reduced Exposure to Pollutants	To recognise projects that safeguard occupant health through the reduction in internal air pollutant levels.	13.1	Paints, adhesives, sealants and carpets	Internally applied products meet stipulated VOC limits
1				1			13.2	Engineered wood products	95% of products meet stipulated formaldehyde limits
1				1			14.1.2B	Thermal Comfort - Mechanical Performance	For 95% of nominated space, 98% of year, achieve 80% Acceptability in ASHRAE 55, OR PMV between +1 and -1; OR NatHERS 7 Star
		1		1			14.2	Advanced Thermal Comfort	For 95% of nominated space, 98% of year, achieve 90% Acceptability in ASHRAE 55, OR PMV between +0.5 and -0.5; OR NatHERS 8 Star

Hi	Med	Low	No	Possible					
7	2	2	10	22	Energy				Explanation
X				-	Greenhouse Gas Emissions	Prescriptive Pathway	15A.1	Domestic Hot Water	DHW provided by low emissions or renewable energy sources (inc. gas, solar hot water)
		X		-			15A.2	Lighting	Lighting more than 15% under BCA (9W/m2)
				-			15A.3	Equipment	
				-			15A.4	Air Conditinoing	
				-			15A.5	Green Power	
	-	-		-		NABERS Energy Commitment Agreement Pathway	15D.0	Conditional Requirement: NABERS Pathway	Meet DTS energy efficiency requirements -- OR -- NABERS Energy Commitment Agreement for a minimum of 4.5 Stars.
				-			15D.1	NABERS Energy Commitment Agreement Pathway	Reduction of greenhouse gas emissions compared to NABERS 4.5-star baseline Building. 2pts = 10% ghg reduction. 'Use Green Star - Interiors Greenhouse Gas Emissions Calculator

Y	-	-		-		Performance Pathway: Reference Building Pathway	15E.0	Conditional Requirement: Reference Building Pathway	
6	2	2	10	20			15E.1	Comparison to a Reference Building Pathway	Net zero emissions for 20pts
1				2	Peak Electricity Demand Reduction	Prescriptive Pathway	16E.0	Prescriptive Pathway - On-site Energy Generation	
				-		Performance Pathway	16E.1	Performance Pathway - Reference Building	

Hi	Med	Low	No	Poss-ible					
7	0	0	0	7	**Transport**				**Explanation**
				10		Performance Pathway	17A.0	Travel Emissions Calculator	Reduce parking, make walkable, support transit, support active modes of transportation
3				3	Sustainable Transport	Prescriptive Pathway	17B.1	Access by Public Transport	Accessibility of the site by public transport. The points score is determined by completing the *Access by Public Transport Calculator*
1				1			17B.2	Reduced Car Parking Provision	Reducing number of car parks from allowable in planning provision
1				1			17B.3	Low Emission Vehicle Infrastructure	parking spaces and/or dedicated infrastructure is provided to support the uptake of low-emission vehicles
1				1			17B.4	Active Transport Facilities	Bicycle parking and associated facilities are provided to a proportion of regular occupants and visitors
1				1			17B.5	Walkable Neighbourhoods	Walk Score of at least 80 as determined by the website www.walkscore.com. OR the project is located so that at least eight (8) amenities are within 400m of the project.

Hi	Med	Low	No	Poss-ible					
4	3	3	2	12	**Water**				**Explanation**
4	3	3	2	12		Performance Pathway: Reference Buil	18A	Reference Building Model	12pts requires 100% potable water produced on site
				1	Potable Water	Prescriptive Pathway	18B.1	Sanitary Fixture Efficiency	Taps, Urinals, Toilets and Showers are within 1 star of WELS rated 6, 6, 5 and 3 stars respectively
				1			18B.2	Rainwater Reuse	Rainwater tank is installed to collect and reuse rainwater at a ratio of 10 L/m2
				2			18B.3	Heat Rejection	2pts where no potable water is used for heat rejection
				1			18B.4	Landscape Irrigation	Drip irrigation with moisture sensor override is installed, or where no potable water is used for irrigation
				1			18B.5	Fire System Test Water	Test system does not expell water, or stores 80% of routine test water for reuse onsite

Hi	Med	Low	No	Poss-ible					
6	0	1	2	19	**Materials**				**Explanation**
				6	Life Cycle Impacts	Performance Pathway - Life Cycle Assessment Maximum 7 points	19.A.1	Comparative Life Cycle Assessment	Reduce building material and product environmental impacts across a range of categories through LCA or proscriptive pathways
				4			19.A.2	Additional Life Cycle Impact Reporting	Report environmental impacts across five additional categories
				3		Prescriptive Pathway - Life Cycle Impacts Maximum 5 points	19B.1	Concrete	Portland cement content is reduced by 20% 1pt, or 40% 2pts. Water reduction 0.5pts, Aggregates reduction 0.5pts
1				1			19B.2	Steel	5% reduction in steel use compared to reference building
				4			19B.3	Building Reuse	2pts Façade reuse - 80% by area 2pts Structure reuse - 60% by mass
				3			19B.4	Structural Timber	3pts for 90% of building structure is timber
1				1		To reward projects that include	20.1	Structural and Reinforcing Steel	60% of steel (by mass) from responsible manufacturers

1				1	**Responsible Building Materials**	materials that are responsibly sourced or have a sustainable supply chain.	20.2	Timber	95% of timber (by cost) from sustainable sources
1				1			20.3	Cables, pipes, floors and blinds	90% (by cost) of cables, pipes, floors, blinds either PVC free or meet Best Practice Guidelines
		1	2	3	**Sustainable Products**	To encourage sustainability and transparency in product specification.	21.1	Sustainable Products	3, 6, 9% products are recycled, reused, third-party certified, come with EPDs, or through stewardship programs
2				3	**Construction and Demolition Waste**	Prescriptive Pathway	22A	Fixed Benchmark	<2.5 kg/m2 = 3pts, <3.5 kg/m2 = 1.5pts,
				-		Performance Pathway	22B	Percentage Benchmark	at least 90% of the waste generated during construction and demolition has been diverted from landfill

Hi	Med	Low	No	Poss-ible					
1	1	1	2	5	**Land Use & Ecology**				**Explanation**
Yes				-	**Ecological Value**	To reward projects that improve the ecological value of their site	23.0	Endangered, Threatened or Vulnerable Species	demonstrate that no endangered or vulnerable species, or ecological communities were present on the site
		1	2	3			23.1	Ecological Value	the ecological value of the site is improved by the project
Yes				-	**Sustainable Sites**	To reward projects that choose to develop sites that have limited ecological value, re-use previously developed land and remediate contaminate land.	24.0	Conditional Requirement **Mandatory Requirement**	project site did not contain prime agricultural land, wetland, or impact 'Matters of National Significance'
1				1			24.1	Reuse of Land	75% of the site was previously developed land at the date of site purchase or, for previously owned land
				-			24.2	Contamination and Hazardous Materials	the site, or an existing building, was previously contaminated and the site has been remediated
	1			1	**Heat Island Effect**	Heat Island Effect Reduction	25.0	Heat Island Effect Reduction	75% of the total project site area comprises elements that reduce the impact of the heat island effect

Hi	Med	Low	No	Poss-ible					
2	0	2	0	5	**Emissions**				**Explanation**
1				1	**Stormwater**	To reward projects that minimise peak storm water outflows and reduce pollutants	26.0	Stormwater Peak Discharge	Post-development peak ARI event discharge does not exceed the pre-development peak ARI event discharge.
		1		1			26.1	Stormwater Pollution Targets	All stormwater discharged from site meets specified pollution reduction targets
Y	-	-	-	-	**Light Pollution**	To reward projects that minimise light pollution.	27.0	Light Pollution to Neighbouring Properties	Outdoor lighting complies with AS 4282:1997
1				1			27.1	Light Pollution to Night Sky	Minmize upward light OR Minimize light tresspass skyward and across project boundary
		1		1	**Microbial Control**	To recognise projects that implement systems to minimise the impacts associated with harmful microbes in building systems.	28.1	Microbial Control	Building is naturally ventilated OR use waterless heat re-jection OR building heat rejection systems include control measures for Legionella
				1	**Refrigerant Impacts**	To encourage operational practices that minimise the environmental impacts of refrigeration equipment.	29.1	Refrigerant Impacts	Minimize environmental impacts of refrigerants by chosing low ODP and GWP refrgerants and implementing leak detection measures

Hi	Med	Low	No	Poss-ible					
5	5	0	0	10	**Innovation**				**Explanation**
	2			2	**Innovative Technology or Process**	The project meets the aims of an existing credit using a technology or process that is considered innovative	30.A	Innovative Technology or Process	PV Array

				-	**Market Transformation**	The project has undertaken a sustainability initiative that substantially contributes to the broader market transformation towards sustainable development in Australia or in the world.	30.B	Market Transformation	
	1			1	**Improving on Green Star Benchmarks**	The project has achieved full points in a Green Star credit and demonstrates a substantial improvement on the benchmark required to achieve full points.	30.C	Improving on Green Star Benchmarks	
	2			2	**Innovation Challenge**	Where the project addresses an sustainability issue not included within any of the Credits in the existing Green Star rating tools.	30.D	Innovation Challenge	
5				5	**Global Sustainability**	Project teams may adopt an approved credit from a Global Green Building Rating tool that addresses a sustainability issue that is currently outside the scope of this Green Star rating tools.	30.E	Global Sustainability	